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July 24, 2020

Mr. Timothy Gallagher
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U.S. Environmental Protection Agency Region 3
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Philadelphia, PA 19103-2029

| | |
|---|---|
| CONTRACT NO.: | EP-S3-07-06 |
| WORK ASSIGNMENT: | 056-RARA-A3EN |
| DOCUMENT NO.: | 3330-056-EO-CORR-04099 |
| SUBJECT: | Final Operations & Maintenance Plan – Revision 2<br>BoRit Asbestos Superfund Site, Operable Unit 1<br>Ambler, Pennsylvania<br>(DCN: 3330-056-OM-REPT-04100) |

Dear Mr. Gallagher:

CDM Federal Programs Corporation (CDM Smith) is pleased to submit this Final Revision 2 of the Operations & Maintenance Plan for the subject work assignment.

If you have any questions or comments regarding this submittal, please call me at (717) 437-3701.

Sincerely,

[redacted]

Project Manager
CDM Federal Programs Corporation

Attachment

cc: P. Schwenke, EPA Project Officer (3SD42)
J. Knapp, CDM Smith Program Manager
Project File
Document Control

Contract No.: EP-S3-07-06

# US Environmental Protection Agency Region 3

# Attachment A – Final Operations and Maintenance Plan, Revision 2

**BoRit Asbestos Superfund Site,**
**Operable Unit 1**
**Ambler, Pennsylvania**

July 24, 2020

CDM Smith

**Response Action Contract**
**for Remedial Planning and Oversight Activities at Sites**
**in EPA Region 3**

**U.S. EPA Contract No. EP-S3-07-06**

# Final Operations and Maintenance Plan, Revision 2
**for**
# BoRit Asbestos Superfund Site
# Operable Unit 1
# Ambler, Pennsylvania

**Work Assignment No.: 056-RARA-A3EN**

**Document Control No.: 3330-056-OM-REPT-04100**

**July 24, 2020**


**Prepared for:**
U.S. Environmental Protection Agency
Region 3
1650 Arch Street
Philadelphia, Pennsylvania 19103

**Prepared by**:
CDM Federal Programs Corporation
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# Acronyms

| | |
|---|---|
| ° | degree |
| µg/kg | micrograms per kilogram |
| ABS | activity-based sampling |
| ACM | asbestos-containing material |
| BMP | best management practice |
| BTAG | Biological Technical Assistance Group |
| CCM | concrete cable mat |
| CDM Smith | CDM Federal Programs Corporation |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CERCLIS | Comprehensive Environmental Response, Compensation, and Liability Information System |
| COC | chemical of concern |
| cy | cubic yard |
| DBH | diameter at breast height |
| EC | engineered control |
| EPA | United States Environmental Protection Agency |
| FCOR | Final Close Out Report |
| FS | Feasibility Study |
| FYR | Five-Year Review |
| HASP | Health and Safety Plan |
| HAZWOPER | Hazardous Waste Operations and Emergency Response |
| IC | institutional control |
| ICIAP | Institutional Controls Implementation and Assurance Plan |
| IDW | investigation derived waste |
| K&M | Keasby & Mattison |
| LTM | long-term monitoring |
| MFL | million fibers per liter |
| MG | million gallons |
| NCP | National Contingency Plan |
| NOAA | National Oceanic and Atmospheric Administration |
| O&F | Operational and Functional |
| O&M | Operations and Maintenance |
| OLEM | Office of Land and Emergency Management |
| OSHA | Occupational Safety and Health Administration |
| OSWER | Office of Solid Waste and Emergency Response |
| OU | operable unit |
| PADEP | Pennsylvania Department of Environmental Protection |

# Acronyms (continued)

| | |
|---|---|
| PCOR | Preliminary Close Out Report |
| RA | Remedial Action |
| RAO | Remedial Action Objective |
| RACR | Remedial Action Completion Report |
| RG | remediation goal |
| ROD | Record of Decision |
| RPM | Remedial Project Manager |
| SOP | standard operating procedure |
| the Site | the BoRit Asbestos Superfund Site |
| WSS | waste, soil, and Reservoir sediment |
| WWP | Wissahickon Waterfowl Preserve |

# Section 1

# Introduction

This Operations and Maintenance (O&M) Plan (Revision 2), which is an update to O&M Plan (Revision 1) dated November 26, 2018, presents the administrative and technical details and requirements for inspecting, operating, and maintaining capping and stream bank stabilization at the BoRit Asbestos Superfund Site in Ambler, Pennsylvania (the Site) (Comprehensive Environmental Response, Compensation, and Liability Information System [CERCLIS] #PAD981034887) in accordance with guidance developed by the U.S. Environmental Protection Agency (EPA) for *Operation and Maintenance in the Superfund Program* (EPA 2001a).

An O&M Plan is required at the Site because an engineered control (EC) is employed to contain contamination remaining in place at the Site. Exposure to contaminated waste, soil, and Reservoir sediment was mitigated by EPA Removal Program stream bank stabilization and capping work initiated across the Site at the end of 2008. The Record of Decision (ROD), issued in July 28, 2017, selected waste, soil, and Reservoir sediment (WSS) Alternative WSS2 Capping as the Selected Remedy for the Site.

The Selected Remedy encompasses and enhances the EPA Removal Program work. Alternative WSS2 includes capping of waste, soil, and Reservoir sediment with clean material, implementation of institutional controls (ICs), confirmation sampling, long-term monitoring (LTM), O&M, and five-year reviews (FYRs). The purpose of this O&M Plan is to present the activities necessary for inspecting, operating, monitoring, and maintaining the effectiveness of the remedial action (RA), including administrative and technical details and requirements.

This O&M Plan is a living document, and it has been modified as needed to optimize O&M performance over the lifetime of the Selected Remedy. Modifications to improve O&M performance in the future will require approval from EPA and the Pennsylvania Department of Environmental Protection (PADEP). Such modifications will be incorporated into this O&M Plan and issued as a new version.

This O&M Plan will be used in conjunction with the other components of the BoRit Remedial Design, including the *Final Institutional Controls Implementation and Assurance Plan (ICIAP)* (CDM Federal Programs [CDM Smith] 2017a)**,** which has been prepared to document the long-term stewardship and maintenance of ICs, and the *Final Site Management Plan for Post Remedial Action Confirmation Sampling and Long-Term Monitoring* (CDM Smith 2017b), which has been prepared to document procedures and responsibilities for those components of the Selected Remedy (EPA 2017).

## 1.1 Site Location and Background

The Site includes three adjacent parcels near the intersection of West Maple Street and Butler Pike in Ambler Borough, Montgomery County, Pennsylvania:

- The Park parcel (parcel #660004408008), located in Whitpain Township, is 19.02 acres and contains a former asbestos disposal area (now the closed Whitpain Wissahickon Park).
- The Reservoir parcel (comprised of parcel #660004409007 [3.13 acres] and parcel #540011581002 [15.04 acres]), primarily located in Upper Dublin Township, contains a

reservoir. The Reservoir was man-made using asbestos waste as fill in some areas, and it is not used for drinking water supply.

- The Asbestos Pile parcel (comprised of parcel #010002939003 [6.056 acres] and #540011581209 [0.597 acres]), located in Ambler Borough, contains an asbestos waste pile.

The Site also includes portions of Wissahickon Creek, Rose Valley Creek, and Tannery Run, which flow adjacent to the three Site parcels. The Site map is shown in **Figure 1-1**.

The Site is a result of disposal operations by the former Keasby & Mattison (K&M) Company. K&M produced asbestos products (including paper, millboard, electrical insulation, brake linings, piping, conveyor belts, high pressure packings, roofing shingles, and cement siding) from 1897 to 1962 at their Ambler, Pennsylvania facility. K&M ceased operations in 1962.

EPA Removal Program activities, which occurred from December 2008 through August 2017, largely mitigated exposure to contamination across the Site through the removal of surface soils and capping of waste, soil, and Reservoir sediment. The Selected Remedy for the Site, Alternative WSS2 Capping, encompasses and enhances the EPA Removal Program work. The Selected Remedy includes the following major components:

<u>EPA Removal Program</u>

- Stream bank stabilization at Rose Valley Creek, Tannery Run, and Wissahickon Creek
- Installation of cover at Park
- Installation of vegetative cover at Asbestos Pile
- Dewatering of Reservoir with treatment of surface water prior to discharge
- Re-grading and lining of Reservoir berm interior slopes with vegetative cover
- Installation of a cover on the Reservoir bottom
- Refilling of the Reservoir
- Activity-based sampling (ABS) at residences adjacent to the Site

<u>EPA Remedial Program</u>

- Implementation of ICs
- Confirmation Sampling
- LTM for Site-related chemicals of concern (COCs)
- Seeding of cover at Park
- O&M
- Five-Year Reviews

The following subsections summarize historical information, EPA Removal Program activities, and future land use plans for each of the Site parcels. Additional detail regarding investigation and removal activities at the Site are provided in the *Final Feasibility Study (FS) Report* (CDM Smith 2016). Design details of the completed EPA Removal Program components are shown in the construction as-built drawings provided in **Appendix A**.

### 1.1.1 Park Parcel

**Historical Information**

Starting as early as 1937, K&M disposed of an estimated 195,000 cubic yards (cy) of out-of-specification asbestos manufacturing products and other solid wastes on the Park parcel. Although used as a public park from at least 1973, the Park parcel was officially closed to the public in September 1984.

**EPA Removal Program**

The major components of Park parcel work completed by the EPA Removal Program were:

- Clearing Activities – The storage structure north of the Oak Street entrance was demolished, the far northern portion of the Park area along Wissahickon Creek was cleared and grubbed, and asphalt from the tennis courts was disposed of off-site.
- Excavation Activities – Excavation was undertaken to prepare for curb installation. Excavated areas were lined with geotextile fabric and pinned in place. Asbestos-containing material (ACM) waste was relocated within the Park parcel.
- Cover Installation – Backfill was installed in the slope and curb areas. Geotextile fabric and clean fill were placed in areas at the north end of the Site. Cover elements included a geotextile fabric, a minimum of two feet of clean material, and hydroseeded.

In December 2013, EPA Removal Program stabilization work at the Park parcel was temporarily postponed as EPA Removal Program's efforts focused on addressing the Reservoir parcel. Work on the Park parcel resumed in October 2015 and was completed in August 2017.

**Future Use**

Whitpain Township maintains ownership of the Park parcel and oversees the administration of the public park. Future use plans for the Park parcel include a public park and open space.

### 1.1.2 Reservoir Parcel

**Historical Information**

The Reservoir parcel was used to provide process water for K&M facility operations. The Reservoir appears in 1921 and 1930 Sanborn Fire Insurance maps and in a 1937 aerial photograph. The berm around the Reservoir was constructed of asbestos shingles, millboard, and soil. Asbestos product waste, particularly water pipe and tiles, was observed in the berm surrounding the Reservoir and the stream banks.

**EPA Removal Program**

Work at the Reservoir parcel conducted by the EPA Removal Program addressed the Reservoir interior berms, the Reservoir bottom, and surface water and consisted of the following major components:

- Clearing and Initial Earthwork Activities - Activities included tree removal, placement of clean fill to widen the West Maple Street side of the Reservoir to stabilize and widen the area for brush clearing operations. A platform was constructed on the Wissahickon Creek side of the Reservoir (using clean fill) for placement of a pump and treat system needed to dewater the Reservoir.
- Dewatering - To allow sufficient access to the Reservoir bottom and interior of the berms, it was necessary to completely dewater the Reservoir. Approximately 31 million gallons (MG) of water were pumped out of the Reservoir, treated, and discharged to Wissahickon Creek.

Dewatering operations were completed at the beginning of August 2014. Thereafter, until the Reservoir was refilled, water was pumped intermittently to remove collected storm water runoff. Throughout EPA Removal Program work, more than 37 MG of water was treated.

- Cover Installation - The Reservoir berms were covered with a geotextile fabric, a minimum of 2 feet of clean material, and a 6-inch layer of topsoil to support a vegetative cover (on the berms). Certain areas of the Reservoir berm were covered with up to 10 feet of clean material. Cover installation on the Reservoir bottom was completed in October 2015, and it included a geotextile fabric and a minimum of 2 feet of clean material.
- Refilling of Reservoir - After construction activities were completed at the Reservoir parcel in October 2015, the EPA Removal Program re-filled the Reservoir by pumping water from Wissahickon Creek.

**Future Use**

The Wissahickon Waterfowl Preserve (WWP) currently maintains ownership of the Reservoir parcel and continues to use the property as a waterfowl preserve. The WWP installed amenities along West Maple Street to promote bird watching and improve the aesthetic value of the area (Whitpain Township 2012).

### 1.1.3 Asbestos Pile Parcel

**Historical Information**

Based on observations from a 1930s historical aerial photograph, K&M began disposing a slurry of spent magnesium and calcium and waste asbestos products in a former reservoir located in what is now known as the Asbestos Pile parcel. Prior to the EPA Removal Action, the elevation of the waste in the Asbestos Pile parcel was approximately 20 to 30 feet above the surrounding land. By 1965, the Asbestos Pile parcel was vegetated. The property reportedly was first fenced in approximately 1986. For short periods of time in the 1980s and 1990s, portions of the Asbestos Pile parcel were used as a trash transfer station or trash storage location (including slag disposal) and for local fire department training.

**EPA Removal Program**

The EPA Removal Program’s design for the Asbestos Pile parcel involved regrading the slopes back to a stable 3 horizontal: 1 vertical gradient, placing a geotextile fabric, placing a minimum of 2 feet of clean material, and placing approximately 6 inches of topsoil to support a vegetative cover. Major components of the work performed at the Asbestos Pile parcel by EPA’s Removal Program consisted of the following:

- Clearing Activities - The area was cleared of trees and ACM material, and access roads were constructed.
- Excavation Activities - ACM waste was re-located to different areas on the Asbestos Pile to create the desired subgrade prior to the placement of geotextile, clean fill, and topsoil. All areas with exposed ACM were covered at the end of each day with clean material, straw mats, or geotextile fabric.
- Cover Installation - Waste cells were graded, covered with geotextile fabric, and covered with lifts of compacted clean fill to a minimum depth of 2 feet to meet the grade of the rest of the Asbestos Pile. The cover installation across the Asbestos Pile was completed with 6 inches of topsoil, and the cover was hydroseeded. The topsoil layer was covered with straw mats for erosion control.

**Future Use**

The future use of the Asbestos Pile parcel is unknown at this time. Currently, Kane Core, Inc. owns the Asbestos Pile parcel.

### 1.1.4 Stream Banks

Portions of Wissahickon Creek, Rose Valley Creek, and Tannery Run stream banks were stabilized as part of EPA Removal Program work at the Site to prevent and minimize future contamination of creek surface water and sediment. Stream bank stabilization work was completed in phases, and a summary of completed EPA Removal Program work follows.

- Phase 1 - (December 2008 to June 2009): Addressed approximately 1,350 linear feet of Wissahickon Creek from the north end of the Park parcel to the confluence of Rose Valley Creek and Wissahickon Creek. After approximately 475 tons of ACM waste were removed and properly disposed in an off-site landfill and the east bank of Wissahickon Creek was cleared and stabilized from the water's edge to the 100-year floodplain elevation using 10 to 15 inches of clean fill, geotextile fabric, geo-cells, and rip-rap, followed by hydroseeding.
- Phase 2 - (July 2009 to May 2010): Addressed banks of Rose Valley Creek as well as the adjacent Reservoir berm exterior and floodplain. A 104-foot-long stone wall was constructed on the left side of the headwall, and a 6-foot-high reinforced concrete retaining wall was constructed on the right side of the headwall. The Park-side slope was cleared of large pieces of ACM material and covered with 10 to 12 inches of clean fill followed by a 2 to 3-inch layer of topsoil and then hydroseeded. The slope was further stabilized with erosion control matting. The Reservoir-side slope was cleared of ACM material, covered with 10 to 12 inches of clean fill and a layer of topsoil, and hydroseeded for erosion control. Rose Valley Creek from Chestnut Avenue to the confluence of Wissahickon Creek was cleared of ACM and re-graded at a uniform slope. Concrete cable mats (CCMs) were installed and infilled with concrete at the four stream bend locations. Approximately 1,073 tons of ACM material were removed and properly disposed in an off-site landfill during Phase 2.
- Phase 3 - (March 2010 to June 2010): Addressed a 600-foot section along the Reservoir berm parallel to Wissahickon Creek. Material excavated during Phase 2 activities was placed on the berm slope and covered with 12 to 15 inches of clean fill and 6 inches of topsoil. No ACM material was collected or disposed during this phase.
- Phase 4 - (2010 to 2011): Addressed a 720-foot section of Tannery Run. Approximately 290 linear feet of stream bed downstream of Maple Street were re-graded at a constant gradient and stabilized with CCM along the stream bed and banks. The remaining section of Tannery Run, approximately 380 linear feet, was enclosed in an 8-foot diameter pipe that terminates at the confluence of Wissahickon Creek. During the preparation stages of the slope, the bulk pieces of ACM debris and stumps was removed and collected into roll-off containers and sent to an off-site landfill for proper disposal.
- Phase 5 - (June 2011 to September 2011): Addressed 297 linear feet of Wissahickon Creek between the old dam and the confluence with Tannery Run. The first 65 linear feet of slope along the banks was graded with 2RC stone, and then topsoil was added, hydroseeding was conducted, and the area was covered with heavy duty erosion control mats. Geotextile fabric was placed over the remaining slopes and overlaid with geocells, which were in-filled with stone and/or soil. A final layer, consisting of 4 inches of topsoil, was placed on top, hydroseeded, and covered with straw mats for erosion control. Numerous pieces of ACM (e.g., pipes, shingles, and tiles) were found along the Phase 5 area. During the preparation stages of the slope, the bulk pieces of the ACM debris and stumps was removed and collected into roll-off containers and sent to an off-site landfill for proper disposal.

## 1.2 Current Ownership Information

As mentioned above, Whitpain Township currently maintains ownership of the Park parcel and oversees the administration of the public park. WWP currently maintains ownership of the Reservoir parcel and continues to use the property as a waterfowl preserve. Kane Core, Inc. owns the Asbestos Pile parcel.

The parcel ownership information listed below was obtained from the Montgomery County website at the following web address: http://propertyrecords.montcopa.org.

**Park Parcel**

Owner: Whitpain Township (Parks and Recreation)
960 Wentz Road
Blue Bell, Pennsylvania 19422

**Reservoir Parcel**

Owner: WWP
12 Morris Road
Ambler, Pennsylvania 19002

**Asbestos Pile Parcel**

Owner: Kane Corp Inc.
168 W Ridge Pike, Suite 306B
Royersford, PA 19468

## 1.3 Statement of Basis and Purpose

The purpose of this O&M Plan is to present the activities necessary for inspecting, operating, monitoring, and maintaining the effectiveness of the RA including administrative and technical details and requirements.

### 1.3.1 O&M Objectives

This O&M Plan is designed to meet the following remedial action objectives (RAOs), as discussed in the ROD (EPA 2017):

**RAOs for Waste/Soil**

*Protection of Human Health*

- Minimize the inhalation of asbestos associated with waste/soil disturbances, such that related cancer risks from airborne asbestos fibers are within or below EPA's acceptable risk range of 1E-04 to 1E-06.

*Environmental Protection*

- Prevent direct contact (i.e., inhalation, incidental ingestion, and dermal absorption) by ecological receptors to contaminated waste and soil containing ecological COC (asbestos, bis[2-ethyhexyl]phthalate, dioxins and furans, chromium, nickel, or zinc) concentrations exceeding the respective remediation goals (RGs).

**Reservoir Sediment**

*Protection of Human Health*

- None.

*Environmental Protection*

- Prevent direct exposure of ecological receptors to contaminated sediment containing concentrations of carbon disulfide exceeding the ecological screening level of 4.1 micrograms per kilogram (μg/kg).
- Minimize migration of asbestos from sediment to surface water to prevent surface water concentrations of asbestos exceeding the surface water screening level of 0.0001 million fibers per liter (MFL).

O&M objectives for the Site are listed as the following:

1) Maintain the integrity of the soil cap, vegetative cover, and streambank stabilization.
2) Implement and evaluate ICs, LTM, and O&M protocols to ensure protectiveness of the Selected Remedy.
3) Ensure that the protection of human health and the environment is maintained at the Site.

LTM, O&M and FYRs will be conducted indefinitely throughout the life of the Selected Remedy because contaminants remain on the Site at levels that call for restricted use and limited exposure.

### 1.3.2 Summary of Long-Term O&M Activities

Long-term O&M (i.e., indefinite O&M efforts) will be performed to maintain the integrity of the Selected Remedy components, including the cap, stabilized stream banks, vegetation, and ICs.

Prior to any work on site, an O&M Health and Safety Plan (HASP) and Emergency Response Plan will be developed by the property owner or PADEP and submitted to EPA and PADEP for approval. All O&M work will be performed in compliance with the HASP. The HASP and the Emergency Response Plan include provisions for responding to and reporting accidents involving Site personnel, operating emergencies, and other unusual events such as fires, floods, or weather damage. The Emergency Response Plan defines how public access to the Site will be restricted in the event that an unusual event (i.e., a significant weather event) results in conditions that pose a risk to human health and the environment.

The following activities will be considered routine O&M activities:

1) **Site Inspections.** Non-intrusive visual site inspections will be conducted to ensure integrity of the cap, vegetation, and stabilized stream bank areas. Site inspections will be performed at least quarterly. Routine site inspections are discussed in Section 2.
2) **Post-Significant Weather Event Inspection.** Following a significant weather event (defined in Section 2), a non-intrusive visual site inspection will be conducted to determine whether the integrity of the cap, vegetation, and stabilized stream bank areas were impacted by the weather event. Post-significant weather event inspections are discussed in Section 2.
3) **Long Term Monitoring.** LTM is included as a component of the Selected Remedy. LTM will be conducted annually for the first four years leading to the first FYR and then once every FYR cycle thereafter. LTM is discussed in Section 2.

4) **Cap and Physical Remedy Maintenance.** Damage to the cap, vegetation, and stabilized stream bank areas observed during quarterly inspections and post-significant weather event site inspections will be repaired to eliminate potential exposure of underlying contaminated waste, soil, and Reservoir sediment. Section 2.3 discusses cap maintenance for the repair of minor and major breaches as a result of construction or significant weather events. Section 2.3 also discusses requirements for vegetation and tree maintenance.

5) **IC Evaluation and Updates.** ICs will be evaluated on an annual basis at a minimum and updated as necessary to ensure protectiveness. Section 3 includes a list of the Site-specific ICs.

6) **Reporting.** Routine reports summarizing O&M activities will be prepared on an annual basis. Routine reporting also involves regular review and updates as necessary to the O&M HASP as described in Section 2.2 and to as-built drawings, if necessary. Section 4 discusses reporting requirements in detail.

### 1.3.3 Summary of Five-Year Review Activities

Asbestos contamination present in waste, soil, and Reservoir sediment will remain on site above levels which allow unrestricted use; therefore, FYRs of the Site will be required to evaluate the implementation and performance of the Selected Remedy and to determine whether the Selected Remedy remains protective of human health and the environment. EPA is responsible for performing and funding the FYRs as long as they are required. The FYR process consists of six components: 1) community involvement and notification, 2) document review, 3) data review and analysis, 4) site inspection, 5) interviews, and 6) protectiveness determination (EPA 2003).

1) Community involvement activities will include notifying the community that the FYR will be conducted, notifying the community that the FYR has been completed, and providing the results of the review.

2) Document review involves a review of all relevant documents and data to obtain information to assess the performance of the response action. Documents for review include, but are not limited to, the ROD (EPA 2017), annual O&M reports, and annual IC evaluations.

3) Data review and analysis will involve a review of sampling and monitoring plans and results from monitoring activities.

4) Site inspections will be conducted to gather information about the Site's current status and to visually confirm and document the conditions of the Selected Remedy, the Site, and the surrounding area.

5) Interviews may be conducted as necessary with the Site manager, Site personnel, local elected and municipal officials, and people who live or work near the Site to gather additional information about the Site's status or to identify remedy issues.

6) When determining the protectiveness of the Selected Remedy, the FYR will include a technical assessment to examine the following three questions to provide a framework for organizing and evaluating data and information and to ensure that all relevant issues are considered when determining the protectiveness of the Selected Remedy:

    - Is the Selected Remedy functioning as intended by the decision documents?
    - Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

- o Has any other information come to light that could call into question the protectiveness of the Selected Remedy (EPA 2001a)?

The Selected Remedy will be subject to continual re-evaluation as part of the FYR to ensure protectiveness of the Selected Remedy into the future. This will include any re-evaluation based on new scientific studies or any new information gained from monitoring or investigations at the Site. The Selected Remedy will be re-evaluated in accordance with the review requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121(c).

As described in Section 4, reports summarizing the FYR will be prepared by the EPA in accordance with the *Comprehensive Five-Year Review Guidance* (EPA 2001b). Additional information regarding asbestos specific FYR's can be found in *Assessing Protectiveness for Asbestos Sites: A Supplemental Guidance for Evaluating Asbestos Contamination at Private and Federal Superfund Sites During a Five-Year Review* (EPA 2009).

## 1.4 Overview of Transition from RA to O&M

The National Contingency Plan (NCP), 40 CFR §300.435(f)(2), states, "A remedy becomes 'operational and functional (O&F)' either one year after construction is complete, or when the remedy is determined concurrently by EPA and the State to be functioning properly and is performing as designed, whichever is earlier. Formal O&F determinations are made because the O&F milestone governs when the EPA turns remedies over to the State for O&M. A joint inspection conducted by EPA and the State at the conclusion of construction marks the beginning of the one-year O&F period and determines whether the remedy has been constructed properly. This section outlines the timeline of major milestones during the transition from RA to O&M and discusses Site access considerations and staffing needs for O&M activities.

### 1.4.1 Schedule for Transition from RA to O&M

**Table 1-1** lists the major milestone events and their respective dates during the transition from RA to O&M at the Site. See Sections 1 and 3 of the Final FS Report (CDM Smith 2016) for a summary of all investigation and removal activities that occurred prior to the ROD.

**Table 1-1 Summary of the Major Milestone Events for Transition from RA to O&M**

| Date | Event |
|---|---|
| July 2017 | ROD for Operable Unit (OU) 1 Signed |
| August 2017 | Removal Action Completed |
| August 2017 | Removal Action As-Built Drawings Finalized |
| September 2017 | Remedial Design Approved |
| April 2018 | First Quarterly O&M Site Inspection (2nd Qtr 2018)** |
| May 2018 | EPA/PADEP Joint Construction Completion Site Inspection |
| July 2018 | Quarterly Site Inspection (3rd Qtr 2018) |
| September 2018 | Remedial Action Completion Report (RACR) |
| September 2018 | Quarterly Site Inspection (4th Qtr 2018) |

| Date | Event |
|---|---|
| September 2018 | Final Remedial Action Report/Construction Completion/Preliminary Close Out Report (PCOR) |
| March 2019 | Quarterly Site Inspection (1st Qtr 2019) |
| June 2019 | Quarterly Site Inspection (2nd Qtr 2019) |
| September 2019 | Quarterly Site Inspection (3rd Qtr 2019) |
| December 2019 | Quarterly Site Inspection (4th Qtr 2019) |
| February 2020 | O&F Determination/Start of O&M Phase |
| March 2020 | Quarterly Site Inspection (Whitpain Township – 1st Qtr 2020; Park Parcel Only) |
| July 2020* | RACR Addendum |

* Estimated Completion Date

** Quarterly O&M Site Inspections, Annual O&M Reporting, and FYRs will be conducted indefinitely as long as contaminants remain on site at levels that call for limited uses and restricted exposure.

### 1.4.2 Access

Future use plans for the Park parcel include a public park and open space. Whitpain Township will maintain ownership of the Park parcel and oversee the administration of the public park. WPP will maintain ownership of the Reservoir parcel and continue to use the property as a waterfowl preserve. WWP installed amenities along West Maple Street to promote bird watching and improve the aesthetic value of the area. The future use of the Asbestos Pile parcel is not known at this time.

### 1.4.3 Summary of O&M Staffing Needs

Staffing for O&M at the Site primarily consists of personnel performing site inspections, maintenance, monitoring, and FYRs.

Pursuant to the Occupational Safety and Health Administration (OSHA), all persons engaged in on-site operations under this O&M Plan will follow OSHA regulations as specified in 29 Code of Federal Regulations *Hazardous Waste Operations and Emergency Response* (HAZWOPER) 1920.120(e). In general, persons conducting intrusive O&M activities (i.e., activities where exposure to hazardous substances, pollutants, or contaminants is anticipated) will have, at a minimum, 24 hours of initial HAZWOPER training and one day of supervised hands-on training, or a current 8-hour annual refresher. In some instances, 40 hours of HAZWOPER training may be required. HAZWOPER training is not required for persons conducting non-intrusive O&M activities (i.e., activities where exposure to hazardous substances, pollutants, or contaminants is not anticipated). As required under Section 1.3.2 of this O&M Plan, the EPA-approved HASP for each property will specify training needs for O&M-related activities.

# Section 2

# Site Inspection and Maintenance

Site inspections are conducted to provide information about a site's status and to visually confirm and document the conditions of the Selected Remedy, the site, and the surrounding area (EPA 2001a). On January 26, 2017, EPA conducted a site walk to inspect capping work completed by the EPA Removal Program at the Site and identified key inspection measures that will be included in this O&M Plan. The trip report for this site walk is included in **Appendix B**. In addition, on June 20, 2019, EPA and PADEP conducted a final site walk to assess whether the inspection measures noted during the January 26, 2017 site walk were achieved. In March 2020, EPA informed PADEP that the Site was considered Operational and Functional, thereby transferring all future O&M activities to PADEP.

Site inspection and maintenance includes completion of annual reports and quarterly inspection checklists. A site-specific Annual O&M Report modified from the *Recommended Annual O&M/Remedy Evaluation Checklist* designed by the Office of Solid Waste and Emergency Response (OSWER), now known as the Office of Land and Emergency Management (OLEM), is provided as **Appendix C** and will be completed annually (Note: this Annual Report has been modified to include activities specific to capping only). **Appendix D** provides an example inspection checklist that will be completed by O&M personnel during quarterly site inspections and after significant weather events.

## 2.1 Site Inspection Objectives

Consistent with the O&M objectives presented in Section 1.3.1, the objectives of quarterly and post-significant weather event site inspections consist of the following:

- Maintain the integrity of the soil cap, vegetative cover, and streambank stabilization.
- Implement and evaluate ICs, LTM, and O&M protocols to ensure protectiveness of the Selected Remedy.
- Ensure that the protection of human health and the environment is maintained at the Site.

## 2.2 Observe Site Conditions

Monitoring protocol includes non-intrusive visual site inspections to ensure integrity of the cap, vegetation, and stream bank stabilization. Site inspections will be performed quarterly according to the proposed O&M schedule presented in Section 1.4.1. Site inspections will also be performed immediately following a significant weather event. It is anticipated that routine maintenance conducted by Whitpain Township for the Park parcel and conducted by WWP for the Reservoir parcel will provide an additional layer of oversight to complement O&M activities. Therefore, it is recommended that Site personnel performing inspections communicate with Whitpain Township and WWP personnel. Subsections included in Section 2.2 identify components of the Selected Remedy that will be inspected specific to the Park parcel, the Reservoir parcel, the Asbestos Pile parcel, and stream bank stabilization. A subsection is also included to outline the monitoring procedures after significant weather events.

## 2.2.1 Inspect the Integrity of Capping

A non-intrusive (surficial), visual inspection of the immediate ground surface at the Site will be conducted quarterly to identify any indications of erosion, burrowing animals, or other damage to capped areas and to determine whether exposure of ACM or debris has occurred. The extent of the cap implemented at the Site is depicted in the construction as-built drawings provided in **Appendix A**. **Exhibit 1** below provides a conceptual schematic of cap components implemented at the Site. Personnel involved in quarterly inspections will be required to meet the H&S requirements identified in the Site HASP as previously stated in Section 1.4.3.

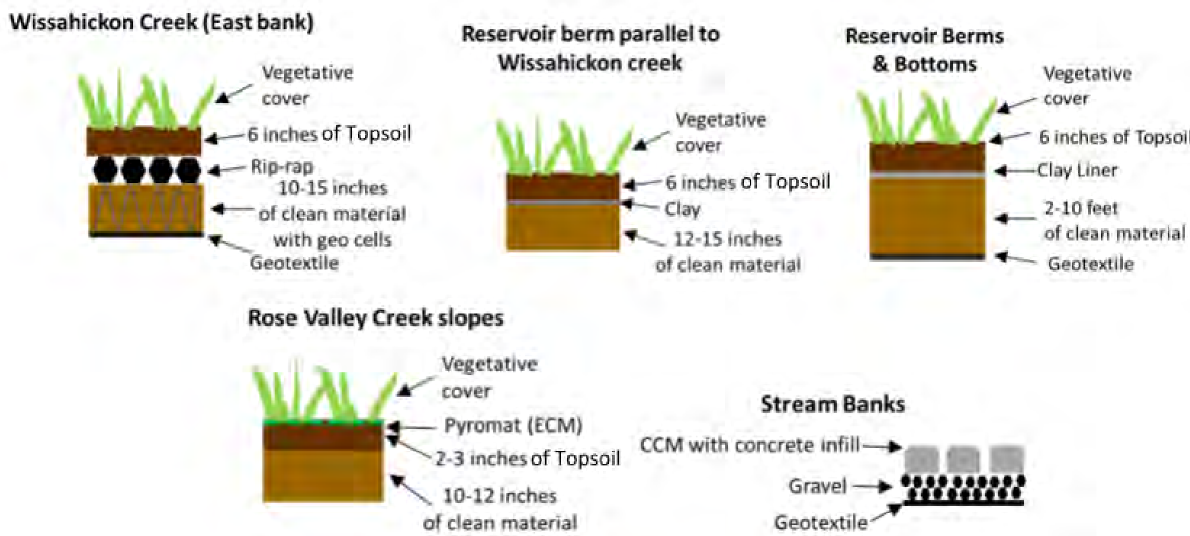


**Exhibit 1:** Conceptual Schematic of Capping Components

### 2.2.1.1 Inspection of the Park Parcel

The Park parcel is covered with a protective cap consisting of a geotextile fabric, a minimum of 2 feet of clean material, and vegetative cover. Waste was also consolidated from areas of the Park parcel into two waste cells constructed on the south end of the Park parcel. These waste cells are covered with this protective soil cap.

Quarterly inspections will involve observing whether the soil cap and vegetation are intact and preventing ACM exposure. The Park parcel will be examined for any signs of erosion or other activities that have negatively impacted the effectiveness of the Selected Remedy. Trees in the Park parcel will be inspected for the potential for windthrows or toppling of any kind. If any breaches, animal burrows, ACM, toppled trees, invasive plants, or debris are observed, the impacted capped areas will be identified for repair and maintained as described in Section 2.3. Any observed impacted areas of the Selected Remedy will be photographed, georeferenced, and attached to the inspection checklist provided in **Appendix D**.

Quarterly inspections of the Park parcel will also include interviews with Whitpain Township personnel responsible for overseeing routine maintenance activities for the Park parcel such as grass cutting and tree maintenance. Interviews will be designed to gather information or observations noted by Whitpain Township personnel between inspections while performing Park parcel maintenance.

#### 2.2.1.2 Inspection of the Reservoir Parcel

The Reservoir bottom and berms are covered with a geotextile fabric and a minimum of 2 feet of clean soil. The Reservoir berm adjacent to the Wissahickon Creek will be inspected to ensure that trees are not growing along the berm. Any trees that are identified on this berm will be removed in accordance with Section 2.3.3. The inspector will need woody plant identification skills to differentiate between unacceptable trees and permitted shrubs. Trees and shrubs are permitted elsewhere on the Reservoir parcel. Any tree on the remaining berms that is in danger of falling will be cut at ground level. The inspection will also document whether there is adequate vegetative cover and/or water levels on the Reservoir Parcel to prevent erosion and/or exposure of ACM waste. If erosion, animal burrows, invasive plants, debris or ACM is observed, the extent of impacted areas will be marked for repair and maintained as described in Section 2.3. Any observed areas negatively impacting the Selected Remedy or with the potential to negatively impact the Selected Remedy will be photographed, georeferenced, and attached to the inspection checklist provided in **Appendix D**.

**Figure 2-1** shows the location of ICs specific to the Reservoir parcel. Any tree growth identified as not meeting the requirements above and depicted in **Figure 2-1** will be maintained in accordance with Section 2.3.3.

#### 2.2.1.3 Inspection of the Asbestos Pile Parcel

The Asbestos Pile parcel is covered with geotextile material, 2 feet of clean material, and approximately 6 inches of topsoil to support a native meadow vegetative cover. Quarterly inspections will involve observing whether the cap and vegetation are intact and preventing ACM exposure. The side slopes of the Asbestos Pile parcel will be evaluated for any signs of erosion. As shown in **Figure 2-1**, trees are not allowed on the slopes of the Asbestos Pile. Any volunteer trees (trees that grow on their own/not planted by hand) will be removed in accordance with Section 2.3.3. Construction of any structures that could undermine the slope stability of the Asbestos Pile parcel are not allowed. If any breaches, animal burrows, ACM, toppled trees, invasive plants, or debris are observed, affected areas will be identified for repair and maintained as described in Section 2.3. Any observed areas negatively impacting or with the potential to negatively impact the Selected Remedy will be photographed and attached to the inspection checklist provided in **Appendix D**.

### 2.2.2 Inspect the Integrity of Stream Bank Stabilization

Details of stream bank stabilization work for Wissahickon Creek, Rose Valley Creek, and Tannery Run are provided in Section 1.1.4. Additional detail may also be found in the *Final Feasibility Study Report* (CDM Smith 2016). Inspection of stream bank stabilization will include the portions of Wissahickon Creek, Rose Valley Creek, and Tannery Run that intersect the Site as shown in **Figure 1-1** and the as-built drawings in **Appendix A**.

Vegetation along stabilized stream bank areas will be inspected for any signs of distress or decay. The stream banks will be inspected for erosion or damage. Inspection of the stabilized stream banks will include examination of tree growth in accordance with the following ICs:

- Trees are prohibited along the steep slope of Wissahickon Creek where geocells were utilized to stabilize the slope.
- Trees are permitted at the base (lower foot) of the rip-rap along the edge of the creek.

- Shrubs are permitted anywhere within the rip-rap.
- Trees are prohibited on the steep slopes along Rose Valley Creek and Tannery Run where CCMs were utilized to stabilize the slope.
- Shrubs are permitted within the CCM, particularly at the base and within the stream bed.

**Figure 2-1** shows the location of ICs specific to the stream banks. Any volunteer trees identified in these steep-slope areas will be maintained in accordance with Section 2.3.3. If erosion, ACM, or debris is observed, the extent of impacted areas will be marked for repair and maintained as described in Section 2.3. Any observed breaches in CCM, piping, or geocells will be photographed and attached to the inspection checklist.

In addition to quarterly inspections, the entire Site will be inspected within 48 hours of any significant weather event, defined as any storm named by the World Meteorological Organization. Public access to the Site will be prohibited until the Site inspection is complete and the Selected Remedy is deemed to not have been impacted. The Site will be inspected for any major signs of erosion or changes to the designed drainage pattern. Attention will focus on areas within the extent of the 100-year floodplain as shown in **Figure 2-2.** Inspections will look for:

- Wash out of debris, large rocks, or trees that have deposited on the Site;
- Inspection of culverts for signs of damage or obstructions such as debris or trees;
- Inspection of the emergency spillway over the enclosed portion of Tannery Run for signs of damage or erosion; and
- Any signs of cracking, heaving, or breaches in culverts, CCMs, or retaining walls.

Minor or major breeches to stabilized stream bank areas will be addressed in accordance with Section 2.3.1 and Section 2.3.2.

## 2.2.3 Post-Significant Weather Event Inspection

The National Oceanic and Atmospheric Administration (NOAA) defines a storm event (significant weather event) as having one or more of the following characteristics (NOAA 2016):

- The occurrence of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce.
- Rare, unusual, weather phenomena that generate media attention.
- Other significant meteorological events, such as record maximum or minimum temperatures or precipitation, as well as high winds that occur in connection with another event.

If a significant weather event occurs, a site inspection will be completed within 48 hours pending safe access to the Site. Inspection activities will be performed in accordance with Sections 2.2.1 through 2.2.3. The Inspection Checklist provided in **Appendix D** includes a section for post-significant weather events that will be completed during the time of inspection. Inspection activities will include evaluating whether or not the flooded area from the weather event exceeded the current delineation of the 100-year floodplain elevation presented on **Figure 2-2**. Flood waters in exceedance of the current 100-year floodplain elevation and related Site impacts may prompt re-evaluation or modification of existing ICs, LTM, or O&M prior to the FYR.

## 2.3 Physical Remedy Maintenance Activities

Damage to the cap could result from vandalism and/or unauthorized construction or digging. In addition, significant weather events could damage stabilized stream bank areas and expose contaminated waste, soil, and Reservoir sediment. High winds can also damage the cap because of fallen trees and subsequent uprooting of the soil cap. Damage to capped areas can expose ACM that would pose a risk to human health and the environment. **Table 2-1** summarizes the maintenance schedule for the various areas on the Site.

For the purposes of this document, "breaches" are defined as any action or event that results in the breaking, failing, or damage to a physical remedy. A minor breach of the cap can be repaired without additional excavation of contaminated soil or Reservoir sediment. A major breach of the cap is defined as when significant exposure to contaminated waste, soil, and Reservoir sediment beneath the cap requires excavation, removal, or encapsulation of contaminated materials. Prior to implementation of any corrective action, a task-specific Activity Hazard Analysis or separate task specific HASP will be developed.

In general, if contaminated waste, soil, or Reservoir sediment is encountered or suspected during inspection of the soil cap or the stabilized stream banks at the Site, the entity performing the inspection will:

- Take necessary measures to secure the disturbed areas and to limit contaminant migration from inadvertent activities so that the protection of human health and the environment is maintained through access restriction to the area.
- Contact the entity responsible for O&M, who will manage any contamination encountered. Section 1.3.2 further describes the responsibilities of the O&M personnel.
- Take corrective action to repair the soil cap, vegetation, or stabilized stream banks as further described in the following subsections.

### 2.3.1 Repair of Minor Breaches in Soil Cap

General wear and tear or erosion of the cap may result in a minor breach of the cap implemented across the Site. General wear and tear may include rutting and depressions in vegetated areas from mowing or damage to the grass from foot traffic. If the cap can be repaired without additional excavation of contaminated soil, it is considered a minor breach. This type of breach to the cap may or may not result in the exposure of ACM or debris from below the cover. This determination will be made with input from the entity responsible for O&M.

Repair of a minor breach of the soil cap will follow the general steps described below:

- Obtain commercially available, bagged topsoil products available at home improvement stores. It is assumed that these commercially-available, bagged topsoil products sold in home improvement stores in Pennsylvania are compliant with Pennsylvania Clean Fill standards (PADEP 2020) and EPA Biological Technical Assistance Group (BTAG) backfill criteria for ecological protection, detailed in **Appendix E.**
- Transport, place, and compact the clean fill material in the breached area to match the existing grade and to support the vegetative cover. The depth of clean material will match depths placed by the EPA Removal Program for the specific area.

- Apply the same seed mix used by the EPA Removal Program, which can be referenced in **Appendix F** (see **Table 2-2**) to the repaired area and cover with straw mats or erosion control mats until vegetation is established.

**Table 2-2 Seed Mixes**

<table>
<tr><th>Area</th><th>Seed Mixes</th></tr>
<tr><td>Landfill cover (top and sides)</td><td rowspan="3">ERNMX-153 - Showy Northeast Native Wildflower & Grass Mix</td></tr>
<tr><td>Interior and top of Reservoir berms</td></tr>
<tr><td>All level areas outside of the Park</td></tr>
<tr><td>Steep slopes adjacent to Wissahickon Creek, Rose Valley Creek, and Tannery Run</td><td>ERNMX-181-1- Native Steep Slope Mix with Grain Oats (ERNMX 181-2 when seeding from September 1 – February 15)</td></tr>
<tr><td>Retention basin</td><td>ERNMX-127- Retention Basin Wildlife Seed Mix</td></tr>
<tr><td>Riparian areas that are not steep slopes</td><td>ERNMX-178 - Riparian Buffer Mix</td></tr>
<tr><td>Reservoir “flats” and within five feet of planned pool elevation</td><td>ERNMX-131 - Obligate Wetland Mix</td></tr>
<tr><td>Lawn area targeted for infrequent mowing</td><td>Prairie Nursery No Mow Lawn Seed Mix with Rye</td></tr>
<tr><td>Park (turf) area – areas targeted for future development</td><td>ERNMX-113 - Commercial Conservation Mix</td></tr>
<tr><td>Park (turf) area – areas with final turf planting</td><td>ERNMX-114 - 5311 Conservation Mix</td></tr>
</table>

**Appendix G** provides information regarding best management practices (BMPs) for excavation and construction activities and for the importing and exporting of materials. Where applicable, BMPs as described in **Appendix G will** be consulted prior to the initiation of maintenance activities.

As shown in the construction as-built drawings (**Appendix A**), sections of stream bank along Wissahickon Creek and Rose Valley Creek were stabilized using rip-rap. As necessary, repairs to minor breaches of rip-rap protective covers will follow the general steps described above except that transportation and placement of rip-rap will replace the transportation, placement, and compaction of clean fill material. The sizes of rip-rap material used for minor breaches will match the sizes described in the EPA Removal Program Summary Reports provided in **Appendix H**.

The entity responsible for O&M will rely on as-built drawings and EPA Removal Program Summary Reports for methods to repair the damaged cap.

### 2.3.2 Repair of Major Breaches to Cap

A major breach of the protective cap is the result of a rupture or displacement of the geotextile fabric, CCMs, or rip-rap and exposure to contaminated soil, waste, or Reservoir sediment beneath the cap. Additional excavation of contaminated materials may be necessary to secure the disturbed areas so that the protection of human health and the environment is maintained, and contaminant migration does not occur.

Repair of major breaches will be conducted by persons certified to handle or remove ACM. Contaminated soil or ACM displaced by a major breach will be excavated and disposed of at an -approved facility. Sampling and analysis will be conducted consistent with EPA's *Final Site Management Plan for Post Remedial Action Confirmation Sampling and Long-Term Monitoring, BoRit Asbestos Superfund Site, Operable Unit 1, Ambler, Pennsylvania,* dated September 2017 (CDM Smith 2017b), to confirm that contamination was removed and did not migrate beyond the breached area.

Where applicable, repair of a major breach will follow the general steps outlined in Section 2.3.1. The depth of clean material will match depths implemented during EPA Removal Program efforts as detailed in the EPA Removal Program Summary Reports and on as-built drawings. All repairs will be documented on the Site as-built drawings updated by the entity responsible for O&M.

Where applicable, information regarding BMPs, such as importing clean fill material, in **Appendix E** will be considered prior to the initiation of maintenance activities.

EPA and PADEP shall be notified upon the discovery of any major breaches to the cap.

### 2.3.3 Vegetation and Tree Maintenance

Vegetation (i.e., grass and plants) is a component of the Selected Remedy designed to provide a level of protection against erosion to maintain the minimum thickness of clean soil and to maintain proper Site drainage. Drought conditions may require supplemental watering of vegetation and/or require Site access restrictions to reduce stresses to grass and plant root structure. Persistent drought conditions may require permanent methods of Site watering to be implemented such as a permanent sprinkler system within the cap. The Reservoir will not be the source of irrigation water.

Native meadow vegetation at the Site thrives on a three-year mowing cycle during the late winter. Ideally the Asbestos Pile cap, the reservoir berms, and the creek slopes will be mowed in thirds (i.e., first third mowed in 2018 and 2021, second third mowed in 2019 and 2022, third third mowed in 2020 and 2023, etc.). Alternatively, half the Site can be mowed each year. These cycles may be adjusted to meet local concerns or needs, but mowing will occur no more frequently than once per year, and, ideally, rotating portions of the Site will not be mowed annually. Any deviations from the mowing schedule will require approval from EPA.

After mowing, the area will by "hayed" (i.e., collect debris) because the warm-season grasses are very dense, and mowed debris will kill new growth trying to germinate. As an alternative to haying, mow the site in a weave pattern, followed by a second pass perpendicular to the first to ensure adequate mulching of the cut vegetation. Mow no lower than 8 inches, if possible, as mowing lower will significantly damage the crown of these grasses, cause mortality, or open the Site for invasion by less desirable species.

Care must be taken not to mow shrubs in the Reservoir area. Wetland plants (specifically any sedges and rushes) will not be mowed. Paths may be mowed annually on the Asbestos Pile cap to facilitate inspection. Steep slopes along creeks will be inspected by traversing the bottom and the top of the slope. A 10-foot vegetation buffer will be left undisturbed at the bottom of the Park Parcel slopes adjacent to Wissahickon Creek and Rose Valley Creek to provide habitat for select animal species.

Invasive species will also be identified and removed prior to the mowing, or more frequently, as necessary. Non-native invasive species of particular potential concern at the Site include Canada thistle, crownvetch, and Japanese knotweed. Additional species that must be controlled, if present, are those identified as Pennsylvania's state-listed noxious weeds.

Tree growth in allowed areas of the Site, as shown in **Figure 2-1**, will be maintained to minimize the potential for wind throws or toppling of any dead trees. Should a tree fall, any depressions or displacement of the soil cap resulting from the uplifted root mass will immediately be backfilled in accordance with the steps outlined in Section 2.3.1, and seed mix will be applied to the repaired area using a seed mix appropriate for the area (i.e., native grass and forb mix, turf mix, etc.). Fallen trees will be removed and chipped for beneficial reuse as mulch on the Site.

Any volunteer trees discovered in areas identified in Section 2.2.1 where tree growth is prohibited, will be removed. In areas where shrubs, but not trees, are permitted, the inspector will identify each woody species. In addition, any tree exceeding 10 inches in diameter at breast height (DBH) that is prohibited in areas identified in Section 2.2.1 will be cut at the base and removed. The stump will be treated with an appropriate herbicide. Cut trees will be removed, and the trunks will be chipped for beneficial reuse as mulch on the Site.

Appropriate trees (trees species found along the riparian corridor such as black willow, sycamore, etc.) will be allowed to grow at the bottom of the slope along the banks of the Wissahickon Creek and its tributaries. To minimize the remote possibility that such growth may impact the Selected Remedy, any tree exceeding 10 inches DBH will be cut at the base and removed. The intact stump will be allowed to remain and resprout. Similarly, any trees along the stream bank that are in imminent danger of falling (leaning at an angle of 60 degrees (°) or less from the horizon) will also be cut at the base leaving the intact stump to resprout. Cut trees will be removed and chipped, and the wood chips will be beneficially reused as mulch on the Site.

### 2.3.4 Repair of Breaches to Protective Covers from Underground Utility Modifications/Repairs

This type of breach to a protective cover may or may not result in the exposure of ACM or debris below the cover. Possible breaches to the soil cover from underground utility modifications/repairs could include installation of a sprinkler system or connection to existing utilities. As discussed in Section 3, activities or modifications that could disturb or otherwise adversely impact the 2-foot soil cover on the capped areas are prohibited. Any proposed future use of the Site after all ICs have been implemented will be reviewed by EPA, in consultation with PADEP, to ensure that such activity will not adversely impact the Selected Remedy or compromise the protection of human health and the environment. The utility contractor will comply with the required OSHA requirements as listed in Section 1.4.3. The entity responsible for O&M will notify EPA and PADEP of the breach and will manage repair of these utility breaches to the cap from underground utility modifications or repairs, whether or not ACM or debris from below the cover has been exposed.

### 2.3.5 Maintenance Activities

Routine maintenance at the Park, Reservoir, and Asbestos Pile parcels includes lawn maintenance; mowing; supplemental lawn, shrub, and tree watering; and tree and shrub maintenance.

In general, if erosion or ACM has been exposed during maintenance activities at the Park, Reservoir, or Asbestos Pile parcels, the entity responsible for O&M will do the following:

- Notify EPA and PADEP of the discovery.
- Take necessary measures to secure the disturbed areas and limit contaminant migration from inadvertent activities so that the protection of human health and the environment is maintained through restriction of access to the area.
- Contact the entity responsible for O&M who will manage any encountered contamination. Section 2.4 further describes the responsibilities of the entity responsible for O&M.
- Take corrective action to repair the protective cap, with the exception of paved roads and parking surfaces.

### 2.3.6 ACM Removal Activities

A non-intrusive visual inspection will be performed to identify and remove ACM in Wissahickon Creek from the West Mount Pleasant Avenue Bridge area to the Morris Road Bridge area. Note that waterway demolition activities during Spring/Summer 2019 may have altered baseline conditions and exposed previously buried ACM material within the Wissahickon Creek bank. ACM will also be removed from lower-lying portions of the Green Ribbon Walking Trail that are downstream of the BoRit Site up to the area accessed from the walking trail to the Morris Road Bridge. The extent of ACM removal activities is shown in **Figure 2-3**. ACM removal should occur in the spring and fall of each year and following significant weather events. Personnel shall collect ACM in asbestos disposal bags, which will be stored in an on-site roll-off dumpster and ultimately disposed offsite by an investigation-derived waste (IDW) subcontractor in an approved solid waste landfill.

### 2.3.7 Site Security Inspection Activities

Approximately 1,200 ft of aluminum fence including a double-wide gate is installed along the northern site boundary parallel to Ambler Avenue. Inspection of the fence and gate for damage will be conducted during routine site inspections.

## 2.4 Long-Term Monitoring

### 2.4.1 Routine Long-Term Monitoring

LTM is also included as part of O&M activities, and it includes ABS and ambient air, soil, sediment, and surface water sampling to confirm that RGs are not exceeded and to demonstrate that the Selected Remedy continues to perform as designed. Specific LTM sampling protocols to be implemented are specified in EPA's *Final Site Management Plan for Post Remedial Action Confirmation Sampling and Long-Term Monitoring, BoRit Asbestos Superfund Site, Operable Unit 1, Ambler, Pennsylvania,* dated September 2017 (CDM Smith 2017b).

LTM sampling will be conducted annually for the first four years leading to the first FYR and then once every FYR cycle thereafter. The Site will be reviewed at least every five years while on-site contamination remains at concentrations that result in a restricted use/restricted exposure scenario. As part of each FYR, plans for LTM will be re-assessed.

**Appendix I** includes standard operating procures (SOPs) for ABS and ambient air, soil, sediment, and surface water sampling.

### 2.4.2 Piezometer and Monitoring Well Abandonment

The proper abandonment (decommissioning) of a piezometer and monitoring well is a critical final step in its service life. As indicated in the ROD, groundwater was not identified as a medium of concern, and groundwater monitoring is not required as part of the Selected Remedy. Proper piezometer and monitoring well abandonment eliminate the physical hazard of the well (the hole in the ground) and the pathway for migration of contamination. The decommissioning methods were dependent on the condition and construction details of the piezometer and monitoring well.

Piezometers and monitoring wells at the Site were abandoned by EPA in accordance with guidelines provided in PADEP Water-well Abandonment Guidelines (PADEP 2018) (http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_006802.pdf).

**Figure 2-4** shows the locations of abandoned monitoring wells and piezometers. Monitoring wells MW-1 through MW-7 and piezometers PKPZ-01 through PKPZ-03, GT-6, and GT-7 were abandoned in place in September 2018 following PADEP guidelines.

# Section 3

# Institutional Controls

ICs are non-engineering measures designed to prevent or limit exposure to contaminated waste, soil, and Reservoir sediment left in place at the Site. ICs were developed to prohibit activities at the Site that would adversely impact the Selected Remedy and compromise the protection of human health and the environment.

This O&M Plan does not outline monitoring requirements for the Site-specific ICs. However, because ICs at the Site influence O&M activities discussed in this O&M Plan, ICs are listed below for completeness and are shown in **Figure 2-1**.

<u>Site-Wide ICs:</u>

1. Activities or modifications that could disturb or otherwise adversely impact the two-foot soil cover on the capped areas are prohibited unless prior written approval from EPA, in consultation with PADEP, is obtained authorizing the specific activity. Any proposed future use of the Site will be reviewed by EPA, in consultation with PADEP, to ensure that such activity will not adversely impact the Selected Remedy or compromise the protection of human health and the environment.
2. Construction activities are prohibited unless prior written approval from EPA, in consultation with PADEP, is obtained authorizing the specific activity. Prohibited construction activities include, but are not limited to, piling installation, dredging, drilling, digging, excavation, or use of heavy equipment in the capped areas.
3. Any modifications to the drainage pattern on-site are prohibited unless EPA, in consultation with PADEP, determines that such activity will not adversely impact the Selected Remedy.
4. Public access will be restricted after significant weather events until the property has been inspected for any signs of damage or erosion, especially in the 100-year floodplain.
5. The Selected Remedy will be protective for maintenance workers, recreational visitors, and commercial workers. Any other use of the parcels will require further investigations and plans, which will be reviewed and approved by EPA, in consultation with PADEP.
6. Maintain vegetation at stabilized stream banks.

<u>Parcel Specific ICs:</u>

Asbestos Pile Parcel:

7. Construction of structures that may undermine the slope stability of the Asbestos Pile parcel will be prohibited unless prior written approval from EPA, in consultation with PADEP, is obtained authorizing the specific activity.
8. Trees are prohibited on the Asbestos Pile parcel slopes.
9. Trees are prohibited on the stream banks adjacent to Tannery Run, where CCM is present to stabilize the slope.

Reservoir Parcel:

10. Maintain suitable vegetation and/or water levels on the capped areas of the Reservoir parcel (berms and Reservoir floor) to ensure protection from erosion.
11. Trees are prohibited along the berm of the Reservoir adjacent to Wissahickon Creek.

Park Parcel:

12. Trees are prohibited on the steep slope of Wissahickon Creek (where geocells were utilized to stabilize the slope), and on the stream banks of Rose Valley Creek (where CCM is present to stabilize the slope).

At the Site, modification of ICs may be required in the event of a change in land use or ownership. If an event occurs that could lead to a modification, ICs will be reviewed and revised accordingly to ensure that the ICs at the Site continue to provide adequate protection. Although not anticipated for the Site, the termination of ICs may occur if all remaining contamination at the Site is removed to a level below that which poses a risk to human health and the environment. Additional details regarding ICs may be found in EPA's *Final Institutional Controls Implementation and Assurance Plan, BoRit Asbestos Superfund Site, Ambler, PA,* dated September 2017 (CDM Smith 2017a).

# Section 4
# Reporting Requirements

As described in Section 1.3.3, FYR Reports will be completed by the EPA on a five-year cycle and in accordance with *Comprehensive Five-Year Review Guidance* (EPA 2001b). Reports on O&M activities will be generated on a routine basis and as required by unforeseen events (described below). EPA will review the reports on an ongoing basis.

## 4.1 Routine Reports

A quarterly inspection checklist (**Appendix D**) will be prepared by the entity responsible for O&M and will be submitted to the EPA remedial project manager (RPM) and PADEP for the Site for review within two weeks of the quarterly inspection. Annual O&M Reports (**Appendix C**) summarizing O&M activities will be prepared by the entity responsible for O&M and will be submitted to the EPA RPM and PADEP for the Site on an annual basis.

Routine reports will include sections on results from routine and post-significant weather inspections, listing of major repairs, breakdown of actual costs for the reporting period, budget for the next reporting period, regular updates of the Site HASP, O&M Manual and as-built drawings, information from property owners, community complaints and responses, and verifications of the integrity of ICs.

In the event any instrument of ICs for the Site is found to be inadequate or require modification, or additional ICs are necessary to ensure protectiveness of the Selected Remedy, that information will be included within the routine report prepared by the property owner or PADEP.

These reports will assist EPA and PADEP in considering the adequacy of O&M, the frequency of repairs, costs at the Site, and how these factors relate to determining and ensuring protectiveness of the Selected Remedy.

## 4.2 Special Reports

Special reports are required as needed because of unforeseen events or conditions. One example of a special report is an Incident Report. Incident Reports are used to document the details of accidents involving site personnel and other unusual events such as fires, floods, or weather damage as may be required by the O&M HASP. Another example of a special report is a record of modification or amendment to the O&M HASP. When accidents occur on the Site, the O&M HASP may need to be updated depending on the type of incident and whether or not it is already covered in the HASP. These special reports will be provided to EPA, PADEP, Whitpain Township, WWP, and other interested parties in a timely manner (EPA 2001a).

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# Section 5

# References

CDM Smith. 2017a. *Final Remedial Design, Attachment B – Final Institutional Controls Implementation and Assurance Plan*. November 16.

CDM Smith. 2017b. *Final Remedial Design, Attachment C – Final Site Management Plan for Post Remedial Action Confirmation Sampling and Long-Term Monitoring*. November 16.

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# Figures

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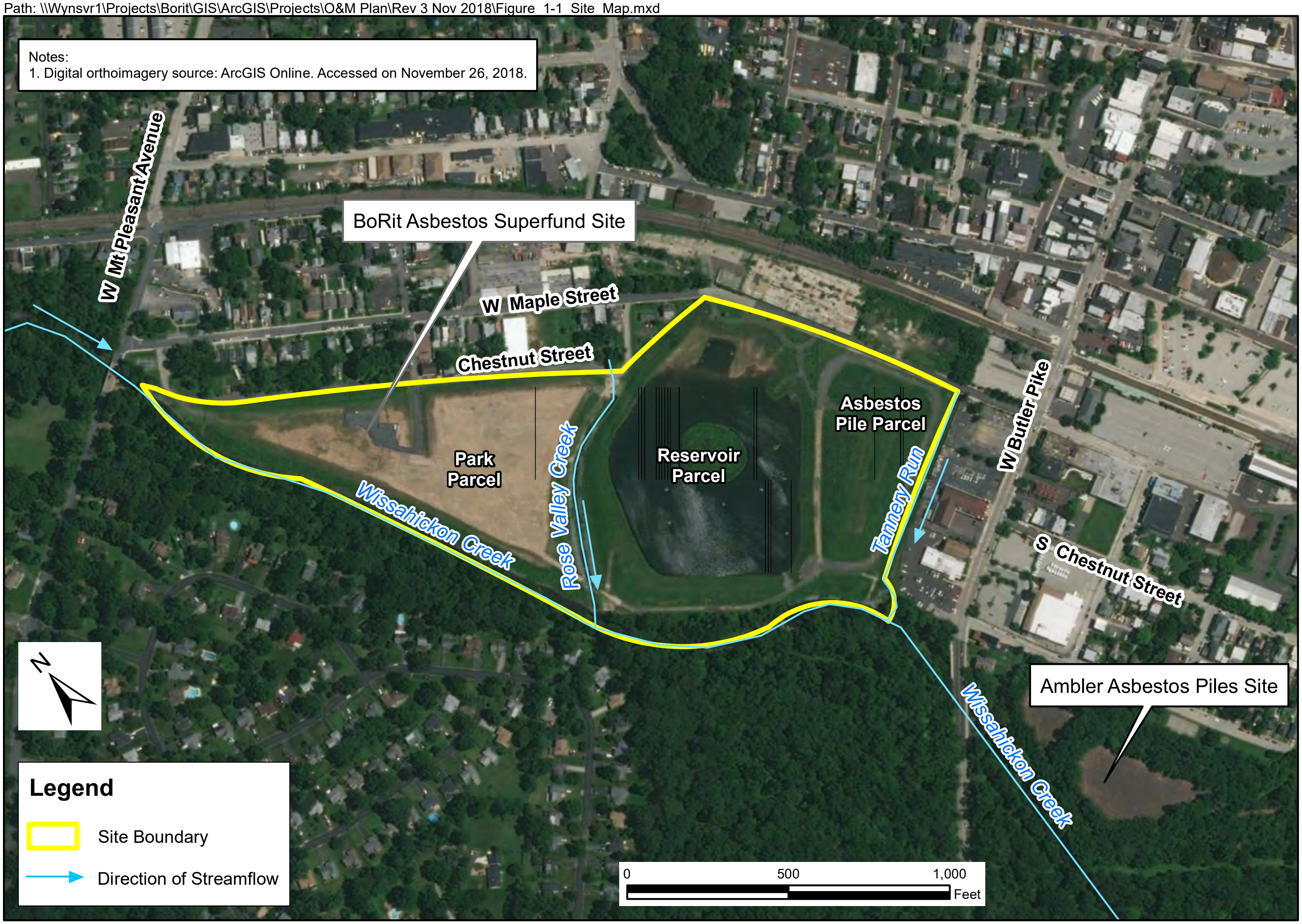
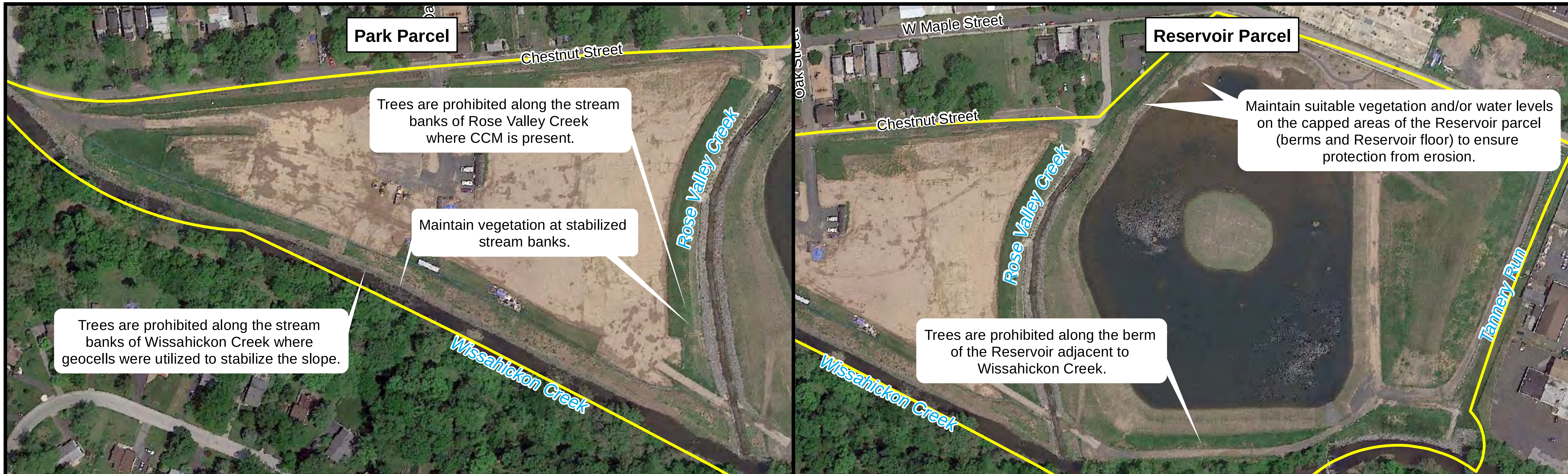
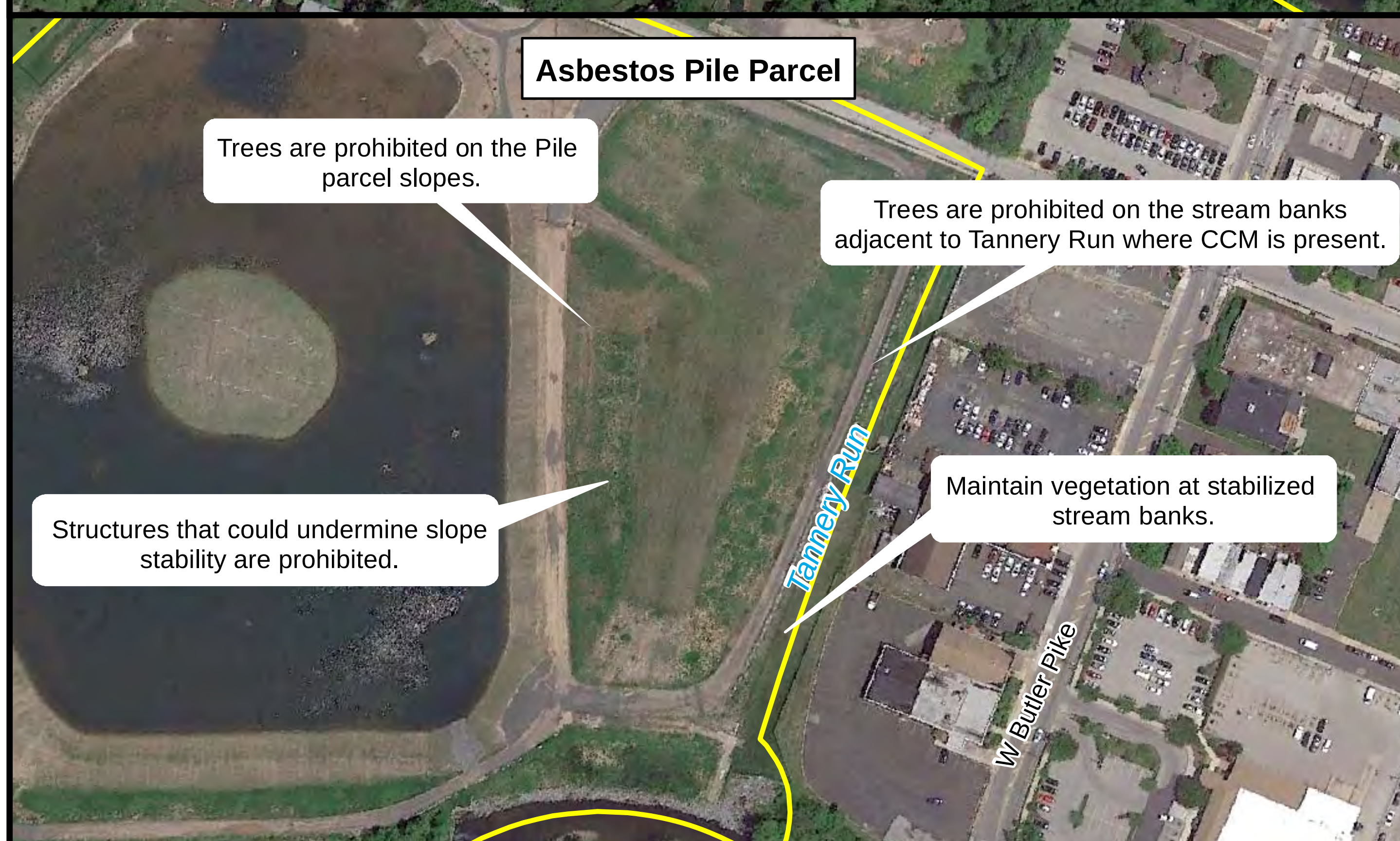



CDM Smith

BoRit Asbestos Superfund Site
Ambler, Pennsylvania

Figure 1-1
Site Map




Site-wide Land Use Controls
1. Land use is restricted to Recreational/Open Space.
2. Activities that disturb the soil cap are prohibited without prior written approval from EPA, in consultation with PADEP.
3. Public access is restricted after major storm events until the Site is evaluated for damage.
Please refer to Section 3 of the O&M Plan for a detailed description of ICs, including Site-wide ICs.

Notes:
CCM = concrete cable mats
EPA = U.S. Environmental Protection Agency
PADEP = Pennsylvania Department of Environmental Protection
ICs = institutional controls
Source: Google Earth, SPOT Image, 2016.

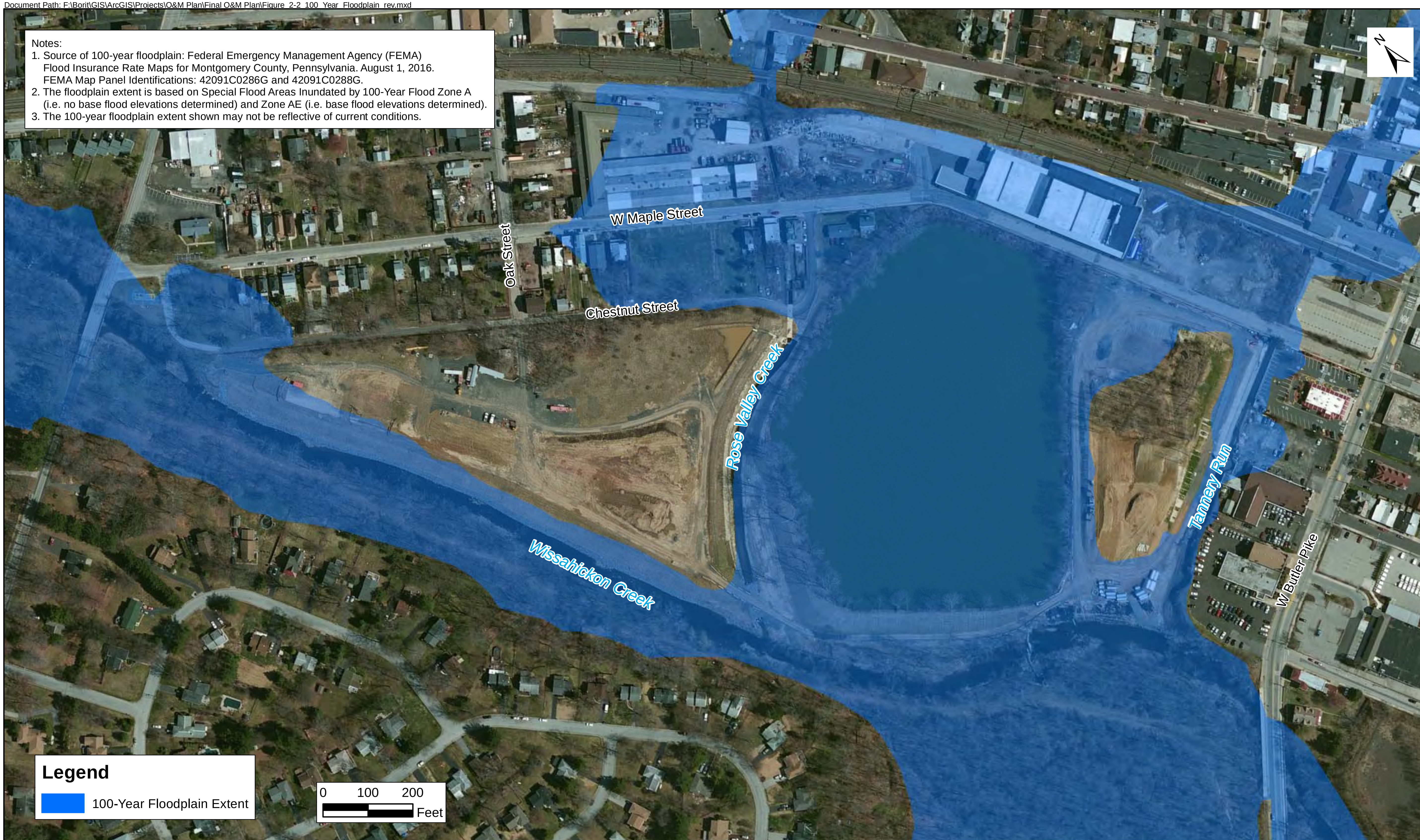
**Legend**

Site Boundary

N

0 250 500 Feet

Document Path: F:\Borit\GIS\ArcGIS\Projects\O&M Plan\Final O&M Plan\Figure_2-2_100_Year_Floodplain_rev.mxd

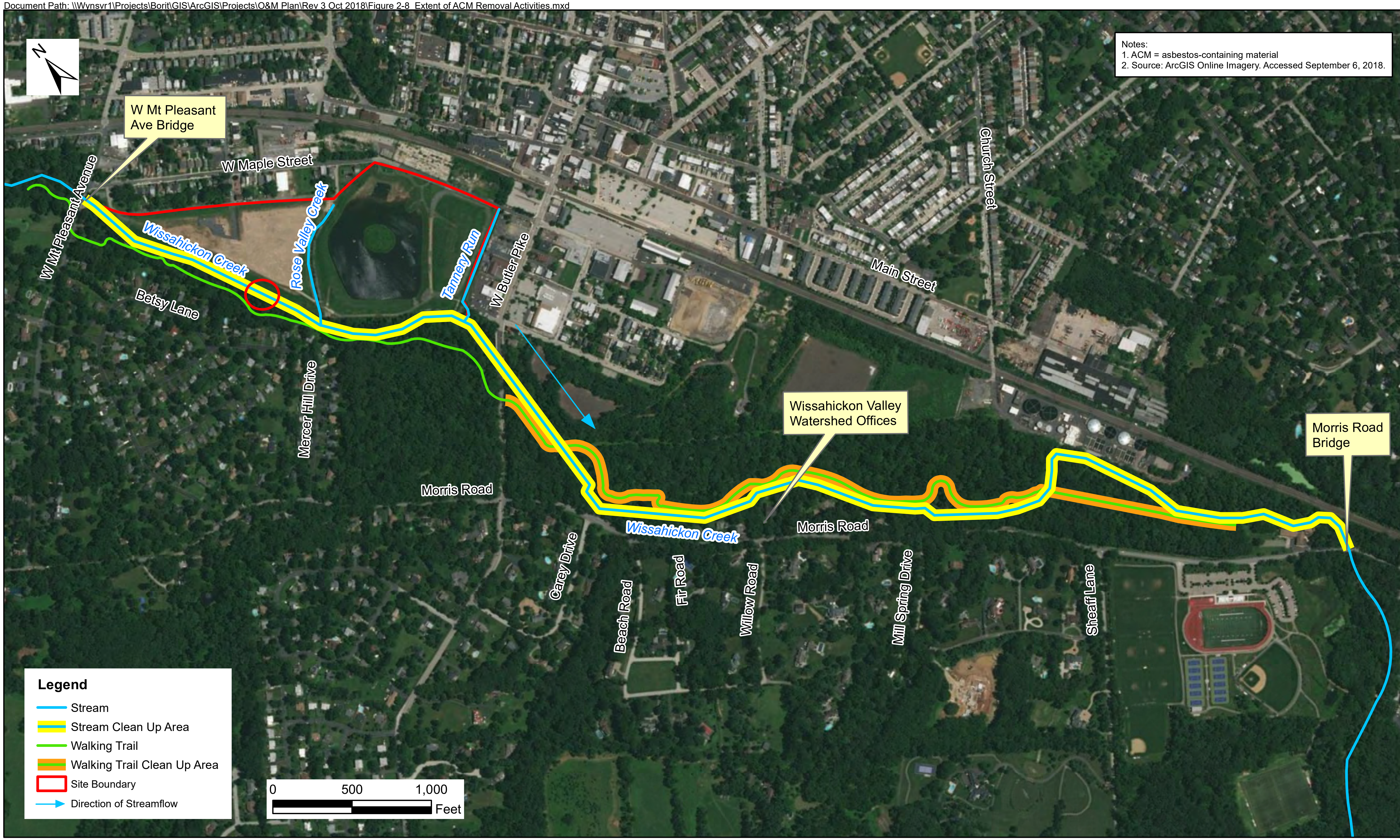



CDM Smith

BoRit Asbestos Superfund Site
Ambler, Pennsylvania

Figure 2-2
100-Year Floodplain Extent

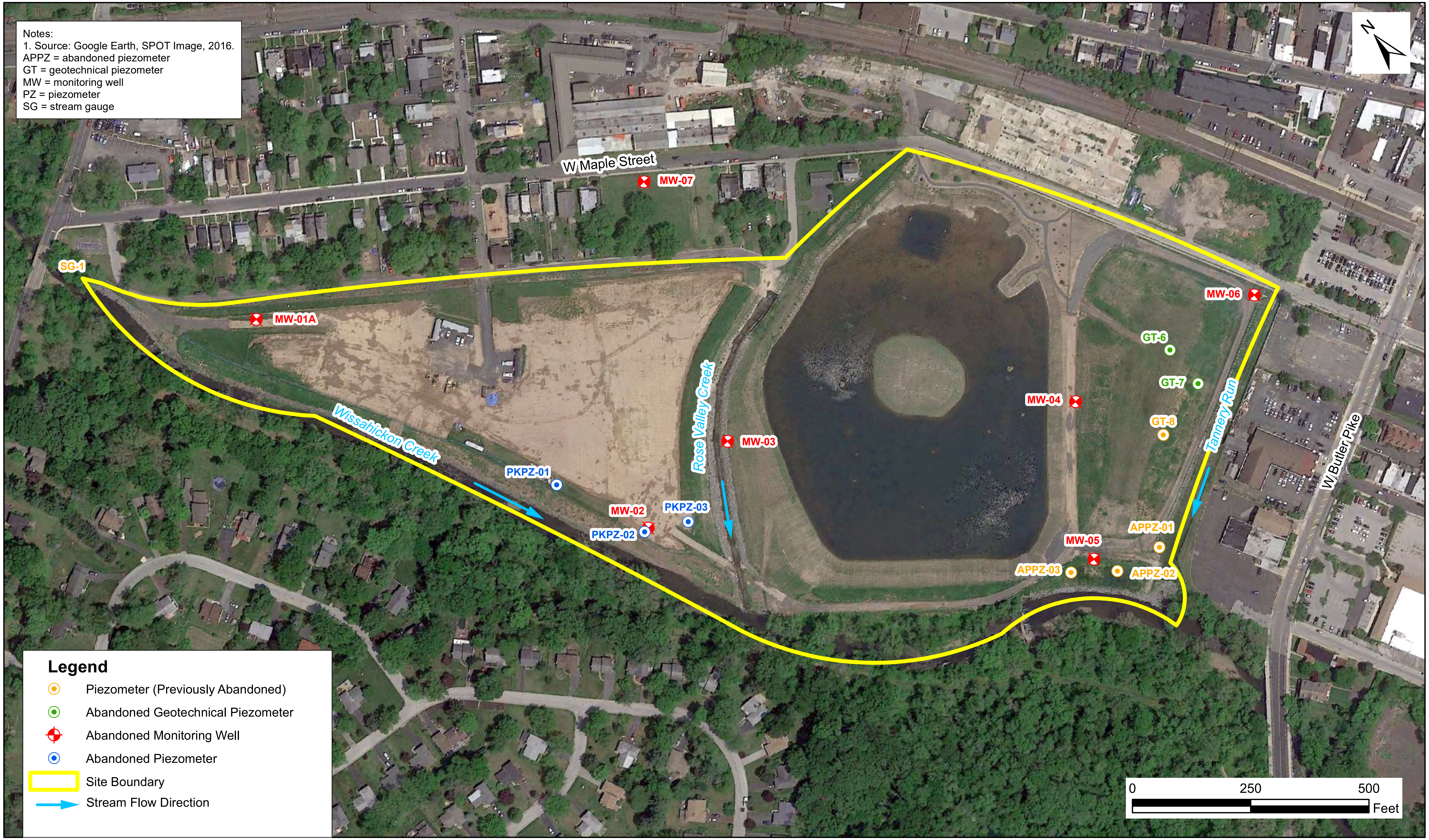
Document Path: \\Wynsvr1\Projects\Borit\GIS\ArcGIS\Projects\O&M Plan\Rev 3 Oct 2018\Figure 2-8 Extent of ACM Removal Activities.mxd




CDM Smith

BoRit Asbestos Superfund Site
Operable Unit 1
Ambler, Pennsylvania

Figure 2-3
Extent of ACM Removal Activities




BoRit Asbestos Superfund Site
Ambler, Pennsylvania

Figure 2-4
Piezometer and Monitoring Well Abandonment Locations

# Tables

**Table 2-1 Summary of Maintenance Requirements/Schedule by Area**

| Parcel | Task | When to be Performed |
|---|---|---|
| Entire Site | Site Inspections | Quarterly and within 48 hours of significant weather event* |
| | Site-specific Annual O&M report | Annually |
| | Inspection checklist | Quarterly and within 48 hours of significant weather event* |
| | Fence/gate inspection | Quarterly |
| | Repair minor breaches in soil cap | When cap can be repaired without additional excavation of contaminated soil |
| | Repair major breaches in soil cap | When rupture or displacement of the geotextile fabric, CCMs, or rip-rap causes exposure to contaminated soil, waste, or Reservoir sediment beneath the cap |
| | Irrigate vegetation/restrict Site access, as desired | During drought conditions |
| | Mowing | 3-year cycle (can be adjusted to meet local concerns, but cannot exceed more than once per year); however, mowing routine can be modified pending use conditions or to prevent conditions near public areas |
| | Backfill tree roots | When a tree falls causing depressions or displacement of soil |
| | Cut and mulch trees | When found in prohibited areas |
| | Long-term monitoring sampling | Annually for first four years leading to the first FYR and then once every FYR cycle thereafter |
| | Vulnerability monitoring for significant weather events | Ongoing |
| Park | Inspection of ground surface to identify erosion, burrowing animals, or other damage to capped area | Quarterly and within 48 hours of significant weather event* |
| | Inspection of soil cap, vegetation, and trees | Quarterly and within 48 hours of significant weather event* |

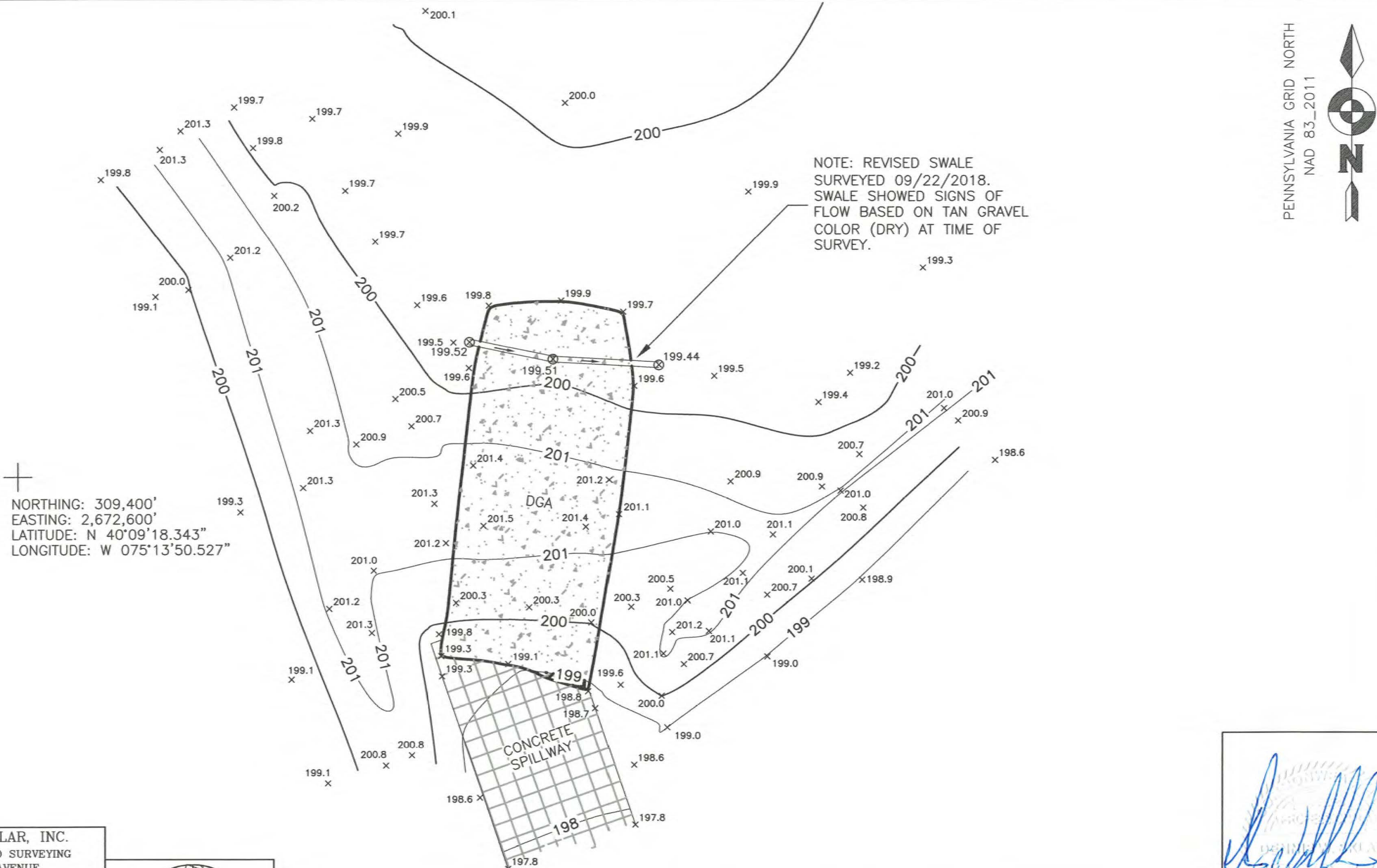
**Table 2-1  Summary of Maintenance Requirements/Schedule by Area**

| Parcel | Task | When to be Performed |
| --- | --- | --- |
| Reservoir | Fence/gate inspection | Quarterly |
| | Lawn maintenance, mowing, supplemental lawn, shrub, and tree watering, tree shrub maintenance | Routine maintenance |
| | Inspection of berms | Quarterly and within 48 hours of significant weather event* |
| | Removal of trees | When identified on berm |
| | Fence/gate inspection | Quarterly |
| Asbestos Pile | Inspection of side slopes to identify erosion | Quarterly and within 48 hours of significant weather event* |
| | Inspection of cap, vegetation, and trees | Quarterly and within 48 hours of significant weather event* |
| | Fence/gate inspection | Quarterly |
| | Removal of trees | When identified on slope |
| Stream banks | Inspect for trees along steep slopes of Wissahickon Creek, Rose Valley Creek, and Tannery Run | Quarterly and within 48 hours of significant weather event* |
| | Inspect for erosion or damage | Quarterly and within 48 hours of significant weather event* |
| | Remove trees | When located in prohibited area |
| | Wash out of debris, inspection of culverts, inspection of emergency spillway, cracking heaving or breaches in culverts, concrete cable mats, or retaining walls | After storm |
| Wissahickon Creek | Asbestos-containing material removal | Spring and fall of each year and following significant weather events. Schedule can be evaluated and modified if a significant decrease in asbestos-containing material is observed. |

*pending safe access to site

# Appendix A

## As-Built Drawings

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2837 OGDEN AVENUE
BENSALEM, PA 19020
(215) 268-7988

DATE: 09/01/2018
DRAWN BY: DWS
2245-01.DWG
DRAWING NO. 2245
SHEET 1 OF 2

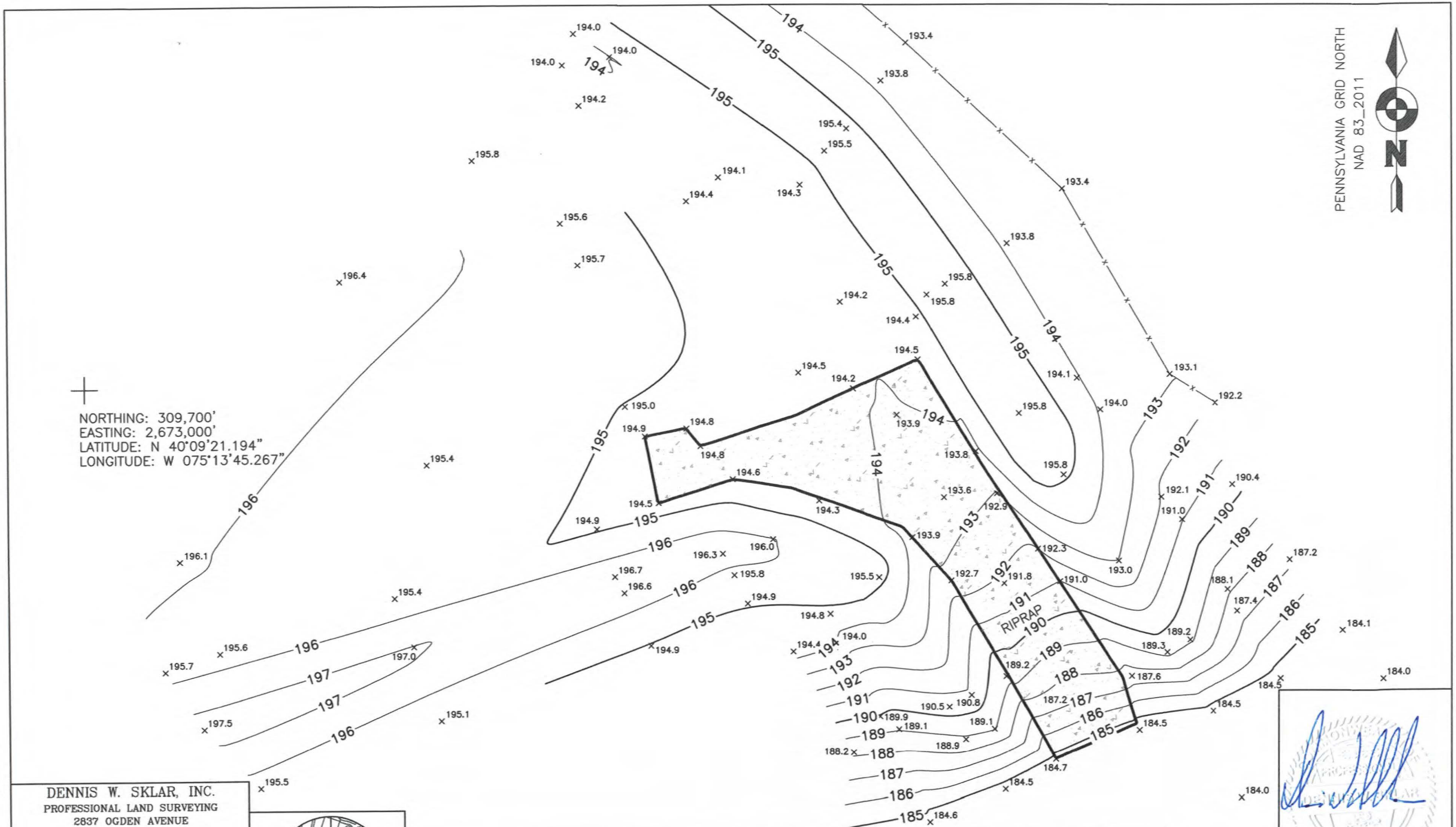
DWS

# BORIT SUPERFUND SITE
## RAMP AREA REPAIR
## POST CONSTRUCTION
## TOPOGRAPHIC SURVEY
**AMBLER – PENNSYLVANIA**

0 10 20
SCALE IN FEET – 1" = 10'

| DATUM | | REVISIONS |
|---|---|---|
| PENNSYLVANIA STATE PLANE COORDINATES NAD 83_2011 SOUTH ZONE NAVD 88 | 1 | 09/22/2018: SURVEY NEW SWALE CUT THROUGH EXISTING DGA. |
| | 2 | |
| | 3 | |
| | 4 | |
| | 5 | |

DENNIS W. SKLAR, PLS
LICENSE NO. SU075154

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DATE: 09/01/2018
DRAWN BY: DWS
2245-01.DWG
DRAWING NO. 2245
SHEET 2 OF 2

DWS

# BORIT SUPERFUND SITE
## SPILLWAY REPAIR AREA
## POST CONSTRUCTION
## TOPOGRAPHIC SURVEY
**AMBLER - PENNSYLVANIA**

0 10 20
SCALE IN FEET - 1" = 10'

| DATUM | | REVISIONS |
|---|---|---|
| PENNSYLVANIA STATE PLANE COORDINATES NAD 83_2011 SOUTH ZONE NAVD 88 | 1 | |
| | 2 | |
| | 3 | |
| | 4 | |
| | 5 | |

DENNIS W. SKLAR, PLS
LICENSE NO. SU075154

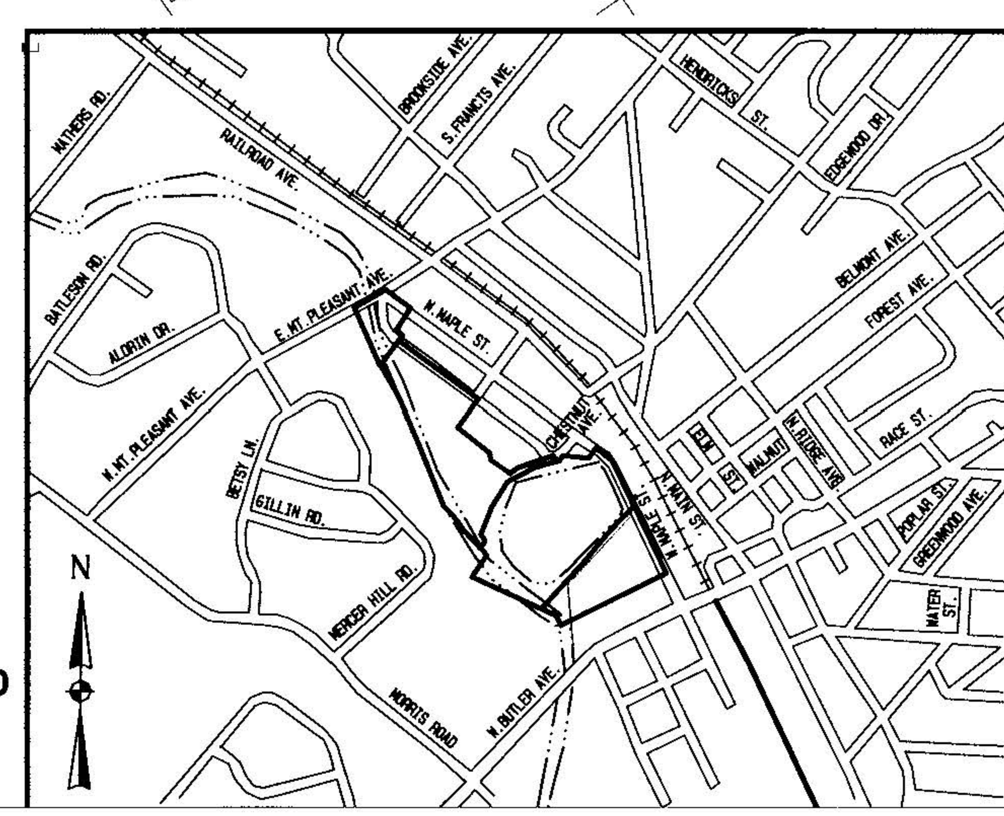

# GENERAL NOTES

1. SITE FEATURES PER LUDGATE ENGINEERING CORPORATION FIELD SURVEY OF 6-2-08. THE 6/08 DATE IS THE DATE OF THE ORIGINAL SURVEY. THE AS BUILT SURVEY DATE IS 7/15/09.
2. HORIZONTAL DATUM:
   NAD 83 (PA SOUTH)
   VERTICAL DATUM:
   NAVD88
3. REFERENCE DATA:
   * MONTGOMERY COUNTY TAX MAPS
   * DEEDS AS LISTED
   * "LOT LOCATION PLAN" FOR WATT WAREHOUSING CO. BY C.RAYMOND WEIR ASSOC., INC. DATED 8/1/1962.
4. CONTOURS SHOWN WITHIN THE LIMIT OF BOTTOM OF BANK PER LIMITED SHOTS WITHIN CREEK/WATERCOURSE. THEY DO NOT SHOW ALL THE ELEVATIONS WITHIN THE WATERCOURSE.
5. 100 YEAR FLOODPLAIN SHOWN PER FEMA FIRM 42091C0286 E & 42091C0288 E. DATED 12/19/96.

NOTE: THE FIRM ELEVATIONS ARE BASED UPON NGVD 29 (NGVD 29 IS +/- 1.1 HIGHER IN ELEVATION TO NAVD88).

## LEGEND

- = MONUMENT FOUND
- = CATCH BASIN (C.B.)
- = SANITARY OR STORM MANHOLES (AS INDICATED)
- = WATER VALVE CAP
- = GAS VALVE
- = UTILITY POLE W/GUY WIRE
- = FIRE HYDRANT
- = STREET SIGN (AS NOTED)
- = EXISTING TREES
- = WOODS LINE
- = EXIST. FENCE LINE
- = EXISTING BUILDINGS



## LOCATION MAP

SCALE: 1"=1000'

## SHEET INDEX

| | |
|---|---|
| OVERVIEW TOPOGRAPHIC SURVEY PLAT | SHEET 1 OF 8 |
| TANNERY RUN DETAIL VIEW | SHEET 2 OF 8 |
| ROSE VALLEY DETAIL VIEW | SHEET 3 OF 8 |
| CROSS SECTION PROFILES | SHEET3 4,5,6,7,8 OF 8 |

| REVISION | | DATE | DESCRIPTION |
|---|---|---|---|
| #6 | PSR | 7-21-09 | ASBUILTS |
| #5 | PSR | 2-13-09 | |
| #4 | PSR | 1-5-09 | |
| #3 | PSR | 8-19-08 | |
| #2 | PSR | 8-15-08 | ADD SECTIONS |
| #1 | PSR | 6-16-08 | |

SITUATE IN:
UPPER DUBLIN TOWNSHIP
MONTGOMERY COUNTY,
PENNSYLVANIA

# OVERVIEW TOPOGRAPHIC SURVEY PLAT

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| PSR | | | | P: 7801508.PRO |
| 6-5-08 | | | | |
| SCALE | TAX MAP PARCEL | | DRAWING NUMBER | |
| 1"=100' | SEE ABOVE | | D-7801508 SHT.1 OF 8 | |


# LEGEND

- □ = MONUMENT FOUND
- = CATCH BASIN (C.B.)
- ○ = SANITARY OR STORM MANHOLES (AS INDICATED)
- = WATER VALVE CAP
- = GAS VALVE
- = UTILITY POLE W/GUY WIRE
- = FIRE HYDRANT
- = STREET SIGN (AS NOTED)
- = EXISTING TREES
- = WOODS LINE
- = EXIST. FENCE LINE
- = EXISTING BUILDINGS

| REVISION | DATE | DESCRIPTION |
|---|---|---|
| #7 PSR | 7-21-09 | AS-BUILTS |
| #6 PSR | 2-13-09 | |
| #5 PSR | 1-5-09 | |
| #4 PSR | 8-19-08 | |
| #3 PSR | 8-15-08 | ADD SECTIONS |
| #1 PSR | 6-16-08 | |

# TANNERY RUN DETAIL VIEW
# TOPOGRAPHIC SURVEY PLAT

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| PSR | | | | P:7801508.PRO |
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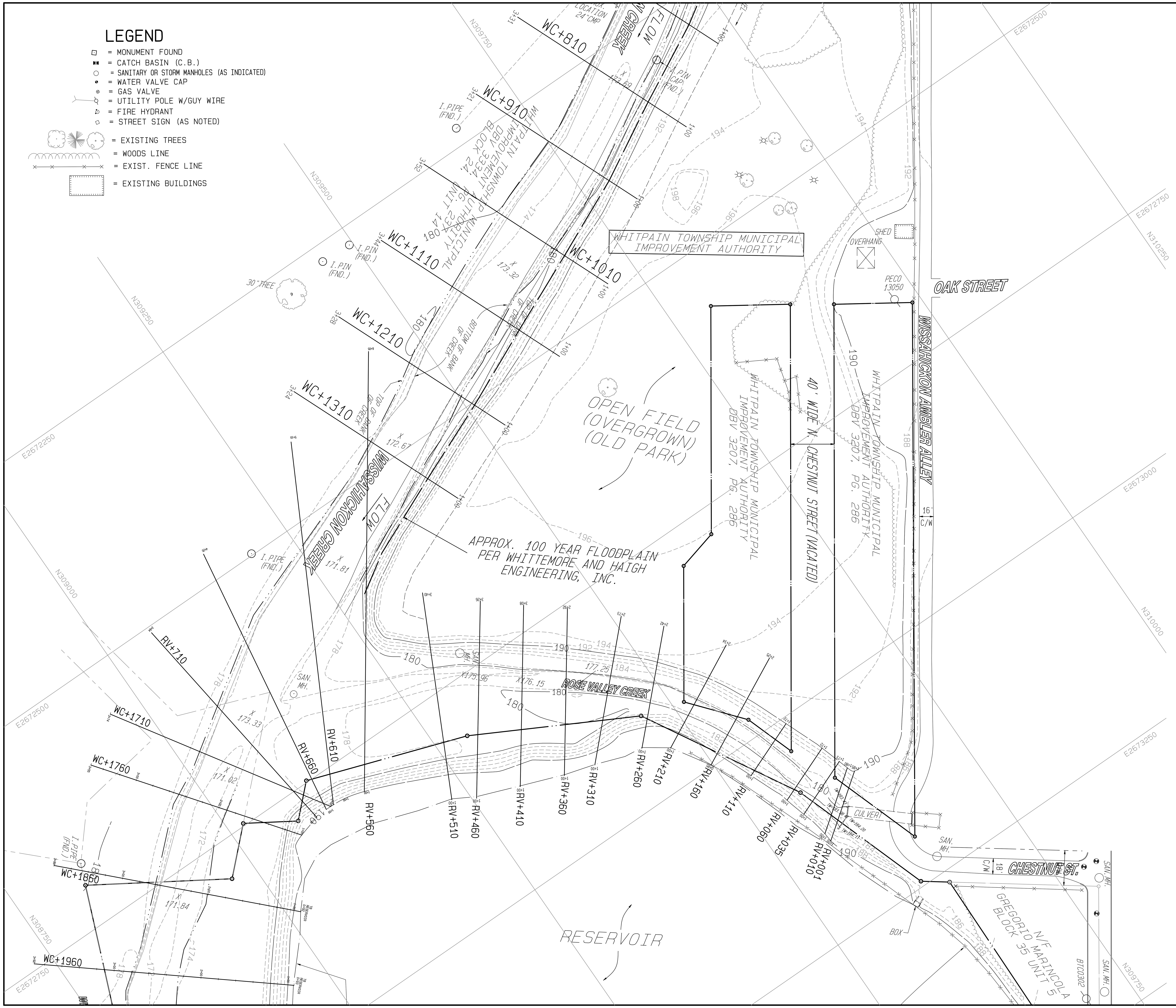


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| #3 PSR | 8-19-08 | |
| #2 PSR | 8-15-08 | ADD SECTIONS |
| #1 PSR | 6-16-08 | |
| REVISION | DATE | DESCRIPTION |

SITUATE IN:
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# ROSE VALLEY DETAIL VIEW TOPOGRAPHIC SURVEY PLAT

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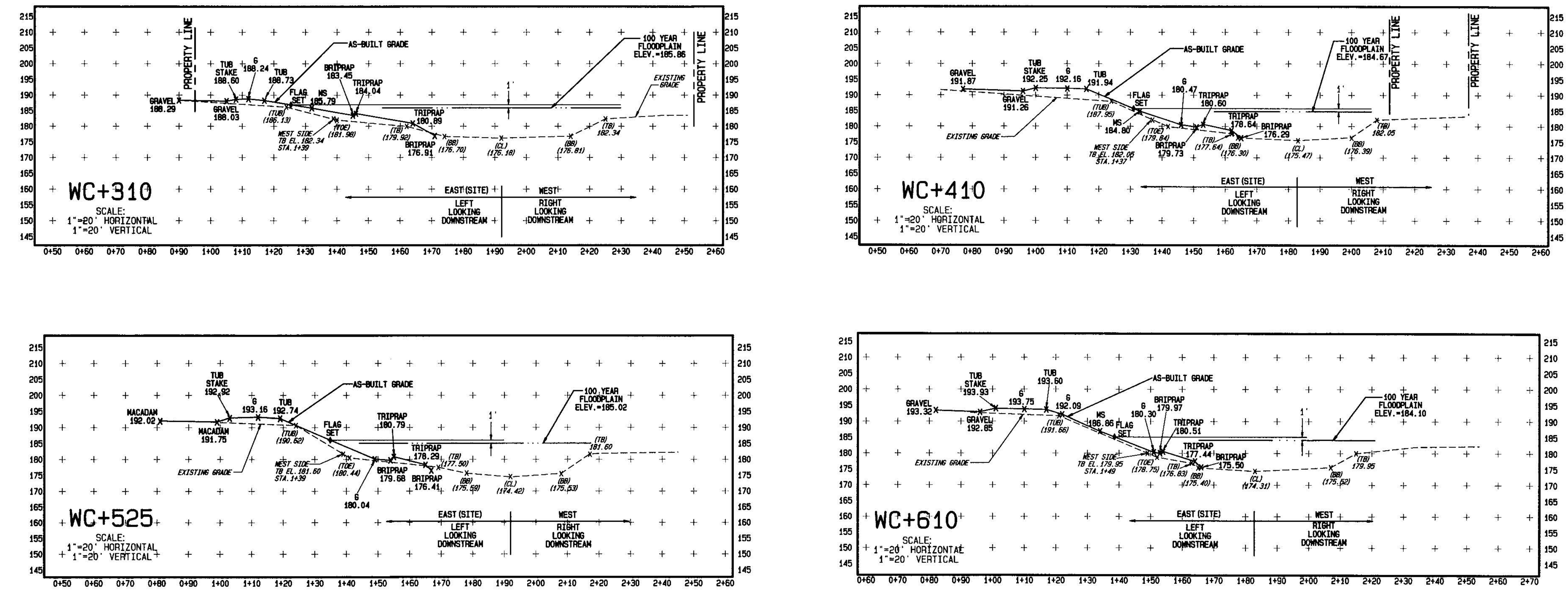


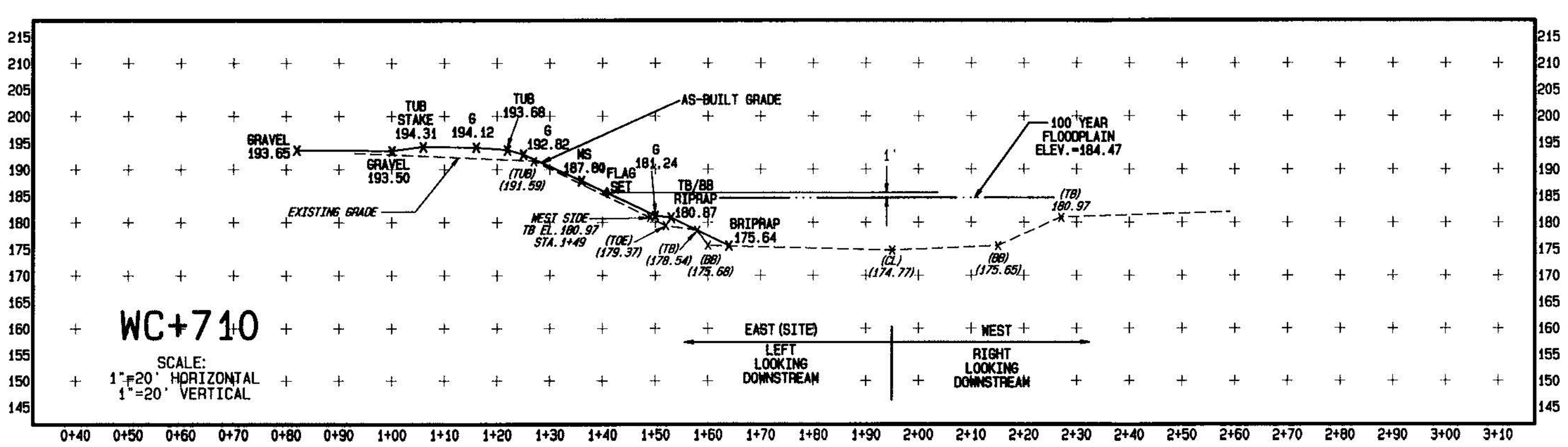


# CROSS SECTION PROFILES

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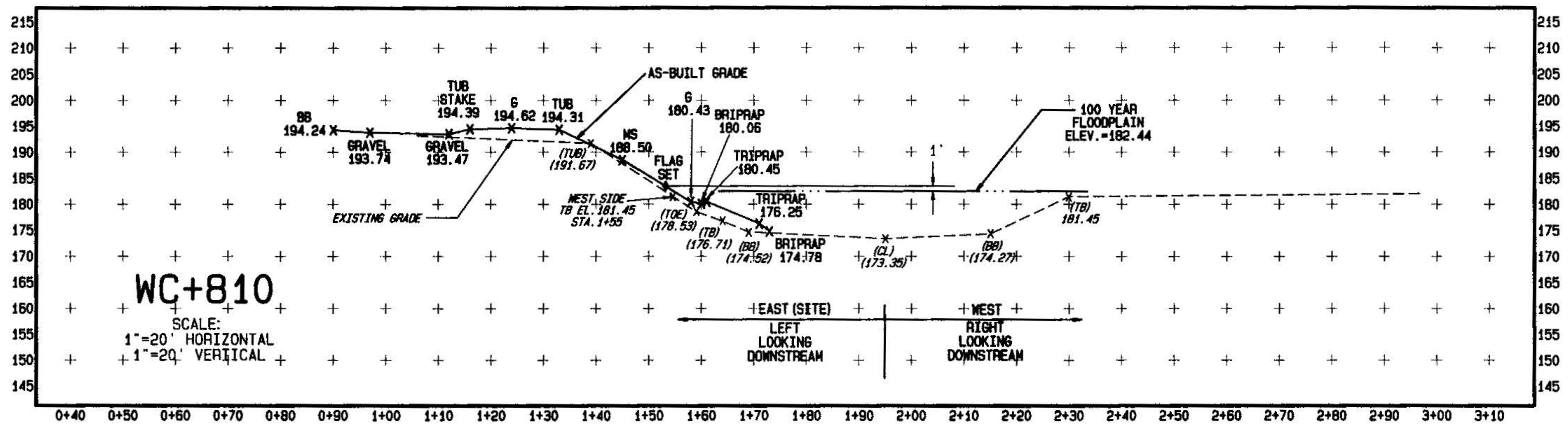


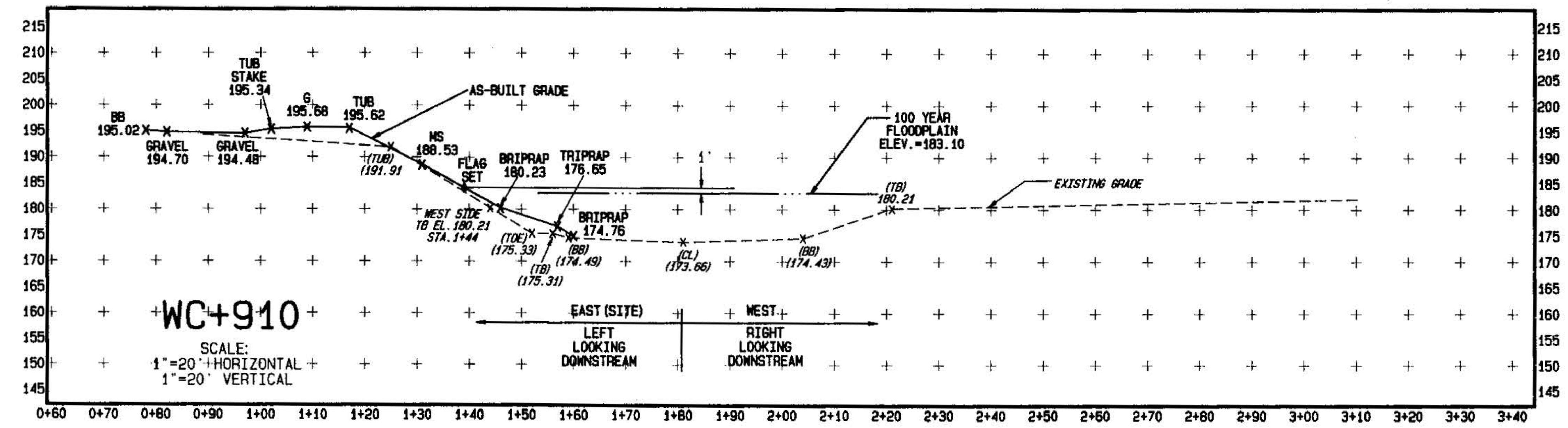


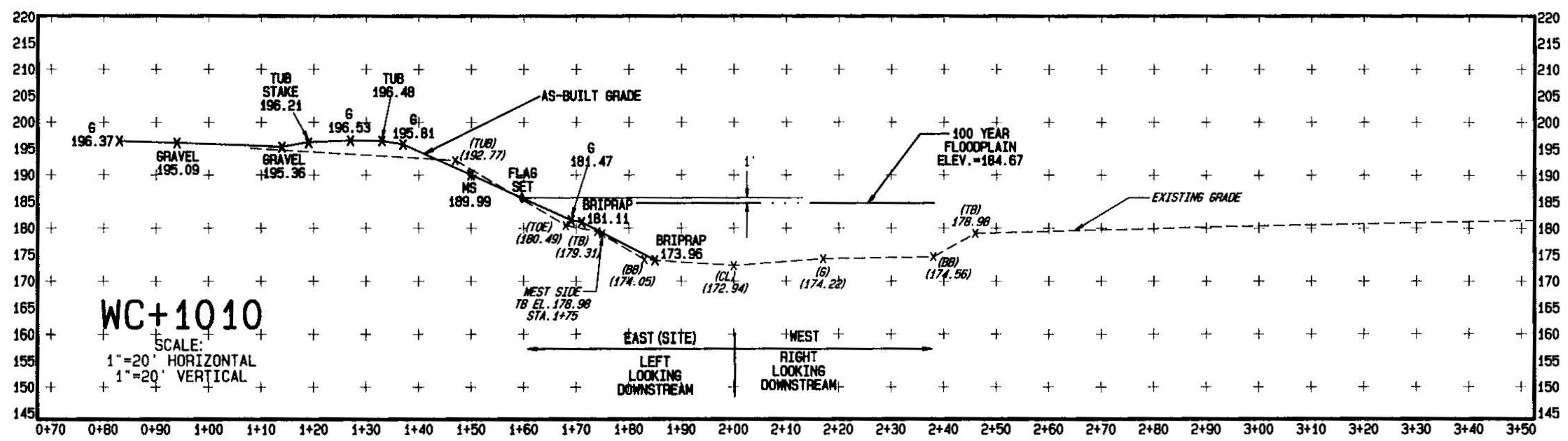


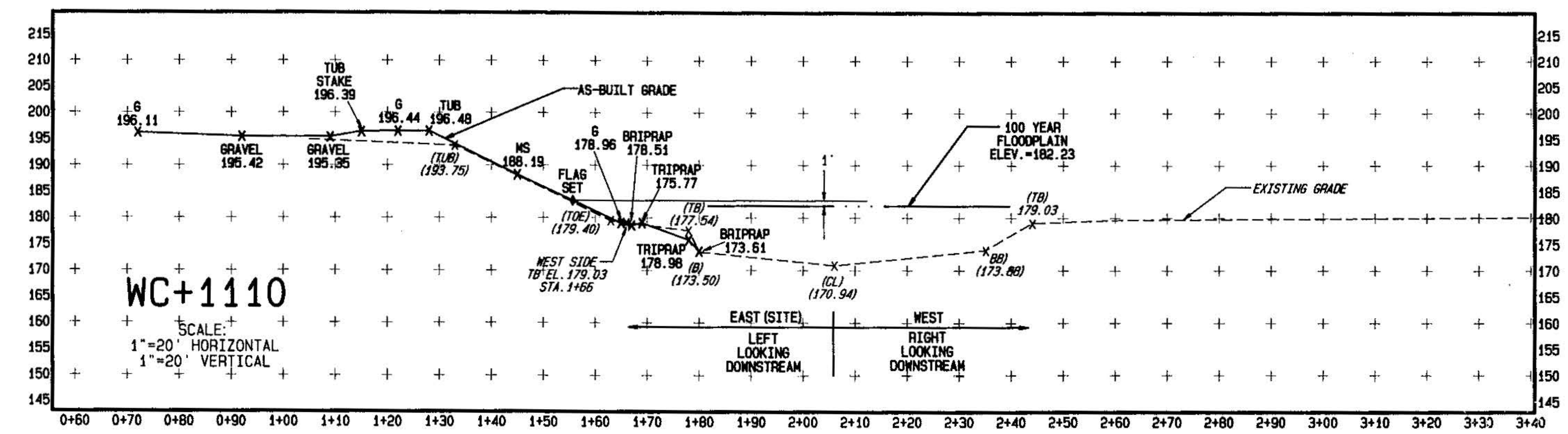


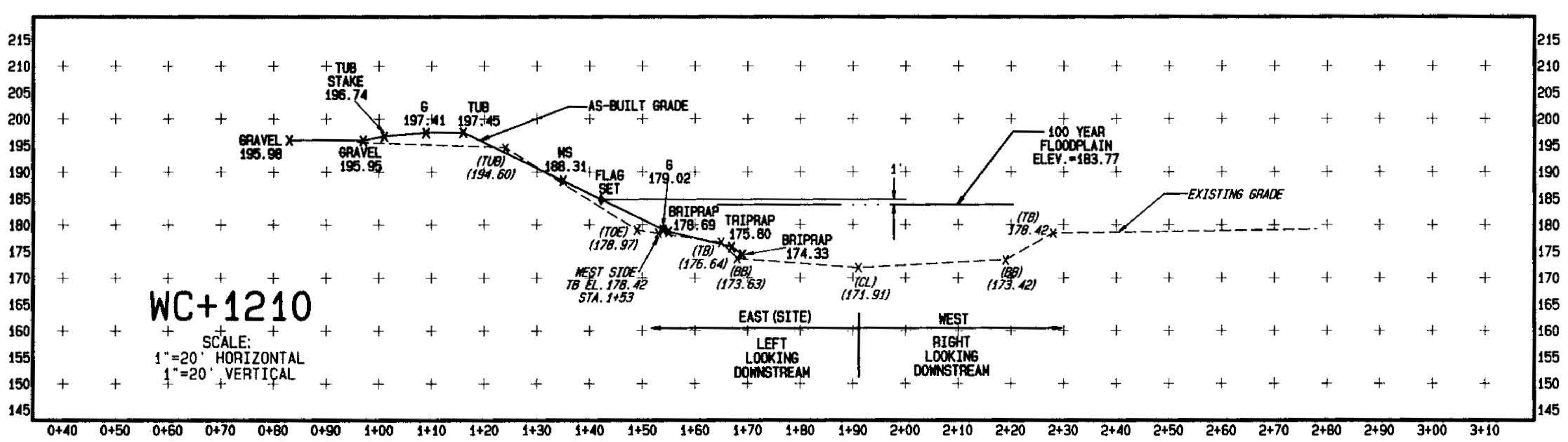


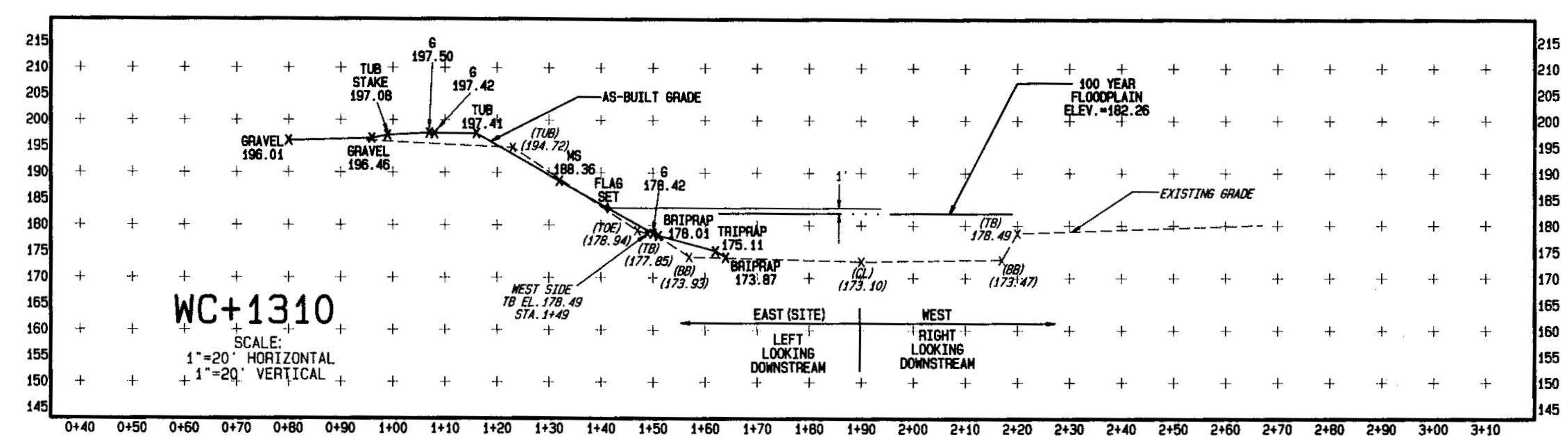


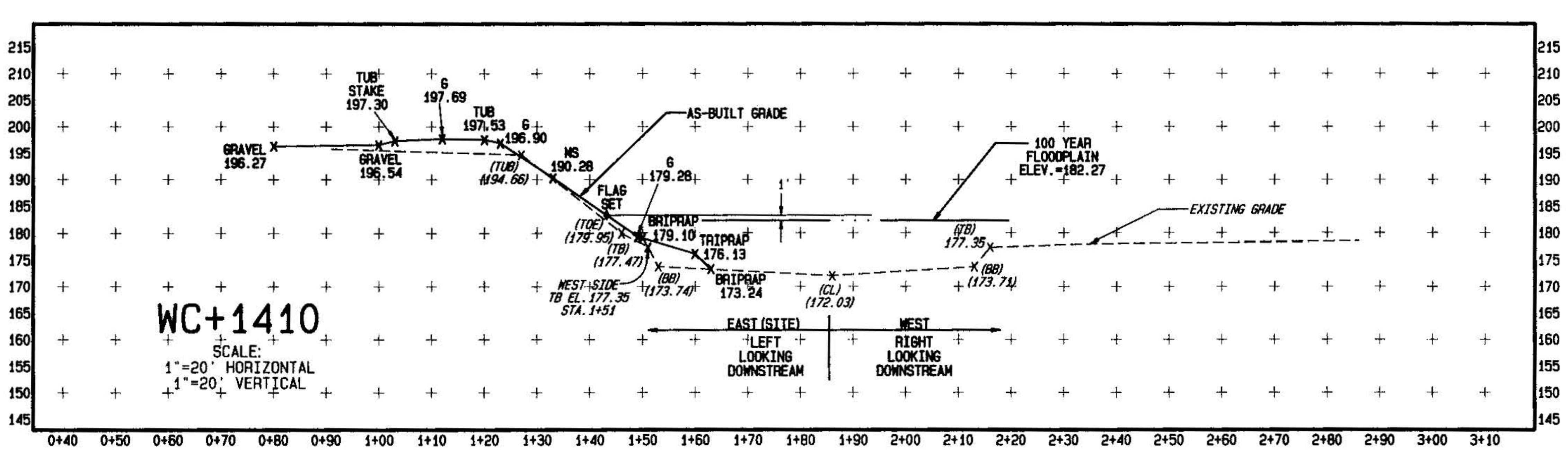


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| REVISION | DATE | DESCRIPTION |
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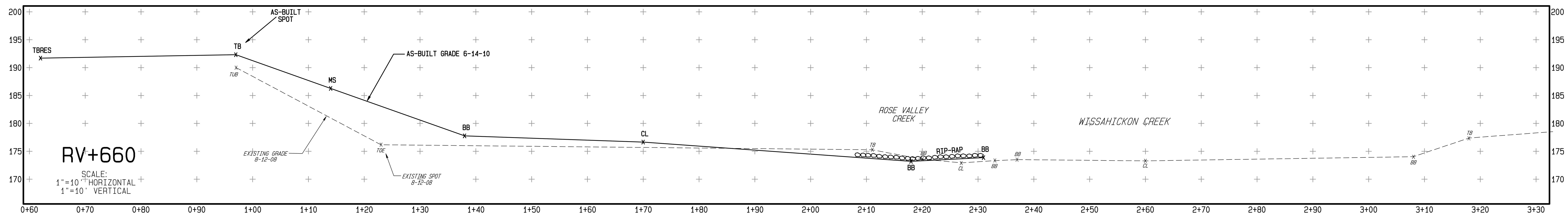
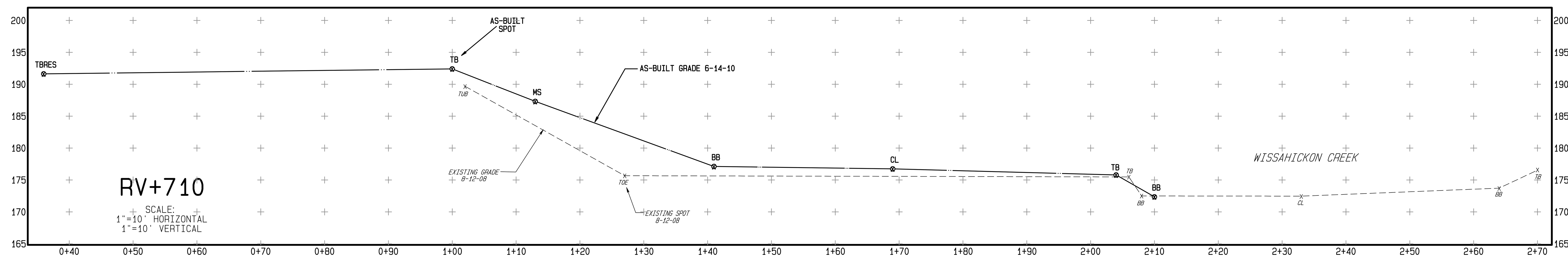
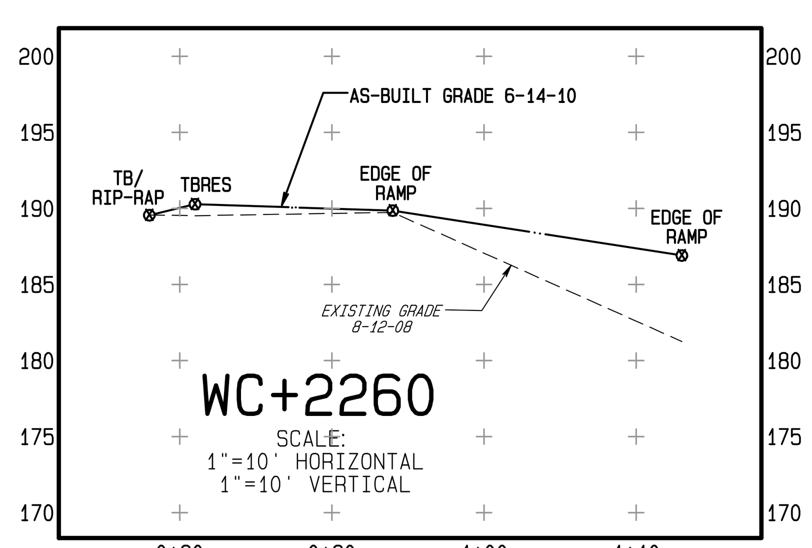
| #1 PSR | 8-19-08 | |




# PHASE II & III CROSS SECTION PROFILES

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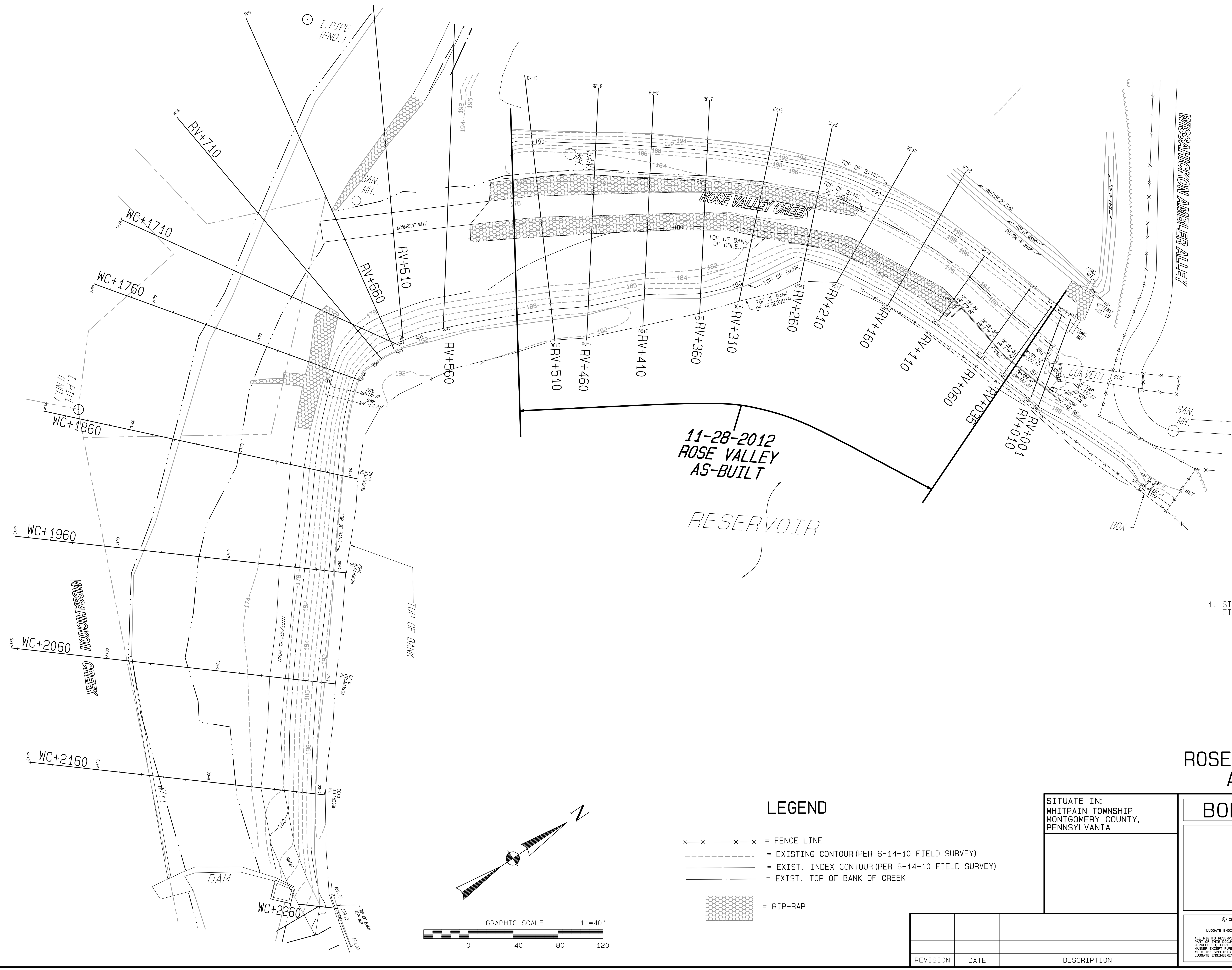


## NOTES

1. SITE FEATURES PER LUDGATE ENGINEERING CORPORATION FIELD SURVEY OF 11-28-2012.

## LEGEND

- = FENCE LINE
- = EXISTING CONTOUR (PER 6-14-10 FIELD SURVEY)
- = EXIST. INDEX CONTOUR (PER 6-14-10 FIELD SURVEY)
- = EXIST. TOP OF BANK OF CREEK
- = RIP-RAP

# ROSE VALLEY RECONSTRUCTION AS-BUILT 11/28/2012

SITUATE IN:
WHITPAIN TOWNSHIP
MONTGOMERY COUNTY,
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| 12-10-12 | | | | |
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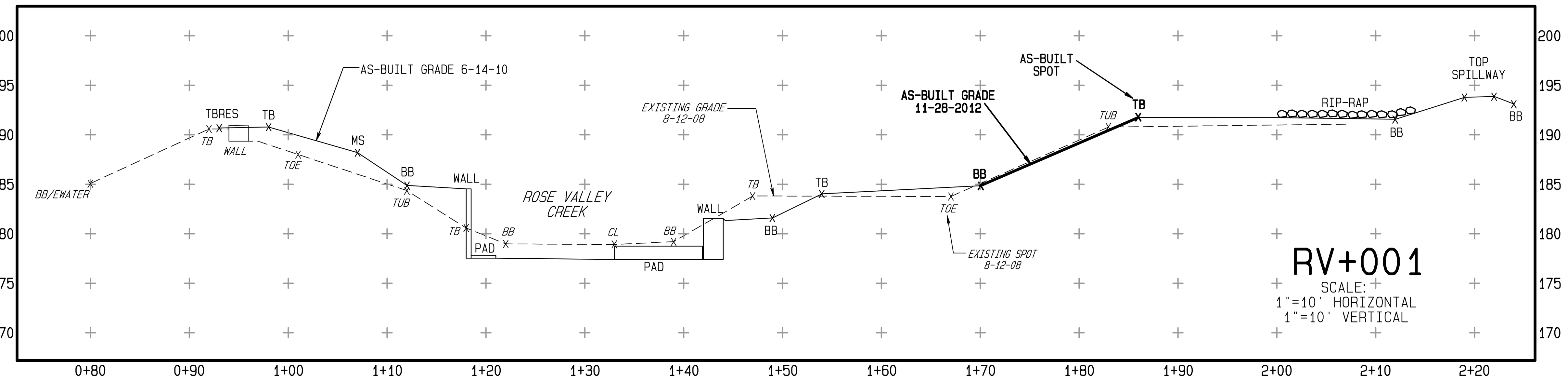


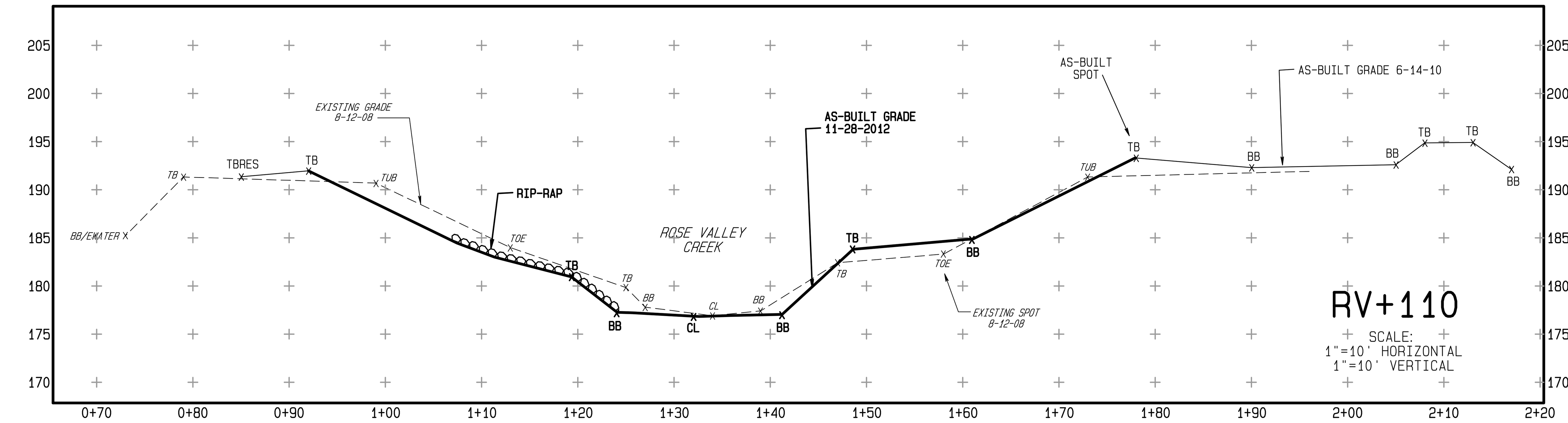


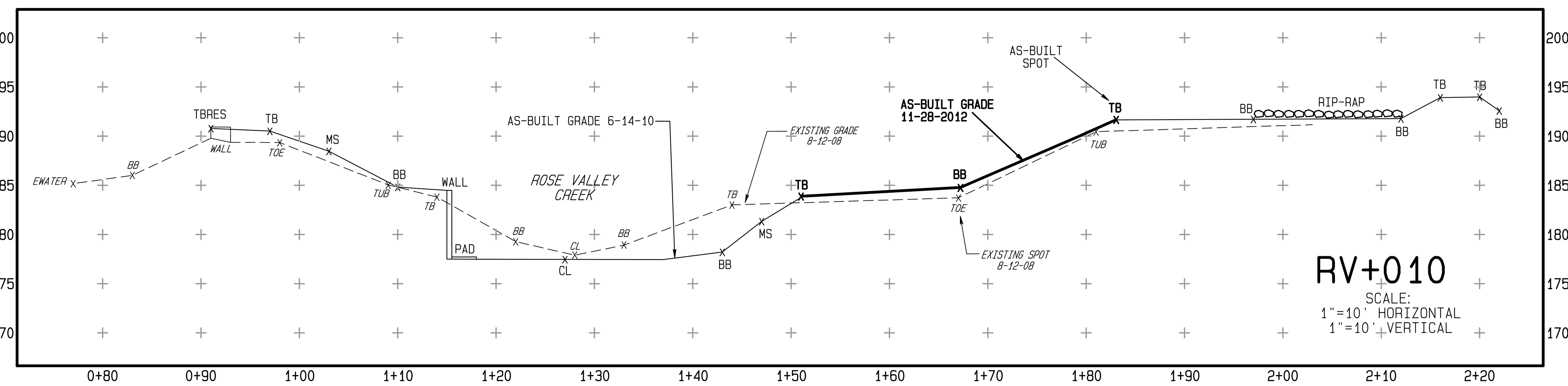


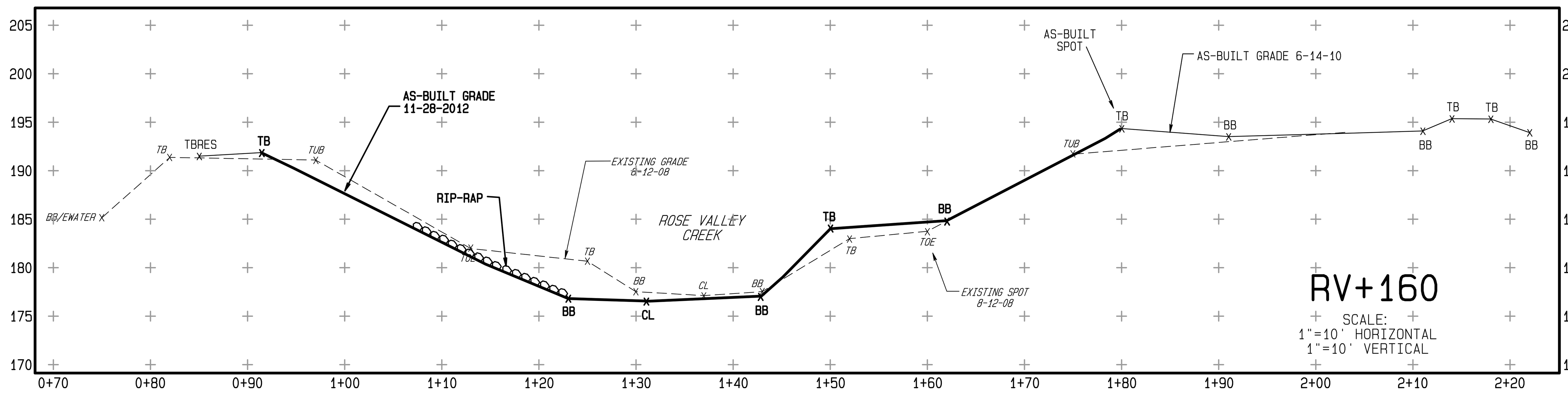


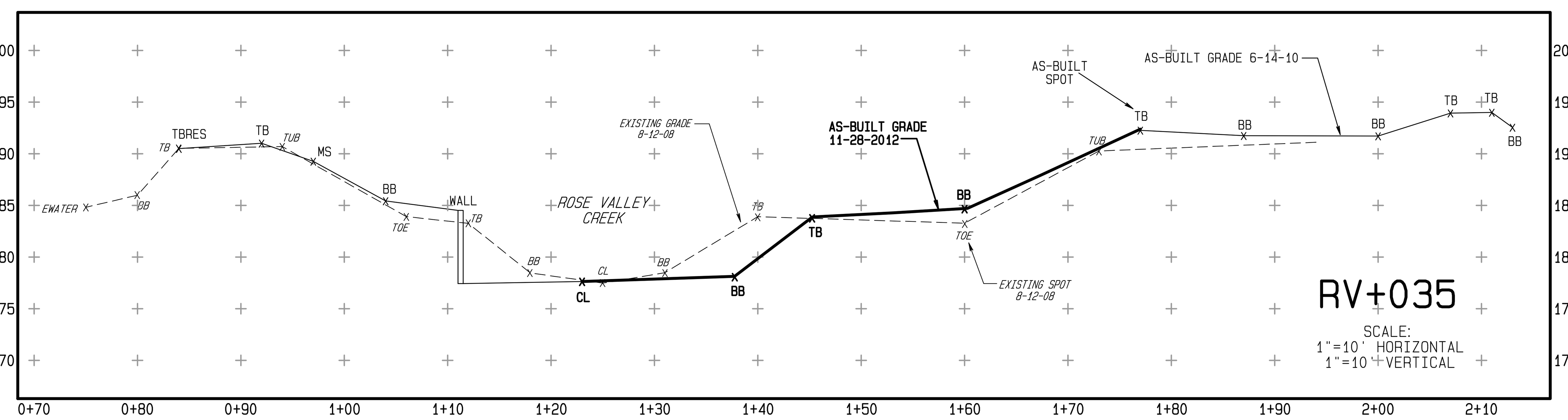


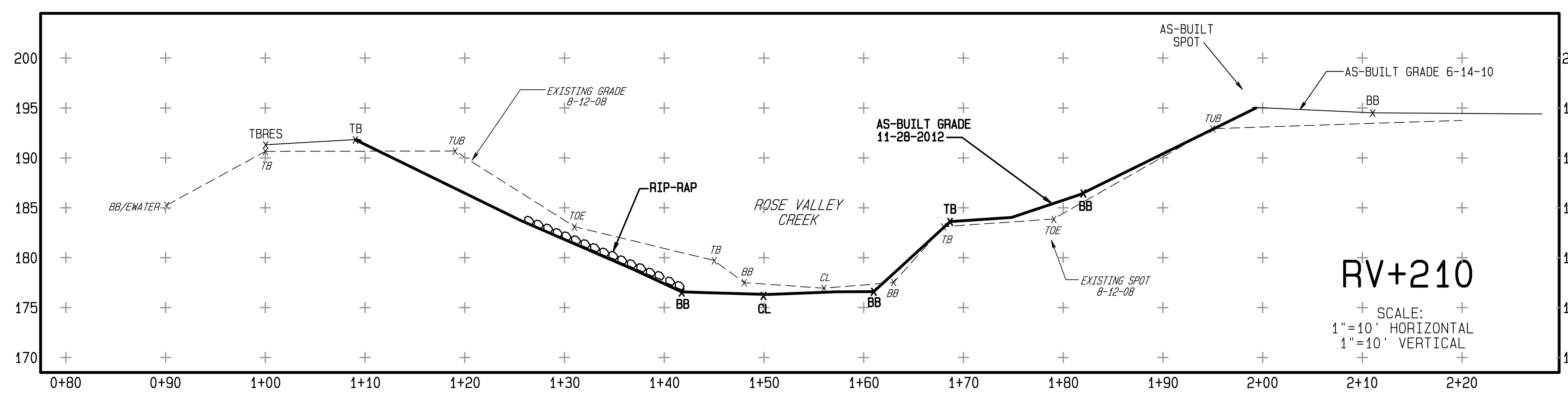


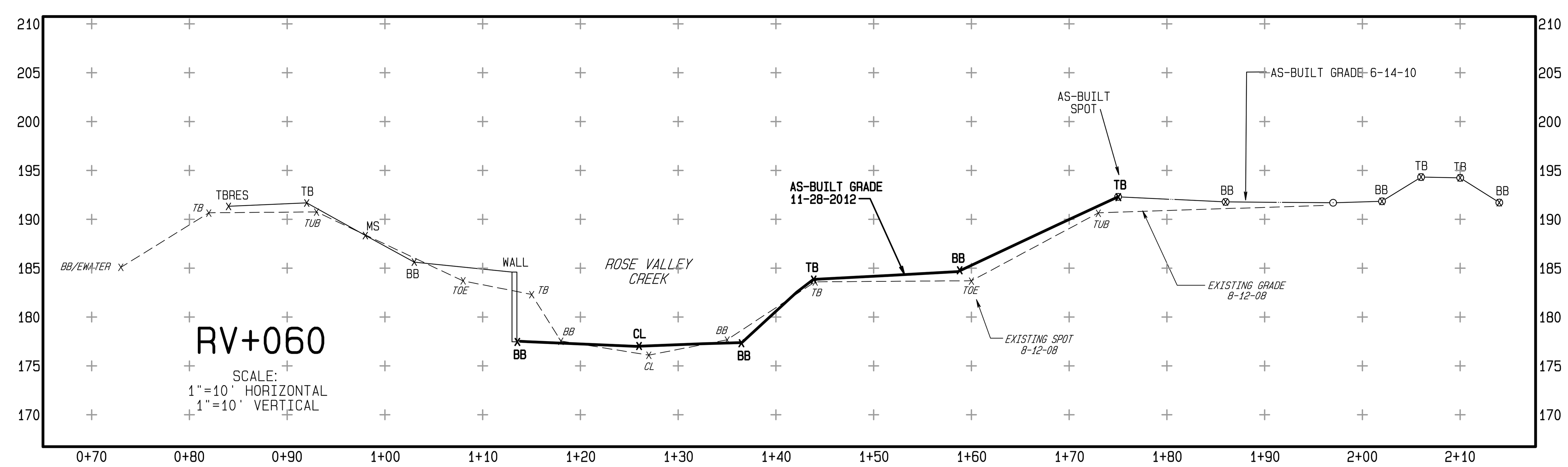


# ROSE VALLEY RECONSTRUCTION
# AS-BUILT 11-28-2012
# CROSS SECTION PROFILES

SITUATE IN:
WHITPAIN TOWNSHIP
MONTGOMERY COUNTY,
PENNSYLVANIA

## BORIT ASBESTOS PILE

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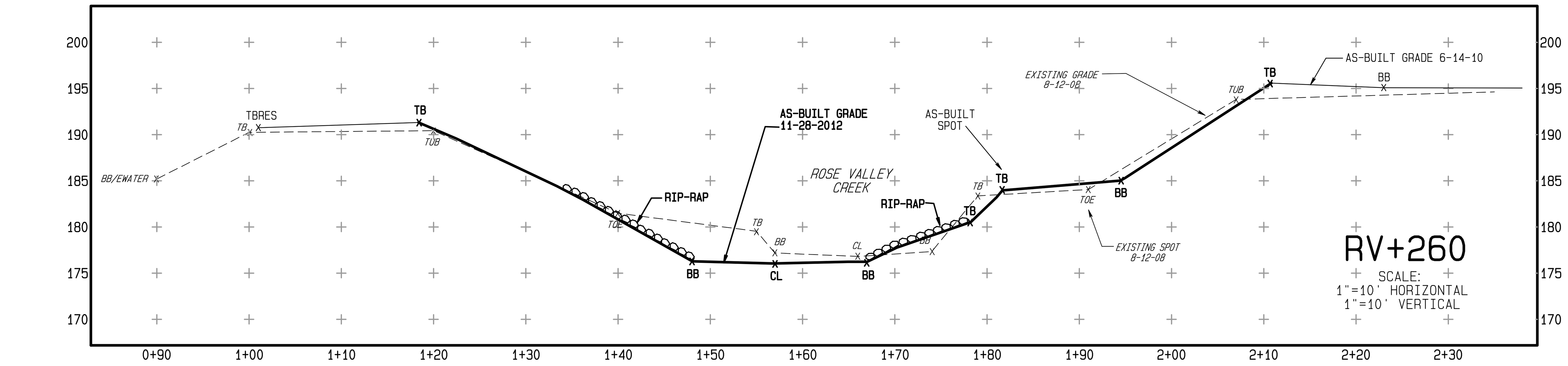
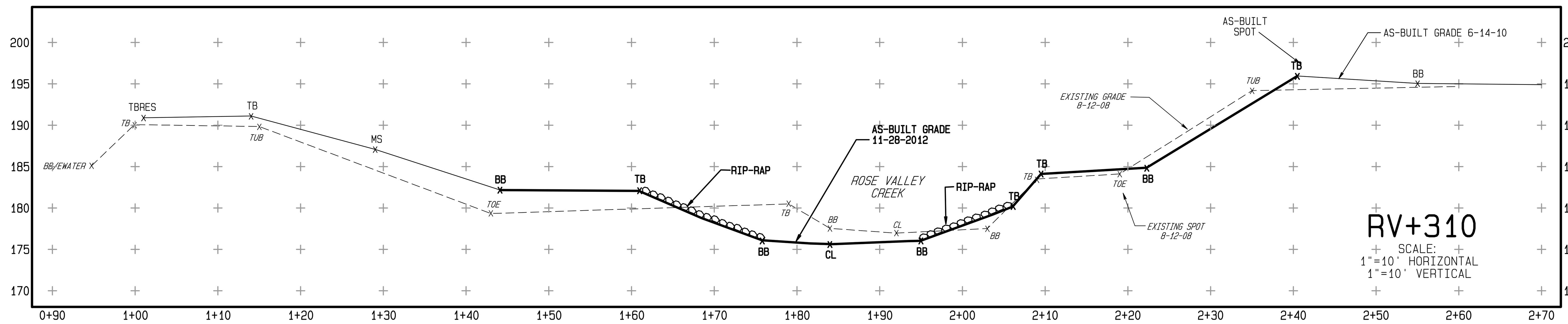
LINCOLN CORPORATE CENTER
10 VANGUARD DRIVE, SUITE 90
READING, PA 19606
PHONE 610-404-7330
FAX 610-404-7371

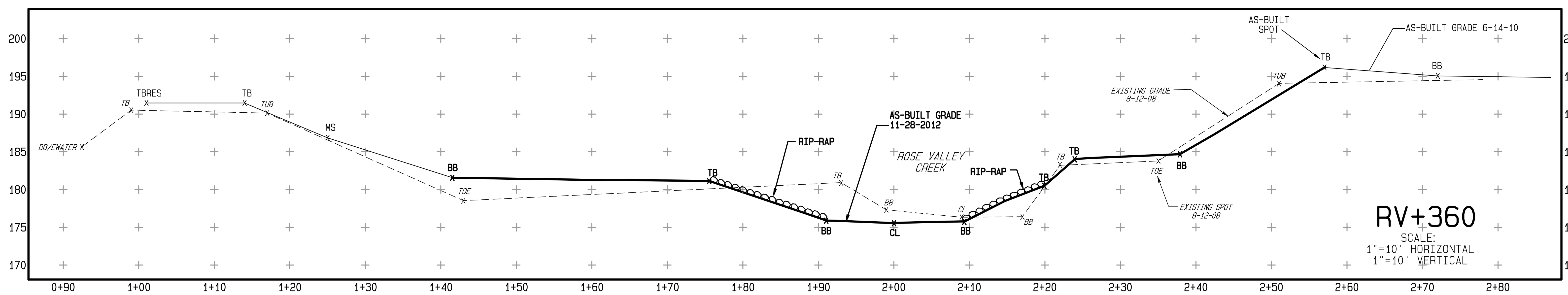


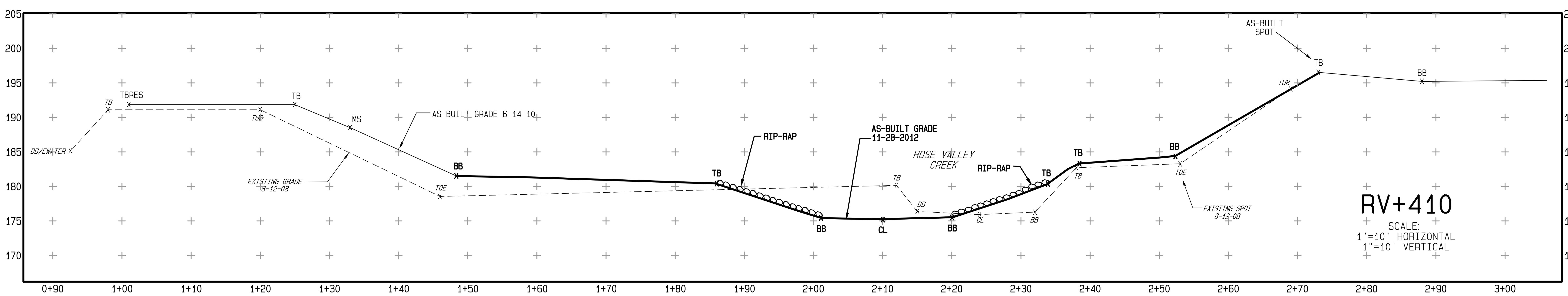
| REVISION | DATE | DESCRIPTION |
|---|---|---|
| | | |

| DRAWN | COMP (BNDY) | COMP (LOTS) | PA ONE CALL DATE | COMPUTER FILE |
|---|---|---|---|---|
| PSR | | | | P:7801508-PHASEIII-II-AB.PRO |
| 12-10-12 | | | | |
| SCALE | TAX MAP PARCEL | | | DRAWING NUMBER |
| AS NOTED | SEE ABOVE | | | D-7801508-AB SHEET 4 |




# ROSE VALLEY RECONSTRUCTION AS-BUILT 11-28-2012 CROSS SECTION PROFILES

SITUATE IN:
WHITPAIN TOWNSHIP
MONTGOMERY COUNTY,
PENNSYLVANIA

## BORIT ASBESTOS PILE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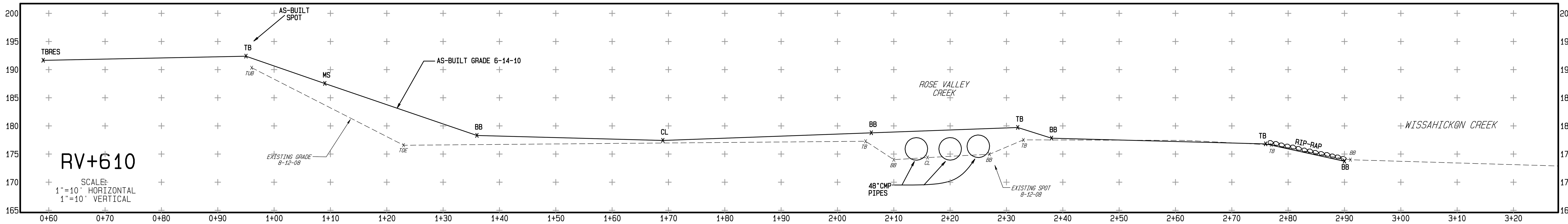
PHONE 610-404-7330
FAX 610-404-7371

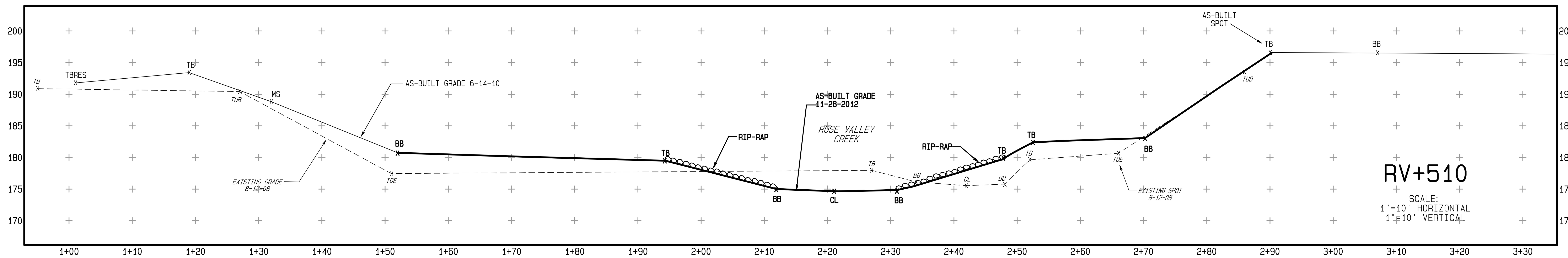


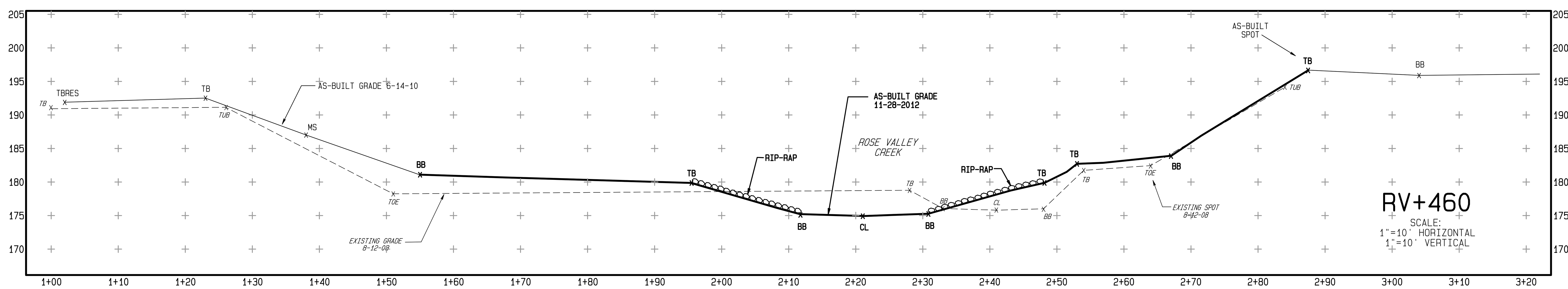

| DRAWN | COMP (BNDY) | COMP (LOTS) | PA ONE CALL DATE | COMPUTER FILE |
|---|---|---|---|---|
| PSR | | | | P:7801508-PHASEIII-II-AB.PRO |
| 12-10-12 | | | | |
| SCALE | TAX MAP PARCEL | | DRAWING NUMBER | |
| AS NOTED | SEE ABOVE | | D-7801508-AB | SHEET 5 |

| REVISION | DATE | DESCRIPTION |
|---|---|---|
| | | |








# ROSE VALLEY RECONSTRUCTION AS-BUILT 11-28-2012 CROSS SECTION PROFILES

SITUATE IN:
WHITPAIN TOWNSHIP
MONTGOMERY COUNTY,
PENNSYLVANIA

## BORIT ASBESTOS PILE

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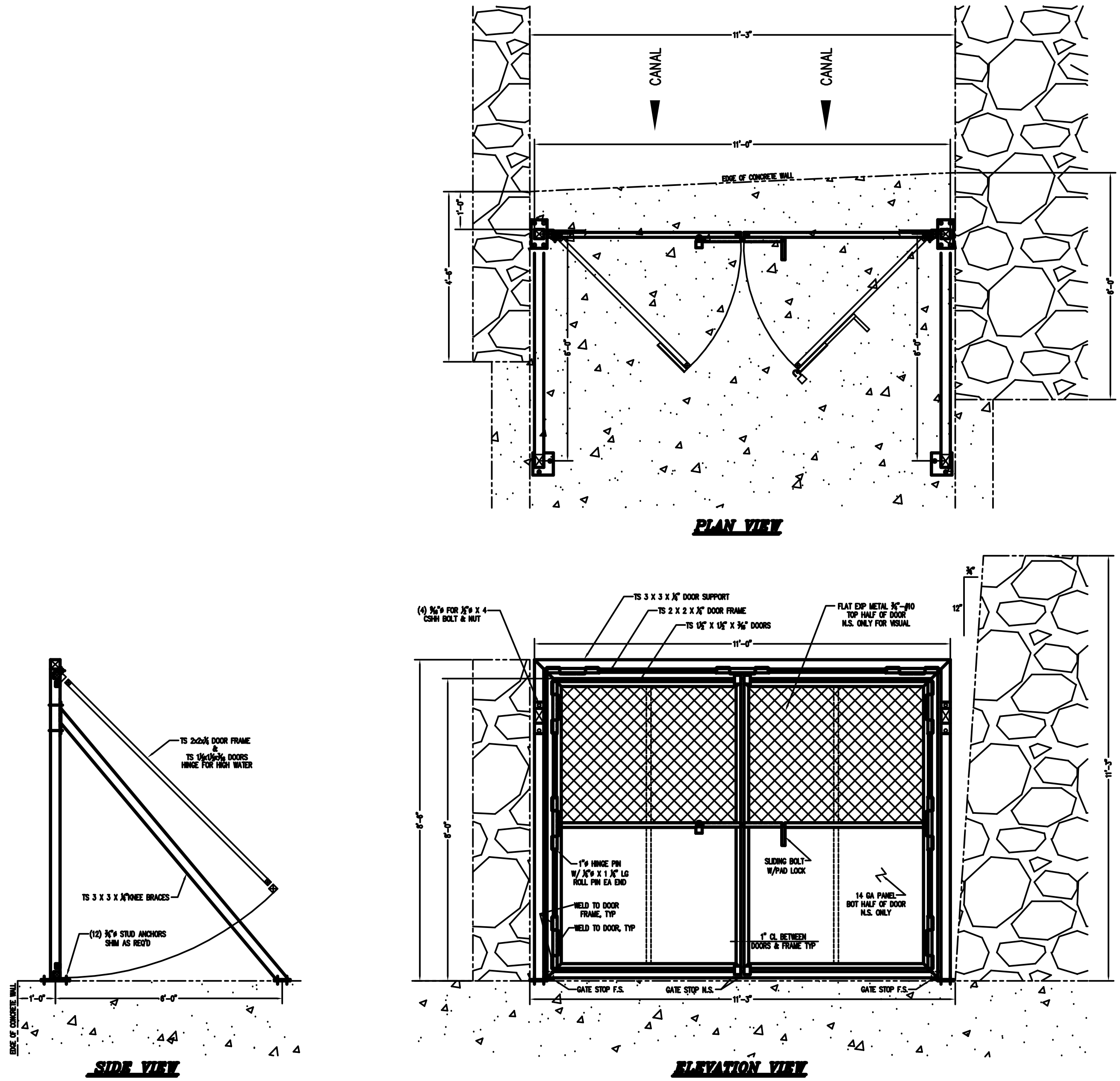
| DRAWN | COMP (BNDY) | COMP (LOTS) | PA ONE CALL DATE | COMPUTER FILE |
|---|---|---|---|---|
| PSR | | | | P:7801508-PHASEIII-II-AB.PRO |
| 12-10-12 | | | | |
| SCALE | TAX MAP PARCEL | | | DRAWING NUMBER |
| AS NOTED | SEE ABOVE | | | D-7801508-AB SHEET 6 |

| REVISION | DATE | DESCRIPTION |
|---|---|---|
| | | |




NOTE: ALL PARTS HOT DIP GALVANIZED



gsm INDUSTRIAL
Metal Fabrication & Installation Contractor
A Gooding Company
717-207-8985 Lancaster, PA

| | | | |
|---|---|---|---|
| CUSTOMER: WRS COMPASS | | | |
| JOB DESCRIPTION: HINGED GATE, ASSEMBLY | | | |
| APPROVED BY | DRAWN BY: RJK | CUSTOMER P.O. NO. | DWG. NO.: 32792-1 |
| CHECKED BY | DATE: 1/5/12 / SCALE: 3/4"=12" | JOB NO.: 32792 | REV.: 0 |


## GENERAL NOTES:

1. SITE FEATURES OF PILE SHOWN PER 3-22-12 AS-BUILT SURVEY OF PILE.

## "PILE" GRADING PLAN

## LEGEND

- = FENCE LINE
- = EXISTING CONTOUR (PER 3-22-12 FIELD SURVEY)
- = EXIST. INDEX CONTOUR (PER 3-22-12 FIELD SURVEY)
- = EXIST. TOP OF BANK OF CREEK
- = RIP-RAP

GRAPHIC SCALE 1"=30'

0 30 60 90

SITUATE IN:
AMBLER BOROUGH,
MONTGOMERY COUNTY,
PENNSYLVANIA

WESTON SOLUTIONS: BORIT ASBESTOS PILE

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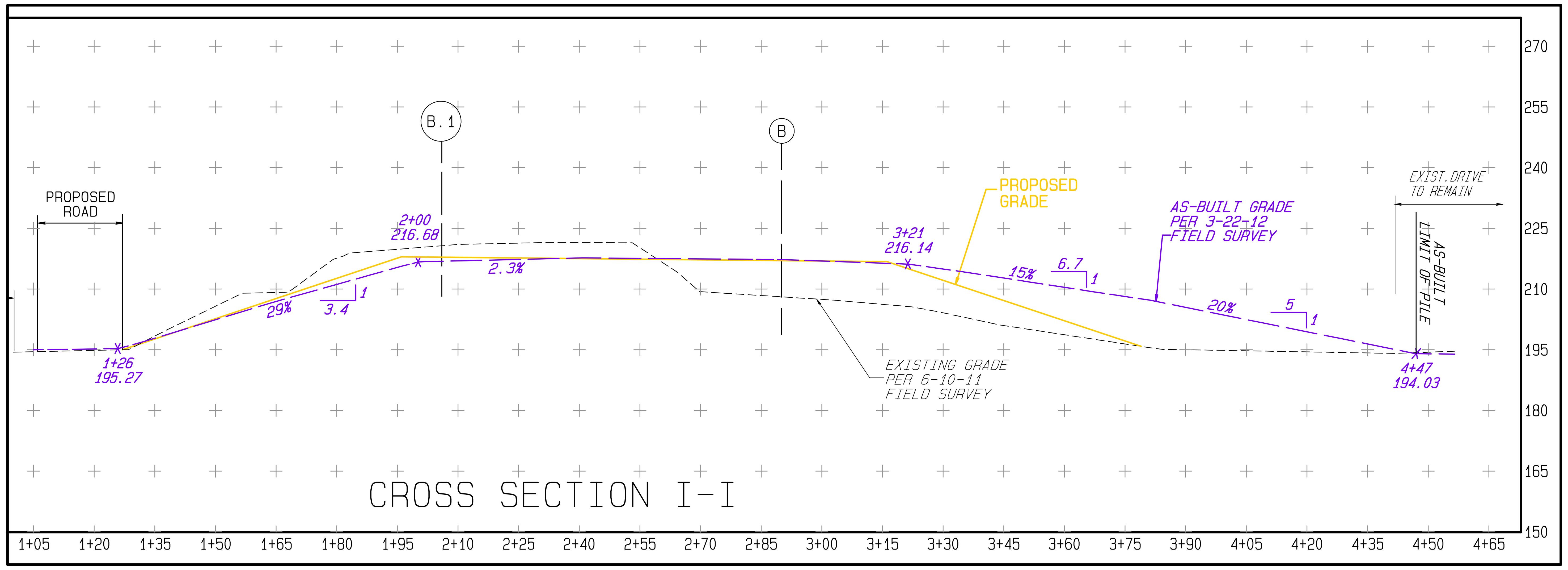
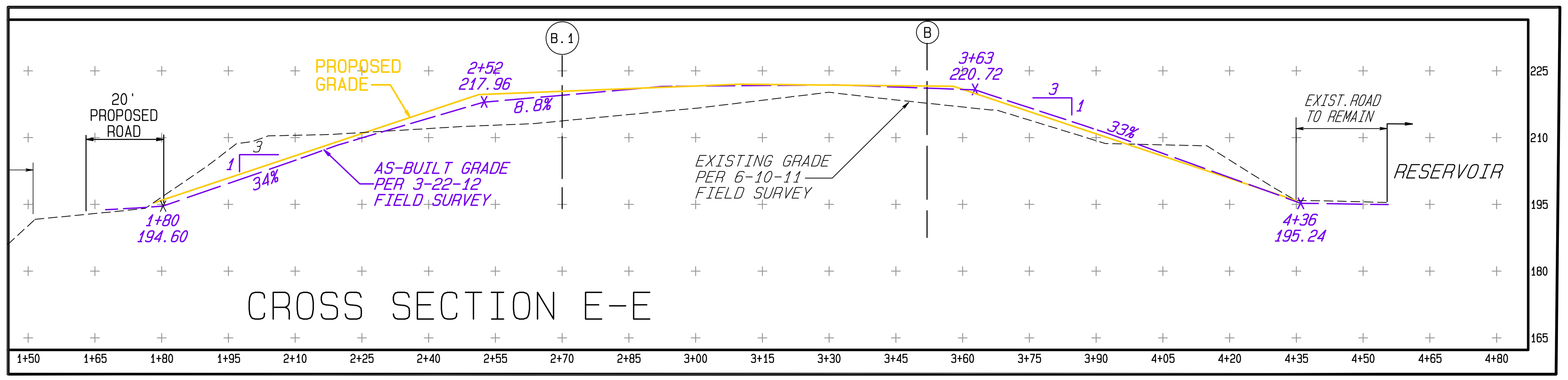
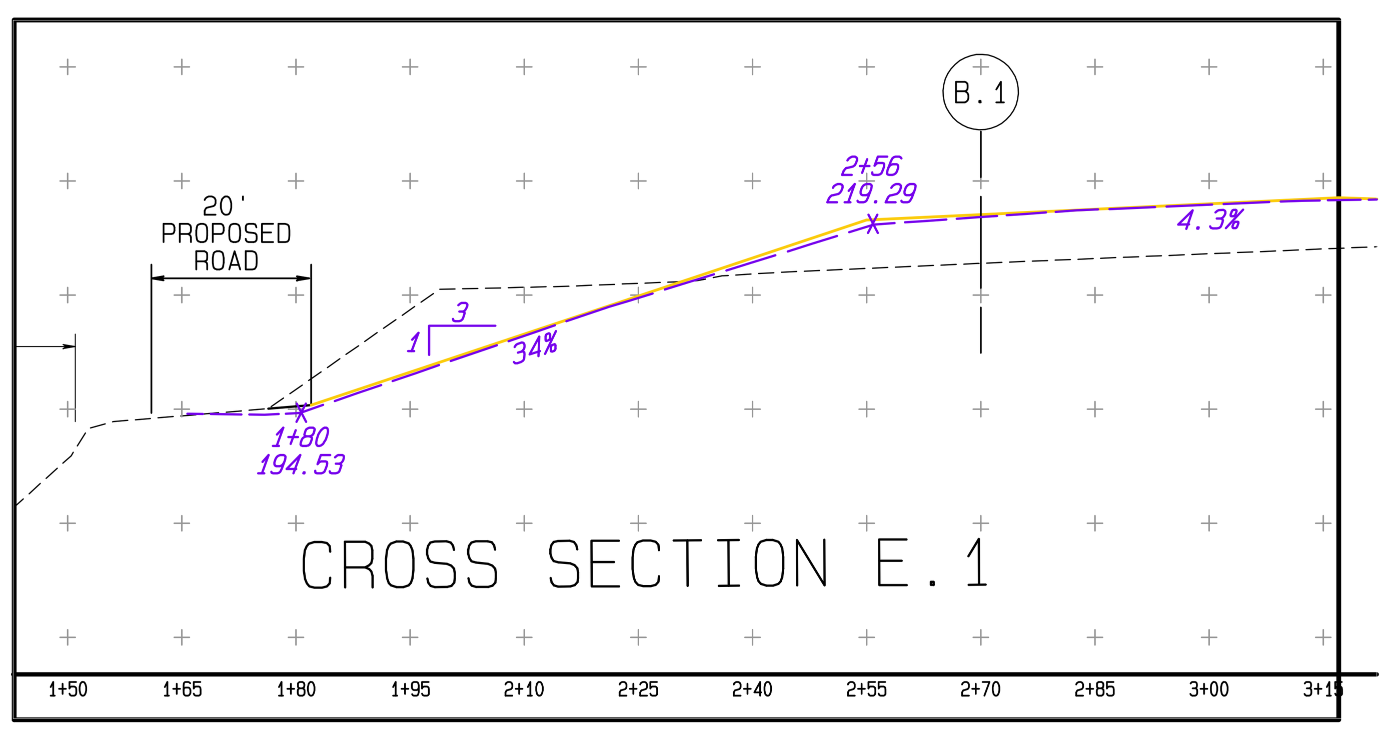
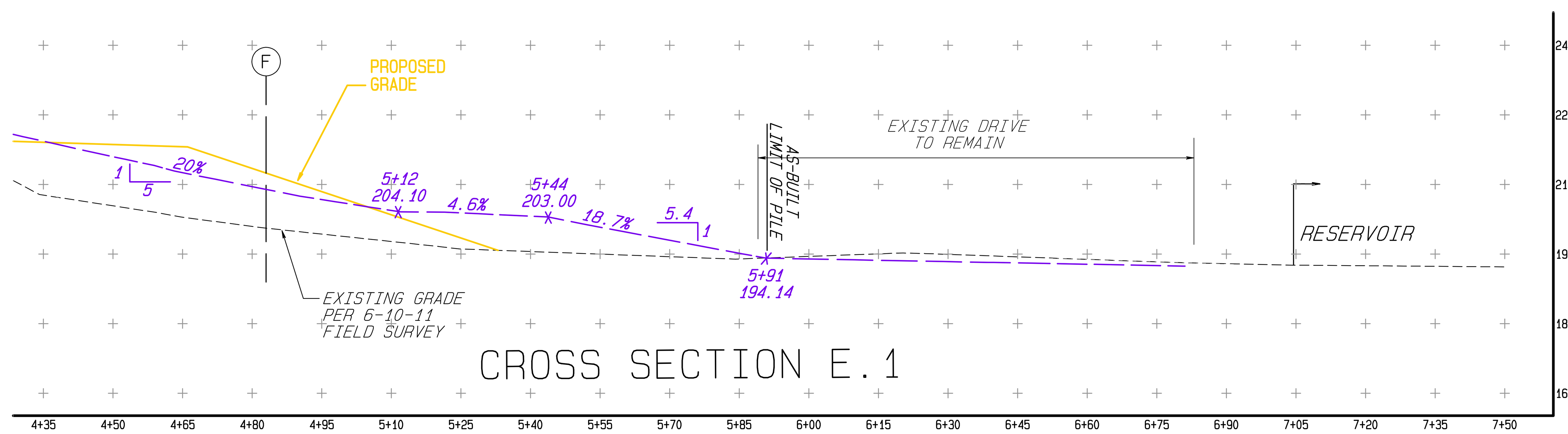
| DRAWN | COMP (BNDY) | COMP (LOTS) | PA ONE CALL DATE | COMPUTER FILE |
|---|---|---|---|---|
| PSR | | | | P:7801508-PILE-AB2012.PRO |
| 3-21-12 | | | | |
| SCALE | TAX MAP PARCEL | | | DRAWING NUMBER |
| 1"=30' | SEE ABOVE | | | D-7801508-AB SHEET 1 |

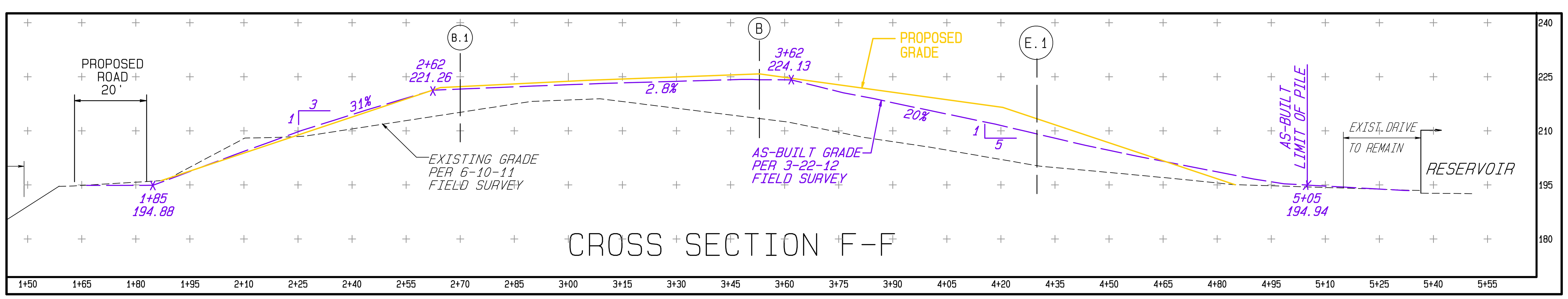
| REVISION | DATE | DESCRIPTION |
|---|---|---|




# "PILE" CROSS SECTIONS

SITUATE IN:
UPPER DUBLIN TOWNSHIP
MONTGOMERY COUNTY,
PENNSYLVANIA

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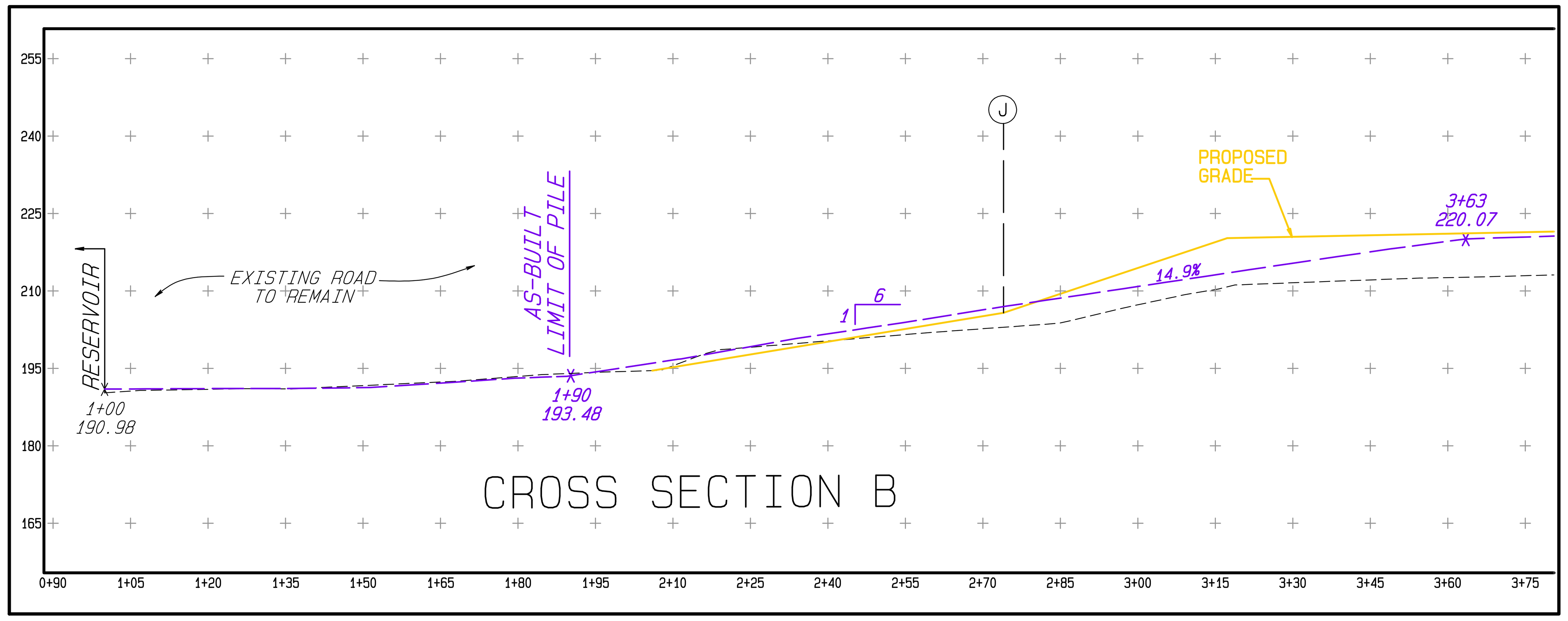
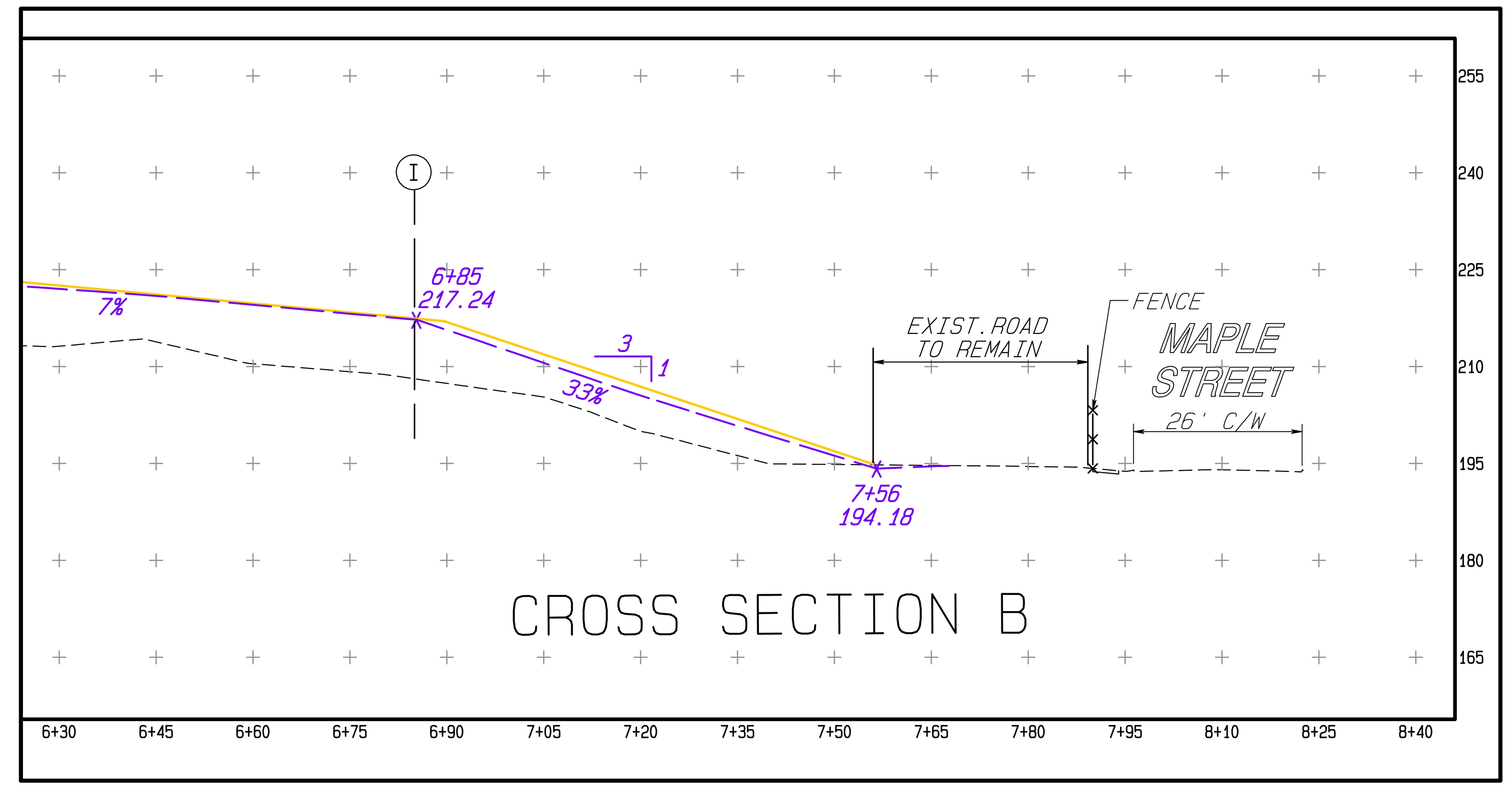
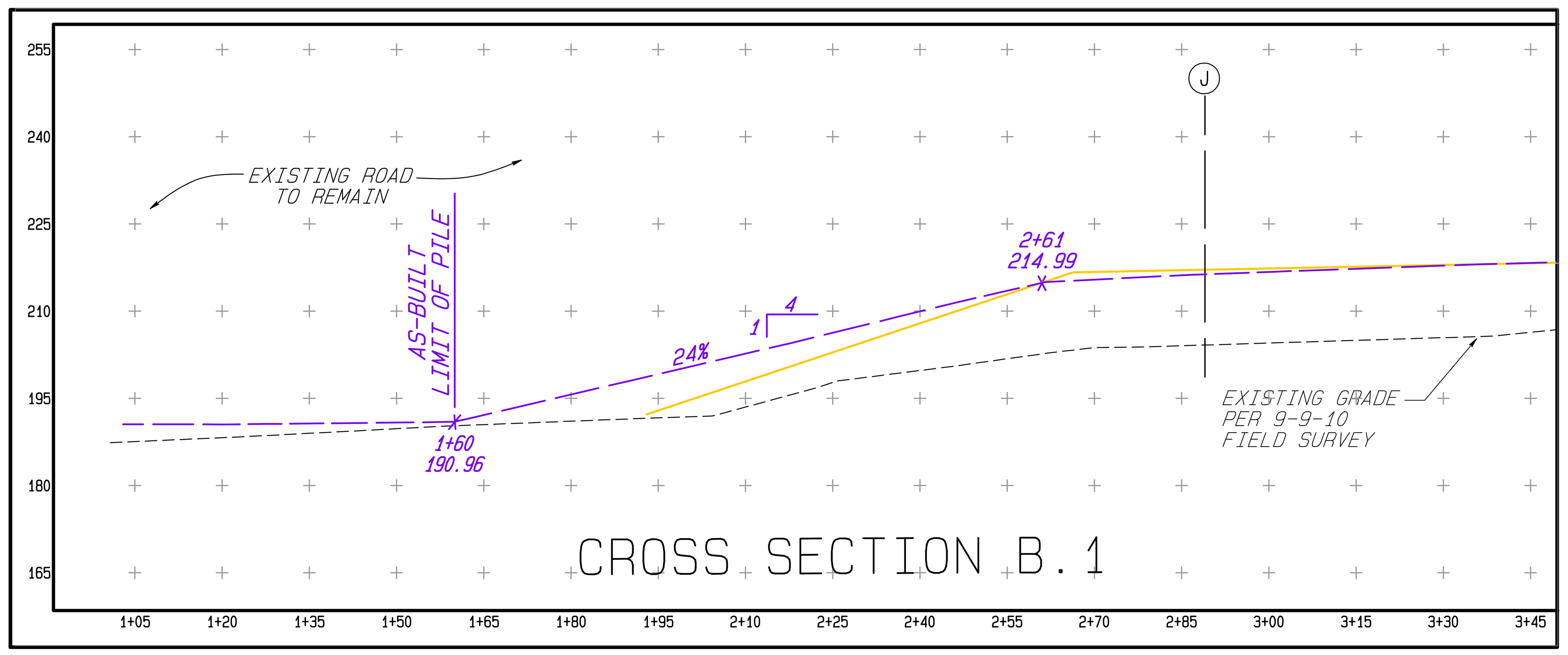
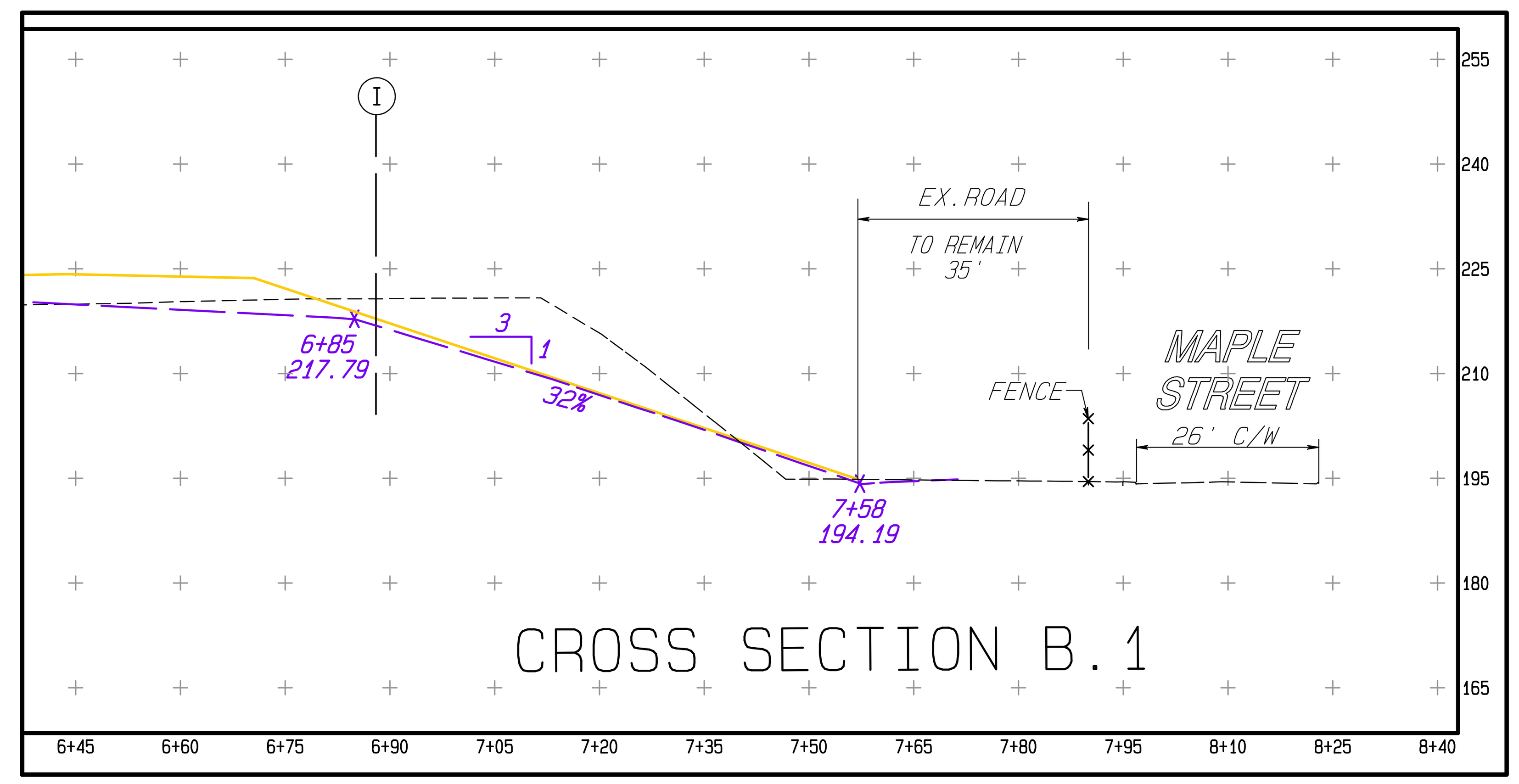
| REVISION | DATE | DESCRIPTION |
|---|---|---|
| #2 PSR | 9-6-11 | |
| #1 PSR | 8-12-11 | |

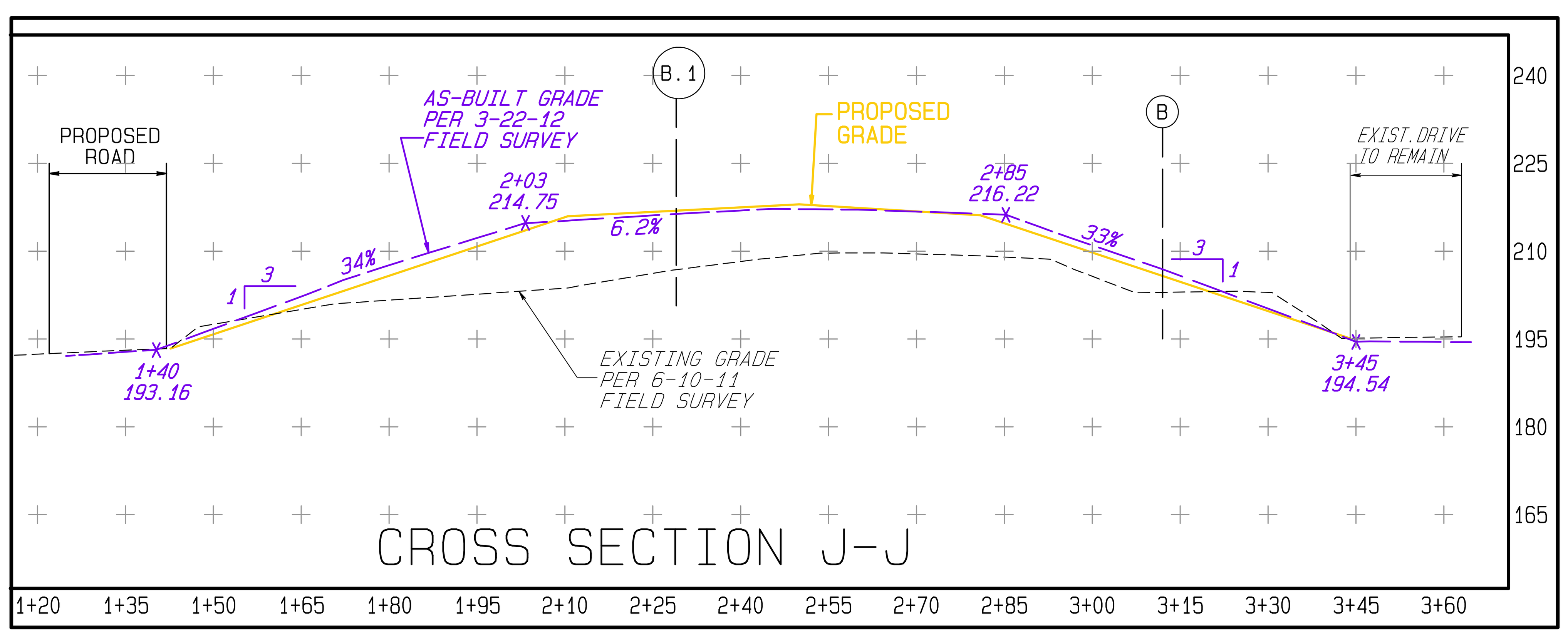
| DRAWN | COMP (BNDY) | COMP (LOTS) | PA ONE CALL DATE | COMPUTER FILE |
|---|---|---|---|---|
| PSR | | | | P:7801508-PILE-AB2012.PRO |
| SCALE | TAX MAP PARCEL | | | DRAWING NUMBER |
| 1"=20' | SEE ABOVE | | | D-7801508-GR |




# "PILE" CROSS SECTIONS

SITUATE IN:
UPPER DUBLIN TOWNSHIP
MONTGOMERY COUNTY,
PENNSYLVANIA

## WESTON SOLUTIONS: BORIT ASBESTOS PILE

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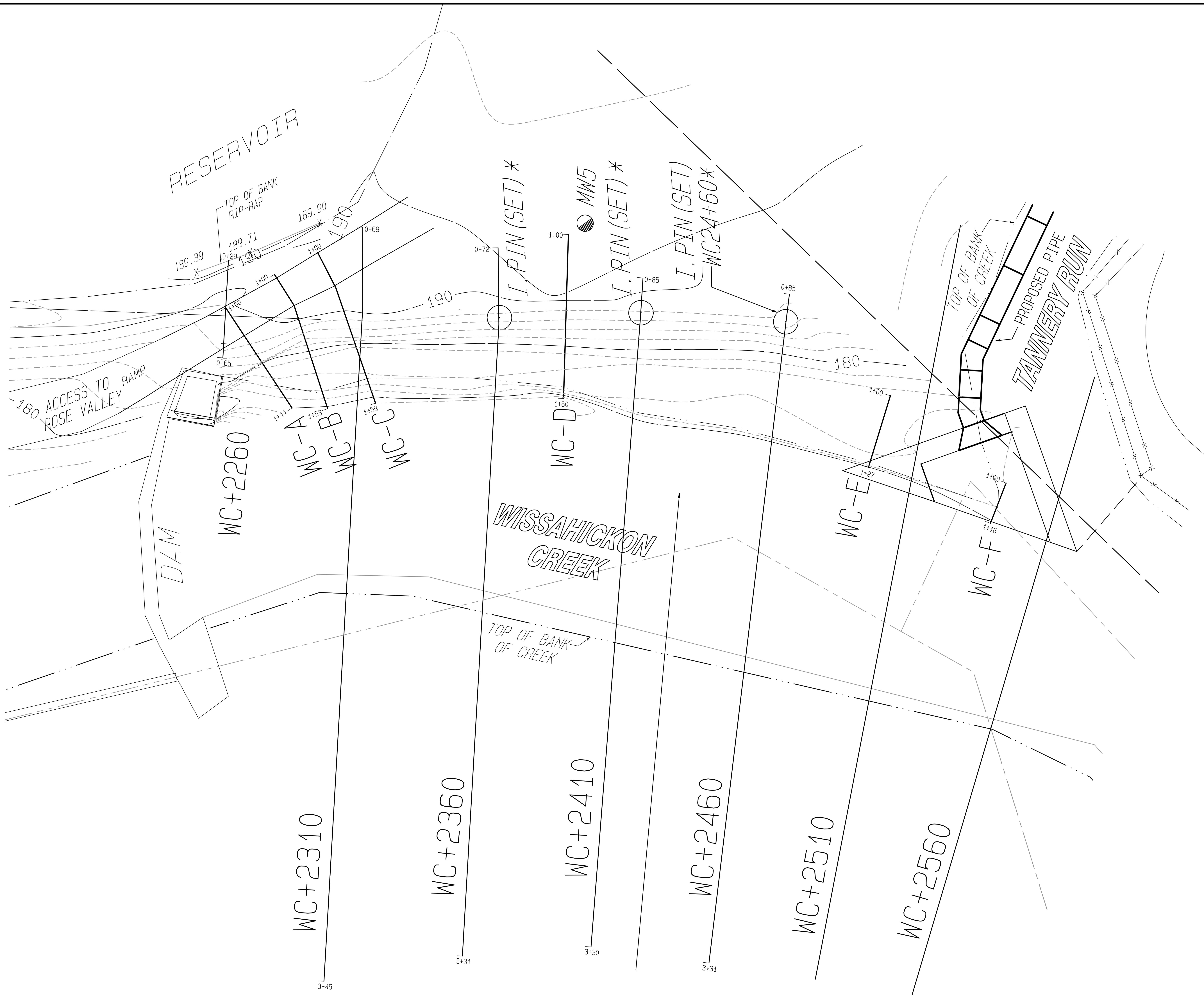
| REVISION | DATE | DESCRIPTION |
|---|---|---|
| #2 PSR | 9-6-11 | |
| #1 PSR | 8-12-11 | |

| DRAWN | COMP (BNDY) | COMP (LOTS) | PA ONE CALL DATE | COMPUTER FILE |
|---|---|---|---|---|
| PSR | | | | P:7801508-PILE-AB2012.PRO |

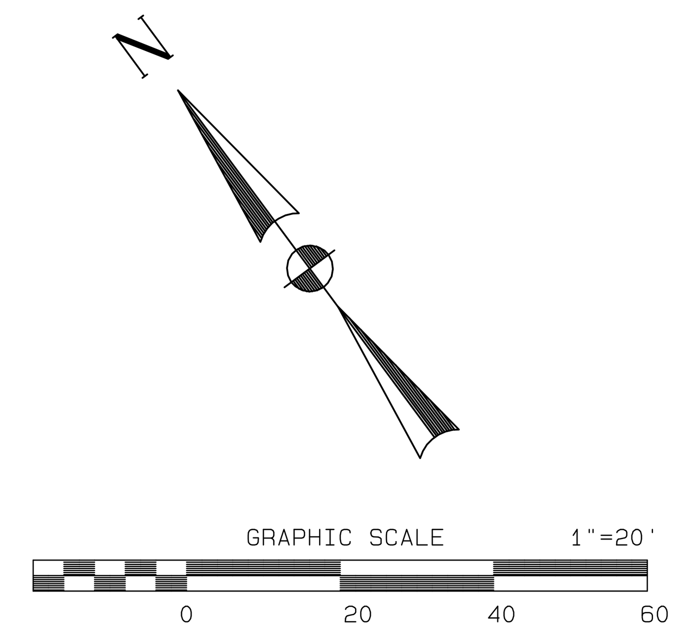
| SCALE | TAX MAP PARCEL | DRAWING NUMBER |
|---|---|---|
| 1"=20' | SEE ABOVE | D-7801508-GR |




## NOTES

1. SITE FEATURES PER LUDGATE ENGINEERING CORPORATION FIELD SURVEY OF 3-30-11.

# PHASE 5 AS-BUILT PLAN




## LEGEND

- = FENCE LINE
- = EXISTING CONTOUR (PER 6-14-10 FIELD SURVEY)
- = EXIST. INDEX CONTOUR (PER 6-14-10 FIELD SURVEY)
- = EXIST. TOP OF BANK OF CREEK
- = RIP-RAP

SITUATE IN:
UPPER DUBLIN TOWNSHIP
MONTGOMERY COUNTY,
PENNSYLVANIA

# TTEMI: BORIT ASBESTOS PILE

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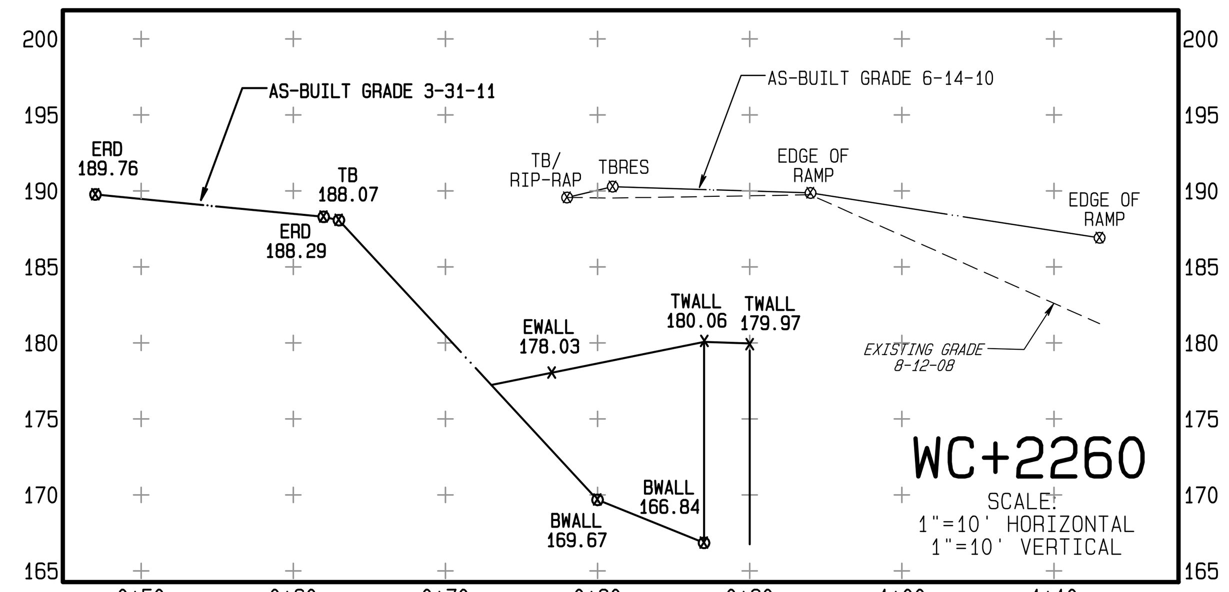
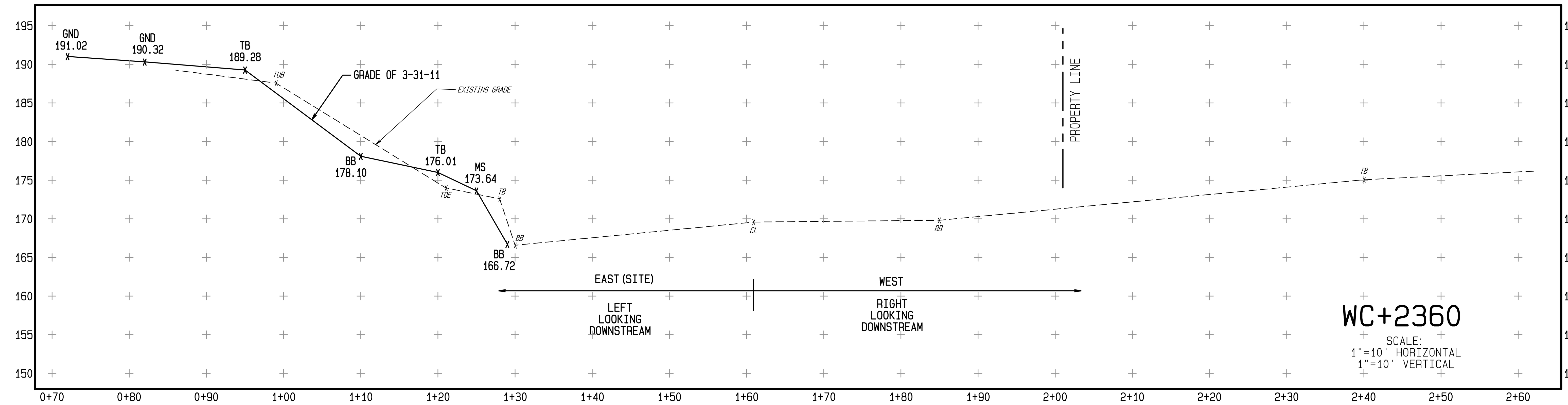
PHONE 610-404-7330
FAX 610-404-7371

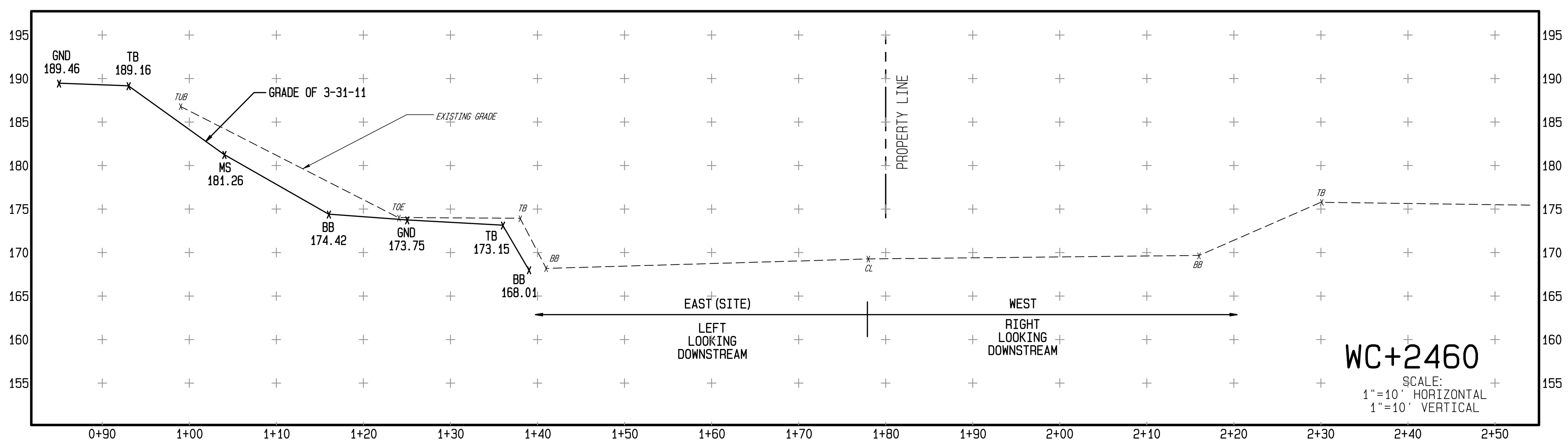


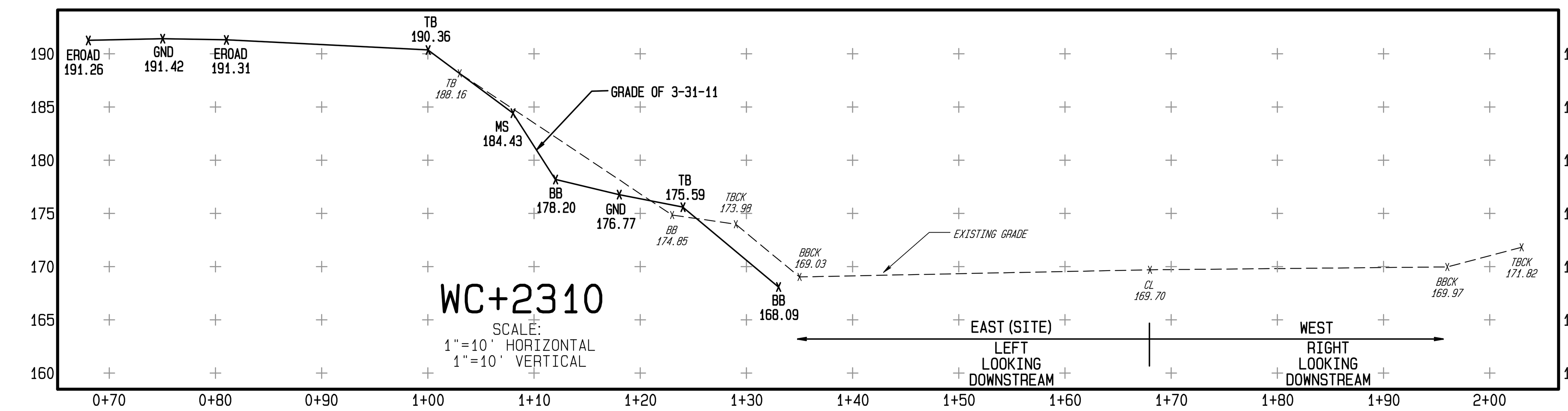
| DRAWN | COMP (BNDY) | COMP (LOTS) | PA ONE CALL DATE | COMPUTER FILE |
|---|---|---|---|---|
| PSR | | | | P:7801508-TANNERY9-9-10.PRO |
| 4-1-11 | | | | |
| SCALE | TAX MAP PARCEL | | DRAWING NUMBER | |
| 1"=20' | SEE ABOVE | | D-7801508-AB | SHEET 1 |

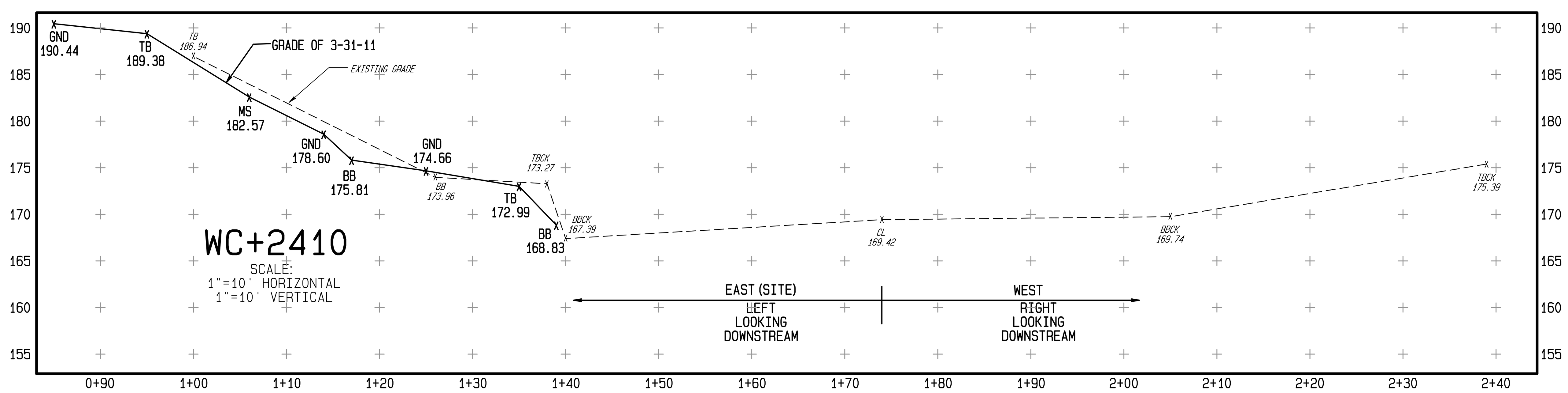
| REVISION | DATE | DESCRIPTION |
|---|---|---|
| | | |

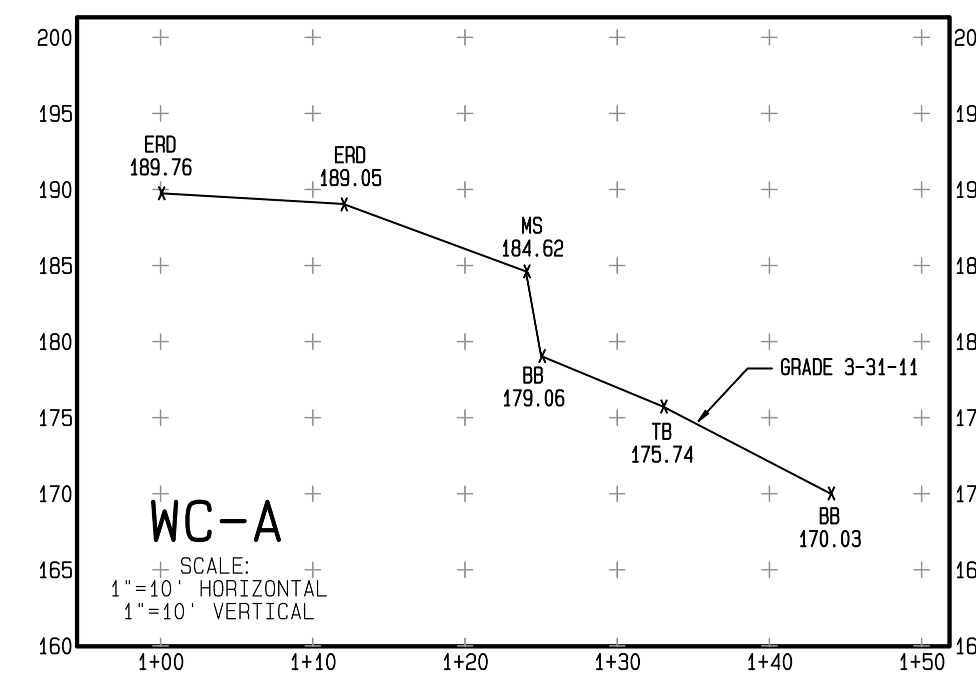


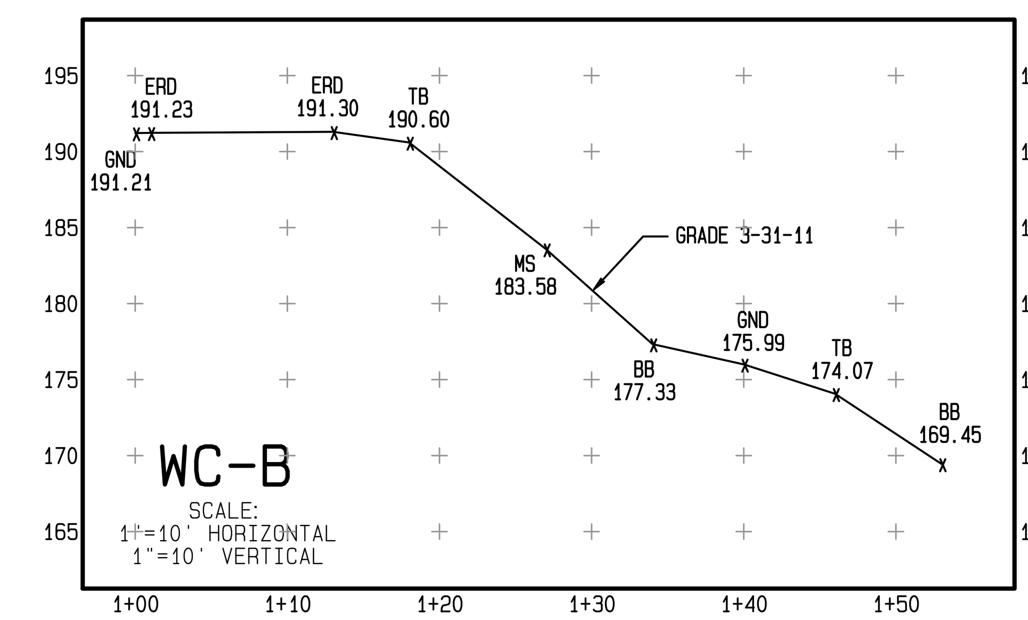



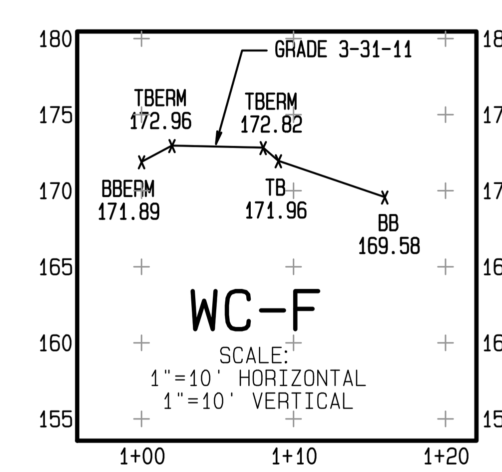



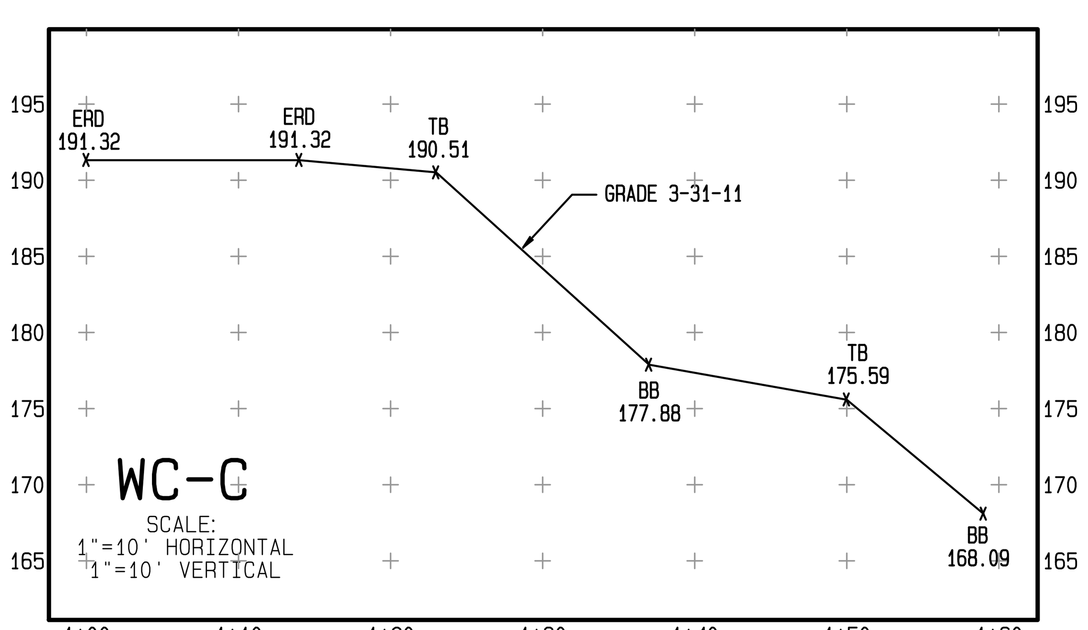



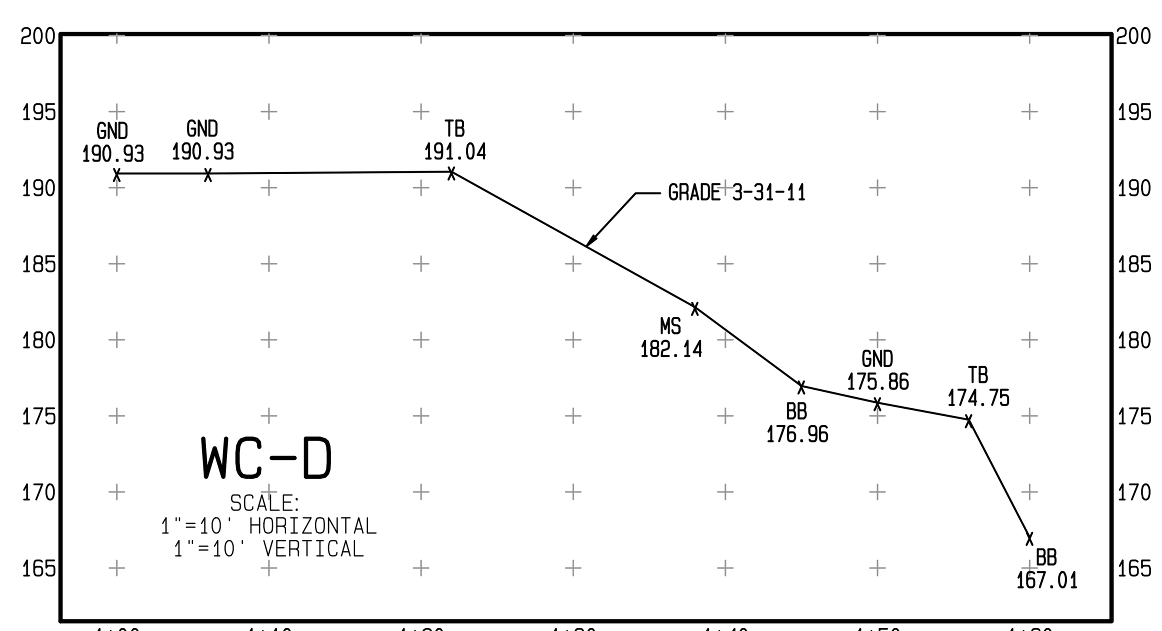



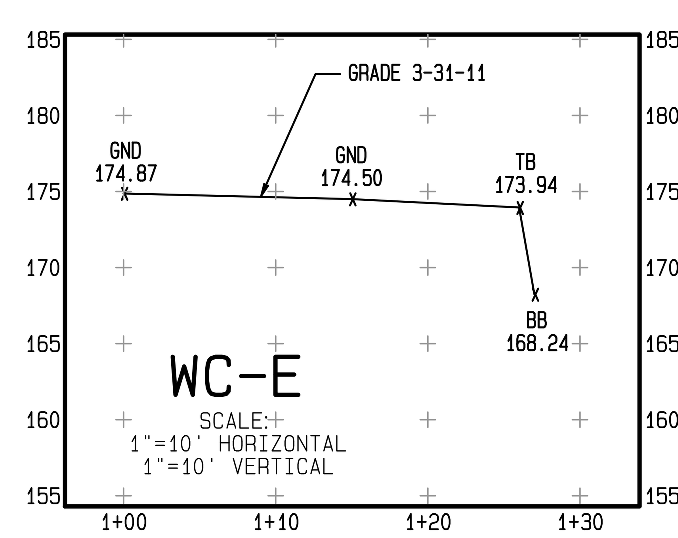




# CROSS SECTION PROFILES

SITUATE IN:
UPPER DUBLIN TOWNSHIP
MONTGOMERY COUNTY,
PENNSYLVANIA

## TTEMI: BORIT ASBESTOS PILE

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READING, PA 19606
PHONE 610-404-7330
FAX 610-404-7371



| DRAWN | COMP (BNDY) | COMP (LOTS) | PA ONE CALL DATE | COMPUTER FILE |
|---|---|---|---|---|
| PSR | | | | P:7801508-TANNERY9-910.PRO |
| 4-1-11 | | | | |
| SCALE | TAX MAP PARCEL | | | DRAWING NUMBER |
| AS NOTED | SEE ABOVE | | | D-7801508 |

| REVISION | DATE | DESCRIPTION |
|---|---|---|
| | | |


PARCIAL ASBUILT
RESOVOIR 6-10-2016

## NOTES

1. SITE FEATURES OF TANNERY RUN PER LUDGATE ENGINEERING CORPORATION FIELD SURVEY OF 6-10-2016.

## LEGEND

- = FENCE LINE
- = EXISTING CONTOUR (PER 11-28-12 FIELD SURVEY)
- = EXIST. INDEX CONTOUR (PER 11-28-12 FIELD SURVEY)
- = EXIST. TOP OF BANK OF CREEK
- = RIP-RAP

SITUATE IN:
WHITPAIN TOWNSHIP
MONTGOMERY COUNTY,
PENNSYLVANIA

# BORIT ASBESTOS PILE

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ENGINEERS SURVEYORS PLANNERS
ENVIRONMENTAL SCIENTISTS
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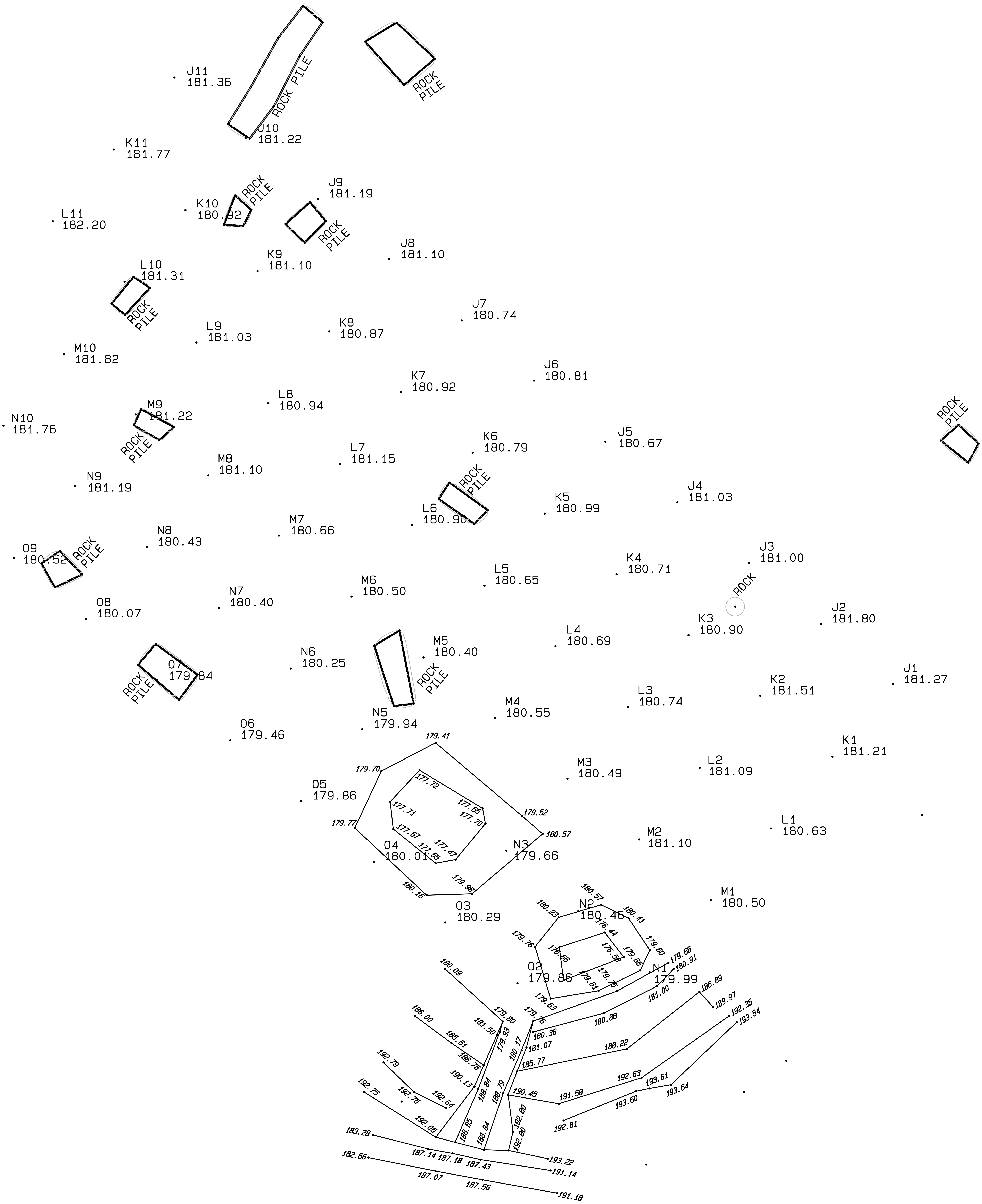
READING, PA 19606
PHONE 610-404-7330
FAX 610-404-7371



| DRAWN | COMP (BNDY) | COMP (LOTS) | PA ONE CALL DATE | COMPUTER FILE |
|---|---|---|---|---|
| PSR | | | | P:7801508-RESOVOIR-ROTATED.PRO |
| 6-20-16 | | | | |
| SCALE | TAX MAP PARCEL | | | DRAWING NUMBER |
| 1"=30' | SEE ABOVE | | | D-7803815-R SHEET 1 |

| REVISION | DATE | DESCRIPTION |
|---|---|---|
| | | |



ROCK PILE
ROCK PILE
J11 181.36
J10 181.22
K11 181.77
ROCK PILE
J9 181.19
K10 180.92
ROCK PILE
L11 182.20
J8 181.10
K9 181.10
L10 181.31
ROCK PILE
J7 180.74
L9 181.03
K8 180.87
M10 181.82
J6 180.81
K7 180.92
L8 180.94
M9 181.22
N10 181.76
ROCK PILE
ROCK PILE
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ROCK PILE
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M2 181.10
N3 179.66
O4 180.01
M1 180.50
O3 180.29
N2 180.46
N1 179.99
O2 179.86


BORO SIGN

## NOTES

1. SITE FEATURES OF TANNERY RUN PER LUDGATE ENGINEERING CORPORATION FIELD SURVEY OF 6-10-2016.

## LEGEND

- = FENCE LINE
- = EXISTING CONTOUR (PER 11-28-12 FIELD SURVEY)
- = EXIST. INDEX CONTOUR (PER 11-28-12 FIELD SURVEY)
- = EXIST. TOP OF BANK OF CREEK
- = RIP-RAP

# ASBUILT
# TANNERY RUN 6-10-2016

SITUATE IN:
WHITPAIN TOWNSHIP
MONTGOMERY COUNTY,
PENNSYLVANIA

## BORIT ASBESTOS PILE


**Ludgate Engineering Corporation**
ENGINEERS SURVEYORS PLANNERS
ENVIRONMENTAL SCIENTISTS

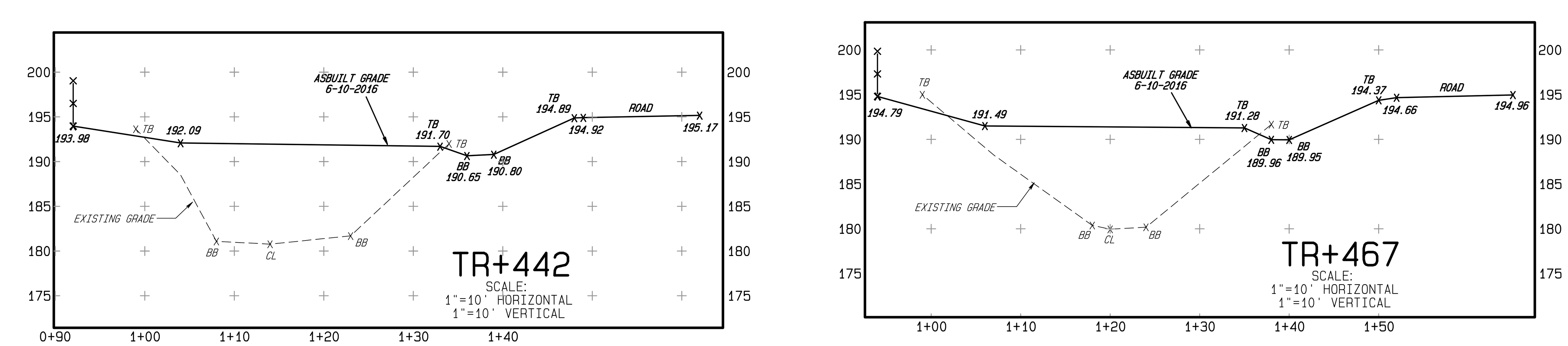



LINCOLN CORPORATE CENTER
10 VANGUARD DRIVE, SUITE 90
READING, PA 19606
PHONE 610-404-7330
FAX 610-404-7371




| DRAWN | COMP (BNDY) | COMP (LOTS) | PA ONE CALL DATE | COMPUTER FILE |
|---|---|---|---|---|
| PSR | | | | P:7801508-RESOVOIR-ROTATED.PRO |
| 6-20-16 | | | | |
| SCALE | TAX MAP PARCEL | | | DRAWING NUMBER |
| 1"=30' | SEE ABOVE | | | D-7803815-T SHEET 1 |

| REVISION | DATE | DESCRIPTION |
|---|---|---|
| | | |


# ASBUILT PROFILES
# TANNERY RUN 6-10-2016

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| 6-21-16 | | | | |
| SCALE | TAX MAP PARCEL | | | DRAWING NUMBER |
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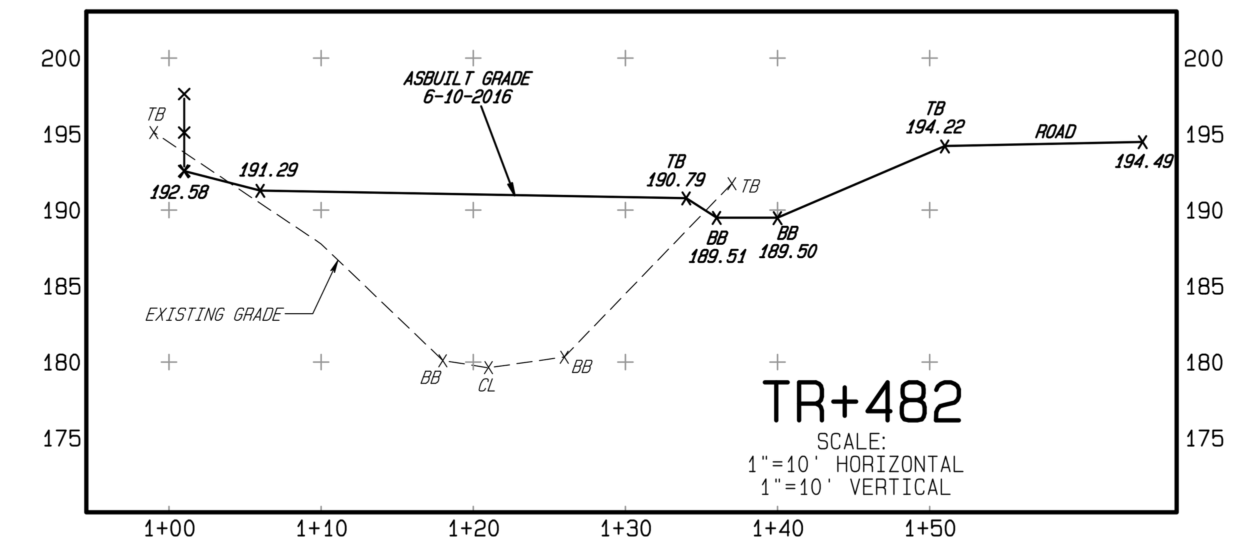


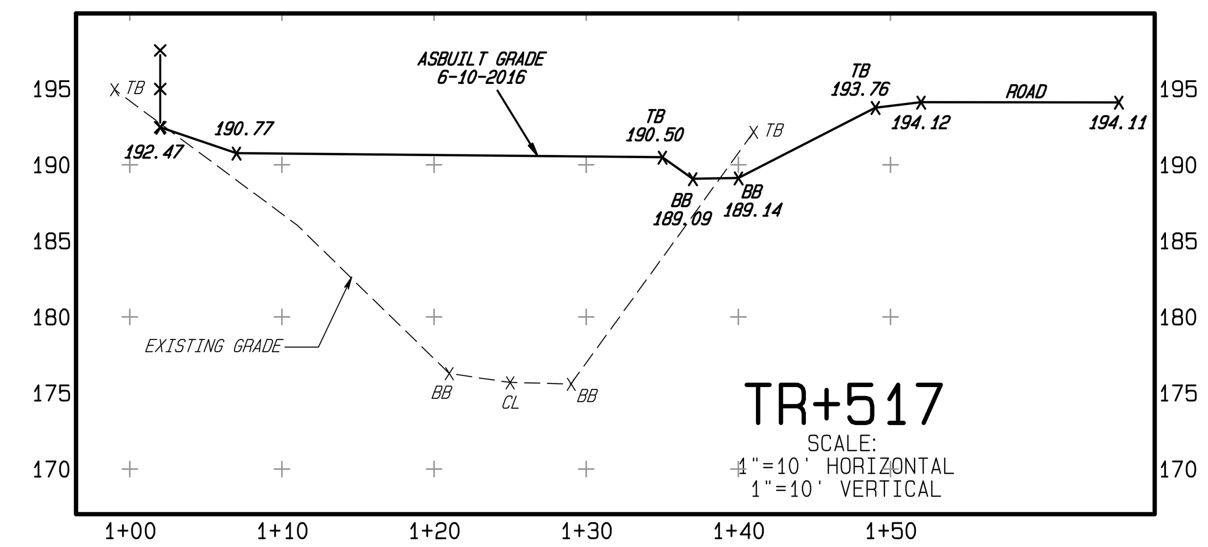


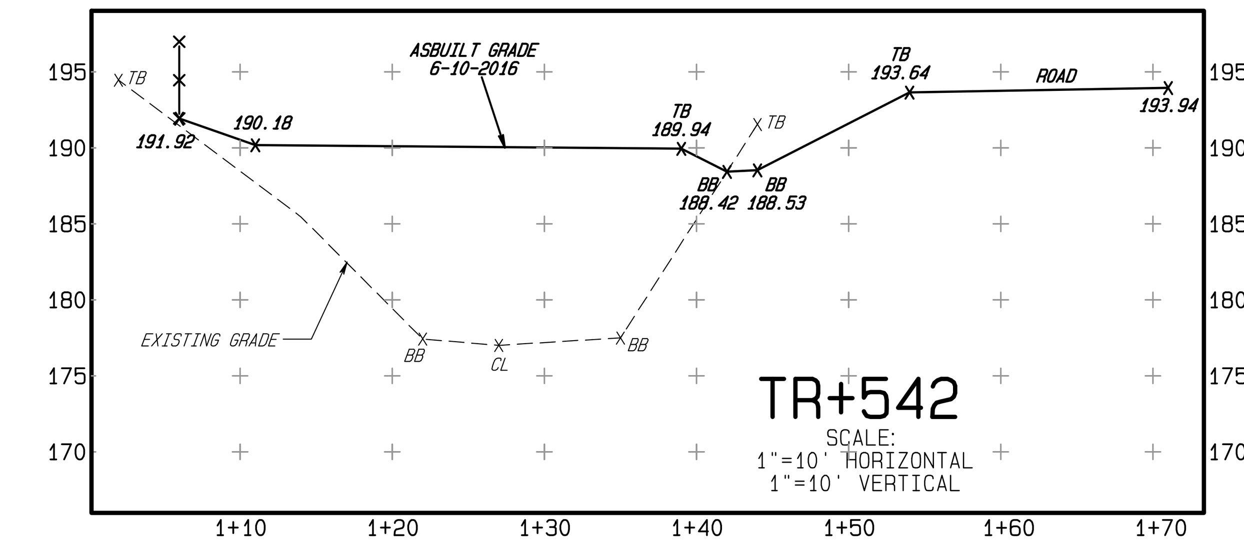


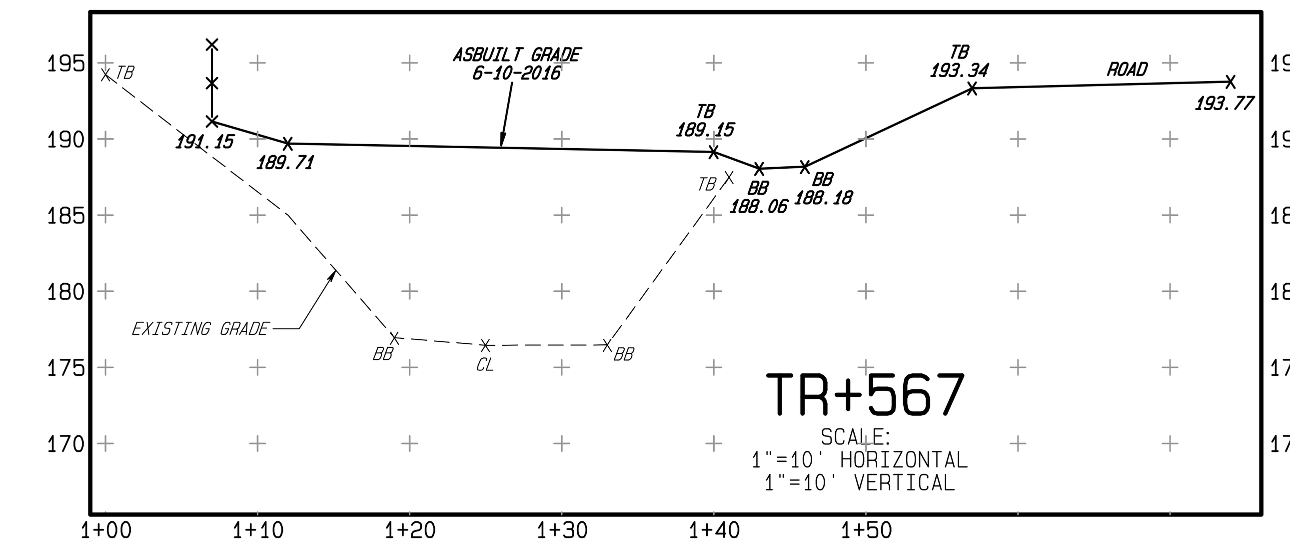


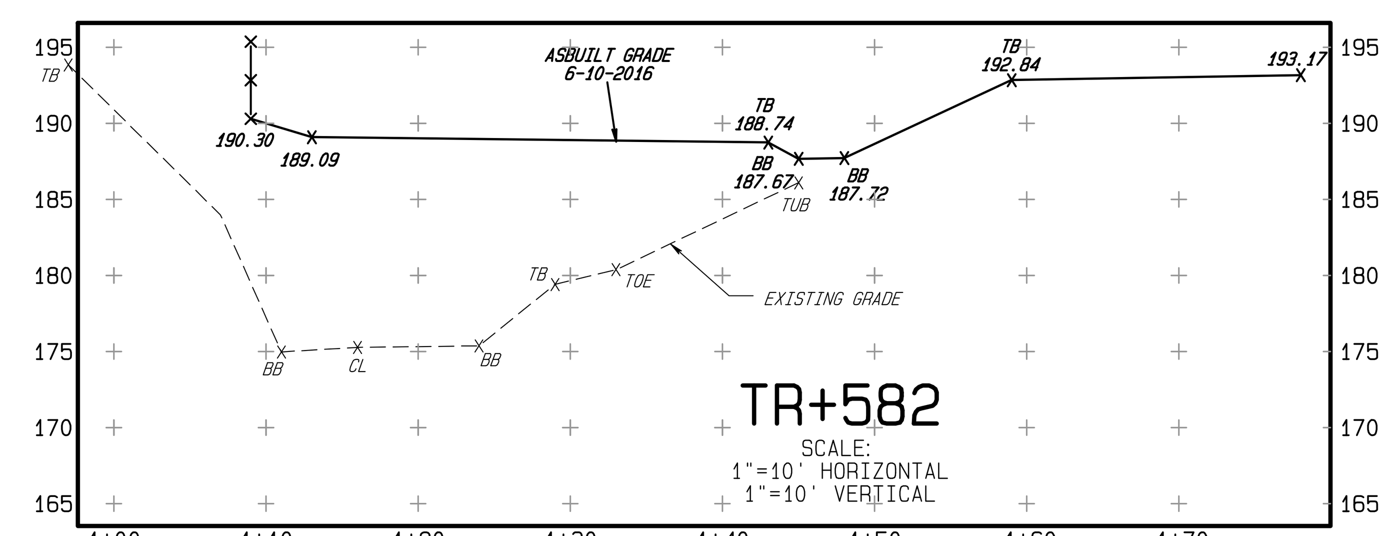


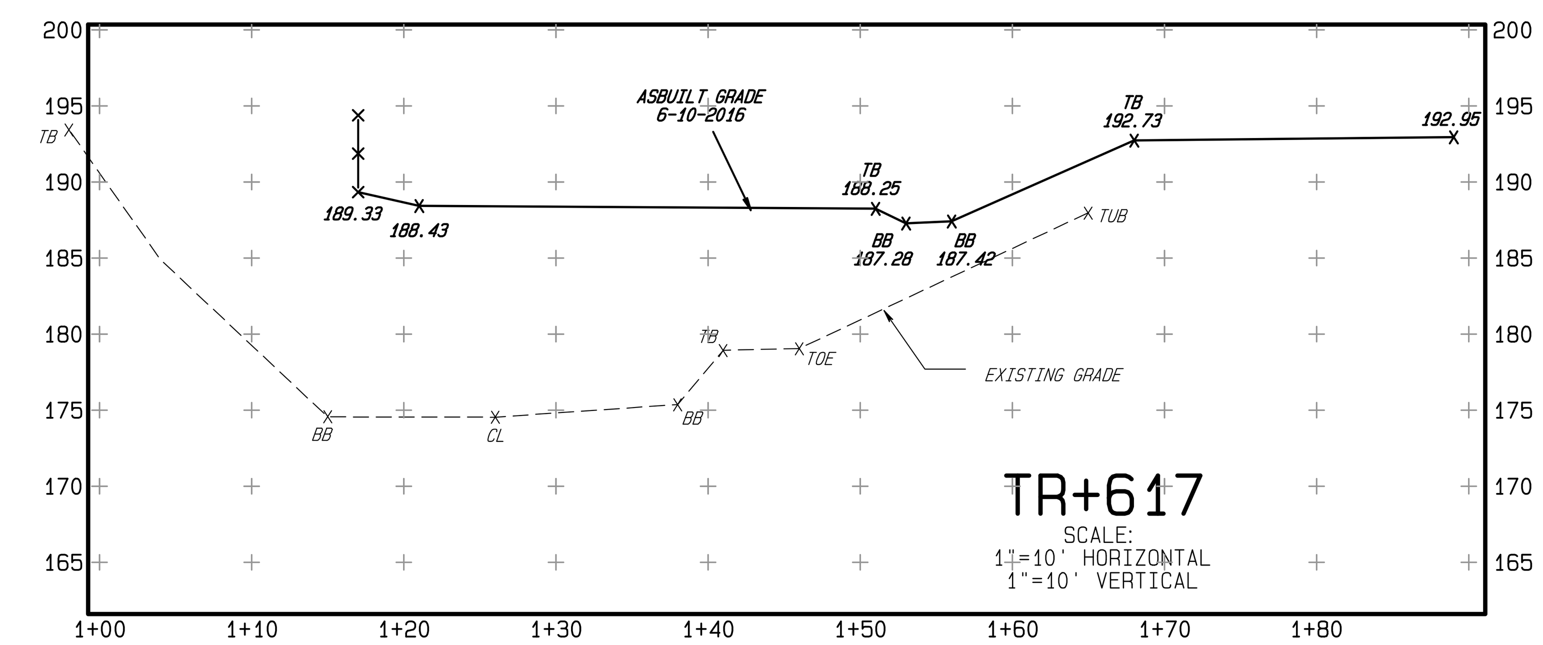


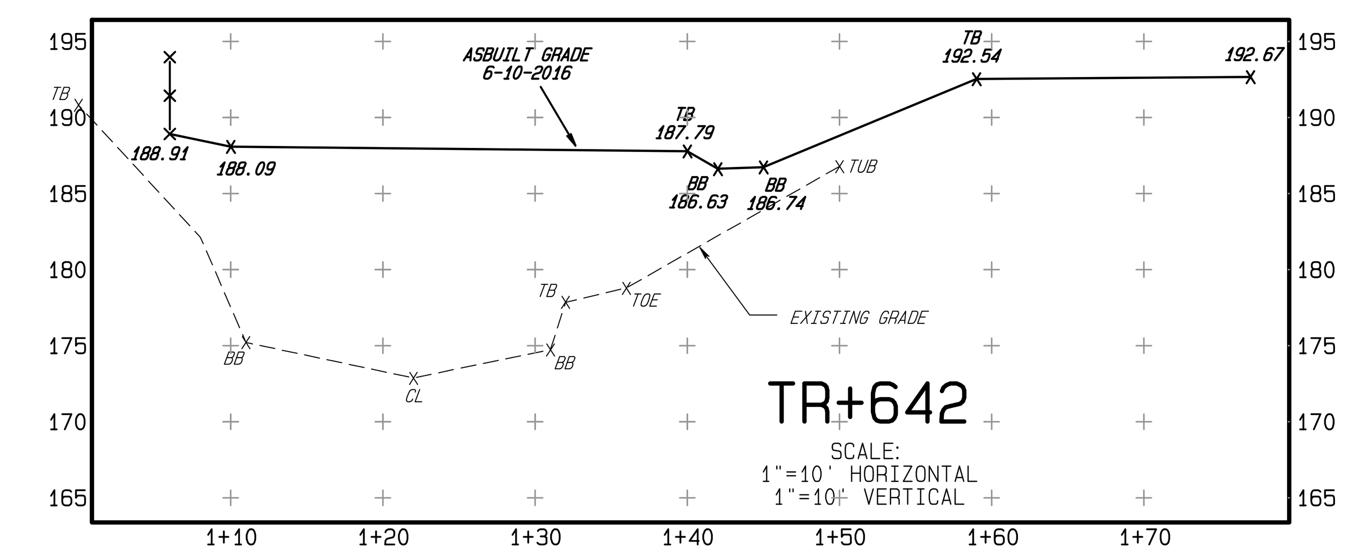


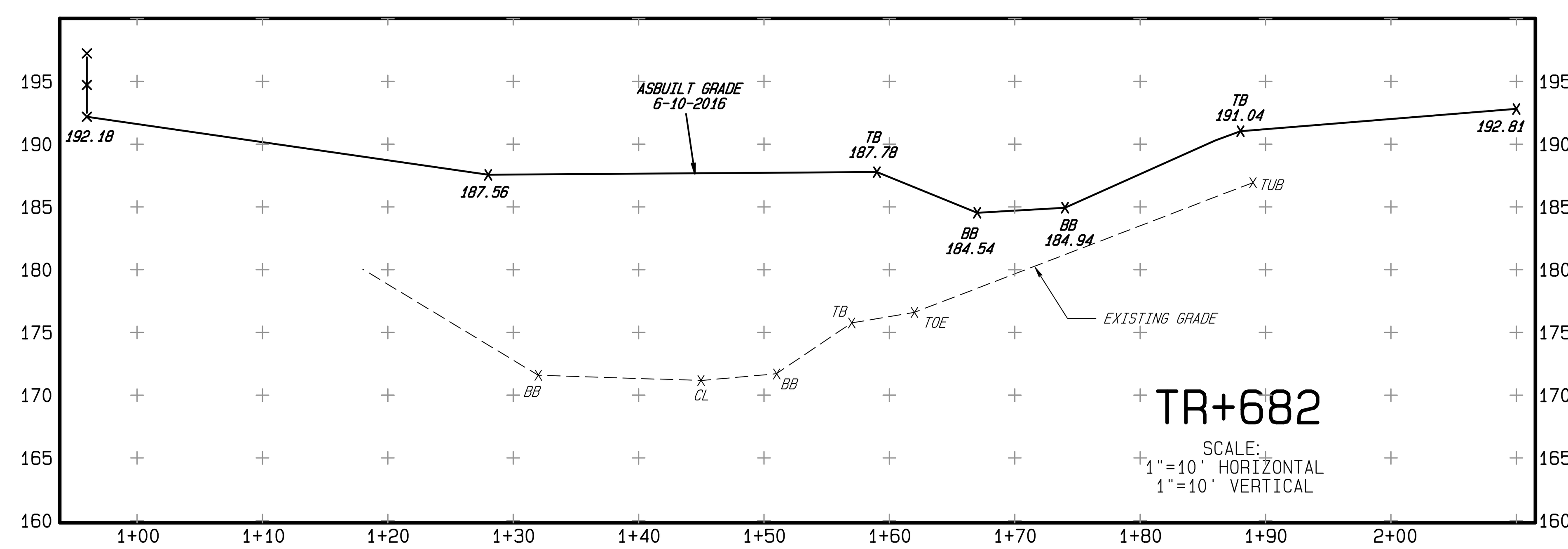


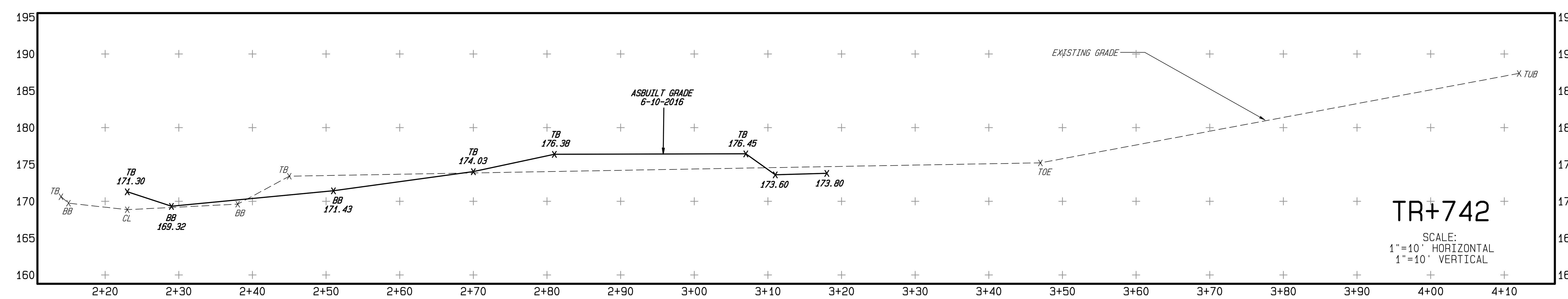


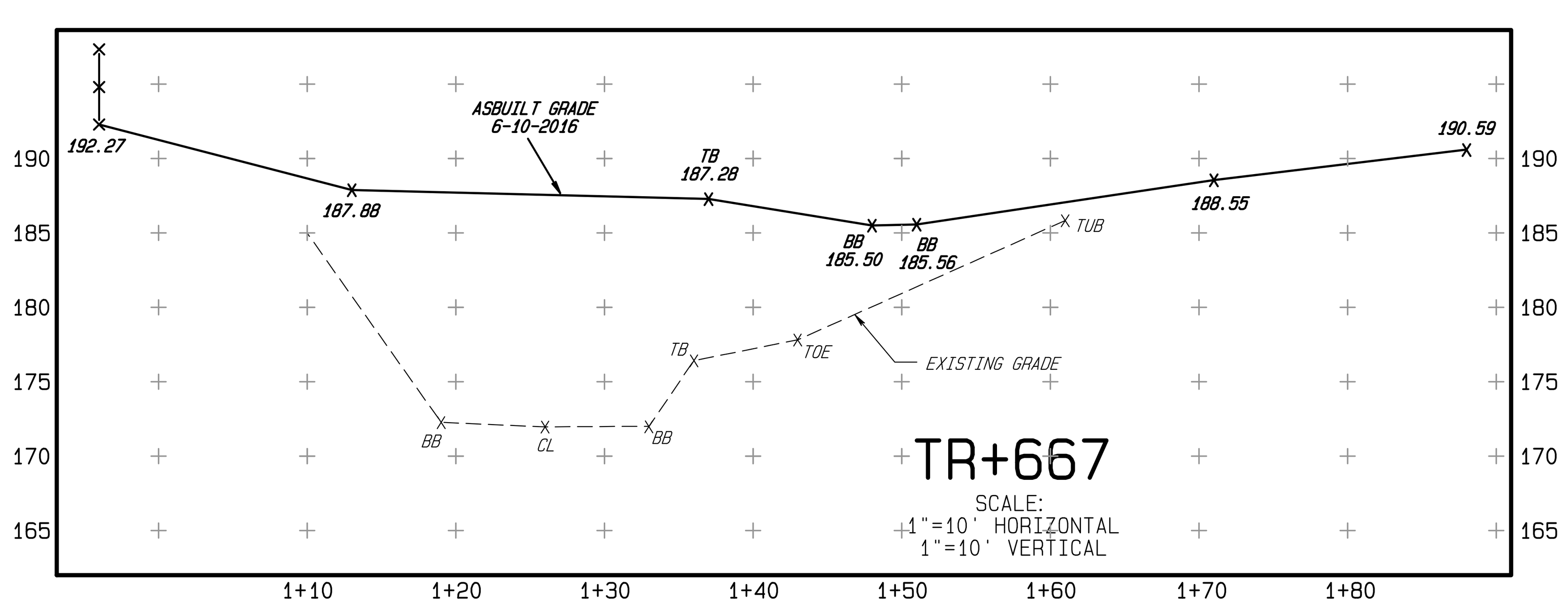


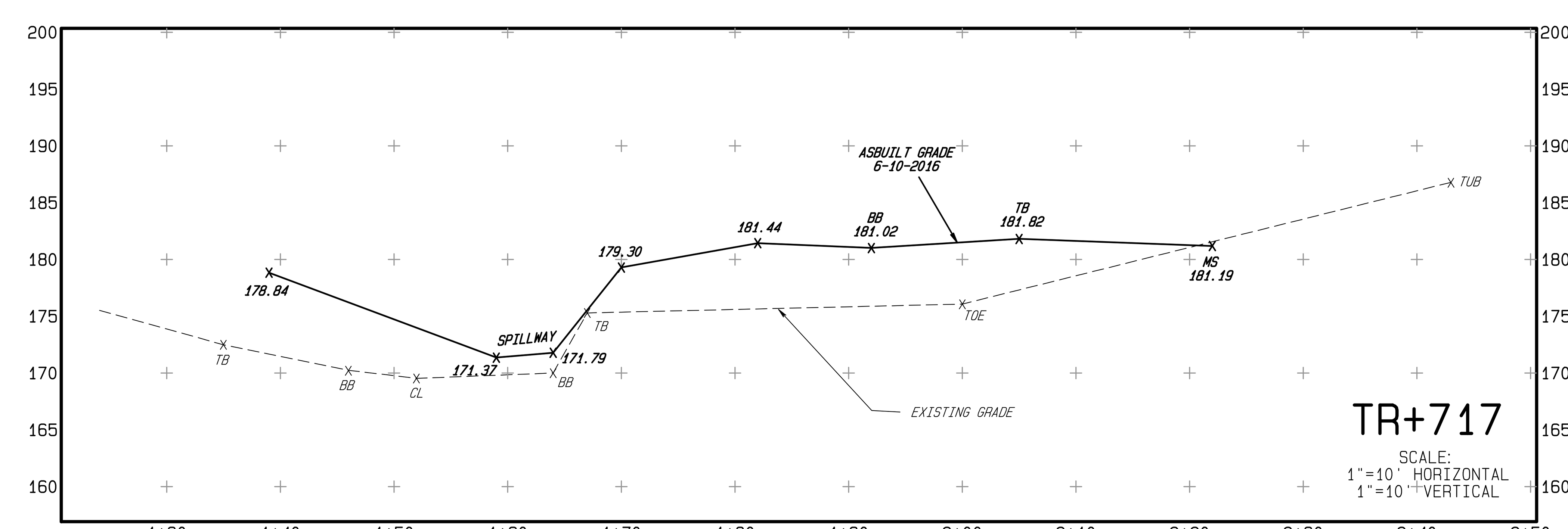


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| REVISION | DATE | DESCRIPTION |
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# "PARK SIDE" AS-BUILT

## LEGEND

- = FENCE LINE
- = EXISTING CONTOUR
- = EXIST. INDEX CONTOUR
- = EXIST. TOP OF BANK OF CREEK
- = EXIST. TOP OF BANK
- = RIP-RAP

GRAPHIC SCALE 1"=50'

0 50 100 150

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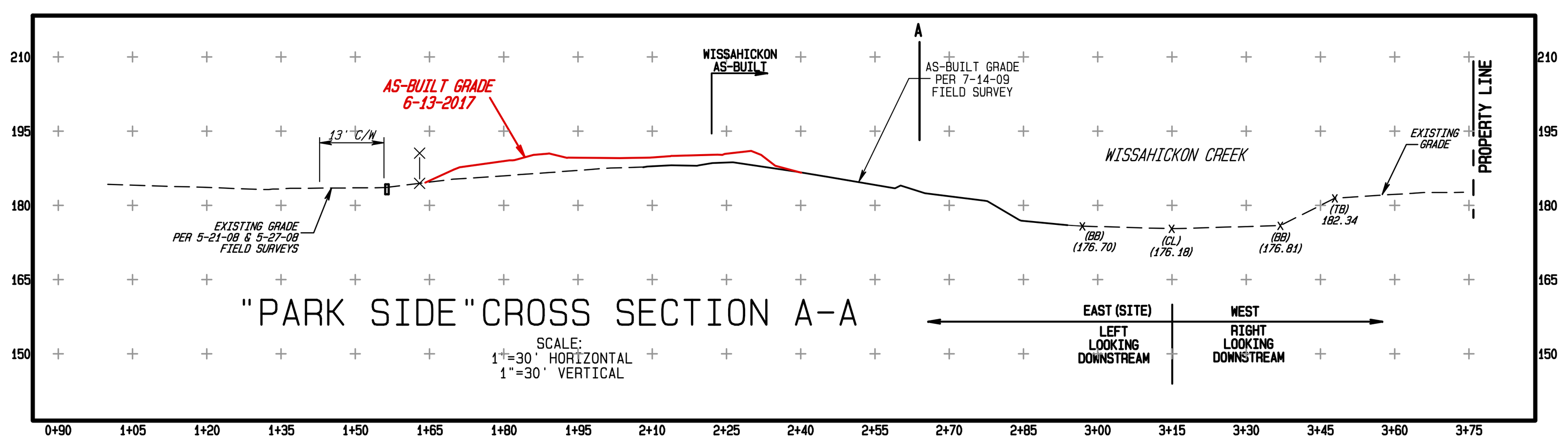


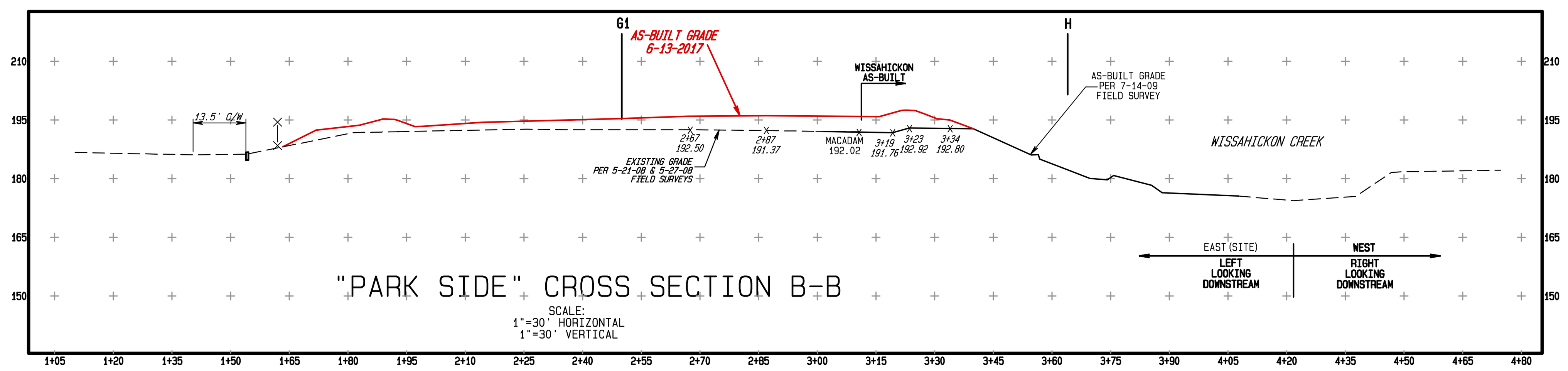


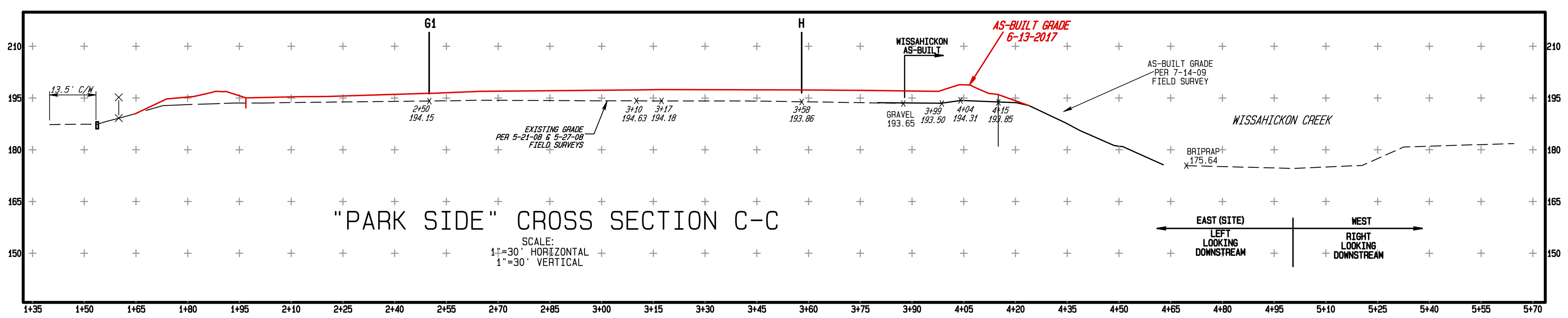


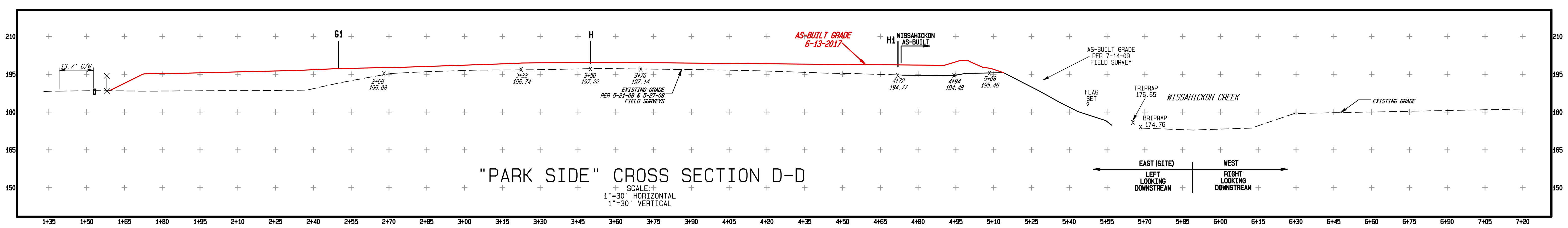


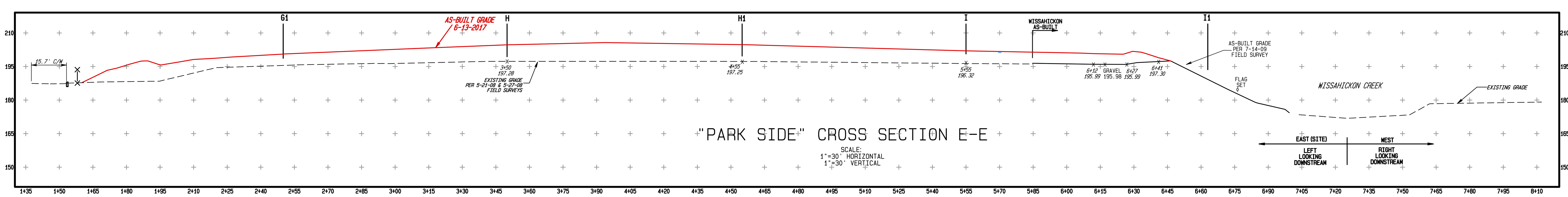


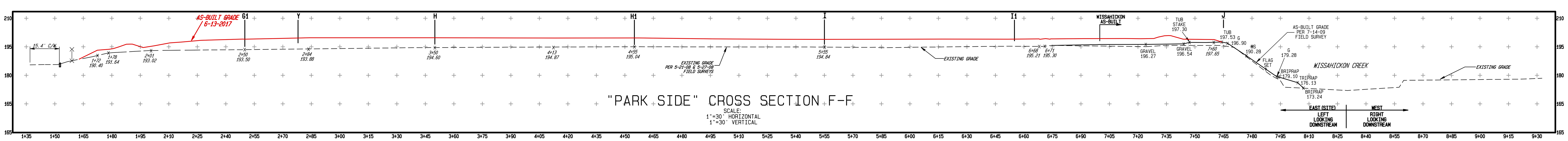


# AS-BUILT PLAN
# "PARK SIDE" CROSS SECTIONS

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| REVISION | DATE | DESCRIPTION |
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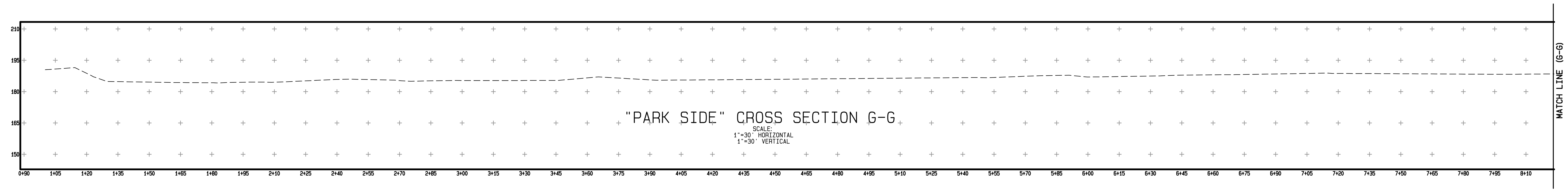


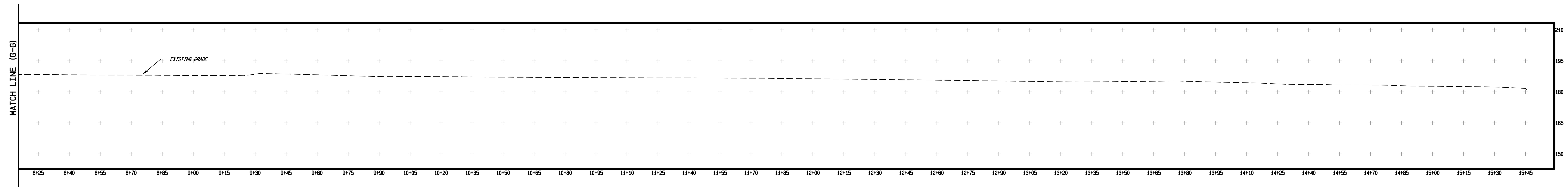


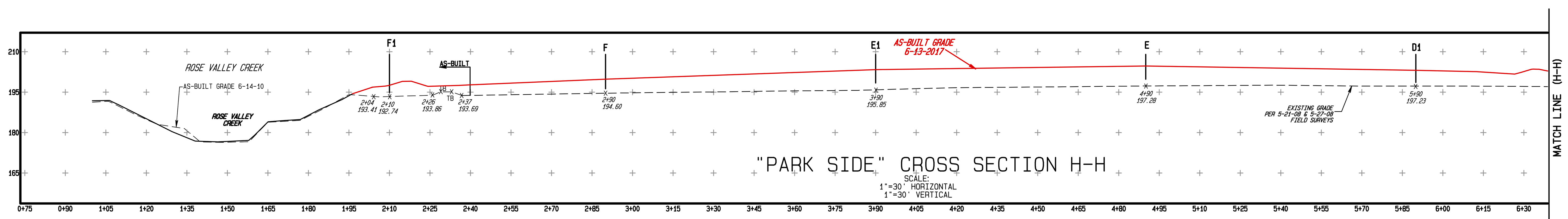


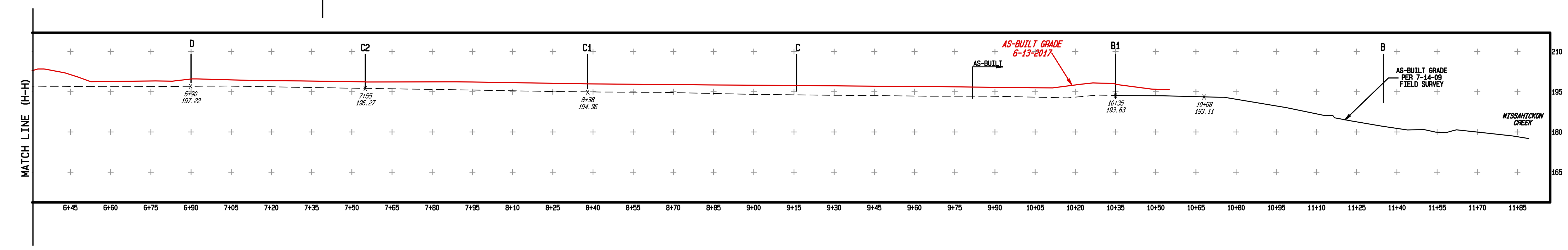


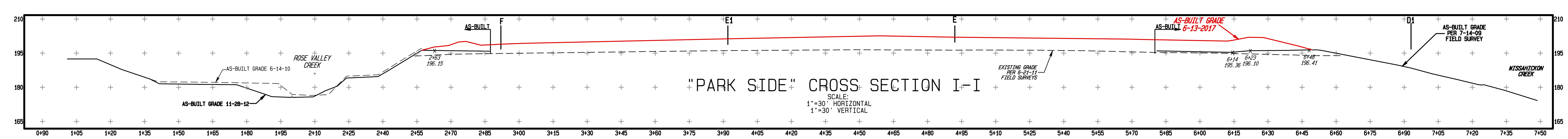


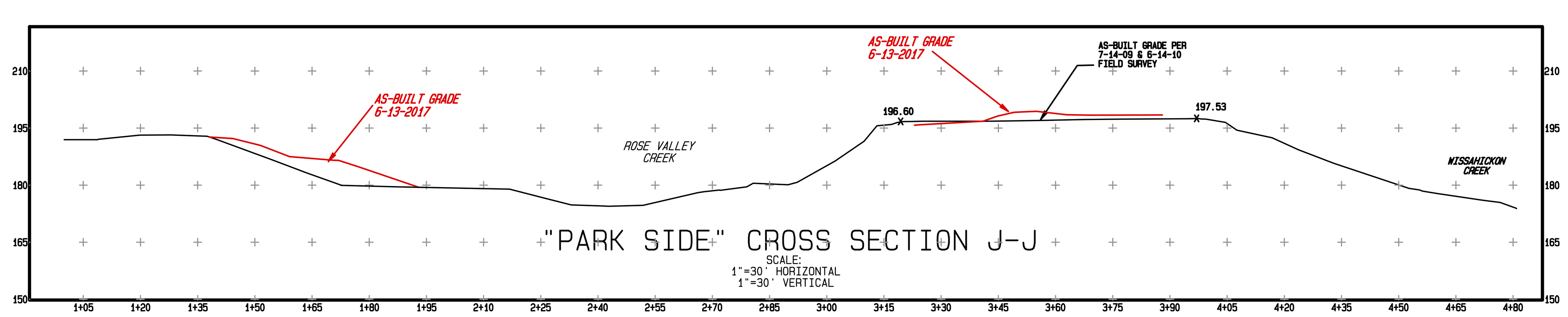


# AS-BUILT PLAN
# "PARK SIDE" CROSS SECTIONS

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| REVISION | DATE | DESCRIPTION |
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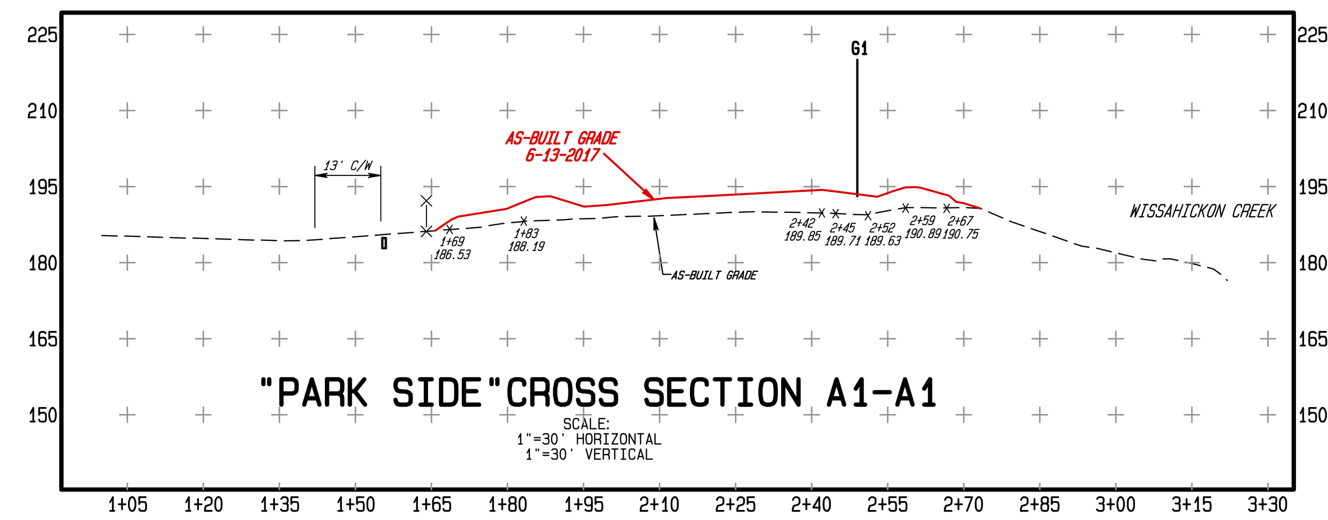


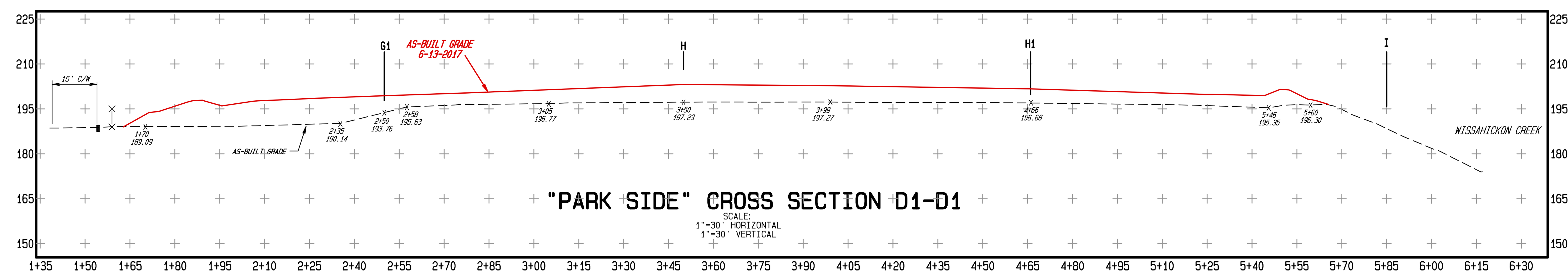


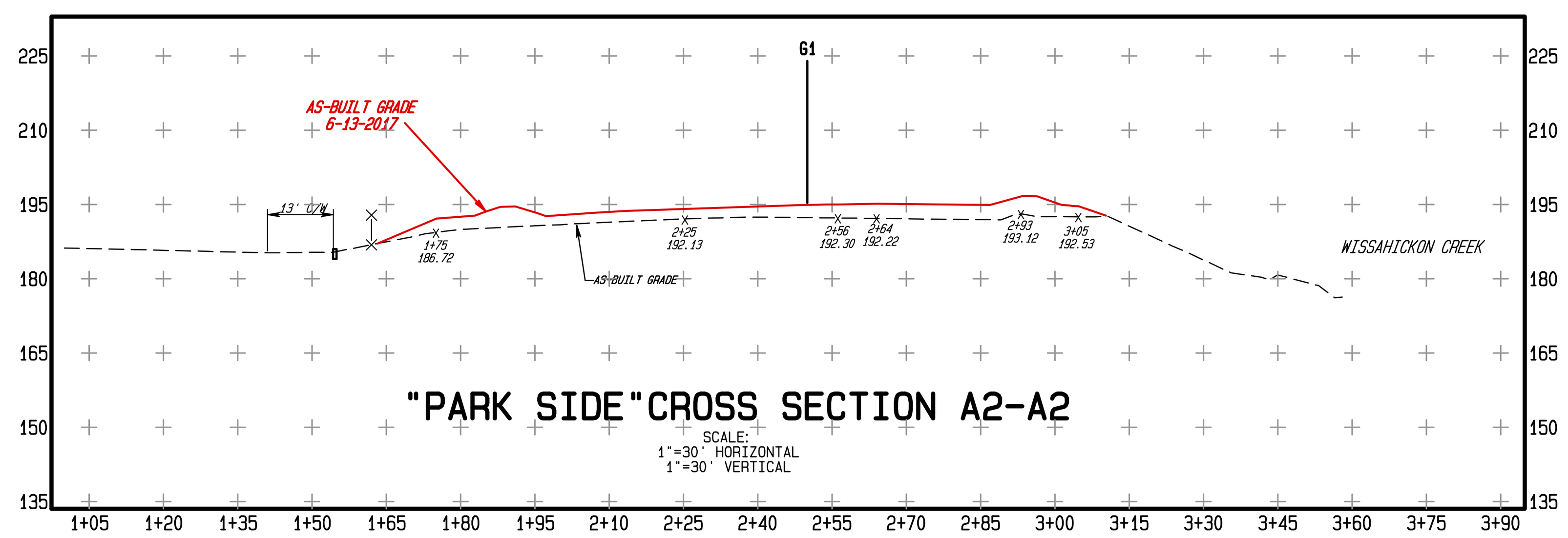


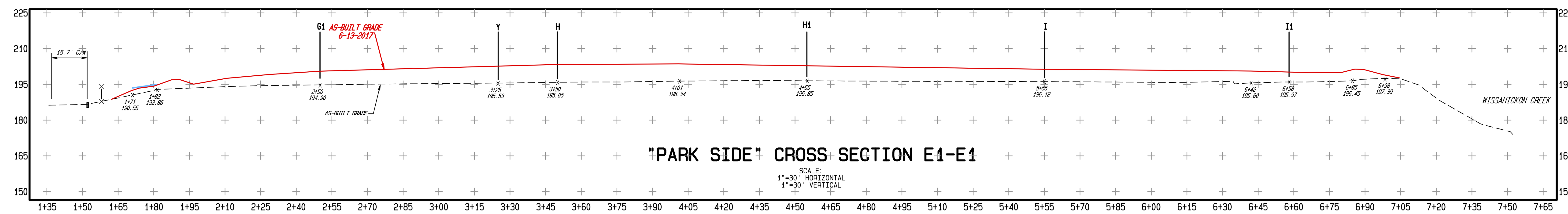


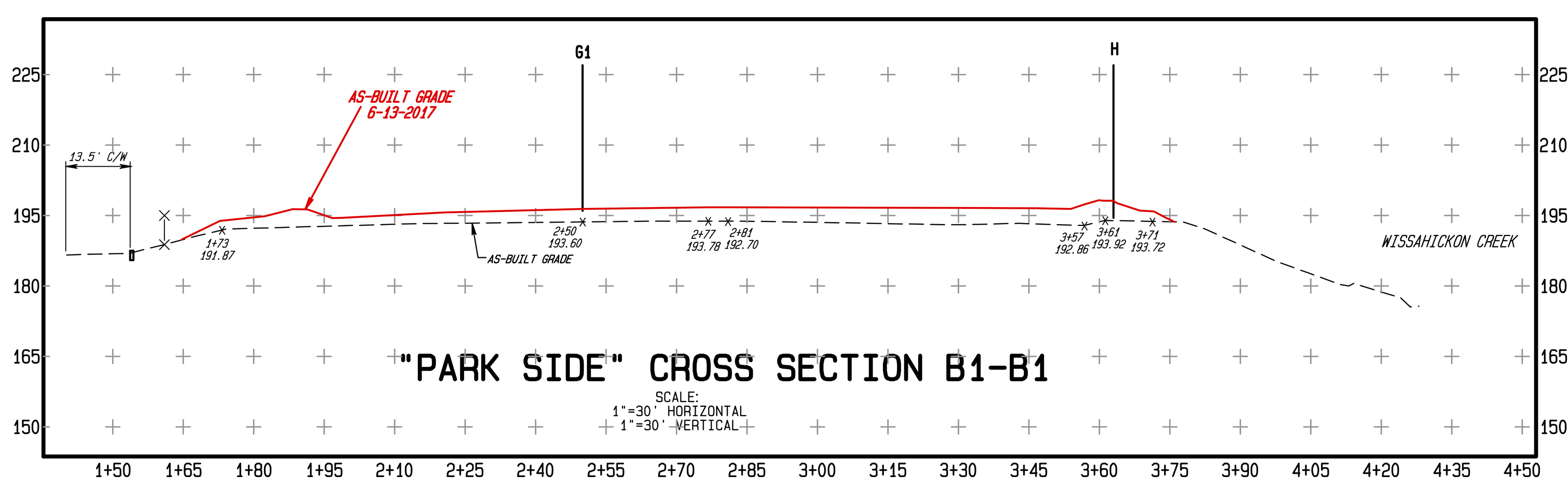


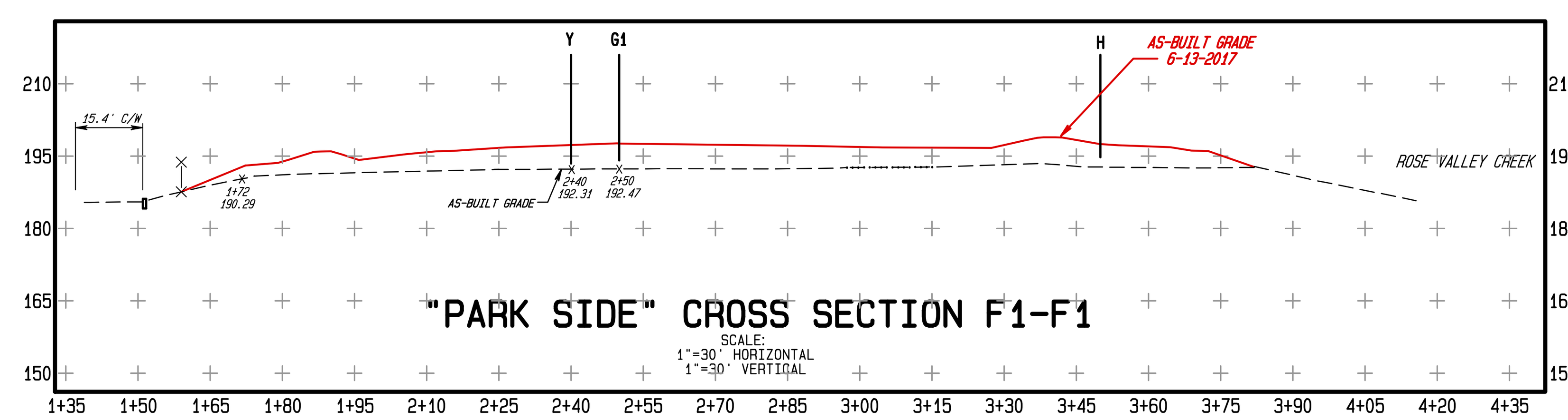


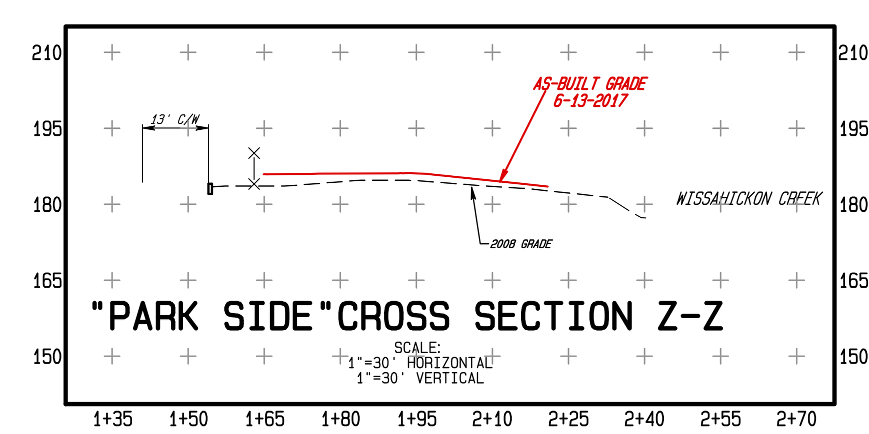


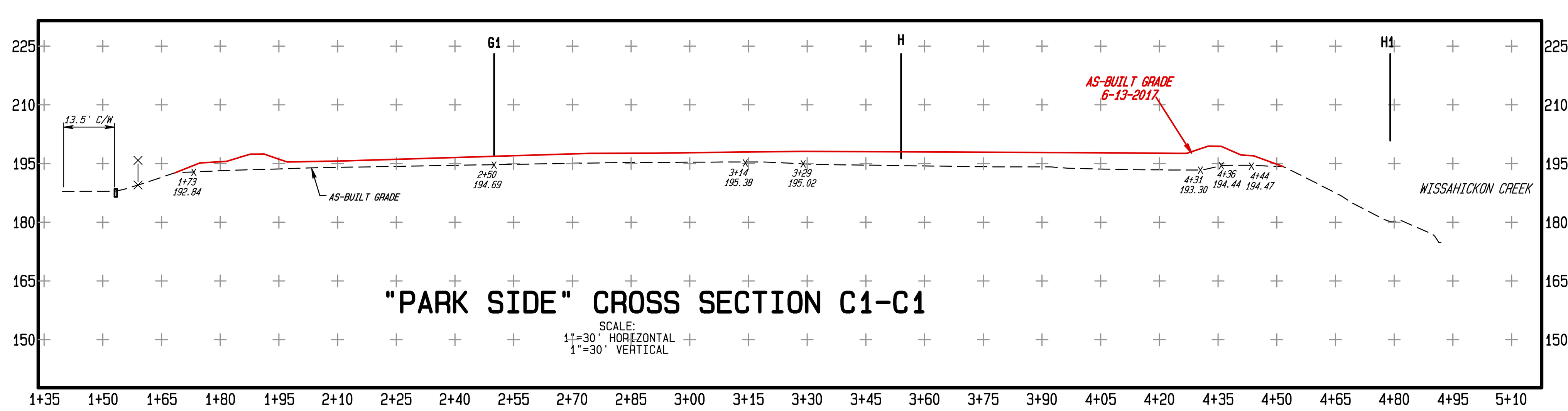


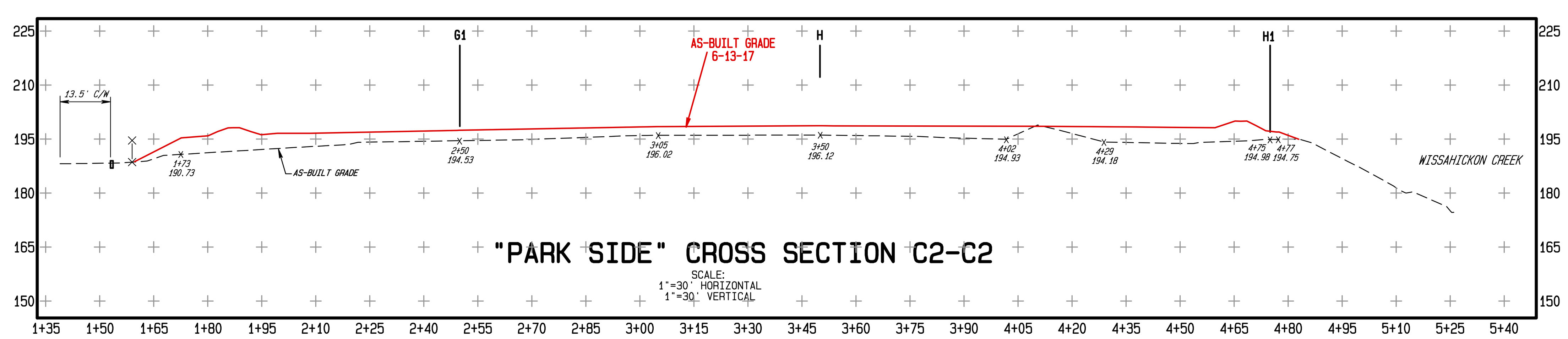


# AS-BUILT PLAN
# "PARK SIDE" CROSS SECTIONS

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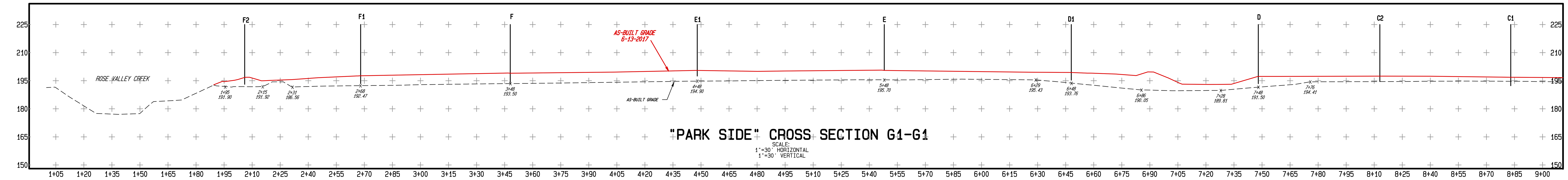
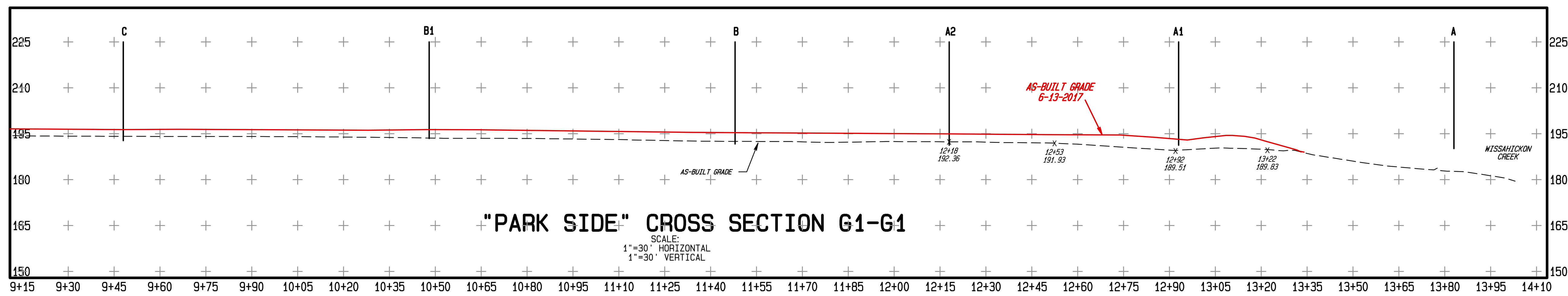
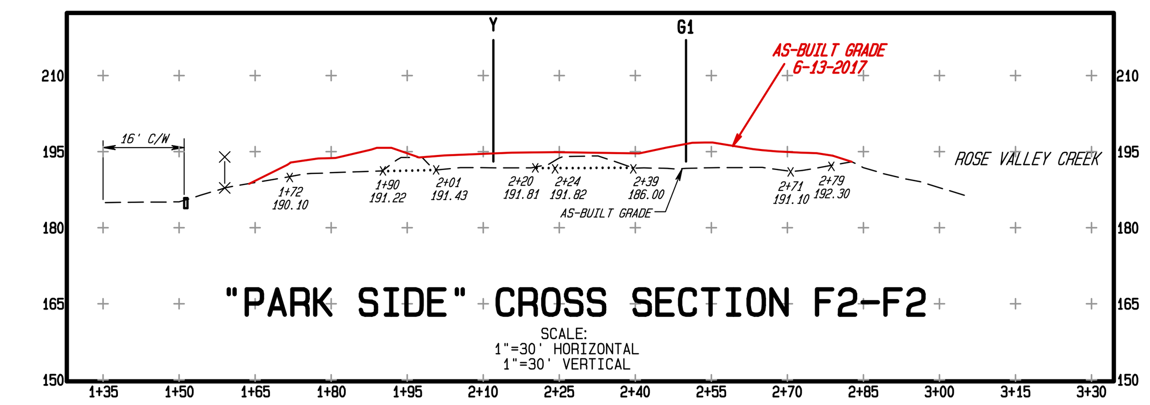
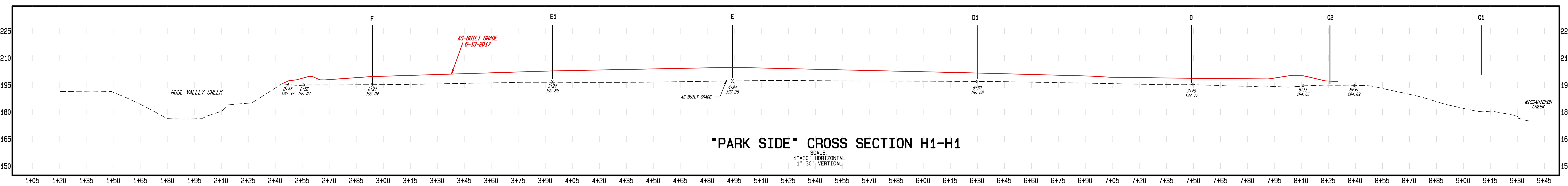
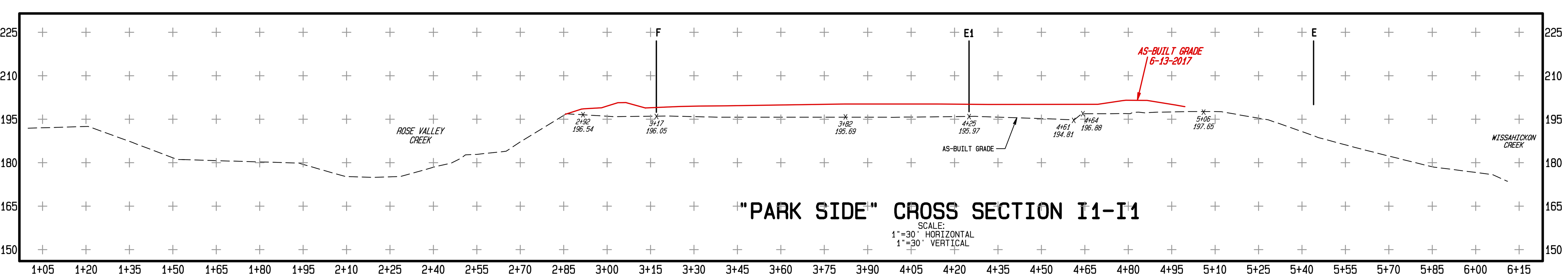
| 1"=30' | SEE ABOVE | | D-7801508-AB SHEET 4 | |

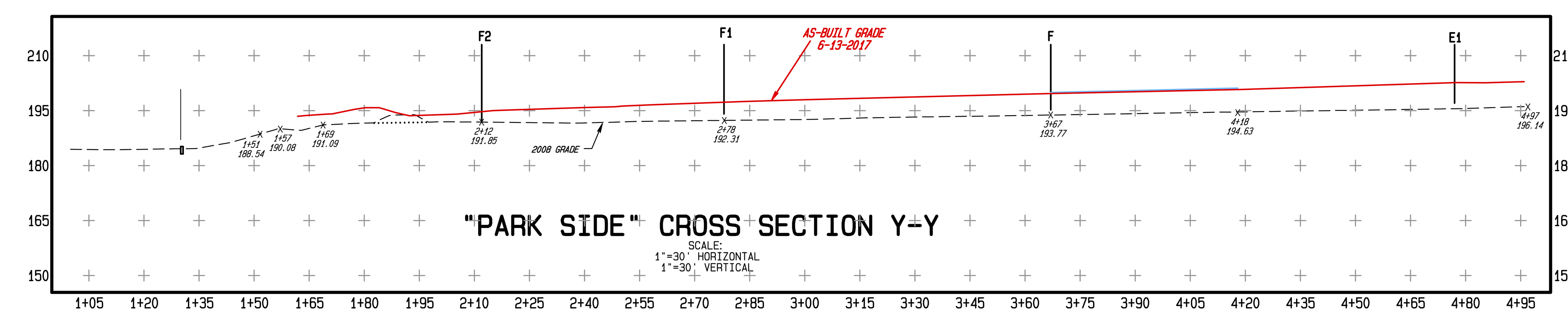



# AS-BUILT PLAN
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| 1"=30' | SEE ABOVE | | D-7801508-AB SHEET 5 | |

# Appendix B

# January 26, 2017 Trip Report

# BoRit Final Site Walk January 26, 2017

# Final Trip Report

On January 26, 2017, the U.S. Environmental Protection Agency (EPA) and CDM Federal Programs Corporation (CDM Smith) participated in a site walk at the BoRit Asbestos Superfund Site in Ambler, Pennsylvania (the Site). The purpose of the site walk was to (1) inspect capping work completed by the EPA Removal Program at the Site and (2) identify key inspection measures that should be included in the Site's Operation and Maintenance (O&M) Plan. Participants in the site walk included:

| | |
|---|---|
| Joseph McDowell (JM) | Senior Remedial Project Manager (EPA) |
| Gregory Voigt (GV) | Remedial Project Manager (EPA) |
| [redacted] | Field Engineer (CDM Smith) |

The weather during the site walk was overcast with an outside air temperature of 45 degrees Fahrenheit (°F). Personnel participating in the site walk wore modified level D personal protective clothing. This Trip Report summarizes discussions, observations, and action items identified during the site walk. **Attachment A** provides photographs taken during the site walk by the CDM Smith participant. **Attachment B** includes the log book entry recorded by the CDM Smith participant during the site walk.

## 1.1 Summary of Inspection

On the morning of January 26, 2017, EPA and CDM Smith personnel met at the Site at 0800. Prior to initiating the site walk, the inspection team assembled in one of the two project trailers on the Site to discuss the site walk objectives. Because the Capping alternative, the selected remedy for the Site, includes quarterly O&M inspections, GV discussed the need for the development of a quarterly inspection checklist to be included in the Final O&M Plan for the Site. It was noted that inspection for groundhog burrows should be included on the quarterly inspection checklist. JM noted that Whitpain Township is currently exploring options for groundhog prevention fences. These fences extend approximately 18 inches below the ground surface. JM indicated that, if groundhog prevention fences were going to be implemented at the BoRit Site, the depth could only extend 6 inches below the ground surface to avoid compromising the integrity of the cap.

At approximately 0840, the EPA and CDM Smith inspection team began the site walk, starting at the Park parcel berms adjacent to Ambler Avenue. The inspection team examined Site features in the order listed in Section 1.2 below. Section 1.2 also provides detail on observations and discussion at each location.

After the site walk, the inspection team met with the EPA Removal Program On-Scene Coordinator Eduardo Rovira (ER). ER indicated that the EPA Removal Program would cut vegetation along all creek slopes and the Asbestos Pile slopes one more time prior to demobilizing from the Site in the Summer of 2017. ER shared photographs from a vendor demonstration using a remote-controlled spider mower for maintenance of the slopes. During capping activities, the EPA Removal Program mowed vegetation annually on all Site slopes and monthly for flat areas of the Site. The EPA Removal Program mowed the flat top of the Asbestos Pile to permit access for inspection purposes.

ER noted that responsibility for Reservoir parcel maintenance and inspection has been turned over to the Wissahickon Waterfowl Preserve (WWP).

Discussion occurred regarding the cost to keep one project trailer on the Site when the EPA Removal Program demobilizes from the Site. ER estimated that monthly costs could total $800 to $1,000. ER noted that another option could be to mobilize a trailer currently stored at EPA's Boothwyn, Pennsylvania warehouse to the Site for usage during O&M activities.

ER noted the following activities EPA Removal Program will complete by the Summer of 2017:

- Grade the non-vegetated portion of the Park parcel to ensure surface water drains to swales located along the perimeter of the Park parcel;
- Mow vegetation along all creek slopes and the Asbestos Pile slopes one more time prior to demobilizing from the Site in the Summer 2017;
- Mow and inspect the flat areas monthly at the Park parcel and on top of the Pile parcel until the Summer of 2017;
- Hydroseed the non-vegetated area of the Park parcel;
- Perform one final stream inspection for asbestos-containing material (ACM) in Wissahickon Creek. ER recommended that inspection for ACM in Wissahickon Creek should continue on an annual basis during O&M; and
- Perform air sampling *(to be determined)*.

## 1.2 Inspection Observations

While examining Site features during the site walk, the inspection team discussed the observations noted below. **Figure 1** shows the Site map and the location of observations noted below.

1. Park Parcel berms along Ambler Avenue: The inspection team discussed monitoring well MW-01 and considered whether monitoring wells should be converted to flush mounted wells or whether the monitoring wells should be abandoned. GV will contact Herminio Concepcion, the Site hydrogeologist, to discuss EPA's options.
2. Fence at the northwest boundary of the Site: JM noted that the Site fence at the northwest boundary of the Site terminated at the bank of Wissahickon Creek to avoid issues with debris during flooding. The inspection team discussed the option of connecting the Site fence to the Township fence (located immediately to the northeast) to deter Site trespassers. Following the Site walk, ER noted that the Township has plans to develop the area northeast of the Site in this location.
3. Wissahickon Creek slopes and vegetation and Park parcel berms: A minor animal burrow was observed along the Wissahickon Creek slopes adjacent to the Park parcel. The inspection team agreed that examination for animal burrows and subsequent filling with clean material should be included on the quarterly inspection checklist.
4. Non-vegetated section of the Park parcel: JM noted that the EPA Removal Program should improve grading of the non-vegetated section of the Park parcel prior to

hydroseeding the remaining area of the Park parcel. As noted in Section 1.1, this observation was discussed with ER.

5. Berms of the Park parcel adjacent to Rose Valley Creek: The inspection team observed the erosion and sediment (E&S) control filter socks, installed by EPA Removal Program, around the rock drainage swale conveying runoff from the Park parcel to Rose Valley Creek. The group agreed that all E&S measures should remain in place until vegetation is permanently established.

6. Rose Valley Creek Concrete Cable Mat (CCM) Ramp: The inspection team evaluated the CCM ramp that intersects Rose Valley Creek. GV noted inconsistency of grouting in the CCM ramp. Some seams are grouted and others are filled with clean material. Erosion was observed between some areas of the CCM in locations where clean material was used. GV noted that inspection of the CCM should be included on the quarterly inspection checklist.

7. Reservoir berms and Reservoir: JM noted that stakes on the Reservoir island should be removed in the Spring or Fall of 2017. The group discussed the potential for pumping water from Rose Valley Creek into the Reservoir during flooding events. JM noted that flooding mitigation measures should be handled by the Federal Emergency Management Agency (FEMA); therefore, they should not be included in monitoring and maintenance for the Site. The WWP is currently operating an aeration system in the Reservoir. The control panel is located by the Site fence adjacent to Maple Avenue. O&M of the aeration system will continue to be the responsibility of the WWP.

8. Tannery Run outfall, emergency spillway, and headwall: No issues were noted or discussed at this location.

9. Asbestos Pile parcel: The inspection team discussed abandoning piezometers located on the Asbestos Pile parcel. GV will follow up with EPA's hydrogeologist, Herminio Concepcion, to discuss whether piezometers can be abandoned.

10. Reservoir fence adjacent to Maple Avenue: The inspection team observed that one Reservoir fence panel adjacent to Maple Avenue was dislodged. EPA staff attempted to secure the fence panel, but the spacing between the panels was too large, and EPA was not able to secure the fence panel in place. In addition, the inspection team observed that a picket was missing from another fence panel near the Reservoir.

11. Reservoir stream gauge: The inspection team noted that the water level on the Reservoir stream gauge read 1.18 feet. At approximately 1015, David Froehlich (DF) from WWP arrived at the Site to check on the Reservoir water level. The inspection team revisited the Reservoir stream gauge with DF. DF noted that, when the Reservoir was refilled to an elevation of 3.0 feet on the stream gauge, this corresponded to an approximate surface water elevation of 187 feet above mean sea level.

## 1.3 Recommendations and Action Items

The site walk concluded at 1130. The following action items and recommendations for O&M were identified during the site walk:

- Completion of the EPA Removal Program activities listed in Section 1.1.

- Maintenance of the fence along the Reservoir is the responsibility of WWP.
- E&S measures should remain in place until vegetation is permanently established at the Site.
- GV will discuss a mowing schedule for the Site with Bruce Pluta.
- GV will discuss options for well and piezometer abandonment with Herminio Concepcion.
- CDM Smith will prepare a quarterly inspection checklist to include in the Final O&M Plan. The quarterly inspection checklist should include inspection for groundhog burrows and inspection of the CCM seams for erosion.
- ER recommended adding an annual stream walk along Wissahickon Creek to inspect for ACM.
- ER will notify GV of mowing dates for the slopes and potential air sampling activities.

# Appendix C

# Annual O&M Report

# ANNUAL O&M REPORT

**Introduction and Purpose**

Effective operation and maintenance (O&M) at the BoRit Asbestos Superfund Site in Ambler, Pennsylvania (the Site) is critical to ensure that the capping remedy remains protective of human health and the environment.

This Annual O&M Report has been adopted from the *Recommended Annual O&M/Remedy Evaluation Checklist* designed by the Office of Solid Waste and Emergency Response (OSWER), now known as the Office of Land and Emergency Management (OLEM). This Annual O&M Report has been designed to help the U.S. Environmental Protection Agency (EPA) Remedial Project Manager (RPM) capture data routinely collected during O&M activities in a way that can improve evaluation of the efficiency and effectiveness of the remedial action. This Annual O&M Report may also be used to evaluate an operating remedy prior to transferring the Site to the Commonwealth of Pennsylvania (the State) for O&M. In addition, remedy performance summarized using this Annual O&M Report can be used to communicate remedy progress to the local community, highlight potential issues before they become problems, and help the RPM complete five-year reviews more efficiently.

Site information collected to complete this Annual O&M Report should help to answer the following questions:

- Is the Capping remedy achieving remedial action objectives (RAOs) and maintaining cleanup levels (CULs)?
- If the Capping remedy is not achieving the established objective and goals as outlined in the O&M Plan what corrective measure(s) must be enacted and how should this be documented?
- If the Capping remedy is achieving the performance goals, objectives, and performance standards, are there any opportunities to optimize the remedy to improve performance?

This Annual O&M Report should be completed annually. Any data used to complete this evaluation should be attached to this report. This Annual O&M Report does not carry out the level of review specified in the EPA five-year review process; however, the Annual O&M Report is consistent with a five-year review process.

**Instructions:**

This Annual O&M Report can be completed electronically. Most questions involve a short answer, yes/no response, or simply checking the box. Questions that involve a short answer will have an expandable box. For responses that ask to “select one” please double click on “select one” and choose the correct answer. If the information is not available (N/A) for a particular question, please respond to this question with “N/A”. A Site visit is strongly encouraged prior to completing the Annual O&M Report.

1. This evaluation should be completed annually once O&M activities have initiated at the Site and can be maintained in an electronic format.
2. This evaluation should be based on quarterly inspections, post-significant weather inspections, and long-term monitoring (LTM) data.
3. The completed Annual O&M Report should be signed, dated, and placed in the Site file. The quarterly inspections checklists should be saved electronically for use in completing the Annual O&M Report.

The Annual O&M Report in the Site repository can provide the community with information about O&M status and remedy performance and can demonstrate that the EPA is tracking performance to ensure that the remedy remains protective.

# ANNUAL O&M REPORT

Please save electronically and send this completed report and any attachments to the Site file and Site repository.

| **I. SIGNATURES AND APPROVALS** | | | |
|---|---|---|---|
| **EPA RPM** | | | |
| Name: | | | |
| Email: | | Telephone: | |
| Signature: | | | Date: |
| **State Contact (if appropriate)** | | | |
| Name: | | | |
| Email: | | | |
| Signature: | | | Date: |

| **II. GENERAL SITE INFORMATION** | | |
|---|---|---|
| Site Name: | | |
| State: | | |
| Period Covered: | To | EPA Site ID: |
| Site Lead: | | Other, specify: |

| | | |
|---|---|---|
| Organization responsible for O&M operations: | | |
| Site Remedy Components: | | |
| Preliminary Close Out Report Date (PCOR) date: | | |
| Operational & Functional (O&F) date: | | |
| Last five-year review date: | | |
| National Priorities List (NPL) deletion date: | | |
| Was a Site visit made during this review: | ☐ Yes ☐ No | Date: |
| If no, why: | | |
| Date of next planned checklist evaluation: | | |
| Location of Administrative Record/Site Files: | | |
| During the Site visit, was monitoring equipment operational? | ☐ N/A ☐ Yes ☐ No | |
| Has an Optimization Study been conducted at the Site: | ☐ N/A ☐ Yes ☐ No | Date: |
| If not, is an Optimization Study planned? | | |
| **List all site events since the last Annual O&M Report that impact or may impact remedy performance.** | | |
| Chronology of events since the last Annual O&M Report (e.g. Site visits, receipt of reports, storm events, vandalism, quarterly inspections): | | |
| Elaborate on significant site events or visits to the Site: | | |

| III. DOCUMENTS AND RECORDS<br>Because these documents may be required for the five-year review, verify what documents are currently available on-site or note off-site location: | | | | |
|---|---|---|---|---|
| **Document** | **Required** | **Not Required** | **On-Site** | **Off-Site (indicate where)** |
| O&M Manual | | | | |
| Quarterly Inspection Checklist | | | | |
| Annual O&M Report | | | | |
| Removal Action As-Built Drawings modified during O&M | | | | |
| Site Specific Health and Safety Plan | | | | |
| Emergency Response Plan | | | | |
| O&M/Occupational Safety and Health Administration (OSHA) Training Records | | | | |
| Capping Inspection Records | | | | |
| Institutional Controls (ICs) Review | | | | |
| Other(s) (Please name each): | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

| IV. ADMINISTATIVE ISSUES<br>Check all that apply: | Date Initiated: |
|---|---|
| ☐ Explanation of Significant Differences in progress | |
| ☐ Record of Decision (ROD) Amendment in progress | |
| ☐ Site in O&F period | |
| ☐ Long-Term Response Action (LTRA) in progress | |
| ☐ LTRA Transition to O&M in progress | |
| ☐ Notice of Intent to Delete Site in progress | |
| ☐ Partial Site Deletion in progress | |
| ☐ Technical Impracticability (TI) Waivers in progress | |
| ☐ Reuse Assessment or Reuse Plan in progress | |

| | |
|---|---|
| ☐ Revised Risk Assessment in progress<br>☐ Ecological OR ☐ Human Health | |
| ☐ Other administrative issues | |

| **V. O&M COSTS**<br>The purpose of this section is to document what is known about O&M Costs for the Site. | |
|---|---|
| What was the total annual O&M cost for the previous year? | |
| What is the expected total annual O&M cost for the upcoming year? | |
| **Please provide the breakout of the previous year's O&M costs below (if applicable).** | **Use either $ or %** |
| Analytical (e.g. lab costs): | |
| Material (e.g. capping materials, fencing): | |
| Maintenance Activities (e.g. mowing, cap repairs): | |
| Oversight (e.g., project management): | |
| Monitoring (e.g. air sampling): | |
| Utilities (e.g. electric, gas, phone, water): | |
| ICs (implementation and enforcement): | |
| Other (e.g., capital improvements, equipment repairs): | |
| **Describe any unanticipated/unusually high or low O&M costs and potential future O&M funding issues.** | |
| | |

| **VI. INSTITUTIONAL CONTROLS (ICs)**<br>The purpose of the IC evaluation at the O&M phase is to determine if the ICs are implemented, effective, and durable. The following references may be useful for completing this evaluation:<br>• *Institutional Controls Bibliography: Institutional Control, Remedy Selection, and Post Construction Completion Guidance and Policy (OSWER 9355.0110, December 2005);*<br>• *Supplement to the Comprehensive Five-Year Review Guidance; Evaluation of Institutional Controls (OSWER 9355.7-12, working draft 3/17/05);*<br>• *National IC Strategy to Ensure Institutional Controls Implementation at Superfund Sites (OWSER 9355.0-106, September 2004); and*<br>• *Institutional Controls: A Site Manager's Guide to Identifying, Evaluating and Selecting Institutional Controls at Superfund and RCRA Corrective Action Cleanup (OWSER 9355.0-7-4FS-P, September 2000).* | |
|---|---|
| Identify each IC (media, objective, instrument) implemented/to be implemented at the Site. Attach an extra sheet, figure, etc if necessary. | |
| Are the ICs adequate to minimize potential for human exposure and protect integrity of the capping remedy?<br>If no, please explain further (and include in the recommendation section). | ☐ Yes<br>☐ No |
| Please describe what the ICs are intended to accomplish, who they were designed to inform, the source document for the IC, and where the IC information is located. | |

| | |
|---|---|
| Please identify the date when the ICs were implemented. If the ICs have yet to be implemented, please identify the scheduled implementation date. | |
| If the ICs have been implemented, are they still in place? | ☐ Yes<br>☐ No |
| If the ICs remain in place, please identify whether there is a planned termination date and, if so, the anticipated date. | |
| Are the ICs being properly implemented and enforced? Please identify the party responsible for compliance and enforcement of the IC.<br>If no, please explain. | ☐ Yes<br>☐ No |
| Are the reasons to clarify or modify the appropriate decision document(s) to improve the effectiveness and/or durability of the ICs?<br>If yes, please explain and describe any plans to clarify/modify the document(s). | ☐ Yes<br>☐ No |

| **VIII. TECHNICAL DATA AND REMEDY PERFORMANCE** | |
|---|---|
| The purpose of this section is to document remedy performance to date, summarize data used to evaluate remedy performance, and identify events in the upcoming year that may affect remedy effectiveness/performance. The following abbreviated set of questions addresses O&M of containment (i.e. capping) remedies. | |
| **A. Remedy Description, Goals, and Conceptual Site Model (CSM)** | |
| **1 Summary of the current remedy** | |
| Identify the containment/capping components in place<br>☐ Cap/cover<br>☐ Liner<br>☐ Vegetative Cover<br>☐ Stream Bank Stabilization<br>☐ Other (describe below): | |
| Identify the O&M components: | |
| **2 Review of the Current Remedy Goals** | |
| What are the RAOs and CULs for contaminated waste, soil, and Reservoir sediment for contaminants of concern (COC) at the Site. | |
| What is the time frame to achieve RAOs and CULs? | |
| Based on new information or events since the last annual O&M review, is there a need to re-evaluate the remedy goals? This might be due to factors such as whether the regulatory framework has been revised, whether existing goals appear to be unrealistic, and whether there have been changes in land use or groundwater use near the Site. If yes, identify the remedy goals that should be re-evaluated, the rationale, and any plans for re-evaluating the goals. | ☐ Yes<br>☐ No |
| **3 Review of changes to the CSM:** The CSM for a containment remedy is the site specific qualitative and quantitative description of the migration and fate of contaminants with respect to possible receptors and the geologic, hydrologic, biological, geochemical and anthropogenic factors that control contaminant distribution. | |

| | |
|---|---|
| Because the CSM provides the basis for the remedy and the O&M plan, the model should be re-evaluated as new data are collected throughout the lifetime of the remedy. | |
| Have new contaminant sources been identified?<br>If yes, please describe the new sources and how they are being addressed**:** | ☐ Yes<br>☐ No |
| Have changes in land use or water body use that could impact the CSM occurred since the ROD?<br>Please explain. | ☐ Yes<br>☐ No |
| Should the CSM be modified to reflect changes in exposure pathways, contaminant sources, fate and transport information, hydrogeology, erosion, or deposition data?<br>Please explain. | ☐ Yes<br>☐ No |
| **B. Remedy Performance Assessment**<br>This section contains a series of questions that can be used to help assess a containment remedy's effectiveness and evaluate the collection and analysis of performance monitoring data. For each potential problem identified, an analysis should be performed to determine what, if anything, should be done to address the problem. | |
| 1. **Evaluate the remedy effectiveness:** The following questions are intended to review whether the containment remedy is performing as intended or whether there is a need to implement a contingency remedy. A contingency remedy is a cleanup technology or approach that functions as a backup remedy in the event that the selected remedy fails to perform as anticipated. A contingency remedy may be considered if there is a "yes" answer to one or more of the following three questions.<br>• *Note that additional measures and methods for evaluating the effectiveness of containment remedies can be found in "EPA/USACE Draft Technical Guidance for RCRA/CERLCLA Final Covers" (EPA 540-R-04-007) and "EPA Comprehensive 5-Year Review Guidance, Appendix D, Five-Year Site Inspection Checklist" (OSWER Directive 9355.7-03B-P).* | |
| Since the last O&M review, has inspection or testing of the cap, vegetative cover, and stabilized stream banks indicated that the system is failing or could eventually fail? | ☐ Yes<br>☐ No |
| Since the last O&M review, have changes in land, surface water, or groundwater use been suggested and or implemented that have the potential to reduce the protectiveness of the capping remedy? | ☐ Yes<br>☐ No |
| Since the last O&M review, have contaminants been identified in new locations or at higher concentrations where they pose or have the potential to pose unacceptable risks to receptors? | ☐ Yes<br>☐ No |
| If any of the questions above were answered "Yes," did the information suggest the need for immediate action or is the condition being monitored to evaluate the need for future action?<br>Use this space to comment.<br>What actions, if any, have been taken and/or are planned in response to the new information? | ☐ Immediate action<br>☐ Monitored for future<br>☐ N/A |
| **2. Monitoring Program**<br>Note that more detailed information about performance parameters can be found in the following documents:<br>• *EPA/USACE Draft Technical Guidance for RCRA/CERCLA Final Covers* (EPA 540-04-007)<br>• *EPA Comprehensive 5-Year Review Guidance, Appendix D, Five-Year Review Site Inspection Checklist* (OSWER Directive 9355.7-03B-P) | |
| Since the last Annual O&M Report, has it been necessary to modify planned quarterly inspections, sampling events, and sample analyses, as reflected in the Site post-closure maintenance plan or O&M plans, to account for new information and/or unforeseen circumstance? | ☐ Yes<br>☐ No |

| | |
|---|---|
| If yes, use this space to comment. | |
| Is the monitoring program accomplishing the objectives outlined in the ROD or in a subsequent enforceable document?<br>If no, identify the objectives that are not being met. | ☐ Yes<br>☐ No |
| Have there been changes in field conditions (e.g. change in flow/deposition rates or patterns) that suggest that the monitoring program should be re-evaluated? | ☐ Yes<br>☐ No |
| Since the last Annual O&M Report, have monitoring data been analyzed to identify trends and their significance?<br>If no, please explain. | ☐ Yes<br>☐ No |
| Is there variability in the quarterly inspections that is interfering with or preventing a meaningful interpretation of the inspection results? | ☐ Yes<br>☐ No |
| If yes, could the situation be mitigated by increasing the density or frequency of data collection? Explain. | ☐ Yes<br>☐ No |
| Are inspection and performance monitoring reports of sufficient quality and frequency to evaluate the efficacy of capping as a remedy and recognize protectiveness problems in time for effective action?<br>If no, what actions, if any, have been taken or are planned to address this situation? | ☐ Yes<br>☐ No |
| **3. Maintenance** | |
| If cap erosion has been observed, was the severity of the erosion enough to warrant cap repair?<br>If no, how was this decision made? | ☐ Yes<br>☐ No |
| Have any major repairs to capping been required since the last time the Annual O&M Report was completed? | ☐ Yes<br>☐ No |
| If yes,<br>• What major repairs were required?<br>• How did the need for repairs affect progress toward meeting remediation milestones and goals?<br>• What actions have been taken to minimize repairs in the future?<br>• What effects were caused by the cap breach? | |
| **C. Remedial Decisions:** Indicate which of the following remedial decisions are appropriate at the present time and provide a basis for each decision: | |
| ☐ No change to the remedy is needed (remedy is performing as designed) | |
| ☐ No decision can be made due to inadequate data | |
| ☐ Modify/optimize remedy | |
| ☐ Contingency/alternative remedy (i.e. Change Remedy) | |
| ☐ Modify/optimize O&M program | |
| ☐ Modify ICs | |
| ☐ Terminate some or all monitoring requirement | |
| Basis for decision: | |

| IX RECOMMENDATIONS<br>Recommendations associated with the capping remedy or part of the capping remedy addressed by this form. | | | |
|---|---|---|---|
| Recommendations based on this annual review: | | | |
| **Recommendation** | **Party Responsible** | **Milestone Date** | **Affects Protectiveness (Y/N)** |
| | | | |
| | | | |
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# Appendix D

# Quarterly Inspection Checklist

**Quarterly Inspection Checklist**
**BoRit Asbestos Superfund Site**
**Ambler, Pennsylvania**

| | | | |
|---|---|---|---|
| **Inspector Name:** | | **Date:** | |
| **Company:** | | **Weather:** | |
| **Phone:** | | **Start Time:** | |
| **Email:** | | **End Time:** | |

**Instructions:**
*Any observed impacted areas of the remedy should be photographed, georeferenced, and attached to the inspection checklist.*
*Some inspection items noted on this checklist refer to institutional controls and the 100-year floodplain. For additional information, refer to Figure 2-1 and Figure 2-2 of the Operation and Maintenance Plan for institutional controls and the extent of the 100-year floodplain, respectively.*
*If the quarterly inspection checklist is completed immediately following a significant weather event, the "Post-Significant Weather Event" section of the checklist should be completed in conjunction with the parcel specific sections.*

**Park Parcel** ☐ Not Applicable

Are there any breaches to the soil cap or evidence of asbestos-containing material (ACM) or debris? ☐ YES ☐ NO
*Comments:*

Are there any signs of erosion or activities that have negatively impacted the effectiveness of the remedy at the Park Parcel? ☐ YES ☐ NO
*Comments:*

Do trees in the Park parcel show evidence of windthrows or toppling? ☐ YES ☐ NO
*Comments:*

Is there evidence of animal burrowing in the Park parcel cap? ☐ YES ☐ NO
*Comments:*

| | |
|---|---|
| Are there any areas of stressed or missing vegetation on the Park parcel cap?<br>*Comments:* | ☐ YES ☐ NO |
| Note any comments or observations from Whitpain Township personnel or recreational users: | ☐ YES ☐ NO |
| Note any negatively impacted capped areas in need of maintenance or repair: | |
| | |

| **Reservoir Parcel** | ☐ Not Applicable |
|---|---|
| Are there any breaches to the soil cap or evidence of ACM along the Reservoir berms?<br>*Comments:* | ☐ YES ☐ NO |
| Is there adequate vegetative cover on the berms and bottom of the Reservoir to prevent erosion and/or exposure of ACM waste?<br>*Comments:* | ☐ YES ☐ NO |
| Are there any signs of erosion or changes in the drainage pattern along the Reservoir berms?<br>*Comments:* | ☐ YES ☐ NO |
| Are there any signs of stressed vegetation along the Reservoir berms?<br>*Comments:* | ☐ YES ☐ NO |
| Is there evidence of sapling or tree growth along the Reservoir berms and Reservoir bottom?<br>*Comments:* | ☐ YES ☐ NO |
| Is there evidence of animal burrowing in the cap along the Reservoir berms?<br>*Comments:* | ☐ YES ☐ NO |
| Reservoir stream gauge surface water elevation: _____________ | |

| Note any comments or observations from Wissahickon Water Fowl Preserve staff or maintenance personnel: |
| --- |
| |
| |

| **Asbestos Pile Parcel** | ☐ Not Applicable |
|---|---|
| Are there any breaches to the soil cap or evidence of ACM?<br>*Comments:* | ☐ YES ☐ NO |
| Is the vegetative cover on the Asbestos Pile slopes maintained at a proper height?<br>*Comments:* | ☐ YES ☐ NO |
| Is vegetation on the top (flat portion) of the Asbestos Pile parcel mowed yearly to allow access and inspection?<br>*Comments:* | ☐ YES ☐ NO |
| Are there any signs of erosion along the side slopes of the Asbestos Pile?<br>*Comments:* | ☐ YES ☐ NO |
| Is there evidence of animal burrowing in the cap along the Asbestos Pile slopes or on the top (flat portion) of the Asbestos Pile?<br>*Comments:* | ☐ YES ☐ NO |
| Are there any areas of stressed or missing vegetation on the Asbestos Pile parcel cap?<br>*Comments:* | ☐ YES ☐ NO |

| **Stream Banks (Wissahickon Creek, Tannery Run, and Rose Valley Creek)** ☐ Not Applicable |
| --- |
| Is any new tree growth observed along the steep slope of Wissahickon Creek where geocells were installed? ☐ YES ☐ NO<br>*Comments:* |
| Is any new tree growth observed along the steep slope of Tannery Run where concrete cable mats (CCMs) were installed? ☐ YES ☐ NO<br>*Comments:* |
| Is any new tree growth observed along the steep slope of Rose Valley Creek where CCMs were installed? ☐ YES ☐ NO<br>*Comments:* |
| Is there any indication of erosion or damage along the stream bank slopes? ☐ YES ☐ NO<br>*Comments:* |
| Is there evidence of erosion of grout or fill material used to infill seams of CCMs for the Rose Valley Creek Ramp? ☐ YES ☐ NO<br>*Comments:* |
| Are there any trees located at the bottom of the slope along Wissahickon Creek and its tributaries that exceed 10 inches diameter at breast height (DBH) or that are in imminent danger of toppling? ☐ YES ☐ NO<br>*Comments:* |

| | |
|---|---|
| Are there any signs of stressed or sparse vegetation along the stream banks?<br>*Comments:* | ☐ YES ☐ NO |
| | |

| **Post-Significant Weather Event** | ☐ Not Applicable |
|---|---|
| *Note: This section should be completed for each Site parcel and stream banks immediately following a significant storm event.* | |
| Is there evidence of damage to the cap?<br>*Comments:* | ☐ YES ☐ NO |
| Is there any washout of debris, large rocks, or trees that have deposited along the Site creeks?<br>*Comments:* | ☐ YES ☐ NO |
| Is there evidence of damage or obstructions inside of culverts such as debris or trees?<br>*Comments:* | ☐ YES ☐ NO |
| Has public access been restricted to the Site?<br>*Comments:* | ☐ YES ☐ NO |
| Is there any evidence of flooding and did the flooding exceed the current delineation of the 100-year floodplain? Note the approximate flood elevations with respect to Site features or land marks.<br>*Comments:* | ☐ YES ☑ NO |
| Is there any evidence of cracking, heaving, or breaches in culverts, CCMs, or retaining walls?<br>*Comments:* | ☐ YES ☐ NO |

# Appendix E

# EPA BTAG Backfill Criteria

# EPA Region 3 BTAG Ecologically Protective Backfill Values

The EPA Region 3 Biological Technical Assistance Group (BTAG) has assembled a list of ecological risk-based values that can be used to evaluate soils that are targeted to be used for backfill during remedial or removal actions.

The BTAG recommended backfill values have been compiled solely for evaluating backfill. The values assume that the backfill is "clean" (i.e., free of anthropogenic chemical contaminants) and any exceedances are extremely limited. The intent of providing these recommended backfill values is to ensure no one is using contaminated soil as backfill and the material is suitable for revegetation. They are not meant to transition ecological screening values from NOAEL to LOAEL or impact the development of cleanup values.

Site specific background concentrations established during the remedial investigation and approved by EPA are also appropriate for use.

For analytes and compounds that are not identified on the table, appropriate state Safe Fill Standards derived for the protection of ecological receptors may be used. If ecological-based values are not available, values for Residential Direct Contact may be used.

Slight exceedances of these values may be acceptable if the backfill area is spatially limited (i.e., less that the home range of receptors expected to occur at the site), the soils are appropriately amended to reduce bioavailability (e.g., organic soils, compost, etc.), or if toxicity testing of the backfill material demonstrates that it does not pose risk.

We recognize that in a limited number of instances the recommended values may be below detection limits that are typically achieved utilizing “standard” analytical techniques (e.g., 2,3,7,8-TCDD, mercury, etc.). In these instances, standard analytical techniques are acceptable provided further information can be provided to document that the backfill sources can be reasonably expected not to be contaminated with these constituents.

# EPA Region 3 BTAG Ecologically Protective Backfill Values

| Analyte* (mg/kg) | EPA Region 3 backfill | Reference |
|---|---|---|
| Al | pH<5.5 | a |
| Sb | 2.7 | b |
| As | 18.0 | c |
| Ba | 330.0 | d |
| Be | 40.0 | d |
| B | 0.5 | e |
| Cd | 3.6 | b |
| Cr (3/6) | 260/1300 | f/b |
| Co | 13.0 | c |
| Cu | 70.0 | c |
| Fe | 2000.0 | g |
| Pb | 110.0 | f |
| Mn | 220.0 | c |
| Hg(inorg) | 0.00051 | h |
| Ni | 38.0 | c |
| Se | 0.5 | c |
| Ag | 42.0 | f |
| Ti | 1.0 | e |
| Sn | 51.5 | e |
| V | 78.0 | f |
| Zn | 120.0 | d |
| CN | 5.0 | e |

References:
a - EPA Eco-SSl - Al is only considered at pH 5.5 or less
b - EPA Eco-SSL Mammalian NOEC with 10 conversion factor to LOEC
c - EPA Eco-SSL Plant geometric mean of NOEC and LOEC
d - EPA Eco-SSL Invertebrate geometric mean of NOEC and LOEC
e - EPA Region 2, Region 4, or the lower of the R2/R4 values
f - EPA Eco-SSL Avian NOEC with 10 conversion factor to LOEC
g - Oak Ridge National Lab NOEC with 10 conversion factor to LOEC Soil Invertebrates and Microbial Processes
h - Oak Ridge National Lab PRG Wildlife

| Compound* (mg/kg) | EPA Region 3 backfill | Reference |
|---|---|---|
| ACENAPHTHENE | 20 | e |
| ANTHRACENE | 0.1 | e |
| BENZO[A]PYRENE | 0.1 | e |
| BIPHENYL, 1,1- | 60 | e |
| CHLOROANILINE, P- | 20 | e |
| CHLOROBENZENE | 0.05 | e |
| CHLOROPHENOL, 2- | 7 | e |
| DDT and metabolites | 0.21 | b |
| DICHLOROBENZENE, P- | 20 | e |
| DICHLOROPHENOL, 2,4- | 20 | e |
| DICHOLOR-2-BUTENE, 1,4- | 1000 | e |
| DIELDRIN | 0.049 | b |
| DIETHYL PHTHALATE | 100 | e |
| DIMETHYLPHTHALATE | 200 | e |
| DI-N-BUTYLPHTHALATE | 200 | e |
| DINITROPHENOL, 2,4- | 20 | e |
| ETHYL BENZENE | 0.05 | e |
| ETHYLENE GLYCOL | 97 | e |
| FLUORANTHENE | 0.1 | e |
| FLUORENE | 30 | e |
| HEXACHLOROCYCLOPENTADIENE | 10 | e |
| NAPHTHALENE | 0.1 | e |
| NITROBENZENE | 40 | e |
| NITROPHENOL, 2- | 7 | e |
| NITROPHENOL, 4- | 7 | e |
| NITROSODIPHENYLAMINE, N- | 20 | e |
| PAHs, LMW | 29 | d |
| PAHs, HMW | 11 | b |
| PCBs, TOTAL | 0.371 | h |
| PENTACHLOROBENZENE | 20 | e |
| PENTACHLOROPHENOL | 5 | c |
| PHENANTHRENE | 0.1 | e |
| PHENOL | 30 | e |
| PYRENE | 0.1 | e |
| PYRIDINE | 0.1 | e |
| STYRENE | 0.1 | e |
| TETRACHLORODIBENZOFURAN, 2,3,7,8- (TCDF) | 0.00084 | e |
| TETRACHLORODIBENZO-P-DIOXIN, 2,3,7,8- (TCDD) | 0.00000315 | e |
| TETRACHLOROPHENOL, 2,3,4,6- | 20 | e |
| TOLUENE | 0.05 | e |
| TRICHLOROBENZENE, 1,2,4- | 20 | e |
| TRICHLOROPHENOL, 2,4,5- | 4 | e |
| TRICHLOROPHENOL, 2,4,6- | 9 | e |
| XYLENES (TOTAL) | 0.05 | e |

*For analytes and compounds not listed, state Safe Fill Standards derived for the protection of ecological receptors may be used. If ecological-based values are not available, values for Residential Direct Contact may be used.

Slight exceedances of these values may be acceptable if the backfill area is spatially limited, the soils are amended with organics to reduce bioavailability, or if toxicity testing of the backfill material demonstrates that it does not pose risk.

Site specific background concentrations established during the remedial investigation and approved by EPA may also be considered.

# Appendix F

# EPA BTAG Seed Mixtures

Landfill cover (top and sides), Interior and top of reservoir berms, all level areas outside of the park: ERNMX-153 Showy Northeast Native Wildflower & Grass Mix

Steep Slopes adjacent to Wissahickon Creek, Rose Valley Creek, and Tannery Run: ERNMX-181-1 Native Steep Slope Mix with Grain Oats (ERNMX-181-2 when seeding from September 1 – February 15)

Retention Basin:  ERNMX-127 Retention Basin Wildlife Seed Mix

Riparian areas that are not steep slopes: ERNMX-178 Riparian Buffer Mix

Reservoir "flats" and within five feet of planned pool elevation: ERNMX-131- Obligate Wetland Mix

Lawn area targeted for infrequent mowing:  Prairie Nursery No Mow Lawn Seed Mix with Rye

Park (turf) Area – Areas targeted for future development:  ERNMX-113 Commercial Conservation Mix

Park (turf) Area – Areas with final turf planting: ERNMX-114  5311 Conservation Mix

The specific mixes (vendor designation) noted above are those utilized during the original seeding and vegetation establishment which was completed during the removal activities.  The composition of the mixes is provided on the following pages.

**Showy Northeast Native Wildflower & Grass Mix**

39.5% *Schizachyrium scoparium*, Fort Indiantown Gap-PA Ecotype (Little Bluestem, Fort Indiantown Gap-PA Ecotype)
23.1% *Bouteloua curtipendula*, 'Butte' (Sideoats Grama, ‘Butte’)
14.0% *Elymus virginicus*, PA Ecotype (Virginia Wildrye, PA Ecotype)
3.5% *Echinacea purpurea* (Purple Coneflower)
3.0% *Chamaecrista fasciculata*, PA Ecotype (Partridge Pea, PA Ecotype)
3.0% *Coreopsis lanceolata* (Lanceleaf Coreopsis)
3.0% *Rudbeckia hirta* (Blackeyed Susan)
2.0% *Asclepias tuberosa* (Butterfly Milkweed)
2.0% *Penstemon digitalis*, PA Ecotype (Tall White Beardtongue, PA Ecotype)
1.5% *Liatris spicata* (Marsh (Dense) Blazing Star (Spiked Gayfeather))
1.0% *Aster laevis*, NY Ecotype (Smooth Blue Aster, NY Ecotype)
0.5% *Rudbeckia fulgida var. fulgida*, Northern VA Ecotype (Orange Coneflower, Northern VA Ecotype)
0.5% *Tradescantia ohiensis*, PA Ecotype (Ohio Spiderwort, PA Ecotype)
0.5% *Zizia aurea*, PA Ecotype (Golden Alexanders, PA Ecotype)
0.4% *Aster novae-angliae* (*Symphyotrichum* n.), PA Ecotype (New England Aster, PA Ecotype)
0.4% *Aster oblongifolius*, PA Ecotype (Aromatic Aster, PA Ecotype)
0.4% *Monarda fistulosa*, Fort Indiantown Gap-PA Ecotype (Wild Bergamot, Fort Indiantown Gap-PA Ecotype)
0.4% *Senna hebecarpa*, VA & WV Ecotype (Wild Senna, VA & WV Ecotype)
0.3% *Pycnanthemum tenuifolium* (Narrowleaf Mountainmint)
0.3% *Solidago nemoralis*, PA Ecotype (Gray Goldenrod, PA Ecotype)
0.2% *Aster prenanthoides*, PA Ecotype (Zigzag Aster, PA Ecotype)
0.2% *Solidago juncea*, PA Ecotype (Early Goldenrod, PA Ecotype)
0.1% *Baptisia tinctoria*, PA Ecotype (Yellow False Indigo (Horseflyweed), PA Ecotype)
0.1% *Penstemon hirsutus* (Hairy Beardtongue)
0.1% *Senna marilandica* (Maryland Senna)

**ERNMX-181-1 Native Steep Slope Mix w/Grain Oats**

40.0% *Avena sativa*, Variety Not Stated (Oats, Variety Not Stated)
20.4% *Sorghastrum nutans*, PA Ecotype (Indiangrass, PA Ecotype)
8.1% *Andropogon gerardii*, 'Niagara' (Big Bluestem, ‘Niagara’)
7.5% *Elymus virginicus*, PA Ecotype (Virginia Wildrye, PA Ecotype)
5.2% *Elymus canadensis* (Canada Wildrye)
4.5% *Schizachyrium scoparium*, Fort Indiantown Gap-PA Ecotype (Little Bluestem, Fort Indiantown Gap-PA Ecotype)
3.7% *Tridens flavus*, Fort Indiantown Gap-PA Ecotype (Purpletop, Fort Indiantown Gap-PA Ecotype)
3.0% *Agrostis perennans*, Albany Pine Bush-NY Ecotype (Autumn Bentgrass, Albany Pine Bush-NY Ecotype)
2.3% *Panicum virgatum*, 'Shawnee' (Switchgrass, ‘Shawnee’)
1.1% *Chamaecrista fasciculata*, PA Ecotype (Partridge Pea, PA Ecotype)
1.0% *Echinacea purpurea* (Purple Coneflower)
0.8% *Coreopsis lanceolata* (Lanceleaf Coreopsis)
0.8% *Rudbeckia hirta* (Blackeyed Susan)
0.7% *Heliopsis helianthoides*, PA Ecotype (Oxeye Sunflower, PA Ecotype)
0.4% *Aster lateriflorus* (Calico Aster)
0.2% *Asclepias syriaca*, PA Ecotype (Common Milkweed, PA Ecotype)
0.2% *Liatris spicata* (Marsh (Dense) Blazing Star (Spiked Gayfeather))
0.1% *Monarda fistulosa*, Fort Indiantown Gap-PA Ecotype (Wild Bergamot, Fort Indiantown Gap-PA Ecotype)

**Retention Basin Wildlife Mix**

25.0% *Panicum clandestinum*, 'Tioga' (Deertongue, ‘Tioga’)
22.0% *Poa palustris* (Fowl Bluegrass)
21.0% *Elymus virginicus*, PA Ecotype (Virginia Wildrye, PA Ecotype)
10.0% *Carex lurida*, PA Ecotype (Lurid (Shallow) Sedge, PA Ecotype)
10.0% *Carex vulpinoidea*, PA Ecotype (Fox Sedge, PA Ecotype)
5.0% *Carex scoparia*, PA Ecotype (Blunt Broom Sedge, PA Ecotype)
3.0% *Juncus effusus* (Soft Rush)
1.0% *Asclepias incarnata*, PA Ecotype (Swamp Milkweed, PA Ecotype)
1.0% *Carex lupulina*, PA Ecotype (Hop Sedge, PA Ecotype)
1.0% *Verbena hastata*, PA Ecotype (Blue Vervain, PA Ecotype)
0.5% *Aster puniceus*, PA Ecotype (Purplestem Aster, PA Ecotype)
0.5% *Scirpus cyperinus*, PA Ecotype (Woolgrass, PA Ecotype)

**Riparian Buffer Mix**

30.0% *Panicum clandestinum*, 'Tioga' (Deertongue, 'Tioga')
16.0% *Sorghastrum nutans*, PA Ecotype (Indiangrass, PA Ecotype)
15.0% *Elymus riparius*, PA Ecotype (Riverbank Wildrye, PA Ecotype)
10.0% *Andropogon gerardii*, 'Niagara' (Big Bluestem, 'Niagara')
7.0% *Panicum virgatum*, 'Carthage', NC Ecotype (Switchgrass, 'Carthage', NC Ecotype)
3.0% *Chamaecrista fasciculata*, PA Ecotype (Partridge Pea, PA Ecotype)
3.0% *Rudbeckia hirta*, Coastal Plain NC Ecotype (Blackeyed Susan, Coastal Plain NC Ecotype)
3.0% *Verbena hastata*, PA Ecotype (Blue Vervain, PA Ecotype)
2.0% *Asclepias incarnata*, PA Ecotype (Swamp Milkweed, PA Ecotype)
2.0% *Heliopsis helianthoides*, PA Ecotype (Oxeye Sunflower, PA Ecotype)
2.0% *Juncus effusus* (Soft Rush)
2.0% *Juncus tenuis*, PA Ecotype (Path Rush, PA Ecotype)
1.5% *Aster puniceus*, PA Ecotype (Purplestem Aster, PA Ecotype)
1.0% *Eupatorium perfoliatum*, PA Ecotype (Boneset, PA Ecotype)
0.8% *Vernonia noveboracensis*, PA Ecotype (New York Ironweed, PA Ecotype)
0.5% *Aster umbellatus*, PA Ecotype (Flat Topped White Aster, PA Ecotype)
0.5% *Eupatorium fistulosum*, PA Ecotype (Joe Pye Weed, PA Ecotype)
0.5% *Monarda fistulosa*, Fort Indiantown Gap-PA Ecotype (Wild Bergamot, Fort Indiantown Gap-PA Ecotype)
0.2% *Pycnanthemum tenuifolium* (Narrowleaf Mountainmint)

**OBL Wetland Mix**

35.0% *Carex vulpinoidea*, PA Ecotype (Fox Sedge, PA Ecotype)
17.0% *Carex lurida*, PA Ecotype (Lurid (Shallow) Sedge, PA Ecotype)
15.0% *Carex lupulina*, PA Ecotype (Hop Sedge, PA Ecotype)
8.8% *Carex scoparia*, PA Ecotype (Blunt Broom Sedge, PA Ecotype)
4.5% *Sparganium eurycarpum*, PA Ecotype (Giant Bur Reed, PA Ecotype)
4.0% *Verbena hastata*, PA Ecotype (Blue Vervain, PA Ecotype)
3.0% *Juncus effusus* (Soft Rush)
2.5% *Sparganium americanum* (Eastern Bur Reed)
1.0% *Asclepias incarnata*, PA Ecotype (Swamp Milkweed, PA Ecotype)
1.0% *Aster puniceus*, PA Ecotype (Purplestem Aster, PA Ecotype)
1.0% *Aster umbellatus*, PA Ecotype (Flat Topped White Aster, PA Ecotype)
1.0% *Eupatorium perfoliatum*, PA Ecotype (Boneset, PA Ecotype)
1.0% *Iris versicolor*, PA Ecotype (Blueflag, PA Ecotype)
1.0% *Onoclea sensibilis* (Sensitive Fern)
1.0% *Scirpus cyperinus*, PA Ecotype (Woolgrass, PA Ecotype)
0.5% *Alisma subcordatum*, PA Ecotype (Mud Plantain (Water Plantain), PA Ecotype)
0.5% *Eupatorium maculatum*, PA Ecotype (Spotted Joe Pye Weed, PA Ecotype)
0.5% *Ludwigia alternifolia*, PA Ecotype (Seedbox, PA Ecotype)
0.5% *Mimulus ringens*, PA Ecotype (Square Stemmed Monkeyflower, PA Ecotype)
0.5% *Scirpus validus*, PA Ecotype (Softstem Bulrush, PA Ecotype)
0.5% *Solidago patula*, PA Ecotype (Roughleaf Goldenrod, PA Ecotype)
0.2% *Chelone glabra*, PA Ecotype (Turtlehead, PA Ecotype)

**ERNMX-114:  5311 Conservation Mix**

30.0% *Festuca rubra* (Creeping Red Fescue)
25.0% *Poa pratensis*, 'Blue Angel' (Kentucky Bluegrass, ‘Blue Angel’)
25.0% *Poa pratensis*, 'Volt' (Kentucky Bluegrass, ‘Volt’)
10.0% *Lolium multiflorum* (Annual Ryegrass)
10.0% *Lolium perenne*, 'Fastball RGL' (Perennial Ryegrass, ‘Fastball RGL’ (turf type))

**ERNMX-113 Commercial Conservation Mix**

25.0% *Festuca rubra* (Creeping Red Fescue)
25.0% *Lolium multiflorum* (Annual Ryegrass)
25.0% *Lolium perenne*, 'Confetti III' (Perennial Ryegrass, ‘Confetti III’ (turf type))
25.0% *Lolium perenne*, 'Fastball RGL' (Perennial Ryegrass, ‘Fastball RGL’ (turf type))

# Appendix G

# Best Management Practices Guidance

# Appendix G

# Best Management Practices Guidance

For the purposes of this document, best management practices (BMPs) are defined as means and methods that when used in combination with developed institutional controls (ICs), provide guidance to entities responsible for O&M and parcel owners for the prevention or reduction in the release and exposure to contaminated waste, soil, and Reservoir sediment. The information within this guidance is grouped by the type of activities anticipated to take place during O&M activities which could cause a release and potential exposure to Site contamination.

## Excavation

Excavation for the purpose of this document refers to any action of cutting, digging, or scooping soil, debris, or other materials from the ground surface or below.

### BMP Guidance

1. Obtain most current information on where contamination was removed or may remain. This information will be available from EPA-developed documents as listed within the Additional Information and Resources section of this document.
2. Notify the parcel owner well in advance and in writing of any known plans to conduct excavation. Do not attempt to conduct excavation or maintenance repairs without prior notification or consent from the parcel owner.
3. Review the IC plan for the Site to ensure any listed proprietary controls, government controls, enforcement tools, or informational devices have been adhered to prior to conducting work.
4. Notify Pennsylvania (PA) One Call utility locate service prior to any excavation or digging activity. Do not attempt to excavate any area prior to all utilities having been marked.
5. When excavating, keep soil, debris, or other materials wet during work to minimize dust migration or potential exposure to asbestos containing material (ACM).
6. Wear personal protective clothing (PPE) while performing excavation activities (i.e., appropriate disposable protective clothing, gloves, and booties. Dispose of protective clothing appropriately.
7. Common dust or surgical masks are not effective against asbestos fibers! Wearing a respirator with a HEPA filter is the best way to avoid breathing asbestos fibers. However, they must be used properly or exposure may still occur. For information on respirator requirements, visit OSHA's website: www.osha.gov/SLTC/respiratoryprotection.
8. If a change of condition occurs whereby ACM is observed, contact the parcel owner or entity responsible for operation and maintenance (O&M) for advice on how to manage the material.
9. See details regarding importing and exporting of materials below.

## New Construction Projects

The following lists BMPs for any new construction projects planned by either the entity responsible for O&M, the parcel owner, or contractor involved in the overall construction in any new area located within the Site. New construction refers to any Site preparation for, and construction of, entirely new areas, new buildings, or new structures on the Site which would cause a change of condition to the ground surface, regardless of size or scale.

### BMP Guidance

1. Obtain most current information on where contamination was removed or may remain. This information will be available from EPA-developed documents as listed within the Additional Information and Resources section of this guidance.
2. Notify the parcel owner well in advance and in writing of any known plans to conduct any new construction project. Do not attempt to conduct any new construction project without prior notification or consent from the parcel owner.
3. Review the IC plan for the Site to ensure any listed proprietary controls, government controls, enforcement tools, or informational devices have been adhered to prior to conducting work.
4. The entity performing new construction projects should develop a contingency plan for cases where contamination is encountered during activities.
5. Follow BMPs for importing and exporting of materials as listed below.

## Importing of Materials

Importing of materials refers to the hauling or transporting of any material for use or placement within the boundary of the Site. Materials include, but are not limited to soil, rock, mulch, organic or non-organic debris, or building materials.

### BMP Guidance

1. Any entity importing materials shall notify the parcel owner when importing materials to the Site either through written documentation or in person. The entity shall make available any documentation confirming that importation of the materials will not have the potential to increase the risk of ACM exposure or impact any protective remedy in place on the Site.
2. Imported materials for minor or major repairs to capping should follow the design criteria implemented during EPA Removal Program work. Review as-built drawings and EPA Removal Program reports when identifying needed materials.
3. Review the IC plan for the Site to ensure any listed proprietary controls, government controls, enforcement tools, or informational devices have been adhered to prior to conducting work.

## Exporting of Materials

Exporting of materials refers to the hauling or transporting of any material for use, placement or disposal from the Site to another location. Materials include, but are not limited to, soil, rock, tree trunks, mulch, organic or non-organic debris, or building materials.

### BMP Guidance

1. The parcel owner or entity responsible for O&M of the Site should have a system in place to ensure exportation of any materials does not have the potential to increase risk of ACM exposure to areas outside of the Site. This may be satisfied through the use of a site management plan.

2. Any entity exporting materials should notify the parcel owner when exporting materials from the Site either through written documentation or in person. Entities should make available any documentation confirming that exportation of materials will not have the potential to increase the risk of ACM exposure or impact the Site remedy.
3. Review the IC plan for the Site to ensure any listed proprietary controls, government controls, enforcement tools, or informational devices have been adhered to prior to conducting work.
4. Check local, state, and federal regulations regarding disposal or transportation of material.

## Additional Information and Resources

The following resources are available to provide information the entity responsible for O&M or parcel owners or while conducting activities at the Site.

### Human Health Risk Assessment – (CDM Smith 2013)

The purpose of this document is to characterize the potential risk to human receptors associated with the Site media in the absence of any EPA Removal Program action or remedial action.

### Remedial Investigation (RI) Report – (CDM Smith 2013)

This document describes the nature and extent of contamination at the Site.

### Remedial Investigation Report Addendum – (CDM Smith 2015)

The RI Addendum presents additional data collected after the RI to further define the nature and extent of contamination.

### Feasibility Study (FS) – BoRit Asbestos Superfund Site (CDM Smith 2016)

The FS Report identifies, develops, and evaluates a range of remedial alternatives for contaminated media at the Site and provides a basis for the Record of Decision. The FS report also provides detail on EPA Removal Program work implemented across the Site

### Proposed Plan – BoRit Asbestos Superfund Site (EPA 2016)

This document provides a description of the preferred alternative, Alternative WSS2 Capping, and provides detail on ICs to be implemented as part of the WSS2 remedy.

## References

CDM Federal Programs Corporation (CDM Smith). 2013. *Final Remedial Investigation Report, BoRit Asbestos Superfund Site, Operable Unit 1*, Ambler, Pennsylvania. November 27.

CDM Smith. 2015. *Final Remedial Investigation Addendum, BoRit Asbestos Superfund Site, Operable Unit 1*, Ambler, Pennsylvania. May 22.

CDM Smith. 2016. *Final Feasibility Study Report, BoRit Asbestos Superfund Site, Operable Unit 1*, Ambler, Pennsylvania. *Date pending.*

EPA. 2016. *Superfund Program Proposed Plan BoRit Asbestos Superfund Site, Ambler Pennsylvania*. *Date pending.*

# Appendix H

# EPA Removal Program Summary Reports

# SUMMARY OF REMOVAL ACTIVITIES
# AS OF OCTOBER 31, 2013

## PHASE I – WISSAHICKON CREEK BANK ADJACENT TO THE PARK

Phase I covered an approximate length of 1,350 feet, starting from the north end of the Park area to the confluence of Rose Valley and Wissahickon Creeks. The design implementation began on December 31, 2008 and was completed on June 30, 2009.

The Phase I work included the following:

1. After the area was cleared of vegetation and the ACM debris was picked up, the slope was covered with about 3 inches of clean fill to prepare a relatively level surface to be able to implement the design.
2. Once the clean fill had been placed on the slope, geotextile fabric was laid down. The geotextile fabric was placed on the lower portion of the slope, from the water's edge to the 100 year flood +1 foot elevation.
3. Geocells (8 inches in height) were installed along the slope over the geotextile fabric. The geocells came in different length panels, but all were 8 feet 4 inches in width. Panels were seamed together with staples, zip ties, or ATRA Keys. All panels were installed from the top down and kept in place with 30 inch long rebar stakes and ATRA Clips.
4. A concrete anchor (approximately 91 feet long, 2 feet wide, and 2.5 feet high) was constructed at the north end of the site to act as deadweight and protect the geocells against any surge of water coming from upstream during a storm event.
5. The geocells were filled with topsoil and an additional 4 inches of topsoil were placed on top. Topsoil was selected to fill the geocells because it would provide a good medium for the vegetation to grow and further stabilize the slope.
6. As a protection against sliding, 560 MR-4 Manta Ray anchors were installed to secure the geocells with 0.625 inches width Kevlar Tendon. To provide additional protection against sliding, 30 inches long (0.5 inches diameter) reinforcement bars were installed along every fifth cell going down the slope.

7. The lower 6 feet of the geocells (closest to the water's edge) were filled with #57 stone before riprap was placed over it. Along the edge of the creek, a 13 feet wide section of R5 riprap was placed as protection against a surge of fast running storm water.
8. Once everything was in place, the entire slope was hydroseeded and covered with straw mats for erosion control.

Disposal Methods and Quantities Removed

There were a lot of ACM pieces (e.g., pipes, shingles, and tiles) along the Phase I slope. During the preparation stages of the slope, the bulk (big pieces) of the ACM debris was collected and placed into roll-off containers for off-site disposal. Based on visual inspections, the organic debris and soil that were removed from the slope was handled as suspected ACM and sent to the landfill. During the Phase I activities, a total of 30 roll-off containers were sent to the landfill. The combined weight of the 30 containers was 475.27 tons.

As for the rest of the Phases, the combined weight of the roll-off containers should not be a direct indication of the amount of asbestos waste sent to the landfill. As stated above, there was also some soil and organic material, which was treated as suspected waste, even though sampling was not performed to confirm the presence of ACM. In addition, since dust suppression was deployed during the collection and consolidation of the materials, everything was wet; therefore, the loads were heavier than they would have been otherwise.

# PHASE II – ROSE VALLEY CREEK AREA

The area under consideration included the banks of Rose Valley Creek, the adjacent reservoir berm and the floodplain. The design implementation began on July 1, 2009 and was completed on May 25, 2010.

In August 2009, the vegetation along the banks of Rose Valley Creek, the reservoir berm parallel to the creek and at the flood plain was cleared.

To facilitate the work in the creek, on September 17, 2009, two 2,600 gallons-per-minute capacity pumps were installed to divert the creek water. The pumps were installed in the sluiceway "on the other side" of Chestnut Alley. The flow was discharged to the Wissahickon Creek through an 18 inch diameter, 700 foot long, high density polyethylene (HDPE) pipe. For the normal stream flow, one pump was sufficient to divert the creek water; however, the second pump was installed to handle an increase of flow that could result from a storm event. The two pumps were shut down and dismantled on March 2, 2010, when all construction activities in the had been completed.

The Phase II work included the following:

1. <u>Rose Valley Creek Ramp</u>

   On July 15, 2009, construction of a ramp to cross Rose Valley Creek (at the southwest corner of the Park area) began. The ramp was necessary to transport materials and equipment to the other side of the creek for Phase II and the subsequent phases. Twelve 48 inch diameter corrugated aluminum pipes, each 20 feet long, were used in three rows, side-by-side, to create an 80 foot crossing. Construction of the ramp finished on August 27, 2009.

2. <u>Stone Retaining Wall</u>

   Construction of a stone retaining wall started on October 6, 2009. The 104 foot long stone wall is located along the left side of the headwall. The wall is made of stone blocks, each approximately 4 feet long (facing the creek), 3 feet deep (perpendicular to the creek), and 1.5 feet in height. The wall is 9 feet high, of which 1.5 feet lies below the grade over a 3 inch thick stone bed (#57). The area behind the wall was filled with #57 stone, placed over geotextile fabric. Construction of the stone retaining wall was completed on October 26, 2009. However, heavy rain damaged the base of the wall. In early November 2009, the entire wall was dismantled and reconstructed with an extra layer of buried stone blocks (as a new base). These reinforcements provide a stronger foundation and are designed to prevent a recurrence of the damage during another storm event. For additional reinforcement, the base area was infilled with concrete.

3. Reinforced Concrete (RC) Retaining Wall

   The 24 inch thick RC wall was constructed on a 12 inch thick RC slab foundation. The wall is located on the right side of the headwall. The wall is 6 feet long and rises 4 feet above the base slab. Reinforcement bars of 0.5 inch diameter were used vertically and horizontally at a distance of 1 foot center to center. The construction of the RC retaining wall, including the base slab, started on November 17, 2009 and was completed on November 19, 2009.

4. Park Side Slope

   The approximate length of the Park side slope is 600 feet, and the average width is 16 feet. It runs parallel to Rose Valley Creek, from the headwall area down to the Wissahickon Creek. The area was first cleared of large pieces of ACM and miscellaneous debris. To construct a uniform slope, the entire area was covered with 10 to 12 inches of clean fill followed by a 2 to 3 inch layer of topsoil, which was then hydroseeded. The area was further covered with a layer of a heavy duty erosion control mat. Less than 1 inch of mulch material (eco blanket) was sprayed over the erosion mat.

5. Reservoir Side Slope

   The Reservoir side slope extends from behind a residential property up to the confluence of the Wissahickon and Rose Valley Creeks. The entire length of the slope is approximately 800 ft; the width of the slope varies from 8 to 18 feet.

Once the area had been cleared of vegetation, large pieces of ACM and debris were removed. Due to concerns regarding the integrity of the Reservoir berm, the tree stumps were not removed from the slope. To provide a uniform slope for the construction, the entire Reservoir berm area was covered with a 10 to 12 inch layer of clean fill. A final layer of topsoil was placed over the clean fill; the area was hydroseeded and covered with straw mats for erosion control.

6. Sewer Road

The 550 feet long Sewer Road starts at the Rose Valley headwall area and ends at the confluence of the Rose Valley and Wissahickon Creeks, along the Park side of Rose Valley Creek. The Sewer Road was originally planned to be used by the Whitpain Township Sewer Department to approach the four sewer manholes located along the Park side of Rose Valley Creek. However, over the course of time, the road became covered with tall trees and bushes, rendering it inaccessible. Once the EPA began construction in preparation for Phase II of the Removal Action, the area was cleared of vegetation and large pieces of ACM debris.

When the road surface had been cleared, geotextile fabric and #57 stone were placed to strengthen the surface area. Initially, the road width varied from 9 to 10 feet. Once the road was stable, cable concrete mats were installed. The cable concrete mats were infilled with topsoil, followed by hydroseed. After construction activities were completed, the average road width is approximately 11 feet.

7. Rose Valley Creek

The length of Rose Valley Creek from Chestnut Avenue to the confluence with the Wissahickon Creek is approximately 775 feet. The creek enters the site through a concrete culvert that runs beneath Chestnut Avenue and is approximately 10 feet wide and 4 feet high. Two 5 foot diameter pipes also enter the site and discharge water to the creek during rain or storm events.

After the area was cleared of vegetation and the ACM debris had been picked up, the surface was covered with approximately 6 to 12 inches of clean fill. The design called for a constant slope of 0.58 feet per 100 feet, from the headwall to the confluence of Wissahickon Creek; therefore, some areas had to be excavated and other had to be infilled. For approximately 200 feet upstream from the Rose Valley Creek crossing, very soft material (silt and mud) was encountered to a depth of up to 36 inches. The unstable soft material, as well as any ACM encountered, were excavated from the creek bed and staged in piles at the Rose Valley flood plain along the Reservoir bank. The excavated area was filled with R4 riprap and #57 stone. To maintain the proper slope, installation of the concrete cable mats (CCM) started from the headwall area and progressed gradually downstream.

The creek changes direction at four bend points. At those four bend points, the CCMs were infilled with concrete. The CCMs on the creek bed were infilled with #57 stone, while the CCMs on the banks were infilled with topsoil. Once the topsoil was in place, the area was hydroseeded and straw mats were installed for erosion control.

Unfortunately, during Tropical Storm Lee (fall 2011), Rose Valley Creek sustained significant damage. Repairs are scheduled for summer 2012.

Description of Cable Concrete Mats

The mats come in different sizes, shapes, and weights depending on design requirements.

| | |
|---|---|
| Type | CC45 |
| Sizes | 16 feet x 8 feet or 16 feet x 4 feet per section |
| Contains | 72 blocks (16 feet x 8 feet) or 36 blocks (16 feet x 4 feet) each mat |
| Each Block | 15.5 inches x 15.5 inches at the bottom |
| | 11.5 inches x 11.5 inches at the top, with a variable height. |
| | For the CC45, the height of each block is 5.5 inches. |
| Spacing | At the base of each block: 0.5 inch |
| | A the top of each block: 4.5 inches |

| | |
|---|---|
| Weight | Each block weighs 80 pounds, making the weight of each 16 foot x 8 foot mat approximately 5,760 lbs. |
| Connection | All blocks are connected with a 1/8 inch diameter steel cable. All mats were connected to adjacent mats using steel cable clamps. |

Disposal Methods and Quantities Removed

During the preparation stages, the bulk (large items) of the ACM debris and stumps removed were collected and placed into roll-off containers for disposal. The suspected contaminated soils were staged and covered later on. During the Phase II activities, a total of 69 roll-off containers were sent to the landfill. The combined weight of the 69 containers was 1,072.43 tons.

# PHASE III – RESERVOIR BERM BY THE WISSAHICKON CREEK

Phase III consisted of approximately 600 feet along the Reservoir berm parallel to the Wissahickon Creek. The implementation of the design began on March 17, 2010 and was completed on June 11, 2010.

The Phase III work included the following:

1. Vegetation Clearing

   On March 22, 2010, the land clearing subcontractor was on-site to start cutting and clearing the trees from the Phase III area; however, the terrain conditions were found to be softer than anticipated and required additional work to support heavy equipment.

   After consideration of various options, it was decided that wooden mats would be the appropriate solution for constructing the approach road along the Phase III flood plain. An access road ("boardwalk") 96 feet long and 8 feet wide was built. In early April, clearing activities were completed.

2. Covering the slope

   Some of the material excavated during the Phase II activities (mixture of soil and small pieces of ACM) was placed along the Phase III slope (12 to 15 inches thick). A 12 to 15 inch thick layer of clean fill was placed and compacted over the ACM layer along the slope. Six inches of topsoil was placed over the slope. The entire area was hydroseeded and straw mats were installed for erosion control.

3. Access to the Pile Property

   A ramp was built providing access from the Phase III floodplain to the Pile area.

Disposal Methods and Quantities Removed

No ACM material was disposed of off-site during the Phase III activities.

## PHASE IV – TANNERY RUN

Phase IV consists of Tannery Run. The approximate length of Tannery Run under consideration was 720 feet, with an average width of 13 feet. However, behind Sons of Italy's parking lot, the width of the creek was approximately 24 feet, due to significant erosion. On June 10, 2008 when conditions were considered normal, the creek flowed over bedrock with an average velocity of 1.3 feet per second (ft/s). The approximate elevation difference between the two ends of the creek was 15 feet. The creek bed dropped approximately 4 feet behind Classic Coachworks. The height of the stream banks varied from approximately 10 feet near Maple Street, to approximately 20 feet near the confluence with the Wissahickon Creek.

Gilmore and Associates, Inc. (Gilmore), a consultant to the Borough of Ambler, completed a study of the Tannery Run Drainage Area, dated March 18, 2010. For the calculation, Gilmore assumed the catchment area for Tannery Run to be 460.76 acres and used a weighted land coefficient of 0.486 (based on the description of land cover). Based on various rainfall intensity rates, Gilmore calculated the discharges for a 2-year flood event through a 100-year flood event for Tannery Run. According to the calculations, the maximum discharge for a 100-year flood event should be approximately 676 cubic ft per second ($ft^3/s$).

Considering all factors mentioned above, and after talking to different stakeholders (e.g., PADEP, EPA Remedial Program, EPA Biological Technical Assistance Group [BTAG], U.S. Fish and Wildlife Service, Army Corps of Engineers, Borough of Ambler, and Gilmore) the following options were considered to address the erosion problem along the stream banks of Tannery Run under the current Removal Action.

**Option 1 – No Action**

The Removal Program would not take an action and Remedial Program would decide what to do once the Remedial Investigation and Feasibility Study (RI/FS) are completed.

With Option 1, the stream banks will continue to erode, therefore; the integrity of the Pile and the adjacent parking lot area (Sons of Italy) might be jeopardized.

**Option 2 – Creek Enclosure**

The creek would flow through either a four sided concrete box culvert or a buried pipe. This option would provide maximum protection against erosion.

Due to the restricted access, logistics issues, and concerns from some of the stakeholders (e.g., the potential for upstream flooding), the use of a concrete culvert was not considered to be a viable option.

The use of pipes from Maple Street to the confluence with the Wissahickon Creek would be a viable option; installation is much simpler than the concrete box culvert. However, PADEP has requested EPA to design for the 100 year flood event. Based on Gilmore's calculation, the pipe should be able to handle a flow of water of at least 676 $ft^3/s$.

Additionally, there were some concerns about debris blocking the pipe. Therefore, a complete pipe enclosure was not considered to be a viable option.

**Option 3 – Open Channel**

Tannery Run would be kept open. To be able to accomplish this, the creek will have to be shifted at least 15 to 20 feet to the northwest (Pile side). This would be required in order to have a moderately stable bank on the southeast side, especially behind the Sons of Italy parking lot, where the stream banks are approximately 20 feet high.

For Option 3 to be implemented a considerable amount of ACM would be required to be excavated; therefore, Option 3 was not considered to be a viable option.

**Option 4 – The "Hybrid"**

Option 4 would entail a combination of Options 2 & 3. Approximately, the first 300 feet of the creek (from Maple Street) will be kept open while the rest of the creek, approximately 325 feet, would flow through a buried pipe and discharge into the Wissahickon Creek.

This was the option of choice.

**Open Section**

1. The stream banks would be graded to roughly a 2H:1V slope.
2. The creek bed would remain at the existing width (or a couple of feet wider) and a constant slope would be maintained.
3. CCMs would be installed on the slopes and the creek bed. The slopes would be filled with topsoil.
4. Finally, the area would be hydroseeded and covered with erosion mats.

**Enclosed Section**

1. An 8 foot diameter pipe would be installed in 20 feet sections. Each section will be joined with a neoprene gasket and a locking metal ring.
2. A headwall with two wings will be placed at the beginning of the pipe. A flared end section will be used at the end of the pipe.
3. The area around and on top of the pipe will be covered with fill material, which will be graded to allow any runoff water flow toward the Wissahickon Creek.
4. In case there is a storm event with flows that exceed the pipe's capacity, an emergency spillway will be constructed along the Pile side of the new ground surface. This will allow the excess flow of water to be channeled to the Wissahickon Creek.

The Phase IV work included the following:

1. <u>Access Roads</u>

   To facilitate the necessary equipment required for construction of Phase IV, access roads were constructed and existing access roads were widened. An access road was built along Tannery Run. Reservoir Road and the access road between the Pile and Maple Street were widened.

2. <u>Tree Clearing</u>

   All vegetation along Tannery Run was cleared and removed. This began with the removal of all debris and existing stumps. The next stage was to remove the standing trees on both sides of the banks from Maple Street to the Wissahickon Creek.

3. Grading the slopes

   Water could not be flowing in Tannery Run when the slopes and the creek bed are being graded; therefore, a pump was installed to bypass the creek. The right slope was grade to a 1.5H:1V gradient and the left slope to a 1H:1V. The left slope was designed with a steeper slope so the center line of the creek would not have to be shifted north, which would allow the creek to maintain its natural path.

4. Installation of CCMs

   The placement of CCMs began at the Maple Street Bridge and moved downstream to the beginning of the headwall location (a distance of 287 feet). Prior to CCM placement, geotextile fabric was laid across the channel. The first sections of CCMs were installed along the creek bed. This provided the necessary stability for the CCMs placed along the slopes. The CCMs placed along the slopes were keyed into an anchor trench at the top of the slope by placing the first row of blocks in the trench. Then, 4 feet duckbill anchors were used to further secure the CCMs into the trench. The CCMs along the slopes were infilled with topsoil and hydroseeded and covered with straw mats for erosion control.

   Description of Cable Concrete Mats

   The CCMs used in Tannery Run were the same as the ones used in Rose Valley Creek.

5. Installation of the Headwall

   In preparation for the headwall, a concrete wall was built at the end of the CCMs (open section) to channel the water into the headwall opening and prevent the water from flowing under the apron of the headwall.

   Both slopes were excavated back approximately 15 feet to provide sufficient room for the wing walls of the headwall and space for equipment and personnel to maneuver during installation. The exposed material along the slopes was covered with geotextile fabric.

   For the crane to have sufficient room while installing the headwall, a temporary platform was built (using 2RC stone) downstream of the headwall. Four 20 feet sections of 4 feet diameter corrugated steel pipe were placed in the center of the creek bed to allow Tannery Run to flow during non-working hours. Once the pipe was set in place, 2RC stone was then placed over the pipe and compacted after each load. With the platform in place, the creek bed was then leveled and built up with #57 stone for a solid foundation for the headwall. The stone foundation was also compacted.

On March 17, 2011, Sautter Crane Rental mobilized their crane on-site with their support staff and Modern Precast Concrete delivered the headwall, for same day installation. The combined weight of the headwall was approximately 50 tons. The headwall was designed with an 8 feet diameter opening for the spiral rib aluminum pipe and two wing walls extending 14 feet long and 11.5 feet tall. The right wing wall was constructed with an emergency spillway recess.

Once the headwall was in place, the 4 feet pipe that was installed to allow Tannery Run to flow during non-working hours was removed.

Biddle Construction was hired to construct a concrete apron on each side of the headwall that would create a smooth transition from the CCMs to the headwall. This was designed to channel the water to the opening of the headwall. The 2RC stone from the crane platform was used to begin filling the sides of the headwall. Once the concrete aprons on each side had cured, additional 2RC stone was placed on each side of the headwall to complete the back filling.

6. Installation of Pipe

The slopes of Tannery Run from the headwall leading downstream required minimal excavation to reach the desired grade. The left side, along Sons of Italy, was approximately a 1H:1V grade was brought to a 2H:1V slope. This was accomplished with clean fill and 2RC stone. Remaining tree stumps were pulled out and sent for off-site disposal. The right slope, along the access road, required no additional excavation to reach the desired grade of 2H:1V.

Before installing the spiral rib aluminum pipe, each pipe end section was ground to remove all sharp edges. Once this was complete, the ends of the pipe sections were painted to prevent corrosion.

Prior to installing the sections of pipe, geotextile fabric was placed across the channel. The fabric provided the necessary barrier to prevent future erosion from under the pipe. Once the fabric was in place, the creek bed was built up to elevation with 2RC stone and compacted. Each pipe section was hoisted using the excavator and lifting straps. The pipe sections were connected to each other with a neoprene gasket and a two piece sleeve made of the same material as the pipe. Each sleeve was attached to each other with two bolting units on each side of the pipe for a total of four bolts.

A total of seventeen 20 foot sections, two 10 feet sections, two 22.5° angled 10 feet sections, and one flared end section were installed.

The first section of Pipe was installed on March 30, 2010, and the last section was installed on May 6, 2010. There is a 7% grade from the headwall to the confluence of Tannery Run with the Wissahickon Creek.

Disposal Methods and Quantities Removed

Numerous pieces of ACM were found in the Phase IV area. During the preparation stages of the slope, the bulk (big pieces) of the ACM debris and stumps removed were collected and placed into roll-off containers for disposal. The suspected contaminated soils were transported to the Pile and covered. During the Phase IV activities, a total of 12 roll-off containers were sent to the landfill. The combined weight of the 12 containers was 82.6 tons.

## PHASE V – WISSAHICKON CREEK BANK ADJACENT TO THE PILE

The design for Phase V covered approximately 297 feet, starting at the "old dam" in the Wissahickon Creek to the Tannery Run confluence with the Wissahickon Creek. The implementation of the design began on June 20, 2011 and was completed on September 1, 2011.

The Phase V work included the following:

1. After the area was cleared of vegetation and the ACM debris was removed, the slope was covered with about 3 inches of clean fill to prepare a relatively level surface to be able to implement the design, similar to Phase I.
2. The first 65 feet of the slope (starting at the "old dam") were built up with 2RC to a 1H:1V slope. Once the desired sloped was achieved, topsoil was added and hydroseeded. Then, a heavy duty erosion control mat was installed.
3. The rest of the slope (down to the confluence) was cut back to a 3H:1V slope. Once the gradient was achieved, geotextile fabric was laid down.
4. Geocells (8 inches in height) were installed along the slope over the layer of geotextile fabric. All the panels were 8 feet 4 inches in width. Panels were seamed together with staples. Panels were installed from the top down and kept in place with 24 inch J-shaped reinforcement bars were installed along every fifth cell going down the slope.
5. The geocells were filled with topsoil and an additional 4 inches of soil was placed on top. Topsoil was selected to fill the geocells to provide a good medium for the vegetation to grow and further stabilize the slope.
6. To prevent sliding, in addition to the J-shaped rebar used along the slope, the geocells were keyed into an anchor trench at the top of the slope by placing the first 3 feet of the panels in the trench. The anchor trench was backfilled with topsoil.
7. The lower 6 feet of the geocells (closest to the water's edge) were filled with #57 stone before placement of the riprap over it. Along the edge of the creek, a wide section of R5 riprap was placed as protection against a surge of fast running storm water.
8. Once everything was in place, the entire slope was hydroseeded and covered with straw mats for erosion control.

Disposal Methods and Quantities Removed

Numerous pieces of ACM (e.g., pipes, shingles, and tiles) were found along the Phase V area. During the preparation stages of the slope, the bulk (big pieces) of the ACM debris and stumps removed were collected and placed into roll-off containers for disposal. The suspected contaminated soils were transported to the Pile and covered. During the Phase V activities, a total of 5 roll-off containers were sent to the landfill. The combined weight of the 5 containers was 24.73 tons.

# PILE AREA

To move equipment in and around the Pile Area during Phase IV (Tannery Run) activities, all sides of the Pile were excavated to allow access roads to be built and/or expanded. This was accomplished by:

1. Installing a new entrance gate along Maple Street.
2. Clearing debris from around the Pile.
3. Building an access road from the new entrance gate towards the Pile.
4. Removing trees and stumps from around the pile.
5. Chipping trees and placing stumps in roll-offs containers for off-site disposal.
6. Excavating the all sides of the Pile back to make room for access roads.
7. Grading the access roads, placing geotextile fabric and the #57 stone.

The design for the Pile was straight forward: cut the slopes back to a stable 3H;1V gradient, place a geotextile fabric, cover the area with a minimum of 2 feet of clean material and then hydroseed the Pile.

The Pile work included the following:

1. Remaining trees on top of the Pile were cut on August 22, 2011. All exposed ACM from clearing activities was covered by end of the work day with clean material. The trees were chipped and placed on the Pile to be covered with clean fill. All remaining stumps were removed and place in roll-offs for off-site disposal.
2. Excavation activities began at the front of the Pile (Maple Street) on September 22, 2011. During excavation activities, ACM waste was relocated to different areas on the Pile to create the desired subgrade prior to the placement the geotextile, clean fill, and topsoil. All areas with exposed material were covered at the end of the day with clean material, straw mats or geotextile fabric, if the desired subgrade had been achieved.
3. By October 10, 2011 the front of the Pile had been cut back to the desired 3H:1V slope. Excavation activities moved to the Tannery Run side of the Pile on October 11th.

4. On September 2, 2011, a permanent access ramp was constructed on the northeast side of the Pile to allow soil to be delivered to the top of the Pile and to give access for maintenance upon completion of the project.
5. By September 14, 2011, excavation along the Tannery Run side of the Pile was completed. Excavations on the Wissahickon Creek side of the Pile began on January 20, 2012.
6. By February 9, 2012 with the exception of one waste cell located on the corner of the Reservoir and Maple Street slopes, the entire Pile had been excavated to subgrade and covered with geotextile fabric.
7. The Pile was then covered with clean fill, over the geotextile fabric, and compacted in lifts to a minimum depth of two feet.
8. On February 14, 2012, a subcontractor cut the trees at the corner of the Pile property and the Reservoir (by the Maple Street gate). Trees were chipped and placed over the last waste cell. Stumps were removed and disposed of off-site as ACM. The area was cleared of debris, graded, covered with clean material, topsoil, and a rock retention wall was constructed along the edge of Reservoir.
9. On February 24, 2012 the last waste cell was graded, covered with geotextile fabric and then covered with lifts of compacted clean fill to a depth of 2 feet to match the grade of the rest of the Pile.
10.
11. On February 28, 2012, the contractor began to cover the Pile with topsoil. By March 13, 2012, the entire Pile was covered with topsoil.
12. On March 16, 2012, the entire Pile was hydroseeded and covered with straw mats for erosion control.
13. On March 23, 2012, the emergency spillway was cut from Tannery Run headwall to the Wissahickon Creek.
14. On April 13, 2012, continued building-up the access road around the Pile to its final elevation.
15. On May 11, 2012, placed R8 boulders along Tannery Run Road (from the headwall to the spillway crossing), as barriers for future traffic (maintenance crews).

16. On May 14, 2012, completed miscellaneous tasks at the Pile Area (e.g., dressed up the roads with stone, some hydroseeding, and moved equipment to the Park Area). Work is now complete at the Pile Area.

# <u>RECONSTRUCTION OF  ROSE VALLEY CREEK</u>

On September 8, 2011, just 11 days after Hurricane Irene, due to the remnants of Tropical Storm Lee, the Ambler area received approximately 7 inches of rain.

The Wissahickon Creek spilled over to the basketball courts by Mount Pleasant Avenue and to Maple Alley by the north gate, at the Park.  Once again, Rose Valley Creek spilled over to the adjacent roadways; however, this time it caused major damage to adjacent properties and the Phase II area.  For the third time since the Removal Action began, the south gate at the park (by the Rose Valley sluiceway) was knocked down by the force of the water coming from Maple Street.

Upstream of the site, Rose Valley Creek flows in a concrete channel.  At Maple Street, there was a chain link fence (gate) which accumulated debris during heavy rain events.  The debris acted as a wall, backing up Rose Valley Creek.  As more and more debris accumulated behind the debris wall, the water kept raising behind the “wall” until the gate could not hold the water (pressure) anymore.  At that time, the water knocked the gate down and flooded all the adjacent properties. Just like if a dam had been released.  Everything on its path got knocked down/moved/destroyed.

Once the creek level went back to normal, the damage the storm had caused to Rose Valley Creek was obvious.  During the reconstruction, a mix of heavier CCMs (on the creek bed) and R6 riprap (along both banks) was used.  In addition, this time all the loops of the CCMs were anchored and all the seams were grouted.  Also, the channel was made even wider.  All excavated material was taken to the waste cell at the Park.  All the excavation was along the left back of the creek.  The CCMs along the floor and left bank were removed.

The reconstruction work of Rose Valley Creek included the following:

1. July 10, 2012: The contractor completed the removal of damaged CCMs from Rose Valley Creek.
2. July 16, 2012: The contractor began excavation of left bank (reservoir side) and floor of Rose Valley Creek according to new design.

3. July 26, 2012: The contractor begins the installation of CCMs on floor of Rose Valley Creek.
4. July 30, 2012: Grading and placement of concrete cable mats (CCMs) continued. Newly placed CCMs were anchored and clamped; then the joints were grouted.
5. August 1, 2012: Rip rap placement began along the left bank (reservoir side) of Rose Valley Creek.
6. August 30, 2012: Rip rap placement in Rose Valley Creek on the left and right banks was completed up to bend point 3.
7. September 28, 2012: Finished CCMs placement up to bend point 4 in Rose Valley Creek.
8. October 2, 2012: Excavation and CCM placement began past bend point 4.
9. October 11, 2012: Excavation, grading and CCMs placement downstream of the Rose Valley Creek crossing was completed.
10. October 16, 2012: Excavation for the access ramp at Rose Valley Creek began. R8 stone was placed in anchor trench on downstream side of crossing in Rose Valley Creek.
11. October 20, 2012: The pipes in Rose Valley Creek were removed to make room for the new creek crossing.
12. October 24, 2012: Excavation of Rose Valley Creek was completed. R5 stone placed in creek mixed with clean fill to stabilize bottom prior to CCMs placement.
13. November 5, 2012: CCM placement on Rose Valley Creek floor is completed. Continued CCM anchoring, clamping, and grouting operations in Rose Valley Creek.
14. November 7: Continued excavation and grading of Rose Valley Creek Crossing and rip rap placement on Rose Valley Creek banks.
15. November 19, 2012: CCM placement and topsoil infill completed on park side of Rose Valley Creek access ramp.
16. November 20, 2012: Grading on the reservoir side of Rose Valley Creek crossing began. Rip rap placement on Rose Valley Creek banks continued.
17. November 30, 2012: CCM placement began on reservoir side of Rose Valley Creek crossing.
18. December 4, 2012: Completed grouting transition area between CCMs and rip rap on right bank of Rose Valley Creek. Completed soil placement and compaction between existing sewer road and Rose Valley Creek crossing.

19. December 8, 2012: Turned off bypass pumps and removed sandbag dam at Rose Valley Creek.
20. December 11, 2012: Removed bypass pumps and line from Rose Valley Creek.
21. December 12, 2012: Completed placement of rip rap along Rose Valley Creek banks and access ramps.
22. December 17, 2012: Completion of Rose Valley Creek left bank access ramp.
23. December 19, 2012: Completed infilling of CCMs on the right bank of Rose Valley Creek with topsoil.
24. December 20, 2012: Hydroseeded Rose Valley Creek flood plain, sewer road and crossing areas and covered with straw mats.
25. December 21, 2012: Demobilized heavy equipment, bypass pumps, and bypass lines from the site.

## PARK AREA

The Park area, just like the Pile will be cover with geotexitle fabric, a minimum of two feet of clean material, topsoil and vegetation. Along the alley, it was decided to have a uniform stable slope (3:1). The area was cut back and all excavated material was taken to the waste cell at the Park.

The cover at the Park area included the following:

1. January 8, 2013: The storage structure north of the Oak Street entrance was demolished. During demolition the structure was sprayed with water to minimize dust. All materials were stockpiled in the Park area and were covered with straw mat prior to off-site disposal.
2. January 9, 2013: Contractor began clearing and grubbing the far northern portion of the Park area along Wissahickon Creek.
3. January 14, 2013: Closed Chestnut Street (alley) to prepare for curb installation. R6 placement on banks of Wissahickon Creek at north end of site began. Began removing permanent fence on north end of site. Surveyors stake curb locations south of Oak Street.
4. January 15, 2013: Contractor began saw cutting the roadway. Installation of temporary fence on the north side of the site.
5. February 4, 2013: Excavation continued along the alley and adjacent slope in the park area to prepare for curb installation. Excavated areas were lined with geotextile fabric and pinned in place. Waste was relocated to waste cells in the Park area and was covered with straw mats.
6. February 21, 2013: START conducted air sampling to determine effectiveness of dust suppression procedures. Some ACM fibers were found on a personnel pump, below the Permissible Exposure Limits (PEL) of 0.1 fiber per cubic centimeter (f/cc). The perimeter sample came back below the detection limit.
7. February 22, 2013: Asphalt at the tennis courts was removed with the excavator after the determination that the area underneath the asphalt was clean material.
8. February 23, 2013: Excavation continues along the alley and adjacent slope in the park area to prepare for curb installation.

9. February 26, 2013: START conducted air sampling to determine effectiveness of dust suppression procedures. Some ACM fibers were found on a personnel pump, below the Permissible Exposure Limits (PEL) of 0.1 fiber per cubic centimeter (f/cc). The perimeter samples came back below the detection limit.
10. March 1, 2013: Continued excavation along Chestnut Street to prepare for curb installation.
11. March 4, 2013: Set up sprinklers at waste piles, for dust suppression. Continued excavation along Chestnut Street.
12. March 11, 2013: START conducted air sampling to determine effectiveness of dust suppression procedures. Results were received and all samples were below the detection limit.
13. March 12, 2013: Completed tennis court excavation. Finished replacement of permanent construction fence with temporary fencing.
14. March 19, 2013: Completed excavation at entrance.
15. March 20, 2013: Began backfilling the trench with 2RC along the alley, starting at the north end of the site.
16. March 26, 2013: Placed geotextile fabric over areas at the north end of the site in preparation to the 2 feet of clean fill cover.
17. March 29, 2013: Continued excavation of the trench area and slope, and backfilling with 2RC along the alley.
18. April 1, 2013: Covered an area at the north end of the site with geotextile fabric and started clean fill placement on that area.
19. April 8, 2013: Completed placing 2 feet of clean on the area at the north end of park mentioned above.
20. April 18, 2013: Subcontractors on-site to complete necessary preparations for curb installation along the alley.
21. April 22, 2013: Subcontractor installed the curb along the alley.
22. April 23, 2013: Backfilled alley side of the curb area with 2RC.
23. April 30, 2013: Continued backfilling of slope and curb bench along Chestnut Street with clean fill.
24. May 2, 2013: Continued backfilling activities along the slope side of the curb.

25. May 13, 2013: Continue backfill and compacting along the curb, from Rose Valley Creek moving toward Oak Street.
26. May 17, 2013: ACM was relocated to the area just north of the main entrance, where the gazebo used to be; water suppression used. Area was covered with straw mat at the end of the work day.
27. May 20, 2013: ACM was relocated to the area just south of the main entrance; water suppression used. Area was covered with straw mat at the end of the work day.
28. May 31, 2013: Continued to move waste from north end of park area to waste cells on south end of park; water suppression was used and the area was covered with straw mat at the end of the day.
29. June 6, 2013: Finished grading and compacting north roadway. Laid filter fabric in park area up to cross section B.
30. June 11, 2013: North roadway construction is finished. Clean fill was spread in the park area where the waste piles used to be.
31. June 18, 2013: Whitpain Township Sewer Dept. installed manhole south of the main gate with ERRS assistance. ERRS backfilled around manhole.
32. June 19, 2013: Continued backfilling manhole excavation. Cleaned up debris from manhole excavation.
33. June 20, 2013: Whitpain Township Sewer Dept. installed manhole for water in-let. ERRS backfilled north of the main gate and dug test pit on north end of site to check clean fill depths.
34. June 21, 2013: Continued backfilling and compacting areas north of main gate.
35. June 24, 2013: North road excavation filled with #1 stone. Begin backfill of curb area north of main gate.
36. June 25, 2013: Clean fill was spread between cross sections A and A2. Topsoil was spread and compacted north of cross section Z.
37. June 27, 2013: 2RC stone was compacted at Chestnut Street pipe extension. Additional ACM is excavated between cross sections Z and A west of north roadway and is covered with 2 feet of clean fill.
38. June 28, 2013: Topsoil is grazed and hydroseeded from the north end of site up to cross section A. Seeded area is covered with straw mat.

39. July 1, 2013: Contractors placed and graded topsoil on the slope and bench area from cross section A to A2.
40. July 3, 2013: Contractors placed and graded topsoil up to cross section C.
41. July 5, 2013: Began covering ACM pile behind EPA trailer with filter fabric. Continued moving clean fill pile to north end of site.
42. July 8, 2013: Continued covering ACM pile with filter fabric.
43. July 10, 2013: Slope and bench area along the alley was hydroseeded up to cross section A2. A subcontractor mows grass along the flat areas of the site. Placed and graded topsoil up to cross section B1.
44. July 12, 2013: Contractors placed and graded topsoil from cross section E to E1. Subcontractor finished mowing grass on flat areas of the site.
45. Began placing clean fill along the top of the bank of the sewer road slope.
46. July 29, 2013: Began excavation of new waste cell, by the top of the Phase I slope, where the clean fill was. Continued placing and grading topsoil from cross section F to F1.
47. July 31, 2013: Placed and graded topsoil around corner by Rose Valley. Hydroseeded and covered with straw mat from cross section F1 to F2. Began ACM relocation.
48. August 2, 2013: Continued relocating ACM to waste cell. Hydroseeded west of north roadway and installed straw mats over area.
49. August 7, 2013: Continued placing clean fill over waste cell. Hydroseeded and placed straw mat around the bend on the east side of the sewer road slope.
50. August 12, 2013: Assisted Whitpain Township with sewer line installation and backfilled area when installation was complete. Watered seeded areas. Placed top soil along RVC top of bank.
51. August 15, 2013: Continued backfill ops along/around sewer line installation and placed topsoil along the top of the bank of the sewer road slope.
52. August 19, 2013: Placed topsoil south of the main gate and along the top of the bank of the sewer road slope.
53. August 20, 2013: Finished grading south of main gate to cross section D1. Continued placing top soil to grade a along the top of the bank of the sewer road slope.
54. August 21, 2013: Began excavation of main gate area to allow for 2 feet of clean fill cover.

55. August 23, 2013: Clean fill was placed and rolled at main gate area. Hydroseeded Chestnut Street slope south of the main gate and along the top of the bank of the sewer road slope up to approximately cross section I.
56. August 28, 2013: Placed straw mats over swales on east site of north roadway. Hydroseeded along the top of the bank of the sewer road slope.
57. August 30, 2012: Laid filter fabric south of new clean fill stockpile at cross section D and covered with clean fill.
58. September 9, 2013: Continued moving clean fill on top of filter fabric at cross section D.
59. September 11, 2013: Placed topsoil at top of bank along Wissahickon Creek and hydroseeded.
60. September 12, 2013: Placed topsoil at top of bank of Wissahickon Creek.
61. September 16, 2013: Hydroseeded top of bank along Wissahickon Creek and covered with straw mats. Placed clean fill north of Oak Street entrance.
62. September 19, 2013: Hydroseeded north of Oak Street entrance.
63. September 20, 2013: Straw mat placed over hydroseeded area north of Oak Street entrance.
64. September 23, 2013: Finished laying straw mats north and south of Oak Street entrance.
65. Currently, waste is still being relocated to then be covered with clean material.

# RESERVOIR (POND)

The pond will be dewatered and then berms and floor of the pond will be covered with a geotextile fabric, a minimum of two feet of clean material, topsoil and vegetation. Currently, we are in the process of awarding the contract for the pump and treat system. We hope to start dewatering operations before Thanksgiving.

In preparation for the dewatering of the pond, the following work has been completed:

1. September 9, 2013: Tree removal started on the Pile side of reservoir with water suppression. Conducted perimeter and personnel air sampling.
2. September 18, 2013: Tree removal operations continued. Permanent fence along Maple Street, by the reservoir, was cut out and a temporary fence was put up in its place.
3. September 19, 2013: Clean fill was placed on the Maple Street side of reservoir to stabilize and widen the area for brush clearing operations. Cleared brush and trash from Maple Street side of reservoir.
4. September 24, 2013: Continued clearing brush and began removing stumps at corner of the reservoir closest to the back of the Pile.
5. September 25, 2013: Finished clearing brush. Continued making placing clean fill on Maple Street side of reservoir to stabilize and widen the area.
6. September 26, 2013: Completed reservoir bank along Maple Street.
7. September 30, 2013: Continued pulling stumps from the bank adjacent to Reservoir Road.
8. During October, completed pulling and disposing of stumps and build a platform at corner of the reservoir closest to the back of the Pile, where the pump and treat system will be set.

# Appendix I

## Standard Operating Procedures (SOPs)

## 1.0 SCOPE AND APPLICATION

Asbestos has been used in many commercial products including building materials such as flooring tiles and sheet goods, paints and coatings, insulation, and roofing asphalts. These products and others may be found at hazardous waste sites hanging on overhead pipes, contained in drums, abandoned in piles, or as part of a structure. Asbestos tailing piles from mining operations can also be a source of ambient asbestos fibers. Asbestos is a known carcinogen and requires air sampling to assess airborne exposure to human health. This Standard Operating Procedure (SOP) provides procedures for asbestos air sampling by drawing a known volume of air through a mixed cellulose ester (MCE) filter. The filter is then sent to a laboratory for analysis. The U.S. Environmental Protection Agency/Environmental Response Team (U.S. EPA/ERT) uses one of four analytical methods for determining asbestos in air. These include: U.S. EPA's Environmental Asbestos Assessment Manual, Superfund Method for the Determination of Asbestos in Ambient Air for Transmission Electron Microscopy (TEM)[1]; U.S. EPA's Modified Yamate Method for TEM[2]; National Institute for Occupational Safety and Health (NIOSH) Method 7402 (direct method only) for TEM; and NIOSH Method 7400 for Phase Contrast Microscopy (PCM)[3]. Each method has specific sampling and analytical requirements (i.e., sample volume and flow rate) for determining asbestos in air.

The U.S. EPA/ERT typically follows procedures outlined in the TEM methods for determining mineralogical types of asbestos in air and for distinguishing asbestos from non-asbestos minerals. The Phase Contrast Microscopy (PCM) method is used by U.S. EPA/ERT as a screening tool since it is less costly than TEM. PCM cannot distinguish asbestos from non-asbestos fibers, therefore the TEM method may be necessary to confirm analytical results. For example, if an action level for the presence of fibers has been set and PCM analysis indicates that the action level has been exceeded, then TEM analysis can be used to quantify and identify asbestos structures through examination of their morphology crystal structures (through electron diffraction), and elemental composition (through energy dispersive X-ray analysis). In this instance samples should be collected for both analyses in side by side sampling trains (some laboratories are able to perform PCM and TEM analysis from the same filter). The Superfund method is designed specifically to provide results suitable for supporting risk assessments at Superfund sites, it is applicable to a wide range of ambient air situations at hazardous waste sites. U.S. EPA's Modified Yamate Method for TEM is also used for ambient air sampling due to high volume requirements. The PCM and TEM NIOSH analytical methods require lower sample volumes and are typically used indoors; however, ERT will increase the volume requirement for outdoor application.

Other Regulations pertaining to asbestos have been promulgated by U.S. EPA and OSHA. U.S. EPA's National Emission Standards for Hazardous Air Pollutants (NESHAP) regulates asbestos-containing waste materials. NESHAP establishes management practices and standards for the handling of asbestos and emissions from waste disposal operations (40 CFR Part 61, Subparts A and M). U.S. EPA's 40 CFR 763 (July 1, 1987)[4] and its addendum 40 CFR 763 (October 30, 1987)[4] provide comprehensive rules for the asbestos abatement industry. State and local regulations on these issues vary and may be more stringent than federal requirements. The OSHA regulations in 29 CFR 1910.1001 and 29 CFR 1926.58 specify work practices and safety equipment such as respiratory protection and protective clothing when handling asbestos. The OSHA standard for an 8-hour, time-weighted average (TWA) is 0.2 fibers/cubic centimeters of air. This standard pertains to fibers with a length-to-width ratio of 3 to 1 with a fiber length >5 µm[5,6]. An action level of 0.1 fiber/cc (one-half the OSHA standard) is the level U.S. EPA has established in which employers must initiate such activities as air monitoring, employee training, and medical surveillance[5,6].

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

## 2.0 METHOD SUMMARY

Prior to sampling, the site should be characterized by identifying on-site as well as off-site sources of airborne asbestos. The array of sampling locations and the schedule for sample collection, is critical to the success of an investigation. Generally, sampling strategies to characterize a single point source are fairly straightforward, while multiple point sources and area sources increase the complexity of the sampling strategy. It is not within the scope of this SOP to provide a generic asbestos air sampling plan. Experience, objectives, and site characteristics will dictate the sampling strategy.

During a site investigation, sampling stations should be arranged to distinguish spatial trends in airborne asbestos concentrations. Sampling schedules should be fashioned to establish temporal trends. The sampling strategy typically requires that the concentration of asbestos at the source (worst case) or area of concern (downwind), crosswind, as well as background (upwind) contributions be quantified. See Table 1 (Appendix A) for U.S. EPA/ERT recommended sampling set up for ambient air. Indoor asbestos sampling requires a different type of strategy which is identified in Table 2 (Appendix A). It is important to establish background levels of contaminants in order to develop a reference point from which to evaluate the source data. Field blanks and lot blanks can be utilized to determine other sources.

Much information can be derived from each analytical method previously mentioned. Each analytical method has specific sampling requirements and produce results which may or may not be applicable to a specific sampling effort. The site sampling objectives should be carefully identified so as to select the most appropriate analytical method. Additionally, some preparation (i.e., lot blanks results) prior to site sampling may be required, these requirements are specified in the analytical methods.

## 3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

### 3.1 Sample Preservation

No preservation is required for asbestos samples.

### 3.2 Sample Handling, Container and Storage Procedures

1. Place a sample label on the cassette indicating a unique sampling number. Do not put sampling cassettes in shirt or coat pockets as the filter can pick up fibers. The original cassette box is used to hold the samples.

2. Wrap the cassette individually in a plastic sample bag. Each bag should be marked indicating sample identification number, total volume, and date.

3. The wrapped sampling cassettes should be placed upright in a rigid container so that the cassette cap is on top and cassette base is on bottom. Use enough packing material to prevent jostling or damage. Do not use vermiculite as packing material for samples. If possible, hand carry to lab.

4. Provide appropriate documentation with samples (i.e., chain of custody and requested analytical methodology).

## 4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Flow rates exceeding 16 liters/minute (L/min) which could result in filter destruction due to (a) failure of its physical support under force from the increased pressure drop; (b) leakage of air around the filter mount so that the filter is bypassed, or (c) damage to the asbestos structures due to increased impact velocities.

## 4.1 U.S. EPA's Superfund Method

### 4.1.1 Direct-transfer TEM Specimen Preparation Methods

Direct-Transfer TEM specimen preparation methods have the following significant interferences:

- The achievable detection limit is restricted by the particulate density on the filter, which in turn is controlled by the sampled air volume and the total suspended particulate concentration in the atmosphere being sampled.

- The precision of the result is dependent on the uniformity of the deposit of asbestos structures on the sample collection filter.

- Air samples must be collected so that they have particulate and fiber loadings within narrow ranges. If too high a particulate loading occurs on the filter, it is not possible to prepare satisfactory TEM specimens by a direct-transfer method. If too high a fiber loading occurs on the filter, even if satisfactory TEM specimens can be prepared, accurate fiber counting will not be possible.

### 4.1.2 Indirect TEM Specimen Preparation Methods

Indirect TEM specimen preparation methods have the following interferences:

- The size distribution of asbestos structures is modified.

- There is increased opportunity for fiber loss or introduction of extraneous contamination.

- When sample collection filters are ashed, any fiber contamination in the filter medium is concentrated on the TEM specimen grid.

It can be argued that direct methods yield an under-estimate of the asbestos structure concentration because many of the asbestos fibers present are concealed by other particulate material with which they are associated. Conversely, indirect methods can be considered to yield an over-estimate because some types of complex asbestos structures disintegrate during the preparation, resulting in an increase in the numbers of structures counted.

## 4.2 U.S. EPA's Modified Yamate Method for TEM

High concentrations of background dust interfere with fiber identification.

## 4.3 NIOSH Method for TEM

Other amphibole particles that have aspect ratios greater than 3:1 and elemental compositions similar to the asbestos minerals may interfere in the TEM analysis. Some non-amphibole minerals may give electron diffraction patterns similar to amphiboles. High concentrations of background dust interfere with fiber identification.

## 4.4 NIOSH Method for PCM

PCM cannot distinguish asbestos from non-asbestos fibers; therefore, all particles meeting the counting criteria are counted as total asbestos fibers. Fiber less than 0.25 um in length will not be detected by this method. High levels of non-fibrous dust particles may obscure fibers in the field of view and increase the detection limit.

# 5.0 EQUIPMENT/MATERIALS

## 5.1 Sampling Pump

The constant flow or critical orifice controlled sampling pump should be capable of a flow-rate and pumping time sufficient to achieve the desired volume of air sampled.

The lower flow personal sampling pumps generally provide a flow rate of 20 cubic centimeters/minute (cc/min) to 4 L/min. These pumps are usually battery powered. High flow pumps are utilized when flow rates between 2 L/min to 20 L/min are required. High flow pumps are used for short sampling periods so as to obtain the desired sample volume. High flow pumps usually run on AC power and can be plugged into a nearby outlet. If an outlet is not available then a generator should be obtained. The generator should be positioned downwind from the sampling pump. Additional voltage may be required if more than one pump is plugged into the same generator. Several electrical extension cords may be required if sampling locations are remote.

The recommended volume for the Superfund method (Phase I) requires approximately 20 hours to collect. Such pumps typically draw 6 amps at full power so that 2 lead/acid batteries should provide sufficient power to collect a full sample. The use of line voltage, where available, eliminates the difficulties associated with transporting stored electrical energy.

A stand should be used to hold the filter cassette at the desired height for sampling and the filter cassette shall be isolated from the vibrations of the pump.

## 5.2 Filter Cassette

The cassettes are purchased with the required filters in position, or can be assembled in a laminar flow hood or clean area. When the filters are in position, a shrink cellulose band or adhesive tape should be applied to cassette joints to prevent air leakage.

### 5.2.1 TEM Cassette Requirements

Commercially available field monitors, comprising 25 mm diameter three-piece cassettes, with conductive extension cowls shall be used for sample collection. The cassette must be new and not previously used. The cassette shall be loaded with an MCE filter of pore size 0.45 µm, and supplied from a lot number which has been qualified as low background for asbestos determination. The cowls should be constructed of electrically conducting material to minimize electrostatic effects. The filter shall be backed by a 5 µm pore size MCE filter (Figure 1, Appendix B).

### 5.2.2 PCM Cassette Requirements

NIOSH Method 7400, PCM involves using a 0.8 to 1.2 µm mixed cellulose ester membrane, 25 mm diameter, 50 mm conductive cowl on cassette (Figure 2, Appendix B). Some labs are able to perform PCM and TEM analysis on the same filter; however, this should be discussed with the laboratory prior to sampling.

## 5.3 Other Equipment

- Inert tubing with glass cyclone and hose barb
- Whirlbags (plastic bags) for cassettes
- Tools - small screw drivers
- Container - to keep samples upright
- Generator or electrical outlet (may not be required)
- Extension cords (may not be required)
- Multiple plug outlet
- Sample labels
- Air data sheets
- Chain of Custody records

## 6.0 REAGENTS

Reagents are not required for the preservation of asbestos samples.

## 7.0 PROCEDURES

## 7.1 Air Volumes and Flow Rates

Sampling volumes are determined on the basis of how many fibers need to be collected for reliable measurements. Therefore, one must estimate how many airborne fibers may be in the sampling location.

Since the concentration of airborne aerosol contaminants will have some effect on the sample, the following is a suggested criteria to assist in selecting a flow rate based on real-time aerosol monitor (RAM) readings in milligrams/cubic meter ($mg/m^3$).

| | Concentration | Flow Rate |
|---|---|---|
| Low RAM readings: | <6.0 $mg/m^3$ | 11-15. L/min |
| Medium RAM readings: | >6.0 $mg/m_3$ | 7.5 L/min |
| High RAM readings: | >10. $mg/m^3$ | 2.5 L/min |

In practice, pumps that are available for environmental sampling at remote locations operate under a maximum load of approximately 12 L/min.

### 7.1.1 U.S. EPA's Superfund Method

The Superfund Method incorporates an indirect preparation procedure to provide flexibility in the amount of deposit that be can be tolerated on the sample filter and to allow for the selective concentration of asbestos prior to analysis. To minimize contributions to background contamination from asbestos present in the plastic matrices of membrane filters while allowing for sufficient quantities of asbestos to be collected, this method also requires the collection of a larger volume of air per unit area of filter than has traditionally been collected for asbestos analysis. Due to the need to collect large volumes of air, higher sampling flow rates are recommended in this method than have generally been employed for asbestos sampling in the past. As an alternative, samples may be collected over longer time intervals. However, this restricts the flexibility required to allow samples to be collected while uniform meteorological conditions prevail.

The sampling rate and the period of sampling should be selected to yield as high a sampled volume as possible, which will minimize the influence of filter contamination. Wherever possible, a volume of 15 cubic meters (15,000 L) shall be sampled for those samples intended for analysis only by the indirect TEM preparation method (Phase 1 samples). For those samples to be prepared by both the indirect and the direct specimen preparation methods (Phase 2 samples), the volumes must be adjusted so as to provide a suitably-loaded filter for the direct TEM preparation method. One option is to collect filters at several loadings to bracket the estimated optimum loading for a particular site. Such filters can be screened in the laboratory so that only those filters closest to optimal loading are analyzed. It has been found that the volume cannot normally exceed 5 cubic meters (5000 L) in an urban or agricultural area, and 10 cubic meters (10,000 L) in a rural area for samples collected on a 25 mm filter and prepared by a direct-transfer technique.

An upper limit to the range of acceptable flow rates for this method is 15 L/min. At many locations, wind patterns exhibit strong diurnal variations. Therefore, intermittent sampling (sampling over a fixed time interval repeated over several days) may be necessary to accumulate 20 hours of sampling time over constant wind conditions. Other sampling objectives also may necessitate intermittent sampling. The objective is to design a sampling schedule so that samples are collected under uniform conditions throughout the sampling interval. This method provides for such options. Air volumes collected on Phase I samples are maximized (<16 L/min). Air volumes collected on Phase 2 samples are limited to provide optimum loading for filters to be prepared by a direct-transfer procedure.

### 7.1.2 U.S. EPA's Modified Yamate Method for TEM

U.S. EPA's TEM method requires a minimum volume of 560 L and a maximum volume of 3,800 L in order to obtain an analytical sensitivity of 0.005 structures/cc. The optimal volume for TEM is 1200 L to 1800 L. These volumes are determined using a 200 mesh EM grid opening with a 25-mm filter cassette. Changes in volume would be necessary if a 37-mm filter cassette is used since the effective area of a 25 mm (385 sq mm) and 37 mm (855 sq m) differ.

### 7.1.3 NIOSH Method for TEM and PCM

The minimum recommended volume for TEM and PCM is 400 L at 0.1 fiber/cc. Sampling time is adjusted to obtain optimum fiber loading on the filter. A sampling rate of 1 to 4 L/min for eight hours (700 to 2800 L) is appropriate in non-dusty atmospheres containing 0.1 fiber/cc. Dusty atmospheres i.e., areas with high levels of asbestos, require smaller sample volumes (<400 L) to obtain countable samples.

In such cases, take short, consecutive samples and average the results over the total collection time. For documenting episodic exposures, use high flow rates (7 to 16 L/min) over shorter sampling times. In relatively clean atmospheres where targeted fiber concentrations are much less than 0.1 fiber/cc, use larger sample volumes (3,000 to 10,000 L) to achieve quantifiable loadings. Take care, however, not to overload the filter with background dust. If > 50% of the filter surface is covered with particles, the filter may be too overloaded to count and will bias the measured fiber concentration. Do not exceed 0.5 mg total dust loading on the filter.

## 7.2 Calibration Procedures

In order to determine if a sampling pump is measuring the flow rate or volume of air correctly, it is necessary to calibrate the instrument. Sampling pumps should be calibrated immediately before and after each use. Preliminary calibration should be conducted using a primary calibrator such as a soap bubble type calibrator, (e.g., a Buck Calibrator, Gilibrator, or equivalent primary calibrator) with a representative filter cassette installed between the pump and the calibrator. The representative sampling cassette can be reused for calibrating other pumps that will be used for asbestos sampling. The same cassette lot used for sampling should also be used for the calibration. A sticker should be affixed to the outside of the extension cowl marked "Calibration Cassette."

A rotameter can be used provided it has been recently precalibrated with a primary calibrator. Three separate constant flow calibration readings should be obtained both before sampling and after sampling. Should the flow rate change by more than 5% during the sampling period, the average of the pre- and post-calibration rates will be used to calculate the total sample volume. The sampling pump used shall provide a non-fluctuating air-flow through the filter, and shall maintain the initial volume flow-rate to within ± 10% throughout the sampling period. The mean value of these flow-rate measurements shall be used to calculate the total air volume sampled. A constant flow or critical orifice controlled pump meets these requirements. If at any time the measurement indicates that the flow-rate has decreased by more than 30%, the sampling shall be terminated. Flexible tubing is used to connect the filter cassette to the sampling pump.Sampling pumps can be calibrated prior to coming on-site so that time is saved when performing on-site calibration.

### 7.2.1 Calibrating a Personal Sampling Pump with an Electronic Calibrator

1. See Manufacturer's manual for operational instructions.

2. Set up the calibration train as shown in (Figure 3, Appendix B) using a sampling pump, electronic calibrator, and a representative filter cassette. The same lot sampling cassette used for sampling should also be used for calibrating.

3. To set up the calibration train, attach one end of the PVC tubing (approx. 2 foot) to the cassette base; attach the other end of the tubing to the inlet plug on the pump. Another piece of tubing is attached from the cassette cap to the electronic calibrator.

4. Turn the electronic calibrator and sampling pump on. Create a bubble at the bottom of the flow chamber by pressing the bubble initiate button. The bubble should rise to the top of the flow chamber. After the bubble runs its course, the flow rate is shown on the LED display.

5. Turn the flow adjust screw or knob on the pump until the desired flow rate is attained.

6. Perform the calibration three times until the desired flow rate of ± 5% is attained.

### 7.2.2 Calibrating a Rotameter with an Electronic Calibrator

1. See manufacturer's manual for operational instructions.

2. Set up the calibration train as shown in (Figure 4, Appendix B) using a sampling pump, rotameter, and electronic calibrator.

3. Assemble the base of the flow meter with the screw provided and tighten in place. The flow meter should be mounted within 6º vertical.

4. Turn the electronic calibrator and sampling pump on.

5. Create a bubble at the bottom of the flow chamber by pressing the bubble initiate button. The bubble should rise to the top of the flow chamber. After the bubble runs its course, the flow rate is shown on the LED display.

6. Turn the flow adjust screw or knob on the pump until the desired flow rate is attained.

7. Record the electronic calibrator flow rate reading and the corresponding rotameter reading. Indicate these values on the rotameter (sticker). The rotameter should be able to work within the desired flow range. Readings can also be calibrated for 10 $cm^3$ increments for Low Flow rotameters, 500 $cm^3$ increments for medium flow rotameters and 1 liter increments for high flow rotameters.

8. Perform the calibration three times until the desired flow rate of ± 5% is attained. Once on site, a secondary calibrator, i.e., rotameter may be used to calibrate sampling pumps.

### 7.2.3 Calibrating a Personal Sampling Pump with a Rotameter

1. See manufacturer's manual for Rotameter's Operational Instructions.

2. Set up the calibration train as shown in (Figure 5, Appendix B) using a rotameter, sampling pump, and a representative sampling cassette.

3. To set up the calibration train, attach one end of the PVC tubing (approx. 2 ft) to the cassette base; attach the other end of the tubing to the inlet plug on the pump. Another piece of tubing is attached from the cassette cap to the rotameter.

4. Assemble the base of the flow meter with the screw provided and tighten in place. The flow meter should be mounted within 6° vertical.

5. Turn the sampling pump on.

6. Turn the flow adjust screw (or knob) on the personal sampling pump until the float ball on the rotameter is lined up with the precalibrated flow rate value. A sticker on the rotameter should indicate this value.

7. A verification of calibration is generally performed on-site in the clean zone immediately prior to the sampling.

## 7.3. Meteorology

It is recommended that a meteorological station be established. If possible, sample after two to three days of dry weather and when the wind conditions are at 10 mph or greater. Record wind speed, wind direction, temperature, and pressure in a field logbook. Wind direction is particularly important when monitoring for asbestos downwind from a fixed source.

## 7.4 Ambient Sampling Procedures

### 7.4.1 Pre-site Sampling Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies needed.

2. Obtain necessary sampling equipment and ensure it is in working order and fully charged (if necessary).

3. Perform a general site survey prior to site entry in accordance with the site specific Health and Safety plan.

4. Once on-site the calibration is performed in the clean zone. The calibration procedures are listed in Section 7.2.

5. After calibrating the sampling pump, mobilize to the sampling location.

### 7.4.2 Site Sampling

1. To set up the sampling train, attach the air intake hose to the cassette base. Remove the cassette cap (Figure 6 and 7, Appendix B). The cassette should be positioned downward, perpendicular to the wind

2. If AC or DC electricity is required then turn it on. If used, the generator should be placed 10 ft. downwind from the sampling pump.

3. Record the following in a field logbook: date, time, location, sample identification number, pump number, flow rate, and cumulative time.

4. Turn the pump on. Should intermittent sampling be required, sampling filters must be covered between active periods of sampling. To cover the sample filter: turn the cassette to face upward, place the cassette cap on the cassette, remove the inlet plug from the cassette cap, attach a rotameter to the inlet opening of the cassette cap to measure the flow rate, turn off the sampling pump, place the inlet plug into the inlet opening on the cassette cap. To resume sampling: remove the inlet plug, turn on the sampling pump, attach a rotameter to measure the flow rate, remove the cassette cap, replace the inlet plug in the cassette cap and invert the cassette, face downward and perpendicular to the wind.

5. Check the pump at sampling midpoint if sampling is longer than 4 hours. The generators may need to be regased depending on tank size. If a filter darkens in appearance or if loose dust is seen in the filter, a second sample should be started.

6. At the end of the sampling period, orient the cassette up, turn the pump off.

7. Check the flow rate as shown in Section 7.2.3. When sampling open-faced, the sampling cap should be replaced before post calibrating. Use the same cassette used for sampling for post calibration (increase dust/fiber loading may have altered the flow rate.

8. Record the post flow rate.

9. Record the cumulative time or run.

10. Remove the tubing from the sampling cassette. Still holding the cassette upright, replace the inlet plug on the cassette cap and the outlet plug on the cassette base.

### 7.4.3. Post Site Sampling

1. Follow handling procedures in Section 3.2, steps 1-4.

2. Obtain an electronic or hard copy of meteorological data which occurred during the sampling event. Record weather: wind speed, ambient temperature, wind direction, and precipitation. Obtaining weather data several days prior to the sampling event can also be useful.

## 7.5 Indoor Sampling Procedures

PCM analysis is used for indoor air samples. When analysis shows total fiber count above the OSHA action level 0.1 f/cc then TEM (U.S. EPA's Modified Yamate Method) is used to identify asbestos from non-asbestos fibers.

Sampling pumps should be placed four to five feet above ground level away from obstructions that may influence air flow. The pump can be placed on a table or counter. Refer to Table 2 (Appendix A) for a summary of indoor sampling locations and rationale for selection.

Indoor sampling utilizes high flow rates to increased sample volumes (2000 L for PCM and 2800 to 4200 L for TEM) in order to obtain lower detection limits below the standard, (i.e., 0.01 f/cc or lower [PCM] and 0.005 structures/cc or lower [TEM]).

### 7.5.1 Aggressive Sampling Procedures

Sampling equipment at fixed locations may fail to detect the presence of asbestos fibers. Due to limited air movement, many fibers may settle out of the air onto the floor and other surfaces and may not be captured on the filter. In the past, an 8-hour sampling period was recommended to cover various air circulation conditions. A quicker and more effective way to capture asbestos fibers is to circulate the air artificially so that the fibers remain airborne during sampling. The results from this sampling option typifies worst case condition. This is referred to as aggressive air sampling for asbestos. Refer to Table 2 for sample station locations.

1. Before starting the sampling pumps, direct forced air (such as a 1-horsepower leaf blower or large fan) against walls, ceilings, floors, ledges, and other surfaces in the room to initially dislodge fibers from surfaces. This should take at least 5 minutes per 1000 sq. ft. of floor.

2. Place a 20-inch fan in the center of the room. (Use one fan per 10,000 cubic feet of room space.) Place the fan on slow speed and point it toward the ceiling.

3. Follow procedures in Section 7.4.1 and 7.4.2 (Turn off the pump and then the fan(s) when sampling is complete.).

4. Follow handling procedures in Section 3.2, steps 1-4.

## 8.0 CALCULATIONS

The sample volume is calculated from the average flow rate of the pump multiplied by the number of minutes the pump was running (volume = flow rate X time in minutes). The sample volume should be submitted to the laboratory and identified on the chain of custody for each sample (zero for lot, field and trip blanks).

The concentration result is calculated using the sample volume and the numbers of asbestos structures reported after the application of the cluster and matrix counting criteria.

## 9.0 QUALITY ASSURANCE/ QUALITY CONTROL

Follow all QA/QC requirements from the laboratories as well as the analytical methods.

### 9.1 TEM Requirements

1. Examine lot blanks to determine the background asbestos structure concentration.

2. Examine field blanks to determine whether there is contamination by extraneous asbestos structures during specimen preparation.

3. Examine of laboratory blanks to determine if contamination is being introduced during critical phases of the laboratory program.

4. To determine if the laboratory can satisfactorily analyze samples of known asbestos structure concentrations, reference filters shall be examined. Reference filters should be maintained as part of the laboratory's Quality Assurance program.

5. To minimize subjective effects, some specimens should be recounted by a different microscopist.

6. Asbestos laboratories shall be accredited by the National Voluntary Laboratory Accreditation Program.

7. At this time, performance evaluation samples for asbestos in air are not available for Removal Program Activities.

### 9.2 PCM Requirements

1. Examine reference slides of known concentration to determine the analyst's ability to satisfactorily count fibers. Reference slides should be maintained as part of the laboratory's quality assurance program.

2. Examine field blanks to determine if there is contamination by extraneous structures during sample handling.

3. Some samples should be relabeled then submitted for counting by the same analyst to determine possible bias by the analyst.

4. Participation in a proficiency testing program such as the AIHA-NIOSH proficiency analytical testing (PAT) program.

## 10.0 DATA VALIDATION

Results of quality control samples will be evaluated for contamination. This information will be utilized to qualify the environmental sample results accordingly with the project's data quality objectives.

## 11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and corporate health and safety procedures. More specifically, when entering an unknown situation involving asbestos, a powered air purifying respirator (PAPR) (full face-piece) is necessary in conjunction with HEPA filter cartridges. See applicable regulations for action level, PEL, TLV, etc. If previous sampling indicates asbestos concentrations are below personal health and safety levels, then Level D personal protection is adequate.

## 12.0 REFERENCES


(1) Environmental Asbestos Assessment Manual, Superfund Method for the Determination of Asbestos in Ambient Air, Part 1: Method, EPA/540/2-90/005a, May 1990, and Part 2: Technical Background Document, EPA/540/2-90/005b, May 1990.

(2) Methodology for the Measurement of Airborne Asbestos by Electron Microscopy, EPA's Report No. 68-02-3266, 1984, G. Yamate, S.C. Agarwal, and R. D. Gibbons.

(3) National Institute for Occupational Safety and Health. NIOSH Manual of Analytical Method. Third Edition. 1987.

(4) U.S. Environmental Protection Agency. Code of Federal Regulations 40 CFR 763. July 1, 1987. Code of Federal Regulations 40 CFR 763 Addendum. October 30, 1987.

(5) U.S. Environmental Protection Agency. Asbestos-Containing Materials in Schools; Final Rule and Notice. 52 FR 41826.

(6) Occupational Safety and Health Administration. Code of Federal Regulations 29 CFR 1910.1001. Washington, D.C. 1987.

# APPENDIX A

Tables

| TABLE 1.<br>SAMPLE STATIONS FOR OUTDOOR SAMPLING | | |
|---|---|---|
| Sample Station Location | Sample Numbers | Rationale |
| Upwind/Background[(1)] | Collect a minimum of two simultaneous upwind/background samples 30º apart from the prevailing windlines. | Establishes background fiber levels. |
| Downwind | Deploy a minimum of 3 sampling stations in a 180 degree arc downwind from the source. | Indicates if asbestos is leaving the site. |
| Site Representative and/or Worst Case | Obtain one site representative sample which shows average condition on-site or obtain worst case sample (optional). | Verify and continually confirm and document selection of proper levels of worker protection. |

[(1)] More than one background station may be required if the asbestos originates from different sources.

## APPENDIX A (Cont'd)

Tables

TABLE 2

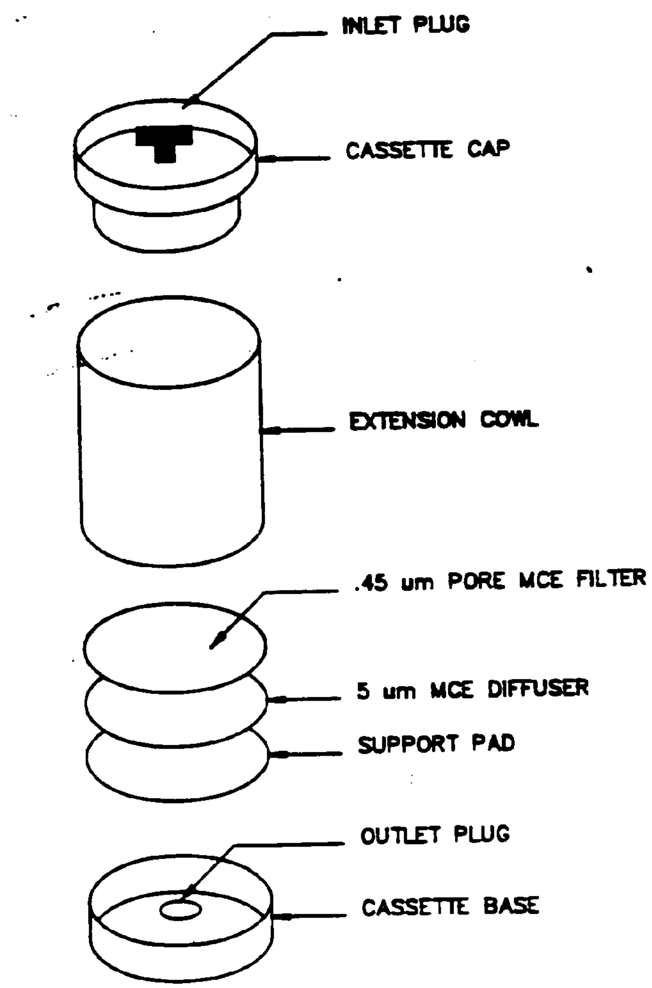
SAMPLE STATIONS FOR INDOOR SAMPLING

| Sample Station Location | Sample Numbers | Rationale |
|---|---|---|
| Indoor Sampling | If a work site is a single room, disperse 5 samplers throughout the room.<br><br>If the work site contains up to 5 rooms, place at least one sampler in each room.<br><br>If the work site contains more than 5 rooms, select a representative sample of the rooms. | Establishes representative samples from a homogeneous area. |
| Upwind/Background | If outside sources are suspected, deploy a minimum of two simultaneous upwind/background samples 30$^{o}$ apart from the prevailing windlines. | Establish whether indoor asbestos concentrations are coming from an outside source. |
| Worst Case | Obtain one worst case sample, i.e., aggressive sampling (optional). | Verify and continually confirm and document selection of proper levels of worker protection. |

# APPENDIX B

Figures

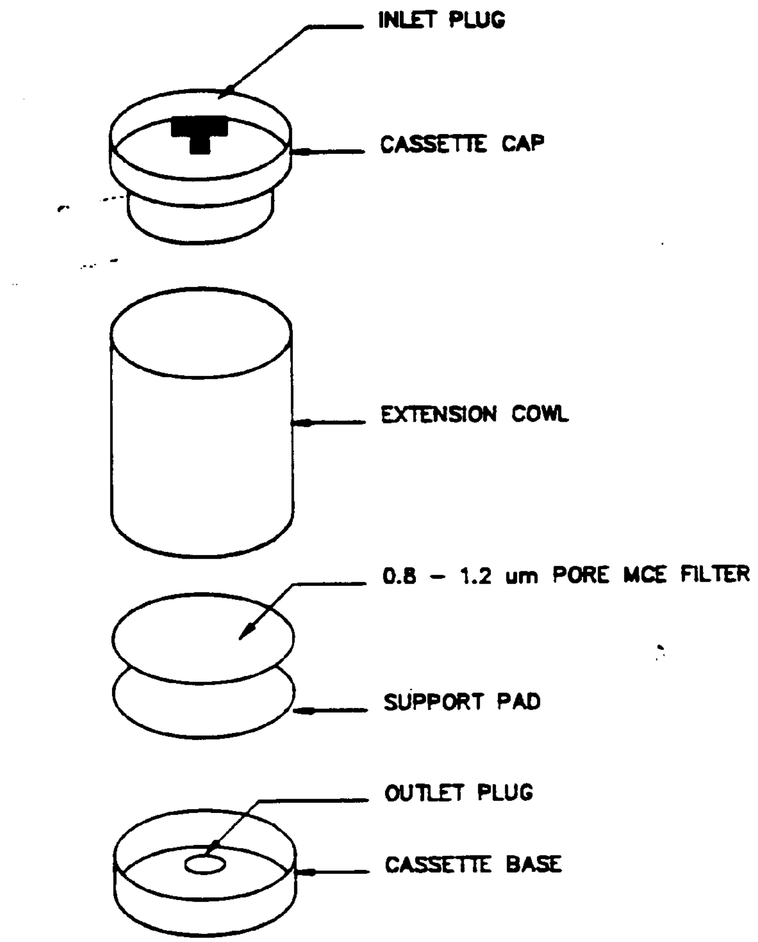
FIGURE 1. Transmission Electron Microscopy Filter Cassette



# APPENDIX B (Cont'd)

Figures

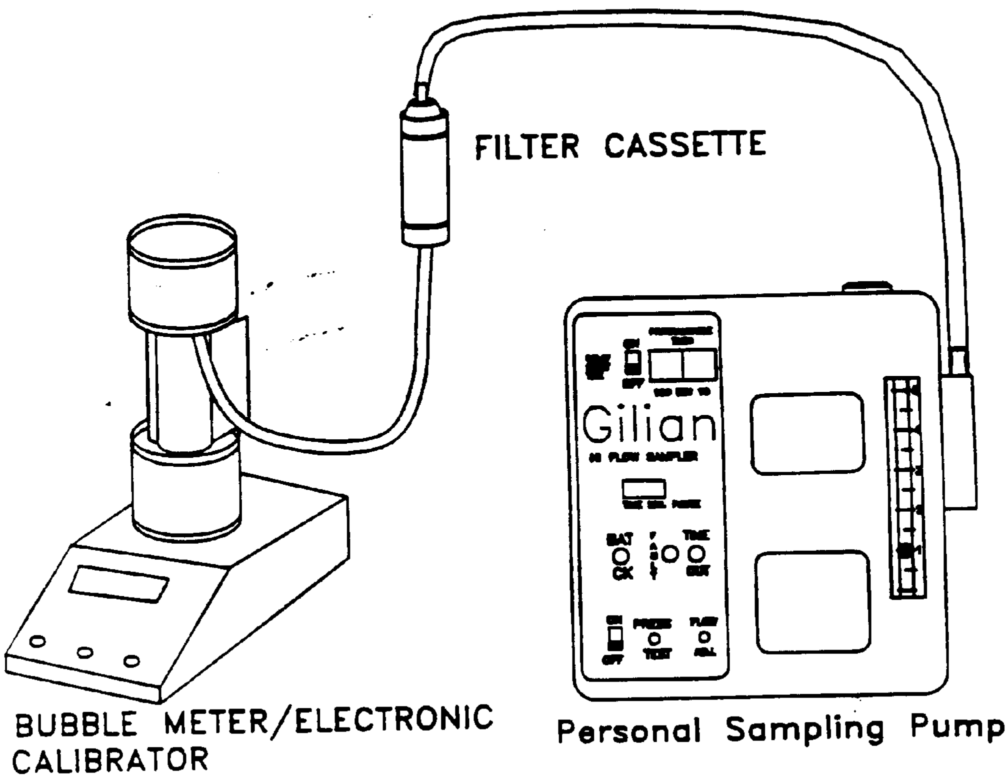
FIGURE 2. Phase Contrast Microscopy Filter Cassette



**APPENDIX B (Cont'd)**

Figures

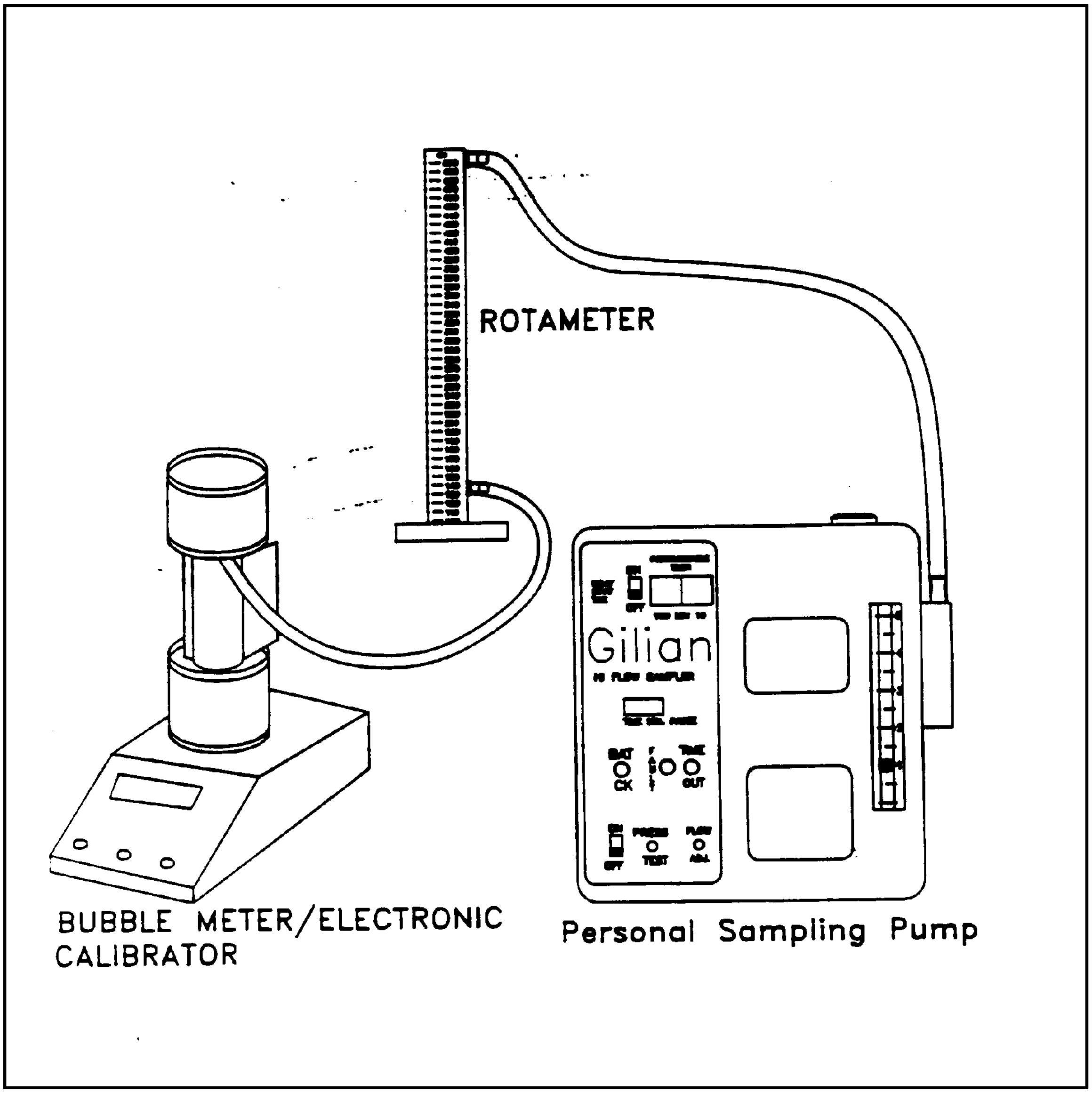
FIGURE 3. Calibrating a Personal Sampling Pump with a Bubble Meter



## APPENDIX B (Cont'd)

Figures

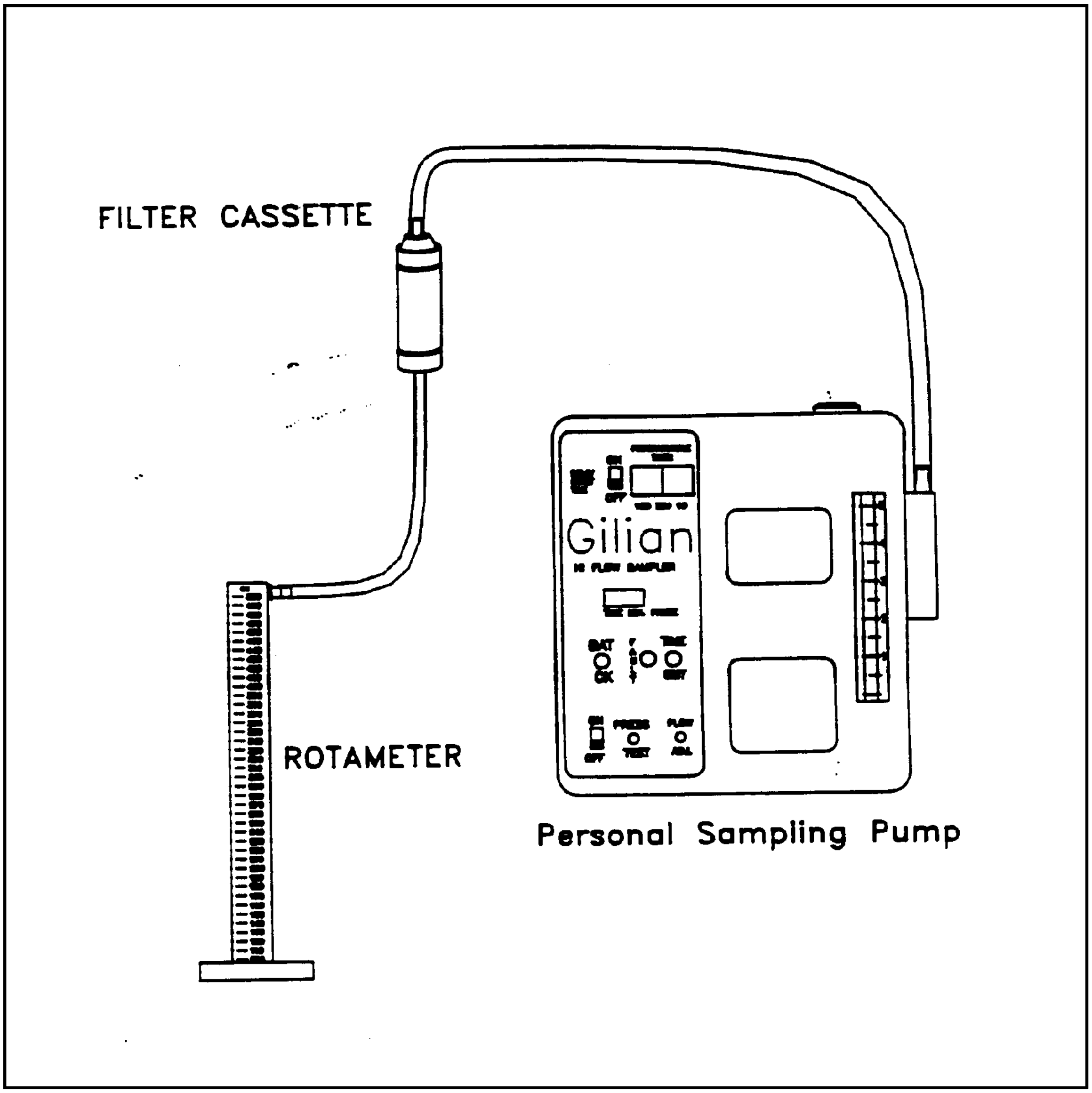
FIGURE 4. Calibrating a Rotameter with a Bubble Meter



## APPENDIX B (Cont'd)

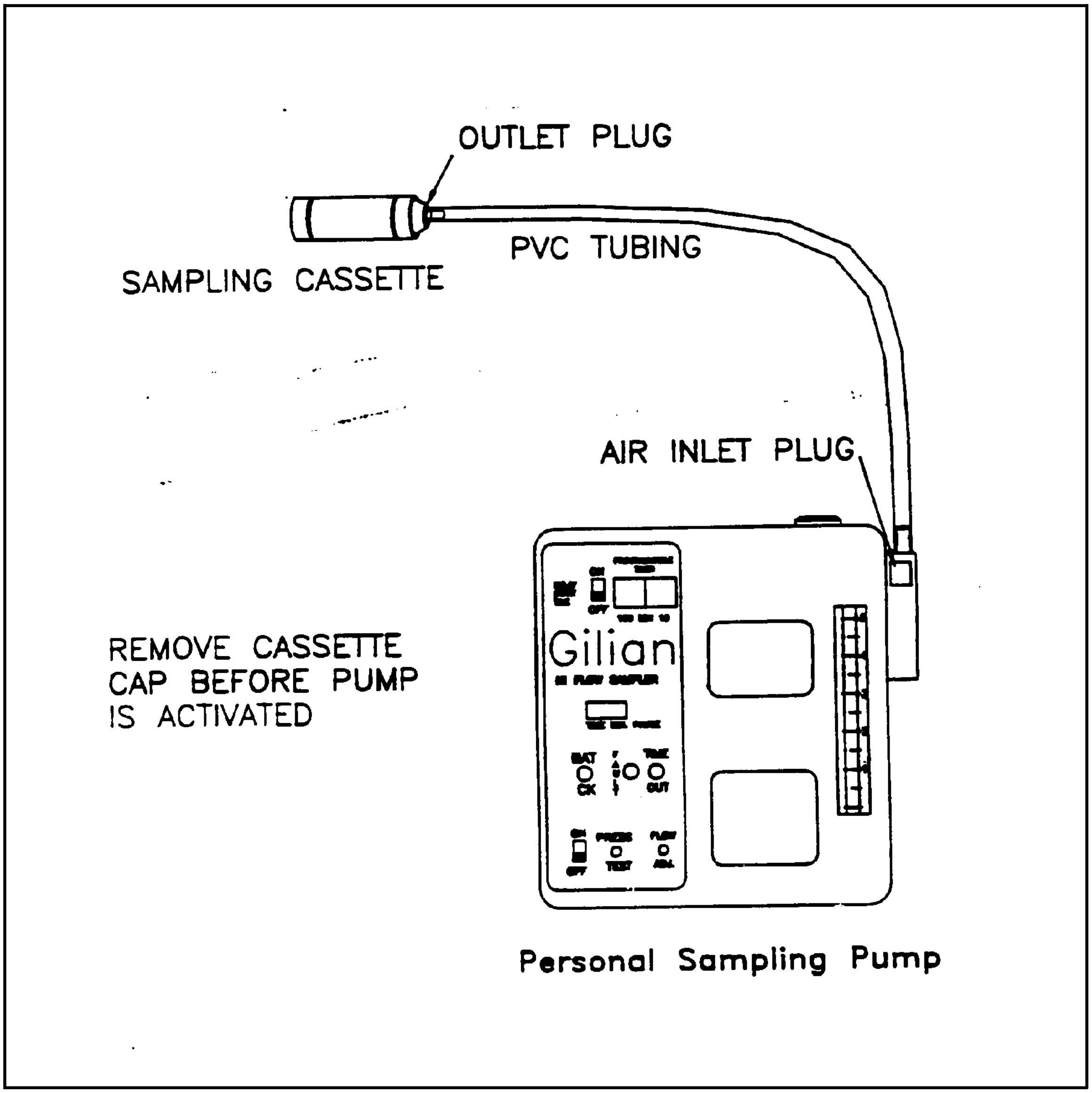
Figures

FIGURE 5. Calibrating a Sampling Pump with a Rotameter



Figures

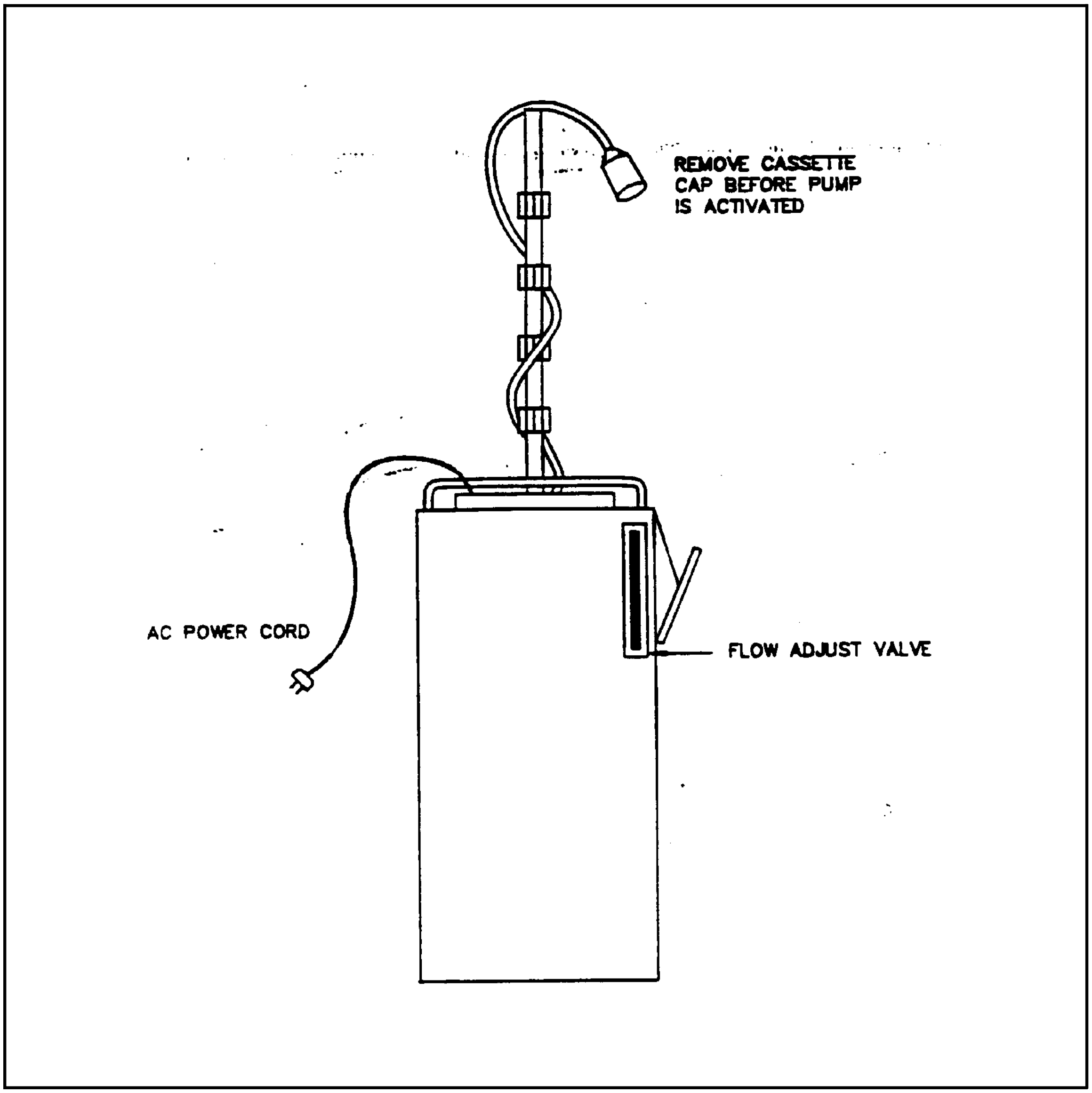
FIGURE 6. Personal Sampling Train for Asbestos



**APPENDIX B (Cont'd)**

Figures

FIGURE 7. High Flow Sampling Train for Asbestos



# ACTIVITY-BASED AIR SAMPLING FOR ASBESTOS

CONTENTS

CONTENTS (cont'd)

## 1.0 SCOPE AND APPLICATION

As a result of a directive issued by the United States Environmental Protection Agency (U.S. EPA) Office of Solid Waste and Emergency Response (OSWER Directive 9345.4), estimating asbestos exposures resulting from suspension of soils is an area of increased importance to the Superfund Program. Such exposures may be estimated via monitoring and/or modeling methods. At present, models are not available to accurately estimate asbestos exposure associated with the disturbance of contaminated soil. Therefore, personal monitoring in the form of activity-based sampling (ABS) is the most appropriate technique to estimate exposure. Personal exposure is influenced by the activities performed, the duration of the activity and the site-specific soils of interest.

At a number of diverse sites across the county (Clear Creek Management Area, San Benito County, California (CA), El Dorado Schools, North Ridge Estates, Klamath Falls, Oregon, Slodusty Road, Garden Valley CA, Ambler Alaska), the U.S. EPA has demonstrated that disturbance of soil with low levels of asbestos (including soil concentrations less than 1.0 percent (%) as measured by Polarized Light Microscopy) can potentially result in significant concentrations (>0.1 structures per cubic centimeter) of respirable asbestos fibers in the breathing zone of individuals engaged in various physical activities. This may result in a cancer risk in excess of Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) remedial objectives.

Since personal monitoring is more representative of actual exposure than samples obtained from a fixed downwind location (McBride 1999, Rodes 1995, Hildemann 2005), personal monitoring results are generally most relevant to CERCLA risk characterizations. Thus the best measure of actual exposure to an individual would be through the collection of personal air samples over the exposure period of interest (NIOSH 1977). However, at CERCLA sites, it is neither always possible nor practical to do so. EPA has thus developed a sampling procedure called ABS, designed to mimic the activities of a potential receptor.

As part of ABS, U.S. EPA or contractor personnel trained in hazard recognition and mitigation, serve as surrogates for the potentially exposed populace of interest. ABS simulates routine activities in order to mimic and evaluate or predict personal exposures from disturbance of materials potentially contaminated with asbestos. Similar sampling approaches have been used to assess exposures to pesticides and lead (U.S. EPA 2000) and this technique has long been a cornerstone of industrial hygiene wherein workplace exposures are routinely assessed via personal exposure monitoring.

This document provides guidance for ABS for a particular set of activities or scenarios. Personal monitoring may be conducted during various activities such as raking, All-Terrain Vehicle (ATV) riding, rototilling, digging, a child playing in the dirt, weed whacking, lawn mowing, walking with a stroller, bicycling, and playing basketball.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

This document is not intended to be used as a substitute for a site-specific Quality Assurance Project Plan (QAPP) or a detailed Sampling and Analysis Plan (SAP). This document is intended to be used as a reference for developing site-specific QAPPs and SAPs.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

## 2.0 METHOD SUMMARY

There are two types of ABS that can be employed in the field: generic ABS and site-specific ABS. Generic ABS can be used with potentially contaminated soil and utilizes a rake to disturb the soil over a known area in conjunction with the collection of air samples to characterize potential exposure. Site-specific ABS is also used with contaminated soil; however, it utilizes site-specific activities to disturb the soil, such as riding ATVs, jogging or riding bikes. Although site-specific ABS provides a more realistic measure of fiber release, it can also be more resource intensive and it is recommended to be used after the generic ABS, if results deem necessary.

For all ABS events, asbestos samples should be collected from the breathing zones of the subjects at an appropriate flow rate. Special consideration should be given to characterizing exposure to children as it has been hypothesized that children are more prone to exposure than adults (U.S. EPA 2000) because they tend to be closer to the source. Sample flow rates, duration and final volume will need to be weighed against the number of grid openings that must be counted (cost factor) to obtain the needed sensitivity. Sampling periods should be of sufficient durations (averaging time) to facilitate collection of a representative sample and achieving the required level of sensitivity.

## 3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

### 3.1 Sample Preservation

No preservation is required for asbestos samples.

### 3.2 Sample Handling, Container, and Storage Procedures

1. Place a sample label on the cassette indicating a unique sampling number. Do not put sampling cassettes in shirt or coat pockets as the filter can pick up fibers or a static charge that could disturb the dust deposited on the filter media.

2. Samples must be handled gently with the filter inlet facing upward to avoid disturbing the particulate deposited on the filter and to minimize the potential of imparting a static charge to the cassette, which might alter the particulate deposition on the filter media.

3. Place the cassette individually in a manila-type envelope. Each envelope should be marked with the sample identification number, total volume, and date.

4. To the best extent possible, the sampling cassettes in the manila envelopes should be placed right side up so that the cassette inlet cap is on top and cassette base is on bottom. Place samples into a shipping container and use enough packing material to prevent jostling or damage. Samples must be handled gently so as not to disturb the dust deposited on the filter media. Do not use vermiculite or any other type of fibrous packing material for samples. If possible, hand carry to lab.

5. Provide appropriate documentation with samples (i.e., chain of custody and requested analytical methodology).

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

4.1 Area Selection

When selecting areas for ABS, consideration should be given to the potential for off-site migration of contaminants and possible exposure of the public. Within the constraints of ABS, to the degree practical, particulate generation migration off-site should be minimized, and constraints or mitigation protocols established to eliminate public exposure. These constraints/mitigation protocols may include conducting the ABS in remote areas of the site, dust suppression using water mist, building a containment structure, etc. Air sampling should be conducted to document the airborne concentration of asbestos at the site perimeter during activities.

4.2 Flow Rate Considerations

For activities that generate a large quantity of dust (i.e., particulates), sample flow rates may need to be reduced accordingly to avoid overloading the filters. For example, a sampling pump flow rate of approximately 3.0 liters per minute (L/min) was found most effective at one site for monitoring for asbestos while riding ATVs on dusty soils while high soil moisture and reduced particulate generation at another site permitted a 5.0 L/min flow rate.

High flow rates may result in filter damage due to failure of its physical support associated with increased pressure drop, leakage of air around the filter mount so that the filter is bypassed or damage to the asbestos structures (breakup of bundles and clusters) due to increased impact velocities (ISO 10312). High flow rates can also tear the filters during initial pump startup due to the shock load placed on the filter when the pump is first started.

Sampling larger volumes of air and analyzing greater areas of the filter media can theoretically lower the limit of detection indefinitely. In practice, the total suspended particulate (TSP) concentration limits the volume of air that can be filtered as TSP can obscure asbestos fibers. The International Organization for Standardization (ISO) Method 10312 states that the direct analytical method cannot be used if the general particulate loading exceeds approximately 10% coverage of the collection filter. An airborne concentration of approximately 10 micrograms per cubic meter

($\mu g/m^3$), corresponding to clean rural air, results in approximately 10% coverage of the filter media based on a 4000-L sample.

The following formula from ISO 10132 may be used to calculate the analytical sensitivity:

$$S = \frac{A_t}{K A_g V}$$

Where:

S = Analytical sensitivity expressed in structures per liter

$A_t$ = Active area in square millimeters of the collection media or filter

$A_g$ = Mean area in square millimeters ($mm^2$) of the grid openings examined,

K = Number of grid openings examined

V = Volume of air sampled, in liters

NOTE: 25-millimeter (mm) cassettes have an effective filter area of 385 $mm^2$ and 37-mm cassettes have an effective filter area of 855 $mm^2$. The typical grid opening is 0.0057 $mm^2$. Note: Grid size will vary between laboratories and dimensions should be verified prior to calculating the number of grid openings that must be counted to achieve a particular level of sensitivity.

Table 1 provides an example of the minimum number of grid openings that must be counted in order to achieve various sensitivity and detection limits.

It is frequently more efficient to employ co-located samplers to collect a high and low volume of air. This increases the likelihood of at least one of the two samples being readable using the direct analytical method (ISO 10312) than to lose the sample due to overloading or having to analyze by the indirect method (ISO 13794).

4.3 Transmission Electron Microscopy (TEM) Specimen Preparation Methods

It can be argued that direct methods yield an under-estimate of the asbestos structure concentration because other particulate material with which they are associated conceals many of the asbestos fibers present. Conversely, indirect methods can be considered to yield an over-estimate because some types of complex asbestos structures disintegrate during the preparation, resulting in an increase in the numbers of structures counted.

4.3.1 Direct-Transfer TEM Specimen Preparation Methods

Direct-transfer preparation methods are intended to retain all particles in the same relative positions with respect to each other on the final TEM grids as on the original filter. The membrane filter, or a portion of it, is placed on a microscope slide with the sample face upward, and then collapsed by exposure to acetone vapor. The cleared filter is then etched in a low-temperature plasma asher, subsequently coated with carbon in a sputtering device and then peeled from the glass slide. A portion of the collapsed, etched and carbon-coated filter is then transferred to an electron microscope grid and then extracted with dimethylformamide, glacial acetic acid and water to remove the filter. Once the process is complete, the particles originally collected on the filter are bound in the carbon film and the grids can be observed on a transmission electron microscope (ISO 1995). Direct-transfer TEM specimen preparation methods have the following significant interferences:

- The particulate density on the filter, which in turn is controlled by the sampled air volume and the total suspended particulate concentration in the atmosphere being sampled, restricts the achievable detection limit.
- The precision of the result is dependent on the uniformity of the deposit of asbestos structures on the sample collection filter.
- Air samples must be collected so that they have particulate and fiber loadings within narrow ranges. If too high a particulate loading occurs on the filter, it is not possible to prepare satisfactory TEM specimens by a direct-transfer method. If too high a fiber loading occurs on the filter, even if satisfactory TEM specimens can be prepared, accurate fiber counting may not be possible.

4.3.2 Indirect TEM Specimen Preparation Methods

In the indirect preparation method the membrane filter, or a portion thereof, is placed on a microscope slide, sample face downward, and ashed in a low temperature asher until complete calcination of the filter is achieved. The ash is then recovered in distilled water and the solution then filtered on a polycarbonate filter. The indirect transfer method re-distributes the particulate on a new membrane filter.

Indirect TEM specimen preparation methods have the following interferences:

- The size distribution of asbestos structures is modified (clusters, matrices bundles, etc. may be broken up during sample preparation).
- There is increased opportunity for fiber loss or introduction of extraneous contamination from laboratory glassware, process water, etc.

- When sample collection filters are ashed, any fiber contamination in the filter medium is concentrated on the TEM specimen grid.

The direct analytical method (ISO 10312) is the preferred method and every reasonable effort should be made to prevent overloading of the filter, which would necessitate use of the indirect method. Samples that are overloaded may, at the discretion of the project management team, be analyzed by ISO Method 13794 "Ambient air – Determination of asbestos fibres – Indirect-transfer transmission electron microscopy method" (ISO 1999). Results of the ISO 13794 analysis should be reviewed discrete of the ISO 10312 samples and a decision made regarding combining the two data sets.

4.4 Sampling Cassette Orientation

Air sampling cassettes must be oriented with the open face pointing down to preclude large non-respirable particles from falling or settling onto the filter media.

5.0 EQUIPMENT/APPARATUS

- Personal sampling pumps, providing a flow rate from 0.020 L/min up to 4.0 L/min, battery powered
- High flow sampling pumps (i.e., Quik Take 30 or AirCon II), capable of providing a flow rate from 4.0 to 12 L/min, battery or alternating current (AC)
- Mixed cellulose ester (MCE) filter cassettes, 0.45 or 0.8 micrometer (µm), 25-mm diameter, purchased from a certified vendor with appropriate documentation (low filter background counts, consistent filter area, certified leak-free cassettes)
- Sampling setups, Tygon® tubing with Luer type adaptor
- Backpacks
- Sampling stands, for perimeter sampling
- Duct tape
- Tools, miscellaneous (e.g., screwdrivers, pliers, cutting tool, etc.)
- Envelopes, manila-type
- Whirlpak® bags
- Sample labels

- Chain of custody (COC) records
- Logbook and/or sampling worksheets
- Precision rotameter or primary flow standard appropriate for sampling flow rate
- Personal protective equipment (PPE), including but not limited to respirators, boots, gloves, eye protection, hard hat, to be determined based on type of activity and possible exposure
- Decon equipment (Plastic sheeting, liquinox®, buckets, brushes, water, Hudson sprayers, garbage bags, etc.)
- Power sources, e.g., line power, solar recharging batteries, power inverters, generators, etc.

## 6.0 REAGENTS

Reagents are not required for the preservation of asbestos samples.

## 7.0 PROCEDURES

### 7.1 Pre-Site Sampling Preparation

1. Determine the extent of the sampling effort (number of locations, repetitions, number of samples, etc.), the sampling methods to be employed, and the types and amounts of equipment and supplies needed.
2. Obtain necessary sampling equipment and ensure it is in working order and fully charged (if necessary).
3. Perform a general site survey prior to site entry in accordance with the site-specific Health and Safety Plan (HASP).
4. Once on-site the calibration is performed in the clean zone. The calibration procedures are listed in Section 7.2.
5. After calibrating the sampling pump, mobilize to the sampling location.

7.2 Calibration Procedures

To determine if a sampling pump is measuring the flow rate or volume of air correctly, it is necessary to calibrate the equipment. Sampling pumps should be calibrated on a routine basis and prior to use.

A rotameter can be used provided it has been calibrated with a primary calibrator. Typically rotameters are calibrated on a yearly basis. Sampling pumps can be calibrated prior to coming on-site in order to expedite on-site calibration. However, calibration must be verified on-site prior to use.

7.2.1 Calibrating a Personal Sampling Pump with a Rotameter

1. Refer to the manufacturer's manual for the Rotameter Operational Instructions.

2. Set up the calibration train using a rotameter, sampling pump and the sampling cassette that will be used during the sampling event. This train may be set up prior to field mobilization and will be checked in the field again prior to use.

3. To set up the calibration train, attach one end of the polyvinyl chloride (PVC) tubing (approx. 2 ft) to the cassette base; attach the other end of the tubing to the inlet plug on the pump. Another piece of tubing is attached from the cassette cap to the rotameter. Insure that the tubing and rotameter used to calibrate the pump do not restrict the airflow.

4. Assemble the base of the flow meter with the screw provided and tighten in place. The flow meter should be mounted within 6 degrees ($^o$) of vertical (Omega 1987).

5. Turn the sampling pump on.

6. Turn the flow adjust screw (or knob) on the personal sampling pump until the float ball on the rotameter is lined up with the pre-calibrated flow rate value on the rotameter. Note: rotameters should be marked with the previous calibration date and corresponding flow rates and scale.

7. A verification of calibration is generally performed on-site in the clean zone immediately prior to the sampling.

7.2.2 Calibrating a Personal Sampling Pump with an Electronic Calibrator

1. Refer to the manufacturer's manual for operational instructions.

2. Set up the calibration train using a sampling pump, electronic calibrator, and the actual sampling cassette or a representative filter cassette. The same lot of cassettes used for sampling should also be used for calibration.

3. To set up the calibration train, attach one end of the PVC tubing (approx. 2 foot) to the cassette base; attach the other end of the tubing to the inlet plug on the pump. Another piece of tubing is attached from the cassette cap to the electronic calibrator.

4. Turn the electronic calibrator and sampling pump on. Select a flow rate to calibrate.

5. Turn the flow-adjust screw or knob on the pump until the desired flow rate is attained on the rotameter.

6. Using the primary calibrator, obtain approximately 10 readings three times until the flow rate of ± 5% of the required flow is attained.

7.3. Meteorology

It is recommended that an onsite, portable, 3-meter meteorological station be established. If possible, sample after two to three days of dry weather and when wind conditions are representative for the climatology of the location based on month and time of day. Historical hourly wind speed and wind direction data should be analyzed before mobilization. Wind speed, wind direction, temperature, and station pressure should be recorded on the meteorological station data logger and real-time data should be available for review on the station display panel. Suggested meteorological station specifications can be found in Table 2, Appendix A or ERT SOP #2129, *Met One Remote Meteorological Station.* Alternatively, a nearby representative meteorological station, as determined by a meteorologist, may be used to acquire the necessary data.

7.4 General Sampling Information

For all activity-based sampling events, except as noted otherwise, asbestos samples will be collected from the breathing zones of the event participants. The breathing zone can be visualized as a hemisphere approximately 6 to 9 inches around an individual's face. Breathing zone samples provide the best approximation of the concentration of contaminants in the air that an individual is actually breathing. Specific breathing zone heights should be determined on a project-by-project basis based on the anthropometrics for the study population and the participants' positions during the performance of each task.

If it is necessary to relieve a participant from the activity, another sample collector should be suited and ready to participate in the ABS prior to the personnel exchange. The participant will stop the activity, remove the backpack or belt, and pass it to the relief participant similar to the transfer of a baton in a relay race. The original participant will assist the relief participant with donning and adjusting the backpack or belt. The exchange is anticipated to take less than 60 seconds, therefore the sampling pumps and event time clock will not be halted during the exchange. If the exchange requires more than 60 seconds, the pump and event clock will be stopped until activity is re-initiated.

Sample volumes and detection/quantification limits should be specified in the site-specific QAPP with flow rates and sampling periods adjusted accordingly. Typical sensitivity limits that have been employed for risk assessment have been approximately 0.001 S/cc for ABS samples and 0.0001 S/cc for background or reference samples. Based on ISO 10312 Table 1, a sensitivity limit of 0.001 S/cc would require a sample volume of greater than 500 liters to keep the number of grid openings to be counted below 100. Similarly, a sample volume greater than 5000 L would be required to reach 0.0001 S/cc and count fewer than 100 grid openings. For all asbestos sampling, an asbestos sampling train consisting of 0.8-µm, 25-mm mixed cellulose ester (MCE) filter connected to a personal sampling pump will be used. The top cover from the cowl extension on the sampling cassette shall be removed ("open-face") and the cassette oriented face down for all asbestos filters. All samples should be collected open-faced unless a specific requirement for sampling closed-faced exists.

For activity based sampling, a personal sampling pump (or equivalent) or SKC Quick Take 30 will be calibrated to collect between 2 and 12 L/min of air through the filter depending on the capacity of the pump. The flow rate will be based upon the duration of time required to collect a minimum target volume of 560 L and provide a sensitivity limit of 0.001 S/cc.

Generally each activity based sampling event should be repeated a minimum of three times in an area to expose trends. This can be accomplished by a single participant repeating the activity three or more times or by having a single simulation with three or more participants. If soil moisture or seasonal variability is a concern, then three events for each different season or meteorological conditions may be appropriate.

The sampling pumps used should provide non-fluctuating airflows through the filter, and should maintain the initial volume flow rate to within ± 10% throughout the sampling period. A constant flow or critical orifice controlled pump typically meets these requirements. If the flow rate changes by more than 5% during the sampling period, the average of the pre- and post-sampling rates will be used to calculate the total sample volume. If at any time the measurement indicates that the flow-rate has decreased by more than 30%, sampling should be terminated. Depending on the type of sampling pump used, it may be possible to salvage the sample if sufficient volume was collected; however, it may not be representative of the time it takes for the actual activity to be completed. Depending on the type of sampling pump used, the actual sampling time in hours and minutes before the sampling fault may be displayed and an actual sample volume calculated. If the fault was due to battery failure, it may be possible to check the post-sampling flow.

During certain ABS activities, participants may be fitted with two sampling pumps to collect a high-flow or volume and a low-flow or volume sample. Co-located samples are collected to sample a high and low volume of air to increase the likelihood of at least one of the two samples being readable using the direct analytical method (ISO 10312). Approximately 560 L (40 CFR 763) is collected for the low-flow samples and up to 4000 L for the high-flow samples. The targeted high volume is typically 1200 L, which permits counting approximately 54 grid openings for a sensitivity level of 0.001 S/cc.

7.5 Generic Activity-Based Sampling Scenario / Raking

The raking scenario, also referred to as the generic scenario, is appropriate for all sites with soils potentially contaminated with asbestos. Generic ABS should be employed in a grid pattern to evaluate the potential for fiber release from soil over a portion of the site. If the analytical results are above the criteria that were derived for the site, then remediation or institutional controls should be implemented or additional site-specific ABS should be undertaken. If the analytical results are below the criteria that were derived, then no further action may be necessary.

In this activity or simulation a participant will rake a lawn or garden area to remove debris such as rocks, leaves, thatch and weeds using a leaf rake with a rake width of approximately 20 to 28 inches. Participants should strive to disturb the top half-inch of soil with an aggressive raking motion. This depth will vary based on the objective of the scenario.

Each raking participant donning appropriate PPE will be fitted with a personal sampling pump contained in a backpack with the cassette secured to the shoulder straps near the operator's lapels in the breathing zone. Personnel will rake a lawn or garden area to remove debris for a minimum of 1 to 2 hours (flow rate and sensitivity level dependent). Raking will occur in a measured area with vegetation, soil or rocks/gravel and will occur in an arched motion raking from the left of the participant to the right. The participants will rake the debris towards themselves facing one side of the square for 15 minutes then the participant will turn 90 degrees clockwise and begin a new side. Participants will continue to rake each side of the square and rotate 90 degrees. Once several small piles of debris have been made, the participant shall pick up the debris and place it in a trashcan. The sequence of raking, rotating and picking up debris shall be repeated for the duration of the sampling period. The participant should stay in the same plot for the entire sampling period.

7.6 Site-Specific Activity-Based Sampling Scenarios

If site-specific ABS is undertaken, the number and types of activities as well as the types of scenarios should be based on current and potential land use. Reference to current and currently planned future land use and the effectiveness of institutional or legal controls placed on the future use of the land should be evaluated. Probable land use should be selected based on zoning and the existing land use of the site and adjacent areas.

Land use assumptions should be based on a factual understanding of site-specific conditions and reasonably anticipated use. The land use evaluated for the assessment should be based on a residential exposure scenario (i.e., the default worst-case) unless residential land use is not plausible for the site. Future land use assumptions should be consistent with reasonably anticipated future land use based on input from planning boards, appropriate officials, and the public.

7.6.1 ATV Riding

This scenario might be appropriate for recreational areas or other areas where ATVs are typically ridden where asbestos contamination is present. This activity is designed to be representative of two or more ATV participants riding on a course or trail. Riders should maintain their relative position (lead, middle, tail) throughout the activity.

Each ATV rider wearing appropriate PPE will be fitted with two personal sampling pumps set at two distinct flow rates, to collect approximately 560 and 1200 liters of air, because of filter overloading concerns. The cassettes for the personal sampling pumps will be attached to the shoulder straps of the backpack proximal to the riders' lapels in the breathing zone. It may be beneficial to attach a dust monitor (e.g., DataRAM) to the tail ATV to record dust levels and gauge dust loading. The sampling pumps will be carried in a backpack while the dust monitor, if used, will be mounted to the ATV.

Personnel will ride the ATVs around a course at the same time until a sufficient volume of air has been collected to achieve the required sensitivity limit of 0.001 S/cc of air. The riders, one lead rider and one following rider, will vary the vehicle speed between 5 and 30 miles per hour (mph). Riders will strive for an average speed of 10 mph. The average speed is a target speed only; vehicle speeds will be adjusted to meet track conditions. Vehicles will be equipped with a speedometer and odometer to record speeds and distance traveled. ATV riding and sampling should be conducted for 30 to 120 minutes in duration, depending on dust loading and required detection limits.

ATVs and ATV tires should be selected as appropriate for the area being studied. Specifically, the size (i.e., weight, horsepower, etc.) of the ATV should be appropriate for the study area. The vehicle tires should have a tread pattern that is representative of those typically used in the area. Local ATV shops or ATV clubs should be consulted for guidance.

7.6.2 Child Playing in the Dirt

This scenario might be appropriate for sites where schools, playgrounds, parks or residential areas, etc. are contaminated with asbestos; the overarching criteria being areas where a child might be expected to play or dig in the dirt. This scenario was designed to be representative of a child playing in the dirt with a shovel and pail.

The event participant wearing appropriate PPE will be fitted with a personal sampling pump; the inlet to the filter will be at a height of approximately 1 to 3 feet above the ground to simulate a child's breathing zone. The actual pump unit should be secured in a backpack or on a belt.

A participant should sit on the ground while digging or scraping the top 2 to 6 inches of surface soil, placing it in a small bucket or pail and dumping it back on the ground. The activity will be paced such that soil will be placed in the bucket and dumped approximately every two to five minutes, regardless of the amount of material in the bucket. The bucket should be emptied rapidly from a height of approximately 12 inches, based on observations of two to four-year-olds playing in a sandbox.

A sampling period and flow rate to collect a sufficient volume of air will be determined as to achieve the project-specific detection/quantification limit. The sampling period will be divided into equal sub-periods to facilitate having the participant face each compass direction for an equal amount of time during the activity. This approach is designed to mitigate the effect of wind direction on potential exposure. Random head and body movement during the activity should further mitigate the impact of wind direction on exposure. Ideally, the participants will face each compass direction at least twice during the sampling event. For example, during a two-hour or 120-minute event, the participant might face North for 15 minutes, rotate to the East for 15 minutes, then South for 15 minutes, then West for 15 minutes and return to the North to repeat the cycle. Participants should move to a fresh patch of soil after the completion of each cycle (360 degree rotation).

7.6.3 Gardening/Rototilling

This scenario might be appropriate for sites where gardening or surface disturbance to a depth of approximately one foot is anticipated. This activity is designed to be representative of individuals participating in gardening activities using a rototiller.

Each rototilling participant donning appropriate PPE will be fitted with a personal sampling pump. The actual pump unit will be contained in a backpack with the cassette secured to the shoulder straps near the operator's lapels in the breathing zone.

Personnel will operate a rototiller for a minimum of two hours to loosen soil in the yard to a depth of approximately 12 inches. The depth chosen is area-specific and will need to be determined on a case-by-case basis. A rear tine rototiller in the six to eight horsepower range will be selected. Other types or sizes of tillers may be appropriate based on the soil conditions and type of gardening being conducted.

A 100 to 720-square-foot plot of land will be selected to till. The average size of a community garden in New Jersey was 720 square feet based on a survey conducted by Rutgers University in 1991 (Patel 1991). The edges will be delineated. Square plots are preferred. The rototiller operator will conduct typical associated activities such as removing rocks and debris from the tilled area. To account for the effects of varying wind direction on potential exposure, the operator will till the soil back and forth towards each side of the square continuously for 10 minutes, shut down the machine or place it in neutral, and rake or sort through the material for five minutes. The operator will then turn 90 degrees in a clockwise direction and repeat the previous 15-minute procedure. The operator will continue to rotate 90 degrees clockwise every 15 minutes until the two-hour sampling period is complete. The participant should stay in the same plot for the entire sampling period.

7.6.4 Weed Whacking/Cutting

This scenario might be appropriate for sites where lawn maintenance might be conducted such as in residential and commercial areas. This activity is designed to simulate a person trimming weeds and grasses.

Each weed-whacking participant will be fitted with a personal sampling pump. The actual pump unit will be contained in a backpack with the cassette secured to the shoulder straps near the operator's lapels in the breathing zone. Personnel wearing appropriate PPE will operate a gas or electric-powered string trimmer. A 25 to 35-cc gas or electric-powered trimmer with a 16 to 18- inch cutting swath will be selected. Trimming and edging will occur in a measured area with thick vegetation (typically 100 to 720-square feet, based on a typical residential garden) (Patel 1991). Trimming will be done using a side to side sweeping motion with the operator moving in a series of straight lines back and forth towards one side of the selected area for 10 minutes, resting five minutes, and turning 90 degrees in a clockwise direction before repeating this 15-minute procedure for the duration of the sampling period. The participant should stay in the same plot for the entire sampling period.

7.6.5 Digging

Digging might be appropriate for sites where construction projects are likely to occur or where plants might be planted. Digging will occur in a measured area with vegetation, soil or rocks/gravel.

Each digger participant donning appropriate PPE will be fitted with a personal sampling pump contained in a backpack with the cassette secured to the shoulder straps near the operator's lapels in the breathing zone. The participants will dig a hole to approximately two feet deep and two feet (representative of planting a small shrub or digging a fencepost; site-specific dimensions should be specified in the QAPP/SAP) in diameter (Vodak 2004) and will place the soil next to the hole. The participants will then refill the hole with the soil that had been removed. Participants will then rotate 90 degrees in a clockwise direction and continue to dig and refill additional holes until the sampling period is complete. The sequence of digging, filling and rotating shall be repeated for the duration of the sampling period.

7.6.6 Lawn Mowing

Lawn mowing might be appropriate for sites where lawn maintenance might be conducted such as residential and commercial areas.

Each lawn-mowing participant will be fitted with a personal sampling pump contained in a backpack with the cassette secured to the shoulder straps near the operator's lapels in the breathing zone. Personnel wearing appropriate PPE will operate a gas-powered lawn mower. Mowing will occur in a measured area with thick vegetation and will occur in a shrinking square pattern. Participants will divide the area into a number of squares that decrease in size towards the center of the square by the width of the mower swath. Mower blades will be set at approximately 2 to 2.5 inches. A bag-less side discharge 3- to 5-horsepower lawn mower will be used for this exercise.

7.6.7 Walker with Stroller

This scenario might be appropriate for sites such as parks, paths or open-space. The actual pump unit will be secured in a backpack. The cassette for the personal sampling pump will be attached to the shoulder straps of the backpack proximal to the walker's lapel in the breathing zone. A second pump will be placed in the stroller at a child's breathing zone height.

During these events, walkers wearing appropriate PPE pushing a stroller will walk back and forth along a portion of a path until a sufficient volume of air has been collected to achieve the required detection limit. The walkers will vary their speed between 1.5 and 4 mph. Walkers will strive for an average speed of 2 mph. The average speed is a target speed only; speeds will be adjusted to meet trail conditions. Walkers should be equipped with a global positioning system (GPS) unit to estimate average speed and distance traveled.

7.6.8 Jogging

This scenario might be appropriate for sites such as parks, paths or open-space. The actual pump unit will be secured in a backpack. The cassette for the personal sampling pump will be attached to the shoulder straps of the backpack proximal to the jogger's lapel in the breathing zone.

During these events, joggers wearing appropriate PPE will run/jog back and forth along a portion of a path until a sufficient volume of air has been collected to achieve the required detection limit. The joggers will vary their speed between 2.5 and 5 mph. Joggers will strive for an average speed of 4 mph. The average speed is a target speed only; speeds will be adjusted to meet trail conditions. Joggers should be equipped with a GPS unit to estimate average speed and distance traveled.

Two or more joggers can participate in this activity. When multiple joggers participate, they should maintain their relative position throughout the event (lead, middle, tail). Joggers should be spaced five feet apart.

7.6.9 Two Bicycles

Bicycling might be appropriate for sites such as parks, paths or open-space. Two bicyclists wearing appropriate PPE will ride back and forth with one leading and one following along the length of the site portion of a path or ride around a site (no trail) until a sufficient volume of air has been collected to achieve the required detection limit.

The bicycling participants will each be fitted with personal sampling pumps. The actual pump units will be contained in backpacks with the cassettes secured to the shoulder straps near the cyclists' lapels in the breathing zone.

During these events, the bicycle riders will vary their speed between 3 and 15 mph. Riders will strive for an average speed of 8 mph. The average speed is a target speed only; bicycle speeds will be adjusted to meet trail conditions. Bicycles will be equipped with a GPS to estimate average speed and distance traveled. Riders should maintain their relative position (lead, tail) throughout the activity.

7.6.10 Basketball Scenario

This scenario might be appropriate for sites where basketball courts are present. The basketball scenario was developed to simulate a group of recreational basketball players gathering to play a casual game of basketball for 120 minutes on an outdoor concrete or macadam court. Between four and 10 players wearing appropriate PPE can participate in this exercise.

- From 0 to 15 minutes, two of the players will sweep court with push brooms from the perimeter of the court to the center. While these two people are sweeping the court, the remaining personnel should mill about under the basket and take a few shots.

- From 15 to 30 minutes, shot practice participants stand around the key as for a free throw, with the exception that one of the participants is positioned under the basket to retrieve the ball after each shot. The player closest to the basket on the left side (facing the basket) takes two shots and the ball/shooter rotates counter clockwise after those two shots. Each person shoots consecutively until everyone has taken two shots. The entire group then rotates clockwise. This sequence should be repeated until time expires. Ideally, each player should shoot from each key position and take a turn retrieving the ball under the basket.

- From 30 to 45 minutes, each player takes turns practicing lay-ups. All players line up on the left side of the basket (facing the basket) and shoot one after another. The first person shoots then retrieves the ball for next person in line and so on. Players should use two basketballs with the second person bouncing the ball outside of the key as the first person shoots. Players should run a full cycle from left then a full cycle from right; repeating the left, right cycles until the interval time is up.

- From 45 to 60 minutes, shot practice as described in the 15 to 30 minute interval above will be conducted.

- From 60 to 75 minutes, a half-court game will be played to the degree practical.

- From 75 to 100 minutes, shot practice as described in the 15 to 30-minute interval above will be conducted.

- From 100 to 120 minutes, a lay-up drill as described in the 30 to 45 minute interval above will be conducted.

7.7 Cumulative Exposure Scenario

A cumulative exposure study might be appropriate for sites where individuals move about a site during the course of a day, with varying levels of exposure at multiple indoor and outdoor locations. The objective is to estimate aggregate and cumulative exposure to asbestos over the course of a day. Cumulative exposure studies should be conducted in order to increase understanding of linkages between sources of asbestos and subsequent exposure and dose to humans for use in mitigating risk and reducing exposure and disease.

Over periods of weeks, years or decades, exposures to environmental agents such as asbestos occur intermittently rather than continuously. Yet long-term health effects, such as cancer, are routinely projected based on an average dose over the period of interest (typically years), rather than as a series of intermittent exposures. Consequently, long-term doses are usually estimated by summing doses across discrete exposure episodes and then calculating an average dose for the period of interest (e.g., year, lifetime).

For the cumulative exposure studies, representative members of the population of interest should be selected for 24 hour sampling. The volunteers should be instructed to go about their day as usual. That is, they should not modify their schedule or activities just because they will be wearing a sampling pump.

A minimal description of exposure for a particular route must include exposure concentration and the duration. This is the method of choice to describe and estimate short-term doses, where integration times are of the order of minutes, hours or days. When projecting long term exposures, on the order of years or a lifetime, since it is typically impractical to sample for the entire exposure period, short-term exposure estimates are assumed to be representative of long-term periods and are integrated to estimate long-term exposures, typically with a safety factor to account for variability.

Observations of activities should be recorded throughout each cumulative exposure study, together with the other relevant factors including locations and activities during the study.

Samples will be collected using a personal air pump with a flow rate of approximately 3.5 L/min. Samples shall be collected open-faced with the inlet facing downward at a personal breathing zone height of 4 to 6 feet for 24 hours. Because the battery life for a personal monitor is typically eight to10 hours, the pump shall be changed out at approximately 8-hour intervals (keeping the same filter cassette). Each pump shall be pre-calibrated to 3.5 L/min prior to use. Each monitor shall be worn at normal breathing height during all waking hours. During sleep, the monitor will be placed in the same room as the sleeping individual. The sampling cassette will be placed proximal to the breathing zone of the reclined participant.

Should a study subject participate in a high dust generating activity such as riding an ATV, the 24 hour sampling cassette event should be paused and a short term exposure sample should be collected on a separate cassette with an appropriately calibrated sampling pump. Once the high dust activity has been terminated, the original 24-hour cassette and pump should be resumed for the remainder of the sampling period. Results of the 2 or more samples, depending on the number of high dust generating events should be summed to derive the total 24-hour exposure data.

7.8 Background/Reference Sampling

Background/reference samples should be collected for all sampling events. A background or reference sample is defined as a sample collected upwind at a distance sufficient to prevent being influenced by the simulated activities and outside the site perimeter. To the degree practical, the area selected for background or reference sampling should be free of known asbestos contamination. The background level should reflect the concentration of asbestos in air for the environmental setting on or near a site or activity location and can be used to evaluate whether or not a release from the site or activity has occurred. Background level does not necessarily represent pre-release conditions or conditions in the absence of influence from source at the site. A background level may or may not be less than the detection limit, but if it is greater than the detection limit, it should account for variability in local concentrations. Background or reference samples should be collected concurrent with ABS using stationary sampling pumps. Sampling and analytical parameters (sample volume grid opening count, etc.) should be prescribed to permit a detection limit approximately an order of magnitude below that of the ABS detection limit.

An Aircon II sampling pump (or equivalent) will be calibrated to collect 10 L/min for on-site and off-site air samples through the filter. The flow rate will allow a minimum target volume of 4000 L and will provide a sensitivity limit of 0.0001 S/cc. Lower volume air samples will be collected concurrently at the ambient air sampling locations. Personal sampling pumps will be utilized in the same manner with the same media at a flow rate between 2- and 3- L/min in order to collect a sample volume of approximately 1000 L. The target sensitivity of these samples is also 0.0001 S/cc when additional grids are counted in accordance with the method. Co-located samples are collected to sample a high and low volume of air to increase the likelihood of at least one of the two samples being readable using the direct analytical method (ISO 10312).

7.9 Perimeter Sampling

Perimeter samples are defined as samples collected upwind, downwind or crosswind of a specific activity. When selecting areas for ABS, consideration should be given to the potential for off-site migration of contaminants and possible exposure of the public. Within the constraints of ABS, to the degree practical, particulate generation migration off-site should be minimized, and constraints or mitigation protocols established to eliminate public exposure. These constraints/mitigation protocols may include conducting the ABS in remote areas of the site, dust suppression using water mist, building a containment structure, etc. Air sampling should be conducted to document the airborne concentration of asbestos at the site perimeter during activities. Perimeter air monitoring should be conducted to:

- Document air quality during ABS and establish background or upwind levels of asbestos during site activities
- Monitor and document air quality during site activities near sensitive receptors
- Provide risk management information and address public confidence
- Reduce possible liabilities associated with ABS

Perimeter air sampling should be performed to ensure that ABS activities do not result in excessive airborne asbestos emissions from the site. Air samples should be collected and analyzed to determine the concentrations of asbestos at the site perimeter.

An Aircon II sampling pump (or equivalent) will be calibrated to collect 10 L/min for on-site and off-site air samples through the filter. The flow rate will allow a target volume of 4000 L and will provide a sensitivity limit of 0.0001 S/cc. Lower volume air samples will be collected concurrently at the perimeter sampling locations using personal sampling pumps, if loading is an issue. These pumps will be utilized in the same manner with the same media at a flow rate between 2- and 3-L/min in order to collect a sample volume of approximately 1000 L. The target sensitivity of these samples is also 0.0001 S/cc when additional grids are counted in accordance with the method. Co-located samples are collected to sample a high and low volume of air to increase the likelihood of at least one of the two samples being readable using the direct analytical method (ISO 10312).

7.10 Soil Sampling

A sufficient number of soil samples should be collected to characterize the study area. Since particulates are expected to be released from the entire study area, the primary objective of the soil sampling is to estimate the populations mean concentration. Composite samples are appropriate for characterizing study areas and a sampling design program such as Visual Sampling Plan is recommended for calculating the number and location of samples with the appropriate confidence intervals. Soil sampling should be conducted in accordance with ERT SOP #2012, *Soil Sampling*.

Soil characteristics should be documented in conjunction with the activity-based personal exposure monitoring using American Society of Testing and Materials (ASTM), Method D2488 - 00: *Description and Identification of Soils (Visual-Manual Procedure)*, soil moisture by ASTM Method D2216-05*: Standard Test Methods for Laboratory Determination of Water (Moisture)*

*Content of Soil and Rock by Mass* and grain size by ASTM Method D6913-04e1: *Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis* or Method D422-63 (2002): *Standard Test Method for Particle-Size Analysis of Soils.*

Soil samples should be representative of the soil. Table 3 provides examples of soil sampling depths, which may be disturbed by the activity being performed.

The relationship between the concentration of asbestos in a source material (typically soil) and the concentration of fibers in air that results when the source is disturbed is very complex, depending on a wide range of variables. To date, no method has been found that reliably predicts the concentration of asbestos in air given the concentration of asbestos in the source. Because of this limitation, this SOP emphasizes an empiric approach, where concentrations of asbestos in air at the location of a source disturbance are measured rather than predicted.

## 8.0 CALCULATIONS

The sample volume is calculated from the average flow rate of the pump multiplied by the number of minutes the pump was running (volume = flow rate X time in minutes). The sample volume should be submitted to the laboratory and identified on the chain of custody for each sample (zero for lot, and field blanks).

The concentration result is calculated by dividing the number of asbestos structures reported after the application of the cluster and matrix counting criteria by the sample volume (concentration = number of asbestos structures / sample volume).

## 9.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The following general QA procedures apply:

1. All data must be documented on field data sheets or within site logbooks. Record the following: date, time, location, sample identification number, pump number, flow rate, and cumulative time.

2. All instruments/equipment must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

3. Field blanks should be collected at a rate of one per twenty samples or one per sampling event, whichever is greater

4. Lot blanks should be collected at a rate of at least two per lot

5. Collocated samples should be collected at the frequency of one per sampling event

For TEM analysis, the following QC procedures apply:

1. Examine lot blanks to determine the background asbestos structure concentration.

2. Examine field blanks to determine whether there is contamination by extraneous asbestos structures during specimen preparation or handling.

3. Examine laboratory blanks to determine if contamination is being introduced during critical phases of the laboratory program.

4. To determine if the laboratory can satisfactorily analyze samples of known asbestos structure concentrations, reference filters shall be examined. Reference filters should be maintained as part of the laboratory's Quality Assurance program.

5. To minimize subjective effects, some specimens should be recounted by a different microscopist.

6. Asbestos laboratories shall be accredited by the National Voluntary Laboratory Accreditation Program.

7. At this time, performance evaluation samples for asbestos in air are not commonly available for Removal Program Activities; however, they should be considered on a case-by-case basis.

## 10.0 DATA VALIDATION

Results of QC samples will be evaluated for contamination. This information will be utilized to qualify the environmental sample results accordingly with the project's data quality objectives.

## 11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and corporate health and safety procedures. More specifically, when entering an unknown situation involving asbestos, a powered air-purifying respirator (PAPR) (full face-piece) is necessary in conjunction with high-efficiency particulate air (HEPA) filter cartridges. See applicable regulations for action levels, permissible exposure levels (PEL) and threshold limit values (TLV). If previous sampling indicates asbestos concentrations are below personal health and safety levels, then Level D personal protection is adequate.

For all ABS, appropriate PPE, including Tyvek coveralls, protective gloves and foot wear, and a respirator with HEPA filter cartridges (P-100 or equivalent) should be worn to protect participants. Details regarding PPE and other protective measures should be specified in the site-specific Health and Safety Plan. Special consideration should be given to the physical safety of the event participants as well as heat stress associated with performing vigorous activities in impermeable clothing.

## 12.0 REFERENCES

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## 13.0 APPENDICES

TABLE 1. Minimum Number of Grid Openings Required To Be Counted to Achieve a Given Analytical Sensitivity and Detection Limit. (Adapted from ISO 10312)

TABLE 2. Suggested Meteorological Station Specifications

TABLE 3. Soil Sampling Depth Based on Activities Performed

TABLE 1. Minimum Number of Grid Openings Required To Be Counted to Achieve a Given Analytical Sensitivity and Detection Limit. (Adapted from ISO 10312)

| Analytical Sensitivity Structures/cc | Limit of Detection Structures/cc | Volume of Air Sampled (Liters) | | | | | |
|---|---|---|---|---|---|---|---|
| | | 500 | 1000 | 2000 | 3000 | 4000 | 5000 |
| 0.0001 | 0.0003 | 1066 | 533 | 267 | 178 | 134 | 107 |
| 0.0002 | 0.0006 | 533 | 267 | 134 | 89 | 67 | 54 |
| 0.0003 | 0.0009 | 358 | 178 | 89 | 60 | 45 | 36 |
| 0.0004 | 0.0012 | 267 | 134 | 67 | 45 | 34 | 27 |
| 0.0005 | 0.0015 | 214 | 107 | 54 | 36 | 27 | 22 |
| 0.0007 | 0.0021 | 153 | 77 | 39 | 26 | 20 | 16 |
| 0.001 | 0.003 | 107 | 54 | 27 | 18 | 14 | 11 |
| 0.002 | 0.006 | 54 | 27 | 14 | 9 | 7 | 6 |
| 0.003 | 0.009 | 36 | 18 | 9 | 6 | 5 | 4 |
| 0.004 | 0.012 | 27 | 14 | 7 | 5 | 4 | 4 |
| 0.005 | 0.015 | 22 | 11 | 6 | 4 | 4 | 4 |
| 0.007 | 0.021 | 16 | 8 | 4 | 4 | 4 | 4 |
| 0.01 | 0.030 | 11 | 6 | 4 | 4 | 4 | 4 |

TABLE 2. Suggested Meteorological Station Specifications

| Variable | Accuracy | Resolution |
|---|---|---|
| Wind Speed (horizontal and vertical) | ± (0.2 m/s + 5% of observed) | 0.1 m/s |
| Wind Direction (azimuth and elevation) | ± 5 degrees | 1.0 degrees |
| Ambient Temperature | ± 0.5° C | 0.1° C |
| Precipitation | ± 10% of observed or ± 0.5 mm | 0.3 mm |
| Pressure | ± 3 mb (0.3 kPa) | 0.5 mb |
| Solar Radiation | ± 5% of observed | 10 $W/m^2$ |

m/s = meters per second
°C = degrees Centigrade
mm = millimeters
mb = millibar
$W/m^2$ = watts per square meter
kPa = kilopascal

TABLE 3. Soil Sampling Depth Based on Activities Performed

| **Activity Based Sampling Scenario** | **Soil Sampling Depth** |
|---|---|
| Raking (metal garden rake) | Surface to 3 inches |
| Raking (leaf rake) | Surface to 2 inch |
| ATV riding | Surface to 2 inch |
| Rototilling | Surface to 12 inches |
| Digging | Surface to depth of excavation |
| Child Playing in the dirt | Surface to 3 inches |
| Weed Whacking | Surface to 2 inches |
| Lawn Mowing | Surface to 2 inch |
| Walking with Stroller | Surface to 2 inch |
| Two Bicycles | Surface to 2 inch |
| Activities on solid surfaces such as asphalt or concrete | Microvacuum ASTM D 5755 |

# SOIL SAMPLING

CONTENTS



SUPERCEDES: SOP #2012; Revision 0.0; 11/16/94; U.S. EPA Contract 68-C4-0022.

## 1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to describe the procedures for the collection of representative soil samples. Sampling depths are assumed to be those that can be reached without the use of a drill rig, direct-push, or other mechanized equipment (except for a back-hoe). Analysis of soil samples may determine whether concentrations of specific pollutants exceed established action levels, or if the concentrations of pollutants present a risk to public health, welfare, or the environment.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the actual procedures used should be documented and described in an appropriate site report.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (EPA) endorsement or recommendation for use.

## 2.0 METHOD SUMMARY

Soil samples may be collected using a variety of methods and equipment depending on the depth of the desired sample, the type of sample required (disturbed vs. undisturbed), and the soil type. Near-surface soils may be easily sampled using a spade, trowel, and scoop. Sampling at greater depths may be performed using a hand auger, continuous flight auger, a trier, a split-spoon, or, if required, a backhoe.

## 3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Chemical preservation of solids is not generally recommended. Samples should, however, be cooled and protected from sunlight to minimize any potential reaction. The amount of sample to be collected and proper sample container type are discussed in ERT/REAC SOP #2003 Rev. 0.0 08/11/94, *Sample Storage, Preservation and Handling*.

## 4.0 INTERFERENCES AND POTENTIAL PROBLEMS

There are two primary potential problems associated with soil sampling - cross contamination of samples and improper sample collection. Cross contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary. Improper sample collection can involve using contaminated equipment, disturbance of the matrix resulting in compaction of the sample, or inadequate homogenization of the samples where required, resulting in variable, non-representative results.

## 5.0 EQUIPMENT

Soil sampling equipment includes the following:

- Maps/plot plan
- Safety equipment, as specified in the site-specific Health and Safety Plan
- Survey equipment or global positioning system (GPS) to locate sampling points
- Tape measure
- Survey stakes or flags
- Camera and film
- Stainless steel, plastic, or other appropriate homogenization bucket, bowl or pan
- Appropriate size sample containers
- Ziplock plastic bags
- Logbook
- Labels
- Chain of Custody records and custody seals
- Field data sheets and sample labels
- Cooler(s)
- Ice
- Vermiculite
- Decontamination supplies/equipment
- Canvas or plastic sheet
- Spade or shovel
- Spatula
- Scoop
- Plastic or stainless steel spoons
- Trowel(s)
- Continuous flight (screw) auger
- Bucket auger
- Post hole auger
- Extension rods
- T-handle
- Sampling trier
- Thin wall tube sampler
- Split spoons
- Vehimeyer soil sampler outfit
    - Tubes
    - Points
    - Drive head
    - Drop hammer
    - Puller jack and grip
- Backhoe

## 6.0 REAGENTS

Reagents are not used for the preservation of soil samples. Decontamination solutions are specified in ERT/REAC SOP #2006 Rev. 0.0 08/11/94, *Sampling Equipment Decontamination*, and the site specific work plan.

## 7.0 PROCEDURES

### 7.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies required.

2. Obtain necessary sampling and monitoring equipment.

3. Decontaminate or pre-clean equipment, and ensure that it is in working order.

4. Prepare schedules and coordinate with staff, client, and regulatory agencies, if appropriate.

5. Perform a general site survey prior to site entry in accordance with the site specific Health and Safety Plan.

6. Use stakes, flagging, or buoys to identify and mark all sampling locations. Specific site factors, including extent and nature of contaminant, should be considered when selecting sample location. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions. All staked locations should be utility-cleared by the property owner or the On-Scene-Coordinator (OSC) prior to soil sampling; and utility clearance should always be confirmed before beginning work.

### 7.2 Sample Collection

#### 7.2.1 Surface Soil Samples

Collection of samples from near-surface soil can be accomplished with tools such as spades, shovels, trowels, and scoops. Surface material is removed to the required depth and a stainless steel or plastic scoop is then used to collect the sample.

This method can be used in most soil types but is limited to sampling at or near the ground surface. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sample team member. A flat, pointed mason trowel to cut a block of the desired soil is helpful when undisturbed profiles are required. Tools plated with chrome or other materials should not be used. Plating is particularly common with garden implements such as potting trowels.

The following procedure is used to collect surface soil samples:

1. Carefully remove the top layer of soil or debris to the desired sample depth with a pre-cleaned spade.

2. Using a pre-cleaned, stainless steel scoop, plastic spoon, or trowel, remove and discard a thin layer of soil from the area which came in contact with the spade.

3. If volatile organic analysis is to be performed, transfer the sample directly into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval or location into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

7.2.2 Sampling at Depth with Augers and Thin Wall Tube Samplers

This system consists of an auger, or a thin-wall tube sampler, a series of extensions, and a "T" handle (Figure 1, Appendix A). The auger is used to bore a hole to a desired sampling depth, and is then withdrawn. The sample may be collected directly from the auger. If a core sample is to be collected, the auger tip is then replaced with a thin wall tube sampler. The system is then lowered down the borehole, and driven into the soil to the completion depth. The system is withdrawn and the core is collected from the thin wall tube sampler.

Several types of augers are available; these include: bucket type, continuous flight (screw), and post-hole augers. Bucket type augers are better for direct sample recovery because they provide a large volume of sample in a short time. When continuous flight augers are used, the sample can be collected directly from the flights. The continuous flight augers are satisfactory when a composite of the complete soil column is desired. Post-hole augers have limited utility for sample collection as they are designed to cut through fibrous, rooted, swampy soil and cannot be used below a depth of approximately three feet.

The following procedure is used for collecting soil samples with the auger:

1. Attach the auger bit to a drill rod extension, and attach the "T" handle to the drill rod.

2. Clear the area to be sampled of any surface debris (e.g., twigs, rocks, litter). It may be advisable to remove the first three to six inches of surface soil for an area approximately six inches in radius around the drilling location.

3. Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole. This prevents accidental brushing of loose material back down the borehole when removing the auger or adding drill rods. It also facilitates refilling the hole, and avoids possible contamination of the surrounding area.

4. After reaching the desired depth, slowly and carefully remove the auger from the hole. When sampling directly from the auger, collect the sample after the auger is removed from the hole and proceed to Step 10.

5. Remove auger tip from the extension rods and replace with a pre-cleaned thin wall tube sampler. Install the proper cutting tip.

6. Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the soil. Do not scrape the borehole sides. Avoid hammering the rods as the vibrations may cause the boring walls to collapse.

7. Remove the tube sampler, and unscrew the drill rods.

8. Remove the cutting tip and the core from the device.

9. Discard the top of the core (approximately 1 inch), as this possibly represents material collected before penetration of the layer of concern. Place the remaining core into the appropriate labeled sample container. Sample homogenization is not required.

10. If volatile organic analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly.

    When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

11. If another sample is to be collected in the same hole, but at a greater depth, reattach the auger bit to the drill and assembly, and follow steps 3 through 11, making sure to decontaminate the auger and tube sampler between samples.

12. Abandon the hole according to applicable state regulations. Generally, shallow holes can simply be backfilled with the removed soil material.

7.2.3 Sampling with a Trier

The system consists of a trier, and a "T" handle. The auger is driven into the soil to be sampled and used to extract a core sample from the appropriate depth.

The following procedure is used to collect soil samples with a sampling trier:

1. Insert the trier (Figure 2, Appendix A) into the material to be sampled at a $0^{o}$ to $45^{o}$ angle from horizontal. This orientation minimizes the spillage of sample.

2. Rotate the trier once or twice to cut a core of material.

3. Slowly withdraw the trier, making sure that the slot is facing upward.

4. If volatile organic analyses are required, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

7.2.4 Sampling at Depth with a Split Spoon (Barrel) Sampler

Split spoon sampling is generally used to collect undisturbed soil cores of 18 or 24 inches in length. A series of consecutive cores may be extracted with a split spoon sampler to give a complete soil column profile, or an auger may be used to drill down to the desired depth for sampling. The split spoon is then driven to its sampling depth through the bottom of the augured hole and the core extracted.

When split spoon sampling is performed to gain geologic information, all work should be performed in accordance with ASTM D1586-98, "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils".

The following procedures are used for collecting soil samples with a split spoon:

1. Assemble the sampler by aligning both sides of barrel and then screwing the drive shoe on the bottom and the head piece on top.

2. Place the sampler in a perpendicular position on the sample material.

3. Using a well ring, drive the tube. Do not drive past the bottom of the head piece or compression of the sample will result.

4. Record in the site logbook or on field data sheets the length of the tube used to penetrate the material being sampled, and the number of blows required to obtain this depth.

5. Withdraw the sampler, and open by unscrewing the bit and head and splitting the barrel. The amount of recovery and soil type should be recorded on the boring log. If a split sample is desired, a cleaned, stainless steel knife should be used to divide the tube contents in half, longitudinally. This sampler is typically available in 2 and 3 1/2 inch diameters. A larger barrel may be necessary to obtain the required sample volume.

6. Without disturbing the core, transfer it to appropriate labeled sample container(s) and seal tightly.

7.2.5 Test Pit/Trench Excavation

A backhoe can be used to remove sections of soil, when detailed examination of soil characteristics are required. This is probably the most expensive sampling method because of the relatively high cost of backhoe operation.

The following procedures are used for collecting soil samples from test pits or trenches:

1. Prior to any excavation with a backhoe, it is important to ensure that all sampling locations are clear of overhead and buried utilities.

2. Review the site specific Health & Safety plan and ensure that all safety precautions including appropriate monitoring equipment are installed as required.

3. Using the backhoe, excavate a trench approximately three feet wide and approximately one foot deep below the cleared sampling location. Place excavated soils on plastic sheets. Trenches greater than five feet deep must be sloped or protected by a shoring system, as required by OSHA regulations.

4. A shovel is used to remove a one to two inch layer of soil from the vertical face of the pit where sampling is to be done.

5. Samples are taken using a trowel, scoop, or coring device at the desired intervals. Be sure to scrape the vertical face at the point of sampling to remove any soil that may have fallen from above, and to expose fresh soil for sampling. In many instances, samples can be collected directly from the backhoe bucket.

6. If volatile organic analyses are required, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

7. Abandon the pit or excavation according to applicable state regulations. Generally, shallow excavations can simply be backfilled with the removed soil material.

## 8.0 CALCULATIONS

This section is not applicable to this SOP.

## 9.0 QUALITY ASSURANCE/QUALITY CONTROL

There are no specific quality assurance (QA) activities which apply to the implementation of these procedures. However, the following QA procedures apply:

1. All data must be documented on field data sheets or within site logbooks.

2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration

activities must occur prior to sampling/operation, and they must be documented.

## 10.0 DATA VALIDATION

This section is not applicable to this SOP.

## 11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OHSA and corporate health and safety procedures, in addition to the procedures specified in the site specific Health & Safety Plan..

## 12.0 REFERENCES

Mason, B.J. 1983. Preparation of Soil Sampling Protocol: Technique and Strategies. EPA-600/4-83-020.

Barth, D.S. and B.J. Mason. 1984. Soil Sampling Quality Assurance User's Guide. EPA-600/4-84-043.

U.S. Environmental Protection Agency. 1984 Characterization of Hazardous Waste Sites - A Methods Manual: Volume II. Available Sampling Methods, Second Edition. EPA-600/4-84-076.

de Vera, E.R., B.P. Simmons, R.D. Stephen, and D.L. Storm. 1980. Samplers and Sampling Procedures for Hazardous Waste Streams. EPA-600/2-80-018.

ASTM D 1586-98, ASTM Committee on Standards, Philadelphia, PA.

APPENDIX A
Figures
SOP #2012
February 2000

FIGURE 1. Sampling Augers

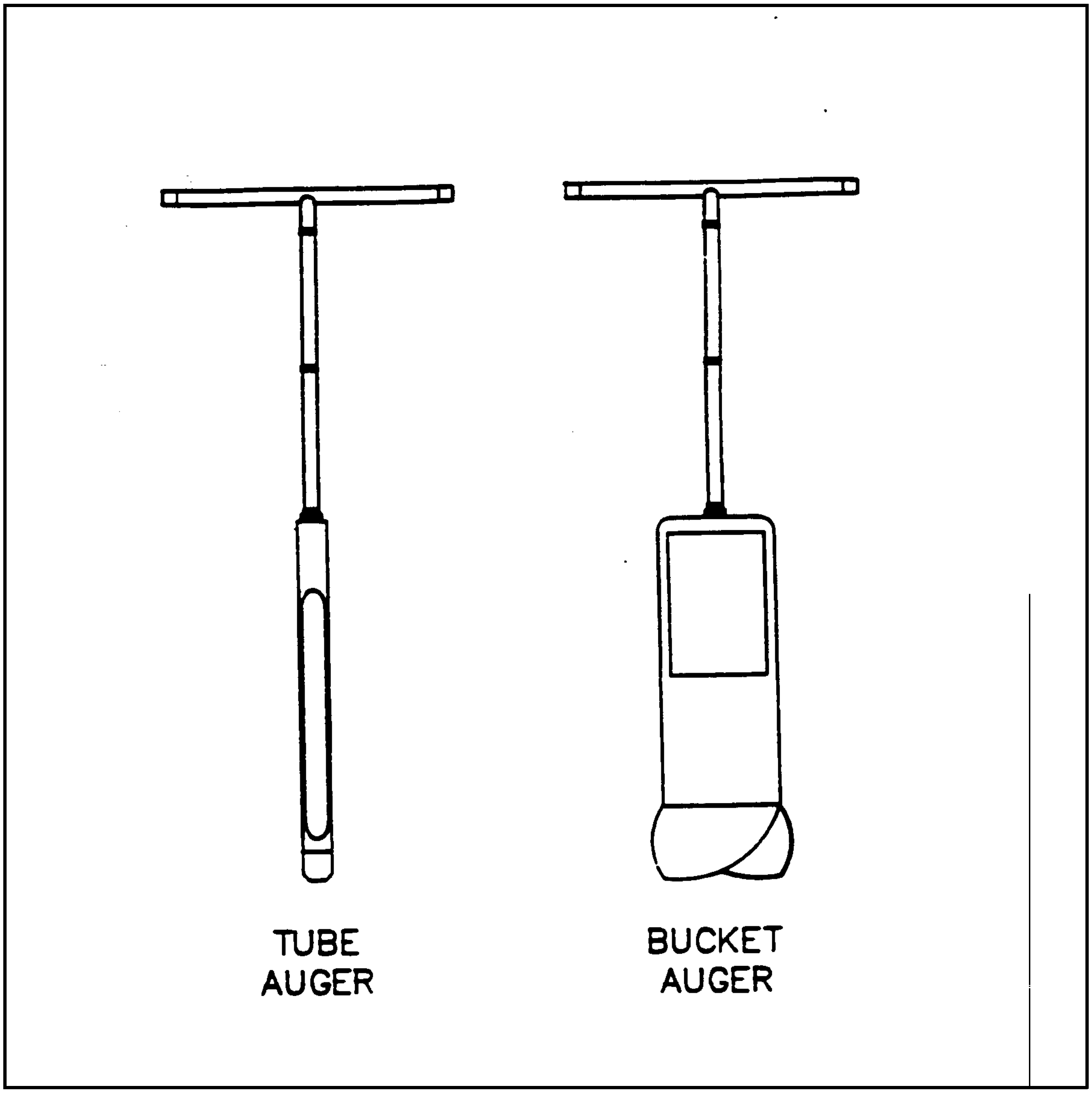
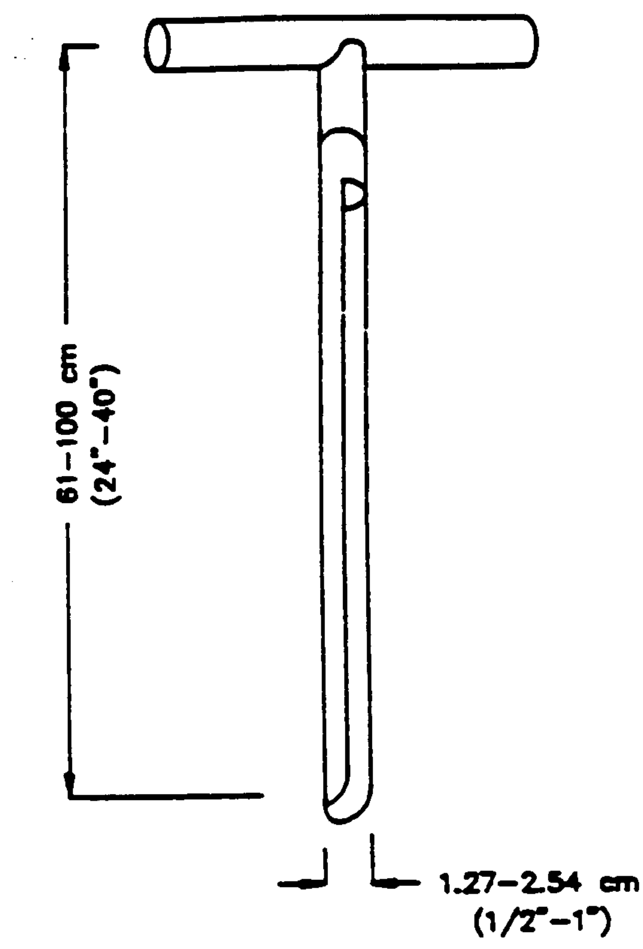


FIGURE 2. Sampling Trier



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United States
Environmental Protection
Agency

Office of Solid Waste and
Emergency Response
Washington DC 20460

EPA/540/P-91/005
January 1991

EPA

# Compendium of ERT Surface Water and Sediment Sampling Procedures

EPA/540/P-91/005
OSWER Directive 9360.4-03
January 1991

# COMPENDIUM OF ERT SURFACE WATER AND SEDIMENT SAMPLING PROCEDURES

Sampling Equipment Decontamination

Surface Water Sampling

Sediment Sampling

Interim Final

Environmental Response Team
Emergency Response Division

Office of Emergency and Remedial Response
U.S. Environmental Protection Agency
Washington, DC 20460

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# Notice

This document has been reviewed in accordance with U.S. Environmental Protection Agency policy and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

The policies and procedures established in this document are intended solely for the guidance of government personnel, for use in the Superfund Removal Program. They are not intended, and cannot be relied upon, to create any rights, substantive or procedural, enforceable by any party in litigation with the United States. The Agency reserves the right to act at variance with these policies and procedures and to change them at any time without public notice.

Depending on circumstances and needs, it may not be possible or appropriate to follow these procedures exactly in all situations due to site conditions, equipment limitations, and limitations of the standard procedures. Whenever these procedures cannot be followed as written, they may be used as general guidance with any and all modifications fully documented in either QA Plans, Sampling Plans, or final reports of results.

Each Standard Operating Procedure in this compendium contains a discussion on quality assurance/quality control (QA/QC). For more information on QA/QC objectives and requirements, refer to the *Quality Assurance/Quality Control Guidance for Removal Activities*, OSWER directive 9360.4-01, EPA/540/G-90/004.

Questions, comments, and recommendations are welcomed regarding the Compendium of ERT Surface Water and Sediment Sampling Procedures. Send remarks to:

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## List of Exhibits

## Acknowledgments

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# 1.0 SAMPLING EQUIPMENT DECONTAMINATION: SOP #2006

## 1.1 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) describes methods used for preventing or reducing cross-contamination, and provides general guidelines for sampling equipment decontamination procedures at a hazardous waste site. Preventing or minimizing cross-contamination in sampled media and in samples is important for preventing the introduction of error into sampling results and for protecting the health and safety of site personnel.

Removing or neutralizing contaminants that have accumulated on sampling equipment ensures protection of personnel from permeating substances, reduces or eliminates transfer of contaminants to clean areas, prevents the mixing of incompatible substances, and minimizes the likelihood of sample cross-contamination.

## 1.2 METHOD SUMMARY

Contaminants can be physically removed from equipment, or deactivated by sterilization or disinfection. Gross contamination of equipment requires physical decontamination, including abrasive and non-abrasive methods. These include the use of brushes, air and wet blasting, and high-pressure water cleaning, followed by a wash/rinse process using appropriate cleaning solutions. Use of a solvent rinse is required when organic contamination is present.

## 1.3 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

This section is not applicable to this SOP.

## 1.4 INTERFERENCES AND POTENTIAL PROBLEMS

- The use of distilled/deionized water commonly available from commercial vendors may be acceptable for decontamination of sampling equipment provided that it has been verified by laboratory analysis to be analyte free.
- An untreated potable water supply is not an acceptable substitute for tap water. Tap water may be used from any municipal water treatment system for mixing of decontamination solutions.
- Acids and solvents utilized in the decontamination sequence pose the health and safety risks of inhalation or skin contact, and raise shipping concerns of permeation or degradation.
- The site work plan must address disposal of the spent decontamination solutions.
- Several procedures can be established to minimize contact with waste and the potential for contamination. For example:
    - Stress work practices that minimize contact with hazardous substances.
    - Use remote sampling, handling, and container-opening techniques when appropriate.
    - Cover monitoring and sampling equipment with protective material to minimize contamination.
    - Use disposable outer garments and disposable sampling equipment when appropriate.

## 1.5 EQUIPMENT/APPARATUS

- appropriate personal protective clothing
- non-phosphate detergent
- selected solvents
- long-handled brushes
- drop cloths/plastic sheeting
- trash container
- paper towels
- galvanized tubs or buckets
- tap water

- distilled/deionized water
- metal/plastic containers for storage and disposal of contaminated wash solutions
- pressurized sprayers for tap and deionized/distilled water
- sprayers for solvents
- trash bags
- aluminum foil
- safety glasses or splash shield
- emergency eyewash bottle

## 1.6 REAGENTS

There are no reagents used in this procedure aside from the actual decontamination solutions and solvents. In general, the following solvents are utilized for decontamination purposes:

- 10% nitric acid[1]
- acetone (pesticide grade)[2]
- hexane (pesticide grade)[2]
- methanol

[1] Only if sample is to be analyzed for trace metals.
[2] Only if sample is to be analyzed for organics.

## 1.7 PROCEDURES

As part of the health and safety plan, develop and set up a decontamination plan before any personnel or equipment enter the areas of potential exposure. The equipment decontamination plan should include:

- the number, location, and layout of decontamination stations
- which decontamination apparatus is needed
- the appropriate decontamination methods
- methods for disposal of contaminated clothing, apparatus, and solutions

### 1.7.1 Decontamination Methods

All personnel, samples, and equipment leaving the contaminated area of a site must be decontaminated. Various decontamination methods will either physically remove contaminants, inactivate contaminants by disinfection or sterilization, or do both.

In many cases, gross contamination can be removed by physical means. The physical decontamination techniques appropriate for equipment decontamination can be grouped into two categories: abrasive methods and non-abrasive methods.

#### *Abrasive Cleaning Methods*

Abrasive cleaning methods work by rubbing and wearing away the top layer of the surface containing the contaminant. The following abrasive methods are available:

- Mechanical: Mechanical cleaning methods use brushes of metal or nylon. The amount and type of contaminants removed will vary with the hardness of bristles, length of brushing time, and degree of brush contact.

- Air Blasting: Air blasting is used for cleaning large equipment, such as bulldozers, drilling rigs or auger bits. The equipment used in air blast cleaning employs compressed air to force abrasive material through a nozzle at high velocities. The distance between the nozzle and the surface cleaned, as well as the pressure of air, the time of application, and the angle at which the abrasive strikes the surface, determines cleaning efficiency. Air blasting has several disadvantages: it is unable to control the amount of material removed, it can aerate contaminants, and it generates large amounts of waste.

- Wet Blasting: Wet blast cleaning, also used to clean large equipment, involves use of a suspended fine abrasive delivered by compressed air to the contaminated area. The amount of materials removed can be carefully controlled by using very fine abrasives. This method generates a large amount of waste.

#### *Non-Abrasive Cleaning Methods*

Non-abrasive cleaning methods work by forcing the contaminant off of a surface with pressure. In general, less of the equipment surface is removed using non-abrasive methods. The following non-abrasive methods are available:

- High-Pressure Water: This method consists of a high-pressure pump, an operator-controlled directional nozzle, and a high pressure hose. Operating pressure usually ranges from 340 to 680 atmospheres (atm) which relates to flow rates of 20 to 140 liters per minute.

- Ultra-High-Pressure Water: This system produces a pressurized water jet (from 1,000 to 4,000 atm). The ultra-high-pressure spray removes tightly-adhered surface film. The water velocity ranges from 500 m/sec (1,000 atm) to 900 m/sec (4,000 atm). Additives can enhance the method. This method is not applicable for hand-held sampling equipment.

### *Disinfection/Rinse Methods*

- Disinfection: Disinfectants are a practical means of inactivating infectious agents.

- Sterilization: Standard sterilization methods involve heating the equipment. Sterilization is impractical for large equipment.

- Rinsing: Rinsing removes contaminants through dilution, physical attraction, and solubilization.

### 1.7.2 Field Sampling Equipment Cleaning Procedures

Solvent rinses are not necessarily required when organics are not a contaminant of concern and may be eliminated from the sequence specified below. Similarly, an acid rinse is not required if analysis does not include inorganics.

1. Where applicable, follow physical removal procedures specified in section 1.7.1.

2. Wash equipment with a non-phosphate detergent solution.

3. Rinse with tap water.

4. Rinse with distilled/deionized water.

5. Rinse with 10% nitric acid if the sample will be analyzed for trace organics.

6. Rinse with distilled/deionized water.

7. Use a solvent rinse (pesticide grade) if the sample will be analyzed for organics.

8. Air dry the equipment completely.

9. Rinse again with distilled/deionized water.

Selection of the solvent for use in the decontamination process is based on the contaminants present at the site. Use of a solvent is required when organic contamination is present on-site. Typical solvents used for removal of organic contaminants include acetone, hexane, or water. An acid rinse step is required if metals are present on-site. If a particular contaminant fraction is not present at the site, the nine-step decontamination procedure listed above may be modified for site specificity. The decontamination solvent used should not be among the contaminants of concern at the site.

Table 1 lists solvent rinses which may be required for elimination of particular chemicals. After each solvent rinse, the equipment should be air dried and rinsed with distilled/deionized water.

Sampling equipment that requires the use of plastic tubing should be disassembled and the tubing replaced with clean tubing, before commencement of sampling and between sampling locations.

## 1.8 CALCULATIONS

This section is not applicable to this SOP.

## 1.9 QUALITY ASSURANCE/ QUALITY CONTROL

One type of quality control sample specific to the field decontamination process is the rinsate blank. The rinsate blank provides information on the effectiveness of the decontamination process employed in the field. When used in conjunction with field blanks and trip blanks, a rinsate blank can detect contamination during sample handling, storage and sample transportation to the laboratory.

Table 1: Recommended Solvent Rinse for Soluble Contaminants

| SOLVENT | SOLUBLE CONTAMINANTS |
|---|---|
| Water | • Low-chain hydrocarbons<br>• Inorganic compounds<br>• Salts<br>• Some organic acids and other polar compounds |
| Dilute Acids | • Basic (caustic) compounds<br>• Amines<br>• Hydrazines |
| Dilute Bases -- for example, detergent and soap | • Metals<br>• Acidic compounds<br>• Phenol<br>• Thiols<br>• Some nitro and sulfonic compounds |
| Organic Solvents[(1)] - for example, alcohols, ethers, ketones, aromatics, straight-chain alkanes (e.g., hexane), and common petroleum products (e.g., fuel, oil, kerosene) | • Nonpolar compounds (e.g., some organic compounds) |

[(1)] - WARNING: Some organic solvents can permeate and/or degrade protective clothing.

A rinsate blank consists of a sample of analyte-free (i.e, deionized) water which is passed over and through a field decontaminated sampling device and placed in a clean sample container.

Rinsate blanks should be run for all parameters of interest at a rate of 1 per 20 for each parameter, even if samples are not shipped that day. Rinsate blanks are not required if dedicated sampling equipment is used.

## 1.10 DATA VALIDATION

This section is not applicable to this SOP.

## 1.11 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA and specific health and safety procedures.

Decontamination can pose hazards under certain circumstances even though performed to protect health and safety. Hazardous substances may be incompatible with decontamination methods. For example, the decontamination solution or solvent may react with contaminants to produce heat, explosion, or toxic products. Decontamination methods may be incompatible with clothing or equipment; some solvents can permeate or degrade protective clothing. Also, decontamination solutions and solvents may pose a direct health hazard to workers through inhalation or skin contact, or if they combust.

The decontamination solutions and solvents must be determined to be compatible before use. Any method that permeates, degrades, or damages personal protective equipment should not be used. If decontamination methods pose a direct health hazard, measures should be taken to protect personnel or the methods should be modified to eliminate the hazard.

# 2.0 SURFACE WATER SAMPLING: SOP #2013

## 2.1 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) is applicable to the collection of representative liquid samples, both aqueous and nonaqueous from streams, rivers, lakes, ponds, lagoons, and surface impoundments. It includes samples collected from depth, as well as samples collected from the surface.

## 2.2 METHOD SUMMARY

Sampling situations vary widely and therefore no universal sampling procedure can be recommended.

However, sampling of both aqueous and non-aqueous liquids from the above mentioned sources is generally accomplished through the use of one of the following samplers or techniques:

- Kemmerer bottle
- bacon bomb sampler
- dip sampler
- direct method

These sampling techniques will allow for the collection of representative samples from the majority of surface waters and impoundments encountered.

## 2.3 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Once samples have been collected, follow these procedures:

1. Transfer the sample(s) into suitable labeled sample containers.

2. Preserve the sample if appropriate, or use pre-preserved sample bottles.

3. Cap the container, put it in a Ziploc plastic bag and place it on ice in a cooler.

4. Record all pertinent data in the site logbook and on a field data sheet.

5. Complete the chain of custody form.

6. Attach custody seals to the cooler prior to shipment.

7. Decontaminate all sampling equipment prior to the collection of additional samples.

## 2.4 INTERFERENCES AND POTENTIAL PROBLEMS

There are two primary interferences or potential problems with surface water sampling. These include cross-contamination of samples and improper sample collection.

- Cross-contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary. Refer to ERT SOP #2006, Sampling Equipment Decontamination.

- Improper sample collection can involve using contaminated equipment, disturbance of the stream or impoundment substrate, and sampling in an obviously disturbed area.

Following proper decontamination procedures and minimizing disturbance of the sample site will eliminate these problems.

## 2.5 EQUIPMENT/APPARATUS

Equipment needed for collection of surface water samples includes:

- Kemmerer bottles
- bacon bomb sampler
- dip sampler
- line and messengers
- sample bottle preservatives
- Ziploc bags
- ice
- cooler(s)
- chain of custody forms, field data sheets

- decontamination equipment
- maps/plot plan
- safety equipment
- compass
- tape measure
- survey stakes, flags, or buoys and anchors
- camera and film
- logbook/waterproof pen
- sample bottle labels

## 2.6 REAGENTS

Reagents will be utilized for preservation of samples and for decontamination of sampling equipment. The preservatives required are specified by the analysis to be performed. Decontamination solutions are specified in ERT SOP #2006, Sampling Equipment Decontamination.

## 2.7 PROCEDURES

### 2.7.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and which equipment and supplies are needed.

2. Obtain necessary sampling and monitoring equipment.

3. Decontaminate or preclean equipment, and ensure that it is in working order.

4. Prepare scheduling and coordinate with staff, clients, and regulatory agency, if appropriate.

5. Perform a general site survey prior to site entry in accordance with the site-specific health and safety plan.

6. Use stakes, flags, or buoys to identify and mark all sampling locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.

### 2.7.2 Sampling Considerations

*Representative Samples*

In order to collect a representative sample, the hydrology and morphometrics (e.g., measurements of volume, depth, etc.) of a stream or impoundment should be determined prior to sampling. This will aid in determining the presence of phases or layers in lagoons or impoundments, flow patterns in streams, and appropriate sample locations and depths.

Water quality data should be collected in impoundments to determine if stratification is present. Measurements of dissolved oxygen, pH, and temperature can indicate if strata exist which would effect analytical results. Measurements should be collected at 1-meter intervals from the substrate to the surface using an appropriate instrument, such as a Hydrolab (or equivalent).

Water quality measurements such as dissolved oxygen, pH, temperature, conductivity, and oxidation-reduction potential can assist in the interpretation of analytical data and the selection of sampling sites and depths anytime surface water samples are collected.

Generally, the deciding factors in the selection of a sampling device for sampling liquids in streams, rivers, lakes, ponds, lagoons, and surface impoundments are:

- Will the sample be collected from the shore or from a boat on the impoundment?

- What is the desired depth at which the sample is to be collected?

- What is the overall depth and flow direction of river or stream?

*Sampler Composition*

The appropriate sampling device must be of a proper composition. Samplers constructed of glass, stainless steel, PVC or PFTE (Teflon) should be used based upon the analyses to be performed.

### 2.7.3 Sample Collection

*Kemmerer Bottle*

Kemmerer bottle (Figure 1, Appendix A) may be used in most situations where site access is from a boat or structure such as a bridge or pier, and where samples at depth are required. Sampling procedures are as follows:

1. Using a properly decontaminated Kemmerer bottle, set the sampling device so that the sampling end pieces are pulled away from the sampling tube, allowing the substance to be sampled to pass through this tube.

2. Lower the pre-set sampling device to the predetermined depth. Avoid bottom disturbance.

3. When the Kemmerer bottle is at the required depth, send down the messenger, closing the sampling device.

4. Retrieve the sampler and discharge the first 10 to 20 mL to clear any potential contamination on the valve. Transfer the sample to the appropriate sample container.

### *Bacon Bomb Sampler*

A bacon bomb sampler (Figure 2, Appendix A) may be used in similar situations to those outlined for the Kemmerer bottle. Sampling procedures are as follows:

1. Lower the bacon bomb sampler carefully to the desired depth, allowing the line for the trigger to remain slack at all times. When the desired depth is reached, pull the trigger line until taut.

2. Release the trigger line and retrieve the sampler.

3. Transfer the sample to the appropriate sample container by pulling the trigger.

### *Dip Sampler*

A dip sampler (Figure 3, Appendix A) is useful for situations where a sample is to be recovered from an outfall pipe or along a lagoon bank where direct access is limited. The long handle on such a device allows access from a discrete location. Sampling procedures are as follows:

1. Assemble the device in accordance with the manufacturer's instructions.

2. Extend the device to the sample location and collect the sample.

3. Retrieve the sampler and transfer the sample to the appropriate sample container.

### *Direct Method*

For streams, rivers, lakes, and other surface waters, the direct method may be utilized to collect water samples from the surface. This method is not to be used for sampling lagoons or other impoundments where contact with contaminants are a concern.

Using adequate protective clothing, access the sampling station by appropriate means. For shallow stream stations, collect the sample under the water surface pointing the sample container upstream. The container must be upstream of the collector. Avoid disturbing the substrate. For lakes and other impoundments, collect the sample under the water surface avoiding surface debris and the boat wake.

When using the direct method, do not use pre-preserved sample bottles as the collection method may dilute the concentration of preservative necessary for proper sample preservation.

## 2.8 CALCULATIONS

This section is not applicable to this SOP.

## 2.9 QUALITY ASSURANCE/ QUALITY CONTROL

There are no specific quality assurance activities which apply to the implementation of these procedures. However, the following general QA/QC procedures apply:

- All data must be documented on field data sheets or within site logbooks.

- All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

## 2.10 DATA VALIDATION

This section is not applicable to this SOP.

## 2.11 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA and specific health and safety procedures.

More specifically, when sampling lagoons or surface impoundments containing known or suspected hazardous substances, take adequate precautions. The sampling team member collecting the sample should not get too close to the edge of the impoundment, where bank failure may cause him or her to lose their balance. The person performing the sampling should be on a lifeline and be wearing adequate protective equipment. When conducting sampling from a boat in an impoundment or flowing waters, follow appropriate boating safety procedures.

# 3.0 SEDIMENT SAMPLING: SOP #2016

## 3.1 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) is applicable to the collection of representative sediment samples. Analysis of sediment may determine whether concentrations of specific contaminants exceed established threshold action levels, or if the concentrations present a risk to public health, welfare, or the environment.

The methodologies discussed in this procedure are applicable to the sampling of sediment in both flowing and standing water. They are generic in nature and may be modified in whole or part to meet the handling and analytical requirements of the contaminants of concern, as well as the constraints presented by the sampling area. However, if modifications occur, they should be documented in the site logbook or report summarizing field activities.

For the purposes of this procedure, sediments are those mineral and organic materials situated beneath an aqueous layer. The aqueous layer may be either static, as in lakes, ponds, or other impoundments or flowing, as in rivers and streams.

## 3.2 METHOD SUMMARY

Sediment samples may be recovered using a variety of methods and equipment, depending on the depth of the aqueous layer, the portion of the sediment profile required (surface versus subsurface), the type of sample required (disturbed versus undisturbed) and the sediment type.

Sediment is collected from beneath an aqueous layer either directly, using a hand-held device such as a shovel, trowel, or auger, or indirectly using a remotely activated device such as an Ekman or Ponar dredge. Following collection, the sediment is placed into a container constructed of inert material, homogenized, and transferred to the appropriate sample containers. The homogenization procedure should not be used if sample analysis includes volatile organics.

## 3.3 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

- Chemical preservation of solids is generally not recommended. Cooling is usually the best approach, supplemented by the appropriate holding time.

- Wide-mouth glass containers with Teflon-lined caps are utilized for sediment samples. The sample volume is a function of the analytical requirements and will be specified in the work plan.

- Transfer sediment from the sample collection device to an appropriate sample container using a stainless steel or plastic lab spoon or equivalent. If composite samples are collected, place the sediment sample in a stainless steel, plastic or other appropriate composition (e.g.: Teflon) bucket, and mix thoroughly to obtain a homogeneous sample representative of the entire sampling interval. Then place the sediment sample into labeled containers.

- Samples for volatile organic analysis must be collected directly from the bucket, before mixing the sample, to minimize loss due to volatilization of contaminants.

- All sampling devices should be decontaminated, then wrapped in aluminum foil. The sampler should remain in this wrapping until it is needed. Each sampler should be used for only one sample. Dedicated samplers for sediment samples may be impractical due to the large number of sediment samples which may be required and the cost of the sampler. In this case, samplers should be cleaned in the field using the decontamination procedure described in ERT SOP# 2006, Sampling Equipment Decontamination.

## 3.4 INTERFERENCES AND POTENTIAL PROBLEMS

Substrate particle size and organic content are directly related to water velocity and flow characteristics of a body of water. Contaminants are more likely to be concentrated in sediments typified by fine particle size and a high organic content. This type of sediment is most likely to be collected from depositional zones. In contrast, coarse sediments with low organic content do not typically concentrate pollutants and are found in erosional zones. The selection of a sampling location can, therefore, greatly influence the analytical results.

## 3.5 EQUIPMENT/APPARATUS

Equipment needed for collection of sediment samples includes:

- maps/plot plan
- safety equipment
- compass
- tape measure
- survey stakes, flags, or buoys and anchors
- camera and film
- stainless steel, plastic, or other appropriate composition bucket
- 4-oz., 8-oz., and one-quart, wide-mouth jars w/Teflon-lined lids
- Ziploc plastic bags
- logbook
- sample jar labels
- chain of custody forms, field data sheets
- cooler(s)
- ice
- decontamination supplies/equipment
- spade or shovel
- spatula
- scoop
- trowel
- bucket auger
- thin-walled auger
- extension rods
- T-handle
- sampling trier
- sediment coring device (tubes, points, drive head, drop hammer, "eggshell" check valve devices, acetate cores)
- Ponar dredge
- Ekman dredge
- nylon rope

## 3.6 REAGENTS

Reagents are not used for preservation of sediment samples. Decontamination solutions are specified in ERT SOP #2006, Sampling Equipment Decontamination.

## 3.7 PROCEDURES

### 3.7.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and which equipment and supplies are required.

2. Obtain necessary sampling and monitoring equipment.

3. Decontaminate or preclean equipment, and ensure that it is in working order.

4. Prepare schedules, and coordinate with staff, client, and regulatory agencies, if appropriate.

5. Perform a general site survey prior to site entry in accordance with the site-specific health and safety plan.

6. Use stakes, flags, or buoys to identify and mark all sampling locations. Specific site characteristics, including flow regime, basin morphometry, sediment characteristics, depth of overlying aqueous layer, and extent and nature of contaminant should be considered when selecting sample location. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.

### 3.7.2 Sample Collection

Selection of a sampling device is most often contingent upon: (1) the depth of water at the sampling location, and (2) the physical characteristics of the medium to be sampled.

*Sampling Surface Sediments with a Trowel or Scoop From Beneath a Shallow Aqueous Layer*

Collection of surface sediment from beneath a shallow aqueous layer can be accomplished with tools such as spades, shovels, and scoops. Surface material can be removed to the required depth; then a stainless steel or plastic scoop should be used to collect the sample.

This method can be used to collect consolidated sediments but is limited somewhat by the depth of the aqueous layer. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sample team member. A stainless steel or plastic scoop or lab spoon will suffice in most applications. Care should be exercised to avoid the use of devices plated with chrome or other materials. Plating is particularly common with garden trowels.

Follow these procedures to collect sediment samples with a scoop or trowel:

1. Using a precleaned stainless steel scoop or trowel, remove the desired thickness of sediment from the sampling area.

2. Transfer the sample into an appropriate sample or homogenization container.

### *Sampling Surface Sediments with a Thin-Wall Tube Auger From Beneath a Shallow Aqueous Layer*

This system consists of an auger, a series of extension rods, and a "T" handle (see Figure 4, Appendix A). The auger is driven into the sediment and used to extract a core. A sample of the core is taken from the appropriate depth.

Use the following procedure to collect sediment samples with a thin-walled auger:

1. Insert the auger into the material to be sampled at a 0° to 45° angle from vertical. This orientation minimizes spillage of the sample from the sampler. Extraction of samples may require tilting of the sampler.

2. Rotate the auger once or twice to cut a core of material.

3. Slowly withdraw the auger, making sure that the slot is facing upward.

4. An acetate core may be inserted into the auger prior to sampling, if characteristics of the sediments or body of water warrant. By using this technique, an intact core can be extracted.

5. Transfer the sample into an appropriate sample or homogenization container.

### *Sampling Deep Sediments with Augers and Thin-Wall Tube Samplers From Beneath a Shallow Aqueous Layer*

This system uses an auger, a series of extension rods, a "T" handle, and a thin-wall tube sampler (Figure 4, Appendix A). The auger bores a hole to a desired sampling depth and then is withdrawn. The auger tip is then replaced with a tube core sampler, lowered down the borehole, and driven into the sediment at the completion depth. The core is then withdrawn and the sample collected. This method can be used to collect consolidated sediments, but is somewhat limited by the depth of the aqueous layer.

Several augers are available which include bucket and posthole augers. Bucket augers are better for direct sample recovery, are fast, and provide a large volume of sample. Posthole augers have limited utility for sample collection as they are designed more for their ability to cut through fibrous, rooted, swampy areas.

Follow these procedures to collect sediment samples with a hand auger:

1. Attach the auger bit to a drill extension rod, then attach the "T" handle to the drill extension rod.

2. Clear the area to be sampled of any surface debris.

3. Begin augering, periodically removing any accumulated sediment from the auger bucket.

4. After reaching the desired depth, slowly and carefully remove the auger from boring. (When sampling directly from the auger, collect sample after the auger is removed from boring and proceed to Step 10.)

5. Remove auger tip from drill rods and replace with a precleaned thin-wall tube sampler. Install proper cutting tip.

6. Carefully lower tube sampler down borehole. Gradually force tube sampler into sediment.

Care should be taken to avoid scraping the borehole sides. Also, avoid hammering of the drill rods to facilitate coring, since the vibrations may cause the boring walls to collapse.

7. Remove tube sampler and unscrew drill rods.

8. Remove cutting tip and remove core from device.

9. Discard top of core (approximately 1 inch), as this represents material collected by the tube sampler before penetration of the layer of concern.

10. Transfer sample into an appropriate sample or homogenization container.

### *Sampling Surface Sediments From Beneath a Deep Aqueous Layer with an Ekman or Ponar Dredge*

This technique consists of lowering a sampling device to the sediment by use of a rope, cable, or extended handle. The mechanism is triggered, and the device entraps sediment in spring-loaded jaws, or within lever-operated jaws.

Follow these procedures for collecting sediment with an Ekman dredge (Figure 5, Appendix A):

1. Thread a sturdy nylon or stainless steel cable through the bracket, or secure the extended handle to the bracket with machine bolts.

2. Attach springs to both sides. Arrange the Ekman dredge sampler so that the jaws are in the open position and trip cables are positioned over the release studs.

3. Lower the sampler to a point just above the sediment surface.

4. Drop the sampler sharply onto the sediment.

5. Trigger the jaw release mechanism by lowering a messenger down the line, or by depressing the button on the upper end of the extended handle.

6. Raise the sampler and slowly decant any free liquid through the top of the sampler. Be careful to retain fine sediments.

7. Open the dredge and transfer the sediment into a stainless steel or plastic bucket. Continue to collect additional sediment until sufficient material has been secured. Thoroughly mix sediment to obtain a homogeneous sample, and then transfer to the appropriate sample container.

8. Samples for volatile organic analysis must be collected directly from the bucket before mixing the sample to minimize volatilization of contaminants.

Follow these procedures for collecting sediment with a Ponar dredge (Figure 6, Appendix A):

1. Attach a sturdy nylon or steel cable to the hook provided on top of the dredge.

2. Arrange the Ponar dredge sampler in the open position, setting the trip bar so the sampler remains open when lifted from the top.

3. Slowly lower the sampler to a point just above the sediment.

4. Drop the sampler sharply into the sediment, then pull sharply up on the line, thus releasing the trip bar and closing the dredge.

5. Raise the sampler to the surface and slowly decant any free liquid through the screens on top of the dredge. Be careful to retain fine sediments.

6. Open the dredge and transfer the sediment to a stainless steel or plastic bucket. Continue to collect additional sediment until sufficient material has been gained. Thoroughly mix sediment to obtain a homogeneous sample, and then transfer to the appropriate sample container.

7. Samples for volatile organic analysis must be collected directly from the bucket before mixing the sample to minimize volatilization of contaminants.

### *Sampling Subsurface Sediments From Beneath a Deep Aqueous Layer with a Sample Coring Device*

Follow these procedures when using a sample coring device (Figure 7, Appendix A) to collect subsurface sediments. It consists of a coring device, handle, and acetate core utilized in the following procedure:

1. Assemble the coring device by inserting the acetate core into the sampling tube.

2. Insert the "eggshell" check valve mechanisms into the tip of the sampling tube with the convex surface positioned inside the acetate core.

3. Screw the coring point onto the tip of the sampling tube.

4. Screw the handle onto the upper end of the sampling tube and add extension rods as needed.

5. Place the sampler in a perpendicular position on the material to be sampled.

6. This sampler may be used with either a drive hammer for firm consolidated sediments, or a "T" handle for soft sediments. If the "T" handle is used, place downward pressure on the device until the desired depth is reached. Rotate the sampler to shear off the core of the bottom, retrieve the device and proceed to Step 15.

7. If the drive hammer is selected, insert the tapered handle (drive head) of the drive hammer through the drive head.

8. With left hand holding the tube, drive the sampler into the material to the desired depth. Do not drive the tube further than the tip of the hammer's guide.

9. Record the length of the tube that penetrated the sample material, and the number of blows required to obtain this depth.

10. Remove the drive hammer and fit the keyhole-like opening on the flat side of the hammer onto the drive head. In this position, the hammer serves as a handle for the sampler.

11. Rotate the sampler at least two revolutions to shear off the sample at the bottom.

12. Lower the sampler handle (hammer) until it just clears the two ear-like protrusions on the drive head, and rotate about 90°.

13. Withdraw the sampler by pulling the handle (hammer) upwards and dislodging the hammer from the sampler.

14. Unscrew the coring point and remove the "eggshell" check valve.

15. Slide the acetate core out of the sampler tube. The acetate core may be capped at both ends. The sample may be used in this fashion, or the contents transferred to a stainless steel or plastic bucket and mixed thoroughly to obtain a homogeneous sample representative of the entire sampling interval.

16. Samples for volatile organic analysis must be collected directly from the bucket before mixing the sample to minimize volatilization of contaminants.

## 3.8 CALCULATIONS

This section is not applicable to this SOP.

## 3.9 QUALITY ASSURANCE/ QUALITY CONTROL

There are no specific quality assurance activities which apply to the implementation of these procedures. However, the following QA/QC procedures apply:

1. All data must be documented on field data sheets or within site logbooks.

2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

## 3.10 DATA VALIDATION

This section is not applicable to this SOP.

## 3.11 HEALTH AND SAFETY

When working with potentially hazardous materials follow U.S. EPA, OSHA and specific health and safety procedures.

More specifically, when sampling sediment from bodies of water containing known or suspected hazardous substances, adequate precautions must be taken to ensure the sampler's safety. The team member collecting the sample should not get too close to the edge of the water, where bank failure may cause him or her to lose their balance. To prevent this, the person performing the sampling should be on a lifeline, and be wearing adequate protective equipment. If sampling from a vessel is necessary, implement appropriate protective measures.

# APPENDIX A

Figures

Figure 1: Kemmerer Bottle

SOP #2013

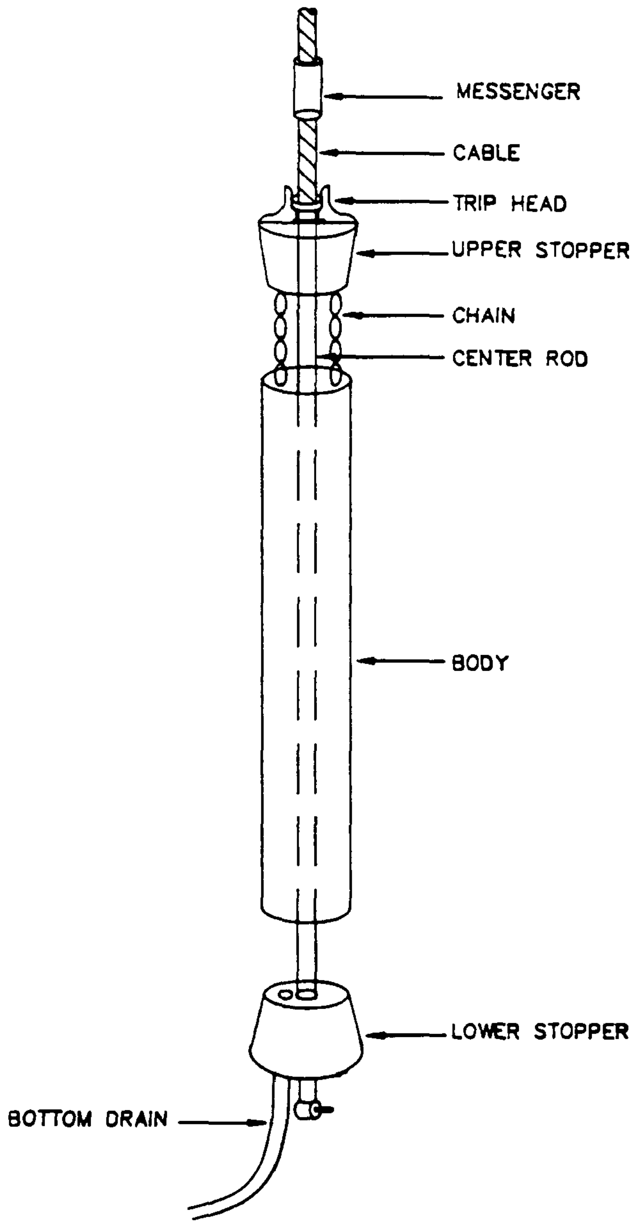


Figure 2: Bacon Bomb Sampler

SOP #2013

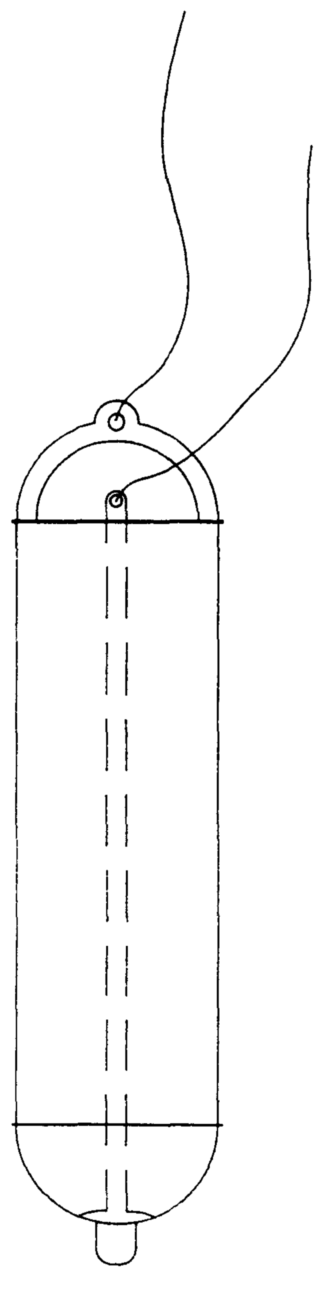


Figure 3: Dip Sampler

SOP #2013

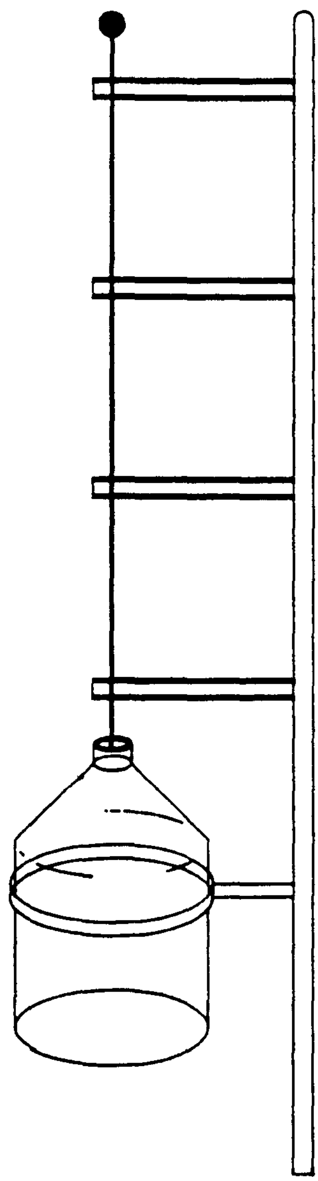


Figure 4: Sampling Auger

SOP #2016

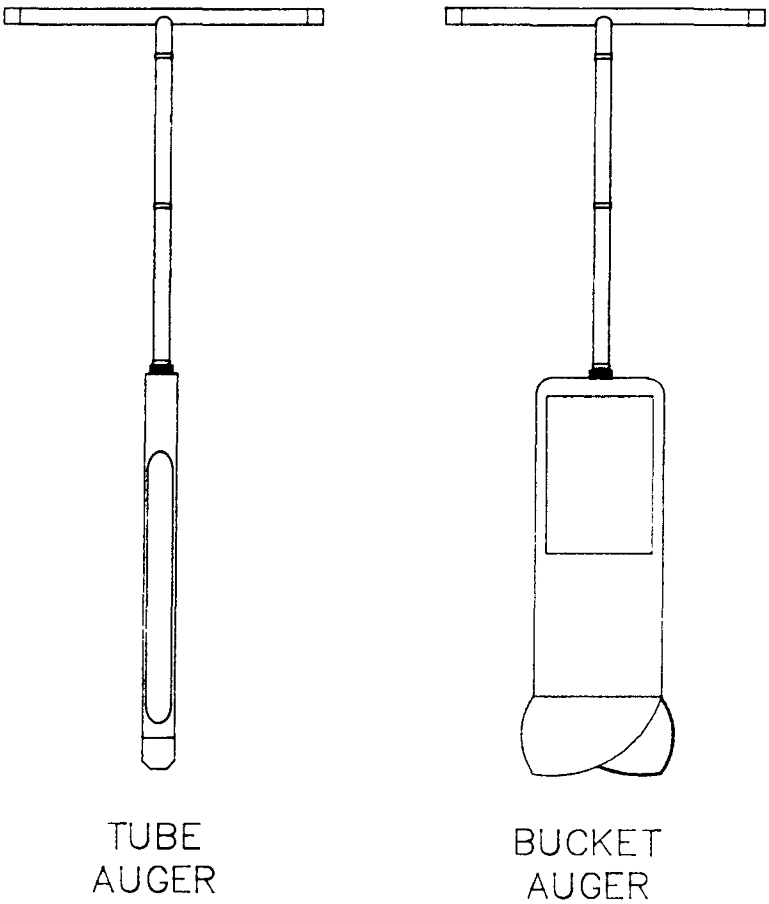


Figure 5: Ekman Dredge

SOP #2016

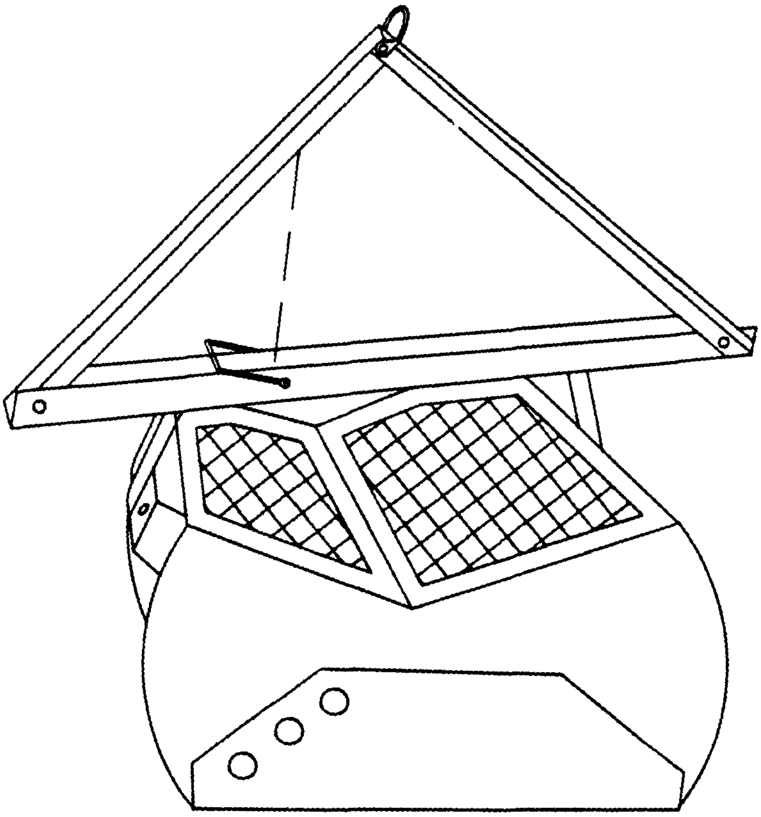


Figure 6: Ponar Dredge

SOP #2016

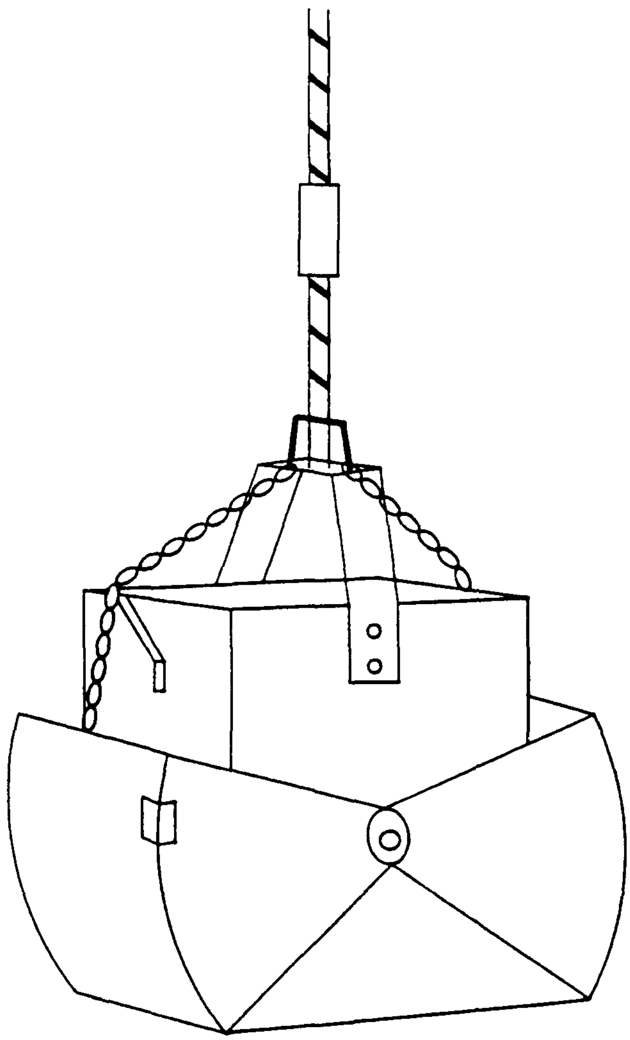
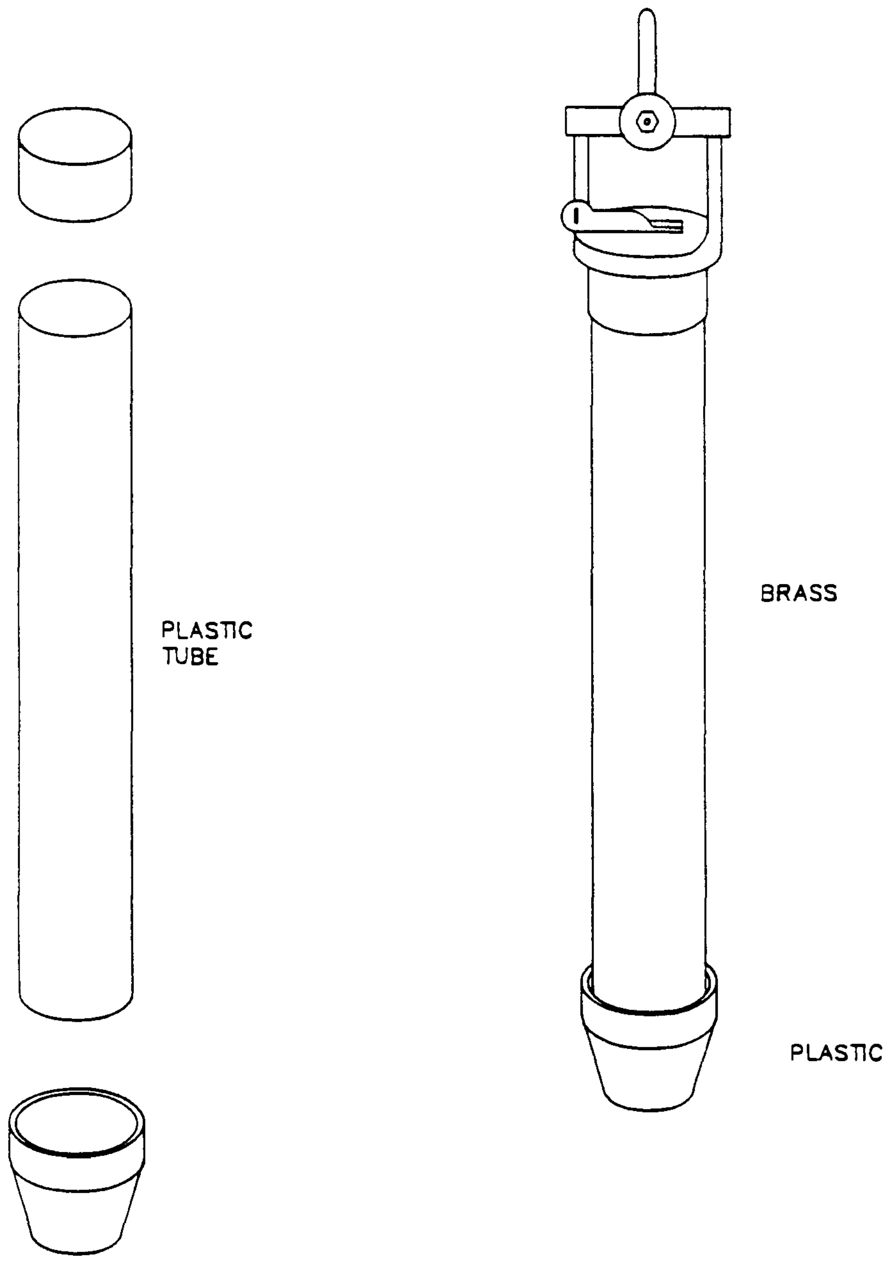


Figure 7: Sample Coring Device

SOP #2016



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