

ATTACHMENT - F

Adjacent Construction Project Manual

Office of Joint Development & Adjacent Construction



Washington Metropolitan Area Transit Authority
600 Fifth Street, NW
Washington, DC 20001

September 21, 2015 (Revision 5a)

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Preface

The Washington Metropolitan Area Transit Authority's (WMATA) Adjacent Construction Project Manual is prepared in the interest of and for the guidance of those who may contemplate construction activities that are adjacent to, beneath, on, or over existing WMATA property, facilities, roadway and/or operating Rights of Way.

The Manual outlines the general procedures and process requirements that must be followed when working in close proximity to any WMATA facility. It also covers WMATA design requirements, design review procedures, submittals, monitoring requirements, safety & security, operational requirements, real estate & insurance requirements and as-built documentation requirements.

The criteria provided herein are general and provide an overview of the design requirements. WMATA review and approvals are required prior to construction of the project. Refer to the Project Flow Chart and the Typical WMATA Design and Coordination Checklist in [Appendix 1](#).

It is WMATA's policy that projects be reviewed to insure that no adverse impacts will be caused to WMATA operations, systems and facilities and to assure the safe operation of the WMATA system.

The WMATA Office of Joint Development and Adjacent Construction (JDAC) within the Office of **Track Structures & Facilities (TSFA)** in the Department of **Chief Engineer Infrastructure Services (CENI)** has the lead responsibility to review, approve and oversee implementation for compliance with WMATA requirements for all construction adjacent to and/or impacting WMATA interests. This latest update has been issued by JDAC.

This update, Revision 5a (September 21, 2015) includes updated coordination and design requirements for joint development and adjacent construction projects.

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[Appendix 6 - Real Estate, Insurance & Design Criteria Section 9 – Right-of-Way](#)

[Appendix 7 - As-Built Documentation & Closeout](#)

[Abbreviations](#)

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Contact Information

Link to JDAC Adjacent Construction Manual:

http://www.wmata.com/business/joint_development_opportunities/adjacent_construction_information.cfm

WMATA Joint Development Adjacent Construction:

Email: **JDAC@WMATA.com**

WMATA Web Address: <http://www.wmata.com/>

For Emergency Use Only:

WMATA Department of System Safety & Environmental Management (SAFE):
(202) 962-1057 or 1-888-637-1329 (24 hr. pager)

WMATA Transit Police: (202) 962-2121

WMATA MOCC: (202) 962-1530

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Introduction and General Procedures

This Manual describes WMATA offices (WMATA) review, approval and operational support process for projects proposed adjacent to, on, over, or under WMATA property and/or facilities which may impact an existing WMATA facility, the Roadway, bus routes and/or bus stops.

Section 1 - General Procedures / Review Process

1.1 Overview

WMATA will review plans for projects adjacent to, on, over, or under WMATA property and joint development projects to ensure that: (1) WMATA facilities and operations are not damaged or affected by the proposed project; (2) WMATA operations are not impacted during and after the proposed project construction; (3) WMATA station capacity is not affected by the ridership generated by these projects; and (4) facilities being built for WMATA to own, operate and maintain comply with WMATA Design Criteria, Administrative and Technical Specifications, Standard Drawings, Design Drawings and this Manual.

Each project will be assigned a unique Project Control Number (PCN). This number must be referenced in all communications with WMATA.

Construction plans will be reviewed to determine whether the proposed construction falls within WMATA's Zone of Influence (ZOI), as defined in Section 3 of this Manual, and whether the project will have an impact on WMATA's facilities or revenue operations.

It is the general policy of WMATA to review the design for the construction of projects adjacent to, on, over, or under WMATA property on a case-by-case basis.

The Owner/Developer/Contractor (ODC) will provide a study/report showing that any additional ridership generated by a project will not cause current Metro station facility capabilities to be exceeded. The study must include mitigation measures if the proposed project adversely impact WMATA. This may include, but not limited to, required expansion of facilities such as the station entrances, elevators, escalators, fare gates, fare vending machines and station mezzanines etc. The costs of any new facilities or revisions to existing facilities will be borne by the ODC. These requirements will be coordinated with all involved parties.

A flow chart is included in [Appendix 1](#) showing the necessary steps and time requirements for adjacent construction project start-up. These are minimum time frames which could be extended depending on the complexity and scope of the project. ODCs are to consider this when developing the project schedule.

- A.** The ODC is to submit design and construction documents to the WMATA Office of Joint Development and Adjacent Construction (JDAC).
 - 1.** The ODC shall provide sufficient drawings and details showing project plan and cross sections to evaluate whether the proposed construction will or

will not be in WMATA's ZOI. Construction plans will not be approved until this information is confirmed.

2. To insure proper coordination of the project, one (1) person shall be designated by the ODC to WMATA as the authorized point of contact to represent the project (including tiered subcontractors and designers). All contact from WMATA to the project will be through the designated representative.

B. The ODC will be advised of WMATA review findings as follows:

1. **No impact.** Letter confirming no impact.
2. **Impact.** Letter Agreement, assigned Project Control Number (PCN), and assignment of WMATA JDAC Project Manager (PM), Construction Engineer (CE) and Construction Inspection Facilitator (CIF).

C. The CE is the point of contact for project reviews and approvals, real estate entry permit, interface and coordination with operations and maintenance offices. The CIF coordinates field activities and oversight. The PM/CE/CIF coordinate with WMATA staff for this work as necessary.

D. All project communications must include the PM/CE/CIF in addition to the PCN.

1.2 Costs

JDAC determines which projects will have impact to WMATA. The services of WMATA's staff are invoiced to the project to provide necessary oversight of the work and ensures that WMATA's interests are protected. Costs, as determined by the Authority, are based on the estimated Level of Support required by the project, and construction schedule duration of the project. Once a project has been identified as having impact to WMATA, the ODC will be advised as to the estimated costs for supporting the project. **Payment is required prior to WMATA completing any review or the ODC accessing WMATA property.**

A. WMATA will require a lump sum advance payment of the estimated cost to coordinate and process project submittals, access requests, reviews and other support required of the project by this Manual and the Authority. This includes, but is not limited to, the following:

1. Reviews
2. Operational Support (e.g., escorts, flagging, support services)
3. Operational adjustments (e.g., bus bridging, single tracking, bus detours)
4. Coordinating and monitoring of construction

- 5. Administrative costs
 - 6. Third-party consultant support (e.g., reviews, inspections, testing)
 - 7. Lost revenue (e.g., lost parking revenue)
 - 8. Modification, repair and/or purchase and installation of any facilities as a result of the Project
- B.** Costs for operational support, and support services for adjacent construction and joint development projects where access is required into the operating Metrorail system, or where other WMATA facilities are impacted, will be invoiced separately project by project.
 - C.** Costs for Revenue Service Adjustments and/or modified service such as, shutdowns, single tracking or bus route modifications will be additional and determined on the approval of the Site Specific Work Plan (SSWP) requirements.

Costs for easement, right of entry, or acquisition of WMATA property interests will be invoiced separately from WMATA's Office of Real Estate and Station Planning (LAND).

- D.** All correspondence, payments, etc. shall reference the unique PCN.

1.3 Requests for WMATA Asbuilt Drawings

- A.** To obtain electronic files of WMATA's as-built records, the ODC must submit a completed Document Request Form (DRF) [Appendix 1](#). WMATA conducts background checks of the ODC representative. Upon WMATA approval of the request, JDAC will provide PDF's of the requested records to the ODC, if available.
- B.** ODC shall field verify, document and engineer their proposed project relative to existing WMATA facilities and utilities in accordance with the applicable sections of this Manual.

1.4 Submittals

Submittals are to be submitted to the CE electronically through WMATA's electronic data management system (EDMS) – Procore. The submittals should include a cover sheet, such as, a transmittal. Additionally, ODC shall provide multiple hard copies (quantity to be determined for each project, but not less than (3) of each submission for WMATA review.

- A.** Project design: General plans of the project showing relative proximity of the work specific to WMATA interests. Where WMATA interests are impacted, specific detailed plans of the work are to be provided.
 - 1. Designs for the protection, support and underpinning of existing WMATA structures will be coordinated internally within WMATA's Offices by JDAC.

WMATA underground structures shall be fully re-evaluated for the effects caused by the adjacent construction, using working stress methods. The stresses and deflections induced in the existing WMATA structures shall be provided. The short-term and long-term effects of the new loading due to the adjacent construction on the WMATA structures shall be provided. The soil parameters and other pertinent geotechnical criteria contained herein shall be used to analyze the existing WMATA structures. WMATA structures shall be analyzed for differential pressure loadings caused by dewatering the adjacent construction site.

2. The ODC shall maintain, protect, and be responsible for the safety, stability, and integrity of all adjacent WMATA structures which may be affected by the work.
3. The ODC shall submit dimensioned clearances, both horizontal and vertical, between the adjacent construction project and WMATA structures, tracks, roadways, parking areas, and utilities. WMATA's easements / right-of-way must be clearly identified on all site plans. Project encroachment(s) shall be specifically identified.
4. Details of the proposed modifications to WMATA's facilities, roadways, parking areas, and busways shall be provided. Include sections and details showing the interface of existing and proposed facilities.
5. Provide cross sections with the existing and proposed contours and limits of grading work shown in relation to the property lines and the impact on or to WMATA facilities. Where grading changes are required on WMATA property, provide the dimensions and square footage of the area required for construction easements.
6. Hydrologic and hydraulic calculations showing the impacts on the WMATA drainage system are required if storm drainage from the proposed development is to be discharged into the existing WMATA drainage system. Storm discharge must be reviewed and approved by WMATA in advance and will require a real estate permit/agreement. Appropriate sedimentation and erosion control measures should be included.

NOTE: No ODC may use WMATA's drainage system for their use either temporary or permanent.

7. Where modifications to WMATA utilities are required by adjacent construction, submit for review cross sections, plan and profiles, specifications and design calculations concerning the utility modifications. Details for maintaining utility services to WMATA facilities shall be shown when WMATA utilities are impacted.
8. Where construction will impact a WMATA station entrance, parking facilities, bus facilities and the public's access to the station, the submittal shall include plans for temporary pedestrian and vehicular traffic circulation

for the area around the station entrance. Where construction is adjacent to or above a WMATA station entrance, protection will be required over the pedestrian areas, escalators and elevators. Provide signed and sealed construction plans, shop drawings, or working drawings showing the phasing of adjacent construction as well as the construction details for overhead protection, pedestrian barricades, and sidewalk protection. Requests for relocation of bus stops and bus shelters shall be clearly shown on the plans. Barricades and signage necessary to direct the public through the construction zone shall be required. Lighting shall be required as part of all overhead protection structures.

9. Provide for review and approval, design and construction documents for projects requiring an expansion of WMATA station facilities. This may include additional or expanded entrances, additional fare gates, fare collection equipment, additional or expanded mezzanines and vertical circulation elements, etc.
10. Provide construction protection details to preclude impacts on WMATA landscaping, street furniture, pylons, bus shelters, and light fixtures.
11. When a gas line is proposed to be installed under a WMATA track, WMATA tunnel, WMATA power feeds or other facility, provide the safety measures to be taken, sleeve or safety jacket, etc., so that WMATA track, tunnel or other facilities would be protected in case of gas leaks and/or explosion.
12. Any and all power requirements are the responsibility of the ODC. Temporary and/or permanent use of WMATA power systems is prohibited.

B. The following is a partial list of potential submittals required:

1. Civil Drawings - site plan showing all existing conditions, including building and basement level(s), parcel limit, distances from WMATA facilities, structures, and utilities. Show demolition area if any. NOTE: No bioretention pond or open water feature is allowed over or near WMATA facilities.
2. Architectural Drawings - showing new project layout, including plans, elevations and sections.
3. Structural Drawings - showing foundation plans, elevations, sections, and loads.
4. Geotechnical report.
5. Signed and sealed Calculations.

6. Support of Excavation, Structural monitoring and contingency plans. ODC shall allow sufficient time (recommend initial submittal not less than six (6) months in advance of scheduled construction) for review and approval of plans. NOTE: ODC shall refer to Section 3 for support of excavation details.
7. A construction sequence and heavy equipment plan shall be submitted indicating the position and loading of major construction equipment, particularly equipment within the WMATA ZOI, and/or crane positions including crane swing radius, which operate with potential to foul WMATA Roadway, impact to any WMATA facility, pedestrian and vehicular access areas.
8. Permanent easement and/or property disposition. Submission is required of a sealed survey plat illustrating the proposed impact to WMATA's property interests, certified legal survey descriptions (Metes & Bounds), and a certified boundary survey tying the project survey into WMATA's coordinate system. This shall be developed and submitted with initial Support of Excavation plans. It is recommended that all impacts to WMATA property interests be addressed in this submittal. Allow a minimum of six (6) months to conclude the review and approval process for issues involving support of excavation and property impact issues.
9. Preconstruction survey data.
10. Material and catalog cut information, Material Safety Data Sheets (MSDS).
11. Insurance policies and certificates of insurance which conform to standard WMATA insurance requirements and coverages including railroad protective liability insurance requirements (as applicable).
12. Updated construction schedule bar chart which is specific to impact on WMATA facilities, Roadway and/or coordination efforts. The project bar schedule should clearly illustrate work activity impact to WMATA facilities and adjacent construction support / coordination requirements from WMATA personnel.
13. Phasing plans and Maintenance of Traffic (MOT) plans which should include pedestrian and vehicular impacts.
14. Drainage area maps and calculations, as necessary.
15. Electrical drawings, photometric studies and lighting plans, as applicable
16. Simulation studies for traction power, as applicable
17. Blasting, monitoring and contingency plans, as applicable

18. Safety and protection plans, as applicable
19. Other materials as requested by WMATA.

1.5 Review Procedures

- A. Design work will be reviewed based upon the assumption that the design will meet all applicable codes adopted in the jurisdiction as well as the current WMATA Design Criteria, Design Drawings, Standard Drawings, Administrative and Technical Specifications as well as the ACPM.
- B. Permits, where required by the local jurisdiction, utility agencies and railroads shall be the responsibility of the ODC. Copies of these permits must be provided to the CE.
- C. WMATA review periods - The ODC should allow **no less than** a period of thirty (30) business days for each WMATA review of submittals. Reviews are conducted on a 'first-come-first-served' basis. Incomplete submissions will delay the review process and may be returned. ODC is responsible to ensure that submissions comply with WMATA's requirements.
- D. Allow thirty (30) business days for each successive review.
- E. Use of JDAC's Comment-Response Matrix will be required for all review comments and responses on submittals.
- F. WMATA's acceptance of the ODC project documents will remain in effect for a 120 day period (4 calendar months) or as previously agreed to by WMATA. If the project goes dormant or does not advance to the next phase the ODC will be required to provide WMATA with written certification that the previously accepted submittals are still valid.
- G. Construction documents approved by WMATA and changed by the ODC must be resubmitted for approval.

1.6 Access to WMATA Roadway and Facilities

Depending on the nature and extent of impact a project may have on the WMATA system, access to the Roadway/Wayside (tracks) and non-Wayside facilities may be necessary. All work within WMATA's Roadway must be performed during non-revenue hours or as approved in advance. WMATA cannot guarantee that the ODC will be able to work within the scheduled non-revenue hours. This access will assist in completing pre and post construction inspections, installation and removal of monitoring equipment, and surveying locations of existing installations.

- A. WMATA Contractor ID Badge is required for all personnel that will be accessing any WMATA property and/or facilities. The following forms must be completed and submitted to obtain the required ID badge.

1. [Certification for Issuance of Metro SmarTrip® Contractor Badge](#)
 - a. Complete the upper section (Contractor Employee Name, SS number).
 - b. Provide the form(s) to the assigned CE or CIF who will complete Section 1.
 - c. All ODC personnel entering WMATA's Roadway and facilities are required to have cleared a background check before a badge will be issued.
 2. [Acknowledgement and Authorization for Background Screening](#) is to be completed by the requestor.
 3. Both forms must be hand delivered to WMATA's ID Office.
 4. The ID Badges are good for a maximum of one (1) year.
- B.** Completion of the WMATA's Contractor Roadway Worker Protection Training course is required for all personnel designated for wayside work and any electrical facility.
1. Training is provided by WMATA Department of System Safety and Risk Management (SAFE) at no cost to the ODC. Scheduling should be coordinated through the assigned CE or CIF.
 2. The ODC will be charged if the employee fails to attend the scheduled training class.
- C.** A completed Site Specific Work Plan (SSWP)
- D.** The ODC must submit a JDAC Support Request (JSR) Form for any work activities on WMATA property that will require operational support.
1. A JSR is required for each activity (event).
 2. An SSWP must be submitted for all work activities on WMATA property regardless if the activity requires operational support.
- E.** For any operational support, a JDAC Daily Support Tracking Form must be completed. See [Appendix 5](#). The completed form must be signed and emailed to the CIF/CE by the next business day.
- F.** An executed real estate permit and insurances are required to work on WMATA property or perform work which may impact WMATA interests. Reference Section 6 and Appendices for WMATA real estate permit and insurance requirements.
- G.** Upon receipt of executed permit the ODC shall contact JDAC's Supervisor of Field Projects a minimum of ten (10) days in advance of scheduling the required pre-

construction site meeting. A checklist of the requirements that will be discussed at the onsite pre-construction meeting is included in [Appendix 1](#).

1.7 Field Monitoring

- A.** Monitoring of the temporary support of excavation structures for adjacent construction shall be required in all cases for excavations within WMATA's ZOI and as deemed required by WMATA. The extent of monitoring will vary from project to project depending on each project's specific impacts.
- B.** The ODC shall develop a plan to monitor affected WMATA facilities, structures and/or tunnels.
- C.** Monitoring of the inside of WMATA tunnels and structures will be required when the adjacent excavation will change the loads on, or could cause movement of the WMATA structure or tunnel. For this purpose, a pre-construction survey of the WMATA structures, will be required and will serve as the monitoring baseline reading. Escorts will be required for the survey parties entering the WMATA operating system in accordance with WMATA Operating Regulations.
- D.** The ODC shall monitor conformance with the approved staging plans effecting WMATA operations.

1.8 Regular Bridge Inspection and Painting

WMATA will support regular bridge inspections and painting by local jurisdictions and states (ODC's) within WMATA's Roadway. This section does not exempt the ODC from any applicable section of this Manual.

- A.** Most inspections and/or painting activities will occur from the ground at track level using ladders or from overhead via the bridge deck by use of a snoopers truck or similar equipment. Since, in both cases, the inspection will be within the WMATA Roadway, Section 1.6, Access to WMATA Roadway and Facilities, applies to the ODC.
- B.** WMATA will review the safety plan as provided in the SSWP. The ODC must submit the work description, plans, materials, MSDS, protection and schedule. In addition to the type, size and location of the bridge, the ODC must depict the inspection and painting equipment for WMATA review. Any structure that will be installed to perform the work must be submitted for review. Note that there is no WMATA equipment available for ODC use.
- C.** WMATA will estimate costs in accordance with Section 1.2 of this manual. All work will be performed during non-revenue hours. The ODC will provide a copy of the bridge inspection report at the completion of the work for WMATA's record.

1.9 Potential Impacts to Bus Routes and Stops

For any project that will affect a Metrobus stop or route, permanently or temporarily, the ODC will initiate contact with JDAC and the Office of Bus Planning (BPLN) metrobusplanning@wmata.com. Provide a description and plans of any affected bus stops and/or routes in the project area.

1.10 Project closeout

The ODC must advise WMATA in writing when project construction impacting WMATA is complete and ensure all WMATA punch list items have been completed. In accordance with WMATA's real estate permits, as-built documentation is also a project requirement where permanent modifications are being made on, above, below, or to WMATA property. WMATA requires as-built documentation be submitted in accordance with WMATA format requirements in AutoCAD and PDF formats on a CD. See Section 7 Asbuilt Documentation and Closeout.

In addition to the above, all financial obligations must be met.

1.11 Miscellaneous

- A.** If uncertainty exists on the possible impacts a project may have on the WMATA facilities and before making a formal application for a review of a construction project adjacent to the Metro System, the ODC must contact JDAC for assessment of the project impact.
- B.** Contract drawings and specifications shall contain a general notes section outlining the scope of work and manner of prosecution of the proposed transit improvement and impacts thereto.
- C.** WMATA reserves the right to place JDAC CIF or other WMATA personnel on the site to observe the effects of the project's construction on WMATA's facilities.

Section 2 - NOT USED

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Section 3 - Design Requirements and Considerations

General Note: Specific designs performed by the Authority, or its consultants may not necessarily be in conformance with the current WMATA Design Criteria or this Manual's appendices. It is considered the Owner/Developer/Contractor (ODC) responsibility to obtain the original design computations, where available, from WMATA to completely understand the original design intent in order to accurately assess the impact of their proposed construction on WMATA structures, facilities and utilities.

3.1 Geotechnical Criteria, Structural Loadings and Zone of Influence

- A.** Geotechnical/Structural evaluation of the adjacent construction shall be based on WMATA's Standard Design Specifications and the WMATA Design Criteria. WMATA facilities are considered to be affected by the adjacent construction when the proposed excavation and construction is in the WMATA Zone of Influence (ZOI). Existing WMATA deep foundations, retaining walls, and underground utility lines are considered to be a part of WMATA facilities.
- B.** Zone of Influence:
- The four following criteria shall be considered in determining WMATA ZOI. If any one of the four criteria applies, the proposed adjacent construction or excavation is considered to be within WMATA ZOI.
1. If the proposed excavation is within 25 feet (horizontal / plan dimension) of a WMATA facility. If the proposed augering of soldier piles and bearing piles are within 25 feet of WMATA facilities.
 2. An envelope starting at a point two feet below the lowest point of the underground structure or excavation continuing upward at a forty five (45) degree angle from the horizontal at the vertical projection of the outside limits of the WMATA structure.
 3. An envelope starting at a point two feet below the lowest point of WMATA structure continuing upwards at forty five (45) degree angle from the horizontal line, up to the horizontal projection of the outside limits of the adjacent structure or excavation, projected at grade level. The (45) degree influence line defining WMATA ZOI envelope should extend until it intersects existing ground line as depicted on plate A-2A ([Appendix 3](#)).
 4. If the proposed rock blasting operation is within 100 feet of WMATA facilities.
- C.** If the proposed construction will be located within the WMATA ZOI the WMATA Design Criteria and Standard Specifications shall be utilized for design and construction of the portion of the proposed facility within the WMATA ZOI.

- D. When the structure adjacent to an existing WMATA structure is required to support or provide resistance to re-establish the 'Long Term' loading on WMATA's structure(s), adjacent structure(s) should be designed for loads accordingly. In the case of uncertainty, the developer must contact WMATA for clarification before design begins.

3.2 Earth Pressure Criteria

- A. The at-rest coefficient of earth pressure (K_o) is expressed as:
$$K_o = 1 - \sin\Phi$$

- B. The active coefficient of earth pressure (K_a) is expressed as:
$$K_a = \tan^2(45 - \Phi/2)$$

- C. The passive coefficient of earth pressure (K_p) is expressed as:
$$K_p = \tan^2(45 + \Phi/2)$$

In these equations the effective friction angle (Φ) should be taken from Table 3-3 of this Manual's [Appendix 3](#), and cohesion, c , shall be considered to be zero.

[If a geotechnical report is prepared, and submitted to WMATA, based on sufficient job specific borings and other geotechnical investigation, other values of effective friction angle (Φ) may be used at the sole discretion of WMATA.]

- D. Plate A-4 in [Appendix 3](#), presents the vertical pressure distribution to be assumed for the loads from the adjacent construction. The effect of resulting lateral loads due to the adjacent construction shall be added along with the vertical pressures, on WMATA structures.
- E. Underpinning Protection Requirements - Plate Nos. A-3A and A-3B in [Appendix 3](#), depict the zone in which underpinning will be required as a result of construction adjacent to WMATA structures. The same principle shall be applied to determine the effects that proposed construction may have on other WMATA facilities.

3.3 Support of Excavation - Design Criteria and Underpinning Provisions

- A. Lateral design loadings to be used for adjacent construction projects are shown in [Appendix 3](#), Plate A-1A and Plate A-1B. Plate A-6A and A-6B show temporary construction loads that shall be added to the lateral earth pressures when developing the horizontal forces acting on the proposed support of excavation.
- B. The original basic design loadings used for the design of WMATA structures and tunnels are presented in [Appendix 3](#), Plate Nos. A-5A, A-5B, A-7A and A-7B. These diagrams are presented to indicate the earth pressure used in the original design of the WMATA facilities. Thus, if the changed earth pressures due to the proposed excavation and construction can be maintained within the limits of the original design pressures (for example the short term loading and the long term loading) at all times, the structural analysis of the existing WMATA facilities can be eliminated, with prior approval of WMATA.

If the tunnel or structure was originally designed by NATM Method, the ODC shall provide a structural adequacy check, based on procedure or computer program

acceptable to WMATA, on WMATA structures. This requirement may be waived at the Authority's discretion.

For tunnels and other structures in rock, the ODC shall provide a structural adequacy check, based on the loading provided in this Manual or based on procedure or computer program acceptable to WMATA, on WMATA structures. This requirement may be waived at the Authority's discretion.

C. For construction proposed within the ZOI the following analyses shall be included in the submission:

1. Establish diagrams illustrating the pressures used in the design, including the long term / existing pressures on the underground WMATA structures. Illustrate the variation in the existing pressures due to the various construction phases, including full excavation to subgrade (which may control) and when the structure is complete. A structural evaluation will not be required if the proposed pressures/loads on WMATA structures are within the limits of WMATA's initial structural design.

If the proposed pressures/loads on WMATA's structures fall outside initial design limitations (of WMATA structures), then a structural analysis will be required to verify that the anticipated earth pressures will not cause over stressing or cracking. The analysis must be submitted for WMATA review and approval. The Authority, may at its sole discretion, waive such an analysis based on the amount of variation in pressures / loads acting on WMATA structures.

2. The design for the excavation support system shall include consideration of a deep seated slope stability analysis of the soldier pile or sheeting wall.

D. As necessary, or if required by WMATA, an analysis shall be provided of the existing WMATA structure for the anticipated loads.

E. Provide the details of any proposed construction dewatering or groundwater drawdown planned during the adjacent construction. Settlement analysis of the existing WMATA facilities shall be performed if the foundations are founded in a subsurface strata of loose material with a thickness of more than 5 feet.

F. If laid back slopes are used at the top of excavation support system, and if they are steeper than one vertical to one and a half horizontal, a slope stability analysis shall be provided.

3.4 Support of Excavation - General Requirements and Provisions

A. The design of the temporary structures shall be the responsibility of the ODC. This section presents minimum design and construction requirements to facilitate WMATA review of support of excavation submittals.

B. Temporary structures may be designed with laid back slopes as long as the soil loads are taken as equivalent to the full height of the excavation from the subgrade

under the working slab to the original street grade or surface elevation of the soil before excavation.

- C. If design criteria and/or methods given in any of the Reference Standards differ with a criteria and/or method explicitly stated in this Manual, then this Manual's criteria and/or method shall govern.
- D. The support systems acceptable to WMATA are steel soldier piles with timber lagging, steel sheet piles, slurry (diaphragm) walls, secant pile walls, tangent pile walls secured in place with bracing members such as walers, rakers, shores, struts and ground anchors. Also for small utility trenching, trench boxes are acceptable. Approval of any other methods of support of excavation will be at the sole discretion of WMATA.

3.5 Design Pressures

- A. Lateral Earth Pressure and Groundwater Pressure. The basic horizontal earth pressures shall be computed using the active earth pressure. The resultant or total active earth pressure shall be multiplied by a stiffness factor depending upon the required stiffness. The resulting load shall be redistributed on the cofferdam in a trapezoidal pressure diagram similar to that shown in Plate A-1A or A-1B of [Appendix 3](#). The stiffness factors shall be applied to both the cofferdam design and the bracing system. The stiffness factors shall be assigned as follows:
 - 1. Use stiffness factor = 1.25 for a soldier pile and lagging or a sheet pile support system.
 - 2. Use stiffness factor = 1.5 for a slurry wall, secant and tangent pile wall support system.

If the water table is above the subgrade, and if de-watering is not done, consider the effect of the lateral water pressure and modify the active earth pressure accordingly.

- B. Depending upon the type of soil, the ordinate of the resultant trapezoidal pressure diagram in pounds per square foot shall be at least equal to 25H (for a soil with $\Phi=38$ degrees, and a stiffness factor of 1.25) and 29H (for a soil with $\Phi=38$ degrees, and a stiffness factor of 1.50), where H = the height in feet of the excavation between the subgrade under the working slab and the surface of the ground. The bottom of a laid back slope at the top of the cofferdam shall not be used as the upper limit in determining the value of H. Any other excavation support systems (not accepted by WMATA in Section No. 3.4B), with the exception of soil nailing walls, shall be designed for at-rest earth pressure ($K_0\gamma_s H$) and full water pressure.

Appropriate soil and rock properties listed in [Appendix 3](#), Table No. 3-3, shall be used in computing soil pressures and other analysis. Note that cohesion of soil shall not to be considered in the analysis (cohesion, $c = 0$), for all types of soils.

- C. Ground water pressures shall be estimated based upon the existing water levels or on permissible drawdown levels, plus an allowance for seasonal variation. Where soldier beams with wood lagging are to be used, ground water may be assumed to be below the level of the interior excavation subgrade. When the shoring wall is intended to prevent all leakage of ground water the exterior water level shall be used and accounted for in the design.
- D. The passive earth pressure available to resist the forces placed upon the temporary support structure shall be computed using the conventional expressions for passive earth pressure. Friction forces on the cofferdam shall be ignored. A safety factor of 1.5 shall be used when computing the theoretical passive resistance. The passive earth pressure should be reduced with consideration of slopes and berms in front of the support system.
- E. Frictional forces shall be considered only on the embedded soldier pile length below the subgrade when balancing the vertical forces imparted to the support structure by rakers or tiebacks. Determine the allowable bearing capacity by applying a safety factor of 3.0 to the ultimate bearing capacity.
- F. The trapezoidal shaped pressure diagram as shown in Plate A-1A of [Appendix 3](#) is applicable only for a multi-level tieback, strut or raker support system. A triangular shaped pressure diagram, as illustrated in Plate A-1B of [Appendix 3](#), shall be used for the single level strut, raker, or tieback support system.
- G. Surcharge Pressure. The structural support system design shall consider the effects of all loads resulting from construction equipment, construction trailers, supported utilities, stockpiled materials, cranes, concrete trucks, and non-underpinned buildings adjacent to the excavation. Minimum surcharge pressure is shown in Plate A-1A, Plate A-1B and Plate A-6A of [Appendix 3](#), which is based on a vertical construction surcharge of 600 pounds per square foot acting adjacent to the excavation. For more severe construction loading a special analysis shall be conducted.
- H. Base Stability of Excavation. The stability of the base of the excavation must be evaluated for all excavation support systems. The evaluation shall consider piping due to seepage, unbalanced external forces, base stability of cohesive soils, etc. An acceptable method of evaluating the stability of the base of the excavation shall be in accordance with the procedures presented in the US Navy Design Manual 7.02, Foundations and Earth Structures.

3.6 Structural Excavation Support Elements

- A. The excavation construction sequence and its effect on the struts, corner braces or diagonal struts, rakers, walers and soldier piles shall be examined for the various stages of partial excavation. The condition where the soldier pile is assumed to be continuous over the brace immediately above the excavated level may produce a condition of maximum loading in the support structure. The excavation support members shall be sized accordingly. For raker bracing system use reduced passive pressure acting on the soldier beams due to the soil sloping down from the edge of berms, for the partially excavated conditions.

When the support of excavation is closer than 10 feet (horizontal dimension) to the WMATA vent structures/ shafts, station locations or underground tunnel sections, WMATA may require the ODC to provide a stiff support system (e.g. slurry walls, tangent walls, etc.) and other means of support of excavation (such as soil grouting). The requirement may also include restricting the spacing of soldier piles to 4 feet maximum, and restricting the spacing of supports (rakers, tiebacks, etc.) to 8 feet maximum. It is recommended that the ODC discuss the support of excavation within ten (10) feet (horizontal dimension) of structures with WMATA before commencing such support design.

- B.** Soldier piles generally shall be designed as simply supported beams, spanning between points of support. In analyzing intermediate stages of excavation, the soldier pile shall be assumed to be continuous across the lowest level of bracing. The embedment length of soldier piles below the design subgrade shall be analyzed for the horizontal resistance required to provide a support point below the subgrade. The maximum horizontal resistance on the soldier beams flange may be assumed to be three times the ordinary passive pressure computed for the width of the flange, or the width/diameter of pre-augured hole when filled with a minimum of 3500 psi concrete, but not to exceed the passive pressure based on the spacing of soldier piles. The minimum embedment length shall be ten (10) feet.
1. For soldier piles terminating in sound or relatively sound rock and subgrade is located below the top of rock, with minimum 3 feet clearance from the excavation edge, minimum embedment in rock shall be five feet.
 2. For soldier piles terminating in weathered rock and subgrade located below the top of rock within 10 feet, minimum embedment in rock is 3 feet below subgrade or 3 feet below auger refusal. The soldier pile shall be laterally supported in an approved manner before the start of rock excavation.
 3. For soldier piles terminating in weathered rock and subgrade located at 10 feet or greater below the top of rock, minimum embedment in rock is 5 feet below auger refusal. The soldier pile shall be laterally supported in an approved manner before the start of rock excavation.
- C.** All structural steel members in the excavation support structure should be sized using **Allowable Stress Design** (Working Stress Method) in the AISC Steel Construction Manual, latest edition. Neither the design axial stress can be reduced nor the permissible allowable bending stress and combined stress ratio be increased for the excavation support structure. SOE design calculations must consider the effects of combined axial, torsional, and flexural loads in the structure and its elements.

Bracing members, such as struts, corner braces, cross struts, rakers, etc., should be designed, other than self-weight, for an additional lateral load, equal to 2% of maximum design axial load and imposed on bracing members in both lateral directions, applied to produce maximum flexure on the members.

The stability of laterally unsupported members and unsupported span lengths should be considered in the design of the supporting members. The use of pin

piles or lacing may be required provided the above stress requirement is not satisfactory.

The pin pile design is presumed as 2% of maximum design axial load of abutted bracings in both horizontal and vertical directions. The lacing design load is assumed to be 2% maximum axial load of abutted main support members.

D. The structural support system design must recognize the effects of all loads resulting from construction equipment, construction trailers, supported utilities, stockpiled materials, cranes, concrete trucks, and non-underpinned buildings adjacent to the excavation. The loading shown in Plate A-6A of [Appendix 3](#) will provide the minimum surcharge loading.

E. Soldier piles shall ordinarily be spaced from four to seven feet on centers. A maximum spacing of eight feet on centers will be allowed where soil conditions are granular. Timber lagging shall have a minimum flexural stress of 1100 pounds per square inch and three inches minimum thickness for soldier piles spaced 7 feet apart and for excavated depths of up to 25 feet. Timber lagging, four inches thick, shall be used in excavations below 25 feet. For other pile spacing, conditions and types of lagging the design details shall be submitted for approval. Soldier pile and lagging walls shall be analyzed in accordance with requirements presented herein.

F. The vertical spacing of bracing tiers shall not exceed 12 feet center to center. The maximum length of unsupported soldier pile between the surface of the ground and the first brace shall not exceed six feet. Deflections in the soldier piles shall not exceed $\frac{1}{2}$ inch. The soldier pile bearing capacity and the soldier pile deflections shall be calculated and included in the calculations.

Cantilevered soldier piles may be used for shallow excavation provided the maximum cantilever length does not exceed 7 feet and the maximum deflection does not exceed $\frac{1}{2}$ inch.

G. Wales may be designed as simply supported beams, spanning between points of support, or as continuous across points of support, depending upon, fabrication and installation details. Axial load shall be considered in the design of wales, as appropriate. Wale deflection shall not exceed $\frac{1}{4}$ inch.

H. Struts and Rakers shall be designed for axial load, torsional and flexural loads as appropriate. Struts and Rakers shall be laterally braced in accordance with the requirements of the current edition of the AISC Steel Construction Manual. Strut and Raker sections shall be chosen to limit deflections to the above requirements.

In addition, for support systems in which braces are installed between opposite sides of excavation (cross-lot struts), design and construct support on both sides to obtain comparable restraint and rigidity.

I. Tiebacks shall be deformed steel bars with a minimum guaranteed ultimate tensile strength (GUTS) of 150,000 pounds per square inch or seven-wire stress relieved steel strand for pre-stressed concrete with a guaranteed ultimate tensile stress (GUTS) of 270,000 pounds per square inch. Tiebacks must be installed and tested in accordance with Section 3.7.

The ODC shall ensure that minimum clearances of tiebacks free length and the anchored length shall be at least 5 feet and 10 feet, respectively from the existing WMATA facilities. Tieback construction procedures shall take every precaution to minimize ground loss. WMATA shall be notified for any changes to the tiebacks / anchors which are made to clear existing utilities (prior to construction).

- J.** When using corner / diagonal bracing, and when the wales do not transfer the load to the other end, analysis shall include calculations required to determine reaction dissipation into the support of excavation wall (soldier piles, slurry walls etc.) on the sides of excavation. If corner bracing is proposed with wales connected at the corners, the corner connection of the wales must be completed after preloading the corner/diagonal bracing.
- K.** Details should be provided on the shop or working drawings indicating how the tieback, strut, or raker loads are to be transmitted from the supporting member through the waler to the soldier pile. Details should include bolted and welded connections, web stiffeners and brackets, dimensions of raker heel blocks, strut lacing, pin piles, jacking lugs and other special details of construction. Illustrate connection details indicating how the forces from the corner braces would be transmitted and dissipated or balanced through the soldier piles and/or walers. Calculations are required for each listed item.
- L.** The sequence and method of construction shall be included on the shop or working drawings. Procedures shall be included for wedging or jacking rakers, loading tiebacks and preloading struts. Details of wedging and jacking to maintain tight contact for all bracing members shall be shown.

 - 1.** Tiebacks shall be preloaded to 140% of the maximum design load and locked off at 100% of the maximum design load.
 - 2.** Struts and rakers **not** used for slurry walls, tangent and secant piles, shall be preloaded to 50% of the maximum design load.
 - 3.** Struts and rakers used to support slurry walls, tangent and secant piles, shall be preloaded to 100% of the maximum design load.
 - 4.** Tieback, raker, and strut loads shall be shown on the shop drawings.
 - 5.** Excavation shall not be allowed to proceed for more than two feet below the point of lateral support before the main bracing members are installed and preloaded. Earth berms are permitted when required for the installation of rakers and heel blocks. Slopes on the berms are to be no steeper than one vertical to one and one half horizontal.
- M.** Bearing capacity for heel blocks shall be analyzed based on accepted methods of analysis of inclined footings, such as are described in the Reference Manuals as listed at the end of this sub-section.

A minimum safety factor of 3 shall be applied to obtain the allowable bearing capacity. The heel block spacing and design shall consider the interaction of the

heel blocks on the supporting soil. Suitable reductions in the allowable bearing capacity of the soil shall be made to account for any overlapping soil stresses.

1. Bowles, Joseph E. "Foundation Analysis and Design", Fourth Edition or Fifth Edition, Chapter 4, Bearing Capacity of Foundations, McGraw-Hill Companies, Inc., New York, N.Y.
 2. United States Naval Facilities Engineering Command, Design Manual 7.02 (NAVFAC DM 7.02), 1986, Foundations and Earth Structures, USNAVFAC, Alexandria, Virginia.
 3. Ralph B. Deck, Walter E. Hanson, and Thomas H. Thorkbur (1974), Foundation Engineering, Second Edition, John Wiley & Sons, Inc.
- N.** Steel sheet piles used adjacent to WMATA structures shall be hot-rolled, steel sheet piles. Lateral soil pressures for sheet piles must be based on undrained condition. For adequate stiffness Z-profile sheet piles are recommended. For sheet piles terminating at top of rock above the base of excavations, the sheet piles shall be laterally supported in an approved manner before the start of rock excavation. Sheet pile deflections shall be calculated and included in the submissions; maximum allowable deflection of sheet piles is ½ inch.
- O.** Slurry (diaphragm) walls consist of structural cast in place concrete walls constructed by tremie placement of concrete in a pre-excavated, slurry filled trench. Slurry wall panels excavated adjacent to WMATA structures shall have a minimum thickness of three (3) feet and maximum length of ten (10) feet. Slurry wall bearing capacity and slurry wall deflections shall be calculated and included in the submissions. Slurry walls shall be analyzed in accordance with the requirements presented herein. For slurry walls terminating at top of rock above the base of excavations, the slurry wall shall be keyed into the rock and laterally supported in an approved manner before the start of rock excavation.
- P.** Secant or tangent pile walls consist of a line of bored piles to form a continuous wall. If the bored piles are tangent or contiguous to each other the wall is tangent pile wall. If the bored pile elements overlap to form an interlocking wall, the wall is called a secant pile wall. Piles shall be reinforced with reinforcing bar cages or structural steel shapes. Secant or tangent pile wall bearing capacity and deflections shall be calculated and included in the submissions. Secant and tangent pile walls shall be analyzed in accordance with the requirements presented herein. For secant and tangent pile walls terminating at top of rock above the base of excavations, the pile wall shall be laterally supported in an approved manner before the start of rock excavation.
- Q.** NATM Shafts may be used with prior approval of WMATA. NATM shafts are shafts constructed using the New Austrian Tunneling Method (NATM). NATM shafts can be constructed in soil and in rock.

NATM shaft construction in soil entails excavation in lifts ranging from three (3) feet to five (5) feet in height. Each lift is supported by a lining girders, normally lattice girders, embedded in shotcrete (sprayed concrete). For all NATM shafts submit supporting design calculations; proposed excavation and support

procedures; proposed groundwater control measures; shotcrete design mix and field trial information; shop drawings for lattice girders, including connection details, rock reinforcement, and welded wire fabric, including details for intermediate anchors between rock reinforcement and lattice girders; concrete mix; formwork design; and concrete placement and consolidation methods.

3.7 Support Systems with Tiebacks

- A.** Install tieback system in accordance with approved working drawings. Install anchorage in soil no closer than a plane extending upward at an angle of 45 degrees to the horizontal from outer limit of lowest depth of excavation. ODC will have to certify that the boundary survey for the proposed tieback / support systems have been tied into WMATA's control coordinates. WMATA's survey control may be located on as-built plans.
- B.** Stress tiebacks to proof loads equal to 140 percent of maximum design load and maintain proof load for 30 minutes prior to reducing to design load. Reject tiebacks which lose more than five percent of proof load during 30-minute period.
- C.** Apply proof loads in increments of five tons at one-minute intervals and provide means to measure load application within accuracy of plus-or-minus five percent.
- D.** After reducing tieback load to design load, encase anchors in grout maintaining design load until anchors are fixed in place.
- E.** In transfer of loads from jacks to support system, use fixation method which will limit load loss to no more than five percent of design load.
- F.** Provide and maintain convenient access and appropriate means to accomplish these observations.
- G.** Preliminary and Creep Tests On Tiebacks:
 - 1.** Reapply proof loads equal to 140 percent of design load at each level of support in excavation on first installation on each side of excavation at horizontal intervals not exceeding 500 feet and wherever there is significant difference in soil in which tiebacks are installed.
 - 2.** As specified for proof loading, apply proof loads in increments of five tons at one-minute intervals. Provide means to measure load applications with an accuracy of plus-or-minus five percent of design load. Maintain proof load for 24 hours prior to reducing it to design load.
 - 3.** Make records of axial movement with incremental applications of load as well as amount and time of load fall-off with no pumping of jack or axial movement during the 24-hour period that proof load on tieback is maintained.
 - 4.** If during the 24-hour period axial deformation of tieback system exceeds 0.02 inch or decrease in jack pressure without pumping is more than five

percent after correcting for temperature changes during the test period, redesign tieback system to satisfy requirements.

3.8 Shop Drawings/Project Drawings

- A.** Copies of the loading records for struts, rakers, tiebacks and the test reports on tiebacks shall be provided to WMATA. The loading records and the test reports shall be signed and sealed by a registered Professional Engineer, licensed to practice in the jurisdiction where the work is being performed.
- B.** Calculations shall be provided for all components of the structural support system required for adjacent construction impacting WMATA's ZOI. The calculations and the drawings shall be signed and sealed by a Professional Engineer, licensed to practice in the jurisdiction where the work is performed. The calculations submitted shall include the following:
 - 1.** A concise statement of the problem and the purpose of the calculation.
 - 2.** Input data, applicable criteria, clearly stated assumptions and justifying rationale.
 - 3.** References to articles, manuals, and source material must be furnished with the calculations.
 - 4.** References to pertinent codes and standards.
 - 5.** Sufficient sketches or drawing references for the work to be easily understood by an independent reviewer. Diagrams indicating data (such as loads and dimensions) shall be included along with adequate sketches of all details not considered standard by WMATA.
 - 6.** The source or derivation of all equations where they are introduced into the calculations.
 - 7.** Numerical calculations shall be clearly shown, orderly and legible; all in English units.
 - 8.** Results and conclusions.
- C.** Include sequence and method of construction on the design drawings. Show details and procedures for wedging or jacking rakers, loading tiebacks and preloading struts and corner braces/struts. The details of wedging and jacking should be such as to maintain tight contact for all bracing members. Tieback, raker and strut loads, sizes and locations shall be shown on the design drawings.
- D.** Maximum size of each sheet will depend on the projects engineering design scale. Minimum requirements for each drawing:
 - 1.** Number and title of the drawing.

2. Date of the drawing and revision date(s).
3. Name of project.
4. Engineering scale.
5. Name of ODC submitting the drawing.
6. Clear identification of contents and location of the work to include delineation of WMATA easements relative to the adjacent work.
7. Title and number of referenced specification sections.
8. Signed and sealed by engineer licensed in the jurisdiction of the proposed project.
9. Other pertinent drawing criteria / documentation:
 - i. Fabrication, erection, layout and setting drawings.
 - ii. Complete list of materials for construction on / directly adjacent to WMATA property.
 - iii. Schedules.
 - iv. Manufacturer's drawings.
 - v. Wiring and control diagrams, as applicable.
 - vi. Catalog cuts or entire catalogs.
 - vii. Descriptive literature
 - viii. Performance test data.
 - ix. Material samples (as required).

E. When computer programs are used to perform calculations, a "User's Manual" shall accompany the calculation. The "User's Manual" shall also include a verification section. The verification section shall describe the verification methods and how they cover all the permitted options and uses of the program.

3.9 Limitations on Construction

- A.** The following construction activities are not permitted within the specified limits of existing WMATA facilities:
1. Excavation under WMATA structures is prohibited, except for access for underpinning.

2. Tunneling under WMATA structures/facilities and tracks is prohibited, unless prior documented approval of WMATA is obtained.
3. Excavation within 10 feet of existing WMATA facilities is prohibited (the 10 feet shall be measured, in plan, from the outside face of the WMATA structure to the crest of slope of any unsupported excavation), unless:

- i. The existing WMATA excavation support system, that was used for construction of the WMATA facility (i.e. soldier piles) can be utilized, with prior approval of WMATA, if the soldier piles can be located, and can be pre-loaded to the required stress level during excavation, without over stressing the WMATA structure.

The capacity of the existing soldier beams shall be based on an allowable flexural stress of 20 ksi. In addition if the soldier beams are corroded or if there is any loss in section, allowance should be made for it. It is essential that the use of existing WMATA excavation system shall not damage the existing waterproofing system; therefore, it is necessary to grout the area between the existing soldier piles to ensure no impact on the existing waterproofing.

Existing soldier piles shall be located by test pit or by geophysical methods supplemented by test pits and the information shall be submitted to WMATA for review.

In addition, when the support of excavation is nearer to WMATA structure or cut-and-cover tunnel than five (5) foot laterally, and is nearer to WMATA bored tunnel than ten (10) foot laterally, and the subgrade of the excavation is below an elevation which is five (5) feet above the bottom of WMATA structure, then provide a rigid support of excavation system like slurry walls, tangent walls or secant walls. Reference Plate A-9 of [Appendix 3](#).

As a rule, WMATA discourages the use of the existing/previous excavation support system, and the use of the existing/previous support system will be at the sole discretion of WMATA. When the ground conditions warrant, use of ground stabilization with flexible support of excavation, in lieu of rigid support of excavation, may be approved by WMATA in its sole discretion.

- ii. An excavation support system, conforming to the requirements of this Manual, shall be installed to protect existing WMATA facilities.
4. Installation of pre-augured piles within five (5) feet (horizontal dimension) of the bored tunnel liners.
5. Pile driving within 25 feet (horizontal dimension) of WMATA structures, and tracks.

6. Blasting shall not occur within 100 feet of WMATA structures without prior approval of WMATA, and unless test blasting that generates a particle velocity-scaled distance relationship indicates that peak particle velocity (PPV) measured at the minimum separation distance between the WMATA structure and proposed blasting locations shall not exceed 2.0 inches per second. (See U.S. Army Corps of Engineers ETL 1110-1-142, Engineering and Design – Blasting Vibration Damage and Noise Prediction and Control, available from www.usace.army.mil). A blast-monitoring program shall be provided to verify compliance.

Measurement of PPV in excess of the requirement stated herein shall require the suspension of blasting operations and revision of blasting procedures to reduce PPV to acceptable limits.

3.10 Installation Criteria

- A. Piles located within 25 feet (horizontal dimension) of existing facilities shall be installed in pre-augured holes. Pre-augured holes shall be protected by either steel casing or drilling mud / slurry to keep the drilled hole open and to prevent ground loss.

Furthermore, these piles shall be embedded at least 10 feet into the strata below the ZOI of the WMATA structure, or should be embedded at least ten (10) feet below the subgrade level as approved by WMATA. The drilled hole around the pile shall be filled with 3500 psi concrete from pile tip to subgrade, and filled with lean concrete from the subgrade to the surface of the ground. Concrete shall be placed using a tremie.

Struts and rakers used to support slurry walls and tangent or secant pile walls shall be preloaded to 100% of their maximum design load. Struts and rakers for steel soldier piles with lagging and sheet pile walls shall be preloaded to a minimum of 50% of their maximum design load (or for any other support system approved by WMATA). When using raker bracing systems, a reduced passive resistance shall be applied for temporary berms during partial excavations.

- B. For tieback installation, the free length and the anchored length shall be at least five (5) feet and ten (10) feet, respectively, from the existing WMATA facilities. Tieback construction procedures shall take every precaution to minimize ground loss. (See Section 3.7 for other requirements of tie-back installation)
- C. A system for monitoring the vertical and horizontal movement of the support of excavation structure shall be submitted for approval.

3.11 Underpinning – General

- A. Underpinning of WMATA structures is required when the WMATA structures fall within the 1:1 influence line of the adjacent construction, see Plate A-3A and Plate A-3B in [Appendix 3](#). The underpinning will be designed to meet the allowable compressive / bearing strength of the soil under the WMATA structure. The allowable bearing capacity shall be determined by applying a safety factor of 3 to ultimate bearing capacity or use allowable bearing pressure contained in [Appendix](#)

[3](#) Table No. 3-3. Alternately, compute ultimate bearing capacity in accordance with procedures in US Naval Facilities Design Manual, NAVFAC DM7.2, Foundations and Earth Structures, Chapter 5, Deep Foundations, ignoring friction and adhesion.

- B.** Location and type of underpinning shall be clearly shown on the excavation support system drawings. When the ground conditions warrant and the WMATA structure load can be supported below the 1:1 slope influence line (Plate A-3B in [Appendix 3](#)), use rigid support of excavation or ground stabilization with flexible support of excavation, in lieu of underpinning if approved by WMATA.
- C.** All proposed underpinning pits shall be clearly shown on the excavation drawings. The size and depth of the pits shall be indicated as well as the stratum into which the underpinning pit is to be excavated. The bearing pressure of the stratum shall be shown together with the lowest pit bearing elevation expected. Details shall be provided for load transfer between underpinning piers and existing foundations (dry packing, etc.).
- D.** Show on the drawings the pit excavation sequence.
- E.** Provide calculations as necessary in support of the drawings.
- F.** Jacked Piles and Bracket Piles may be used for underpinning with WMATA's prior approval.

3.12 Jacked Piles

- A.** Jacked piles may be used for underpinning WMATA structures if installed in accordance with the following criteria.
 - 1.** Approach pit and pile locations shall be shown clearly on excavation support drawings. Submit design calculations for temporary shoring of approach pits. Use hydraulic jacks capable of developing sufficient capacity to jack piles to specified load. Submit recent certified calibration data of pressure gauge and jack as a combined unit. Calibration shall be performed within 30 calendar days of start of field operations.
 - 2.** Use open-end steel pipe shells. Jack to levels/depths shown plus any additional penetration required to develop design working load of pile. Jack pile shells by distributing reactions over existing footing or structure so as to prevent over stressing or damaging the footing or the structure.
 - 3.** Furnish proposed monitoring system. During installation of jacked piles check column or wall movement under each footing. If movement exceeds 1/32 of an inch, immediately cease operations and report the situation to WMATA.
 - 4.** Submit complete procedure for jacked pile installation to WMATA for review.

B. Installation of Jacked Piles

1. Clean out pile shells to within one foot of pile tips. Remove obstructions by drilling or spudding, not blasting. When pile tip is below groundwater table, maintain elevation of water inside pile shell at or above elevation of groundwater table, except during inspection of pile or as otherwise approved.
2. After cleaning and prior to filling shell with concrete apply load equal to the percentage of design working load, shown on the drawings, unless otherwise directed, to each empty pile shell and maintain until there is no measurable settlement over a one hour period.
3. Fill the accepted steel pipe with concrete by either placing concrete continuously by approved tremie or underwater bucket, or by placing five foot seal underwater, dewater pile shell and place remainder of concrete continuously in the dry.
4. After concrete within pile has set for at least 24 hours, test pile by jacking to 150% of design working load of the pile. Maintain load until there is no measurable settlement of pile over one hour period. Details and arrangement of pile shell load test and pre-loading are at the option of the Contractor and subject to WMATA approval. Inserting steel beam on top of pile and jacking or wedging firmly against pile and foundation, and encasing it in concrete is an acceptable solution.

3.13 Bracket Piles

- A. Bracket piles shall be installed in pre-drilled holes. Pre-drilled holes shall be protected by casing or by drilling mud or slurry. Pre-drilled holes shall be backfilled with lean concrete to minimize ground loss.
- B. Provide design calculations for pile and bracket.

3.14 Construction Adjacent to WMATA Tunnels

Tunnel Analysis Criteria - All existing tunnels, shall be considered to be already under the long term loads. Any changes in the loading, due to adjacent excavation and construction, shall not increase stresses and deformations in the WMATA tunnels.

- A. For WMATA bored tunnels: If new construction is adjacent to or over existing WMATA bored tunnels, establish earth pressure diagrams based on WMATA's design criteria and soil properties in Table No.3-3. Establish the short term and long term loading conditions that will result from the adjacent construction. Adjacent construction activities shall not increase stresses and deformations in the existing WMATA tunnels. Any additional loadings must be transferred outside and below the tunnel structure unless expressly permitted by WMATA.
- B. For WMATA cut and cover tunnels and any other underground structures: If new construction is adjacent to or over existing WMATA cut and cover tunnels, establish

earth pressure diagrams based on WMATA's design criteria and soil properties in Table No.3-3. Establish the short term and long term loading conditions that will result from the adjacent construction. Adjacent construction activities shall not increase stresses and deformations in the existing WMATA tunnels and other underground structures. Any additional loadings must be transferred outside and below the tunnels and other underground structures unless expressly permitted by WMATA.

C. The structural check of existing WMATA bored tunnel liners or cut and cover tunnel sections must include calculations for the following:

1. Stresses in the tunnel structure/liner.
2. Tunnel section distortion.
3. Lateral shift of tunnel.
4. Opening of the joints and possibility of water leakage at bolted joints. Bolt stresses shall be calculated.

The support of excavation system of a large number of existing WMATA cut and cover, tunnels consisted of a soldier pile and lagging system. This support of excavation system was frequently left in place. When this system is encountered, it shall not be removed.

D. Additional Requirements for Excavation Adjacent to Underground WMATA Tunnel Structures and Facilities

1. For excavations adjacent to WMATA underground structures within the WMATA ZOI, provide an excavation support system conforming to this Manual's requirements. For excavations within a plan distance of five (5) feet from cut and cover, and ten (10) feet from the bored tunnel, and when the excavation subgrade extends below the level which is 5 feet above the bottom of tunnel use a rigid / stiff support of excavation system with slurry walls, tangent piles or secant piles. Reference Plate A-9 in [Appendix 3](#).
2. Any other system, if a prior approval of WMATA is obtained, may have to be designed for a higher stiffness factor and requirements, based on a case by case basis, at the sole discretion of WMATA. When the ground conditions warrant, use of ground stabilization with flexible support of excavation, in lieu of rigid support of excavation may be approved by WMATA at its sole discretion.
3. WMATA tunnel structures shall be underpinned per the requirements of this Manual and as contained in [Appendix 3](#) Plate A-3A and Plate A-3B. Structure movement shall be monitored during excavation in accordance with monitoring plan.

3.15 General - Construction adjacent to WMATA At-Grade Roadway and/or Facilities

- A.** Work to install casings, drive tunnels and micro tunnels or construct other facilities under WMATA tracks shall normally be done continuously. If the facility is to be installed near the surface where ground borne vibrations or projected settlement / heave may be a problem, then the work will be restricted to non-revenue hours.
- B.** A subsidence detection plan and a detailed tunneling schedule will be required prior to scheduling any such operation adjacent to WMATA structures. Provide detailed description and design of underground crossing (tunneling, micro tunneling etc.).
- C.** A geotechnical or soils report with a proposed dewatering plan shall accompany the plan submitted for an underground crossing of the WMATA at grade operating roadway, or excavation adjacent to the WMATA at-grade roadway or operating roadway. Any ground improvements, like grouting, necessary for the underground crossing should be specified in the geotechnical / soils report.
- D.** No drainage, either surface or subsurface, is to be diverted into WMATA drainage systems from adjacent facilities without calculations to verify that the WMATA facilities will not be overloaded. Specific approval by WMATA is required for these diversions.
- E.** When construction is adjacent to WMATA surface roadway and will impact the WMATA security fence, details shall be provided for the proposed modifications to the WMATA security fencing required to accommodate the project. The drawings shall include the details of temporary and permanent intrusions into or occupancy of WMATA's right-of-way. WMATA will require that the right-of-way is protected at all times and any modifications to current right-of-way fencing will be completed during non-revenue hours. WMATA will also require that all fencing (temporary or permanent), which protects the operating / energized roadway, will meet the standards and specifications provided in the WMATA's Manual of Design Criteria.
- F.** WMATA will require additional protective design measures for modified grade separation between existing facilities and the proposed construction. Such additional design measures, at the ODC's time and expense, may include, but are not limited to; 1) implementation of additional intrusion detection warning (IDW) system along its right-of-way fence, 2) increased vertical height of the right-of-way fence, and/or 3) crash barrier protective devices. The WMATA intrusion detection warning (IDW) system on the security fence must be maintained at all times during adjacent construction. WMATA has standard design criteria for crash barrier walls. This information is available from WMATA upon request.
- G.** Specific protective measures will be required for project activities which may impact the operating roadway. These measures may include protective screening and overhead protections, as well as, restrictions on crane placement and movements. Requirements will be addressed on a project specific basis.

3.16 Tunneling / Boring under WMATA Roadway

The following is based on assumption that the proposed tunnel(s) are smaller than 8 feet in diameter. Tunnels larger than 8 feet in diameter will require a preliminary presentation be made to WMATA prior to proceeding with final design.

- A.** The plans and specifications for the proposed tunnel shall be submitted for review and approval in advance of construction.
- B.** Monitor WMATA track/subgrade movement during underground crossing or excavation in accordance with monitoring plan developed in compliance with WMATA requirements.

At a minimum, subsidence detectors are required along the centerline of the tunnel. Heaving or subsidence of the WMATA at-grade roadway is not permitted. Survey roadway above the underground crossing or adjacent to the excavation and submit survey data to WMATA prior to start of work.

A contingency construction plan is required to allow adjustment of track to compensate for movements in accordance with, and to the track geometry tolerances specified in the WMATA Track Standards Manual. WMATA Track Standards Manual is available upon request. Also, for Monitoring Threshold or Limiting values of Track / Rail movement, see Section 4.8 for details.

3.17 Excavation Adjacent to WMATA Roadway / Right-of-Way and At-Grade Facilities

- A.** Excavation support systems adjacent to surface sections / at-grade roadway of Metrorail shall be designed when roadway is located partially or entirely within the WMATA ZOI.
- B.** Batter piles that require the pile to lean towards or over WMATA Roadway shall be driven during non-revenue hours. Plumb and batter piles that lean away from the WMATA Roadway may be driven during non-peak revenue hours. A WMATA Flagman will be required for all pile auguring within 25 feet (horizontal dimension) of the Metrorail fence and/or structures. Fixed-leads are required for all pile driving where fouling or encroachment onto WMATA property is possible. The ODC will be held responsible financially for any damage to WMATA structures, to include any loss of revenue operations due to detrimental impact from the adjacent construction. This would include, but not limited to, restoring WMATA tracks and/or structures to new construction standards due to the movements and displacements caused by the adjacent construction work, and alternate service in the event of disruption to scheduled revenue service.

3.18 Construction Adjacent to WMATA Aerial Roadway/Structures

- A.** For excavations adjacent to WMATA aerial structures, an excavation support system conforming to requirements for excavations adjacent to aerial facilities must be provided, when the facility is located partially or entirely within the WMATA ZOI.

- B.** For aerial structure foundations that fall partially or entirely above the adjacent excavation influence lines as shown in [Appendix 3](#) Plate A-2E, underpinning shall be provided. Underpinning for WMATA Aerial structures must be extended to bear at least ten (10) feet below the ZOI line. Structure movement shall be monitored during excavation in accordance with monitoring plan developed in compliance with the requirements of this Manual. As coordinated with WMATA, the ODC will be held responsible financially for any damage to WMATA structures, to include any loss of revenue operations due to detrimental impact from the adjacent construction, restoration and alternate service in the event of disruption to scheduled revenue service.

3.19 Structures Built Directly Above or Adjacent to WMATA Roadway and Facilities

- A.** Wind loads shall be considered for any adjacent structure to be built above or adjacent to existing WMATA facilities. Design loads must satisfy minimum requirements of the local jurisdictional codes and must be not less than 50 pounds per square foot of the projected area of the structure for overall design capacity (on a vertical plane at right angles to the wind direction). For design of components, this load may be divided into the ratio of 60% for the windward face and 40% for the leeward face.
- B.** New structures designed for vehicular traffic must have adequate provisions and strength to prevent failure of the structure, and incorporate protective measures to guard against objects or debris from entering WMATA Roadway.

3.20 Blasting / Demolition Criteria

The following criteria will apply if the proposed rock blasting is in the WMATA ZOI. The ODC must verify the proposed blasting impact with WMATA via shop drawing submittals and blasting plan.

- A.** The peak particle velocity imparted to existing WMATA facilities caused by blasting shall not exceed 2 inches per second in all cases.
- B.** If blasting is to be used in the excavation, the following information shall be provided for review and approval:
 - 1.** The ODC will provide WMATA with a site plan to illustrate blasting relative to WMATA structures if a proposed rock blasting operation is within WMATA's ZOI (100 feet).
 - 2.** A blasting plan, which shall include the size, depth and spacing of the blast holes, the blasting agent, the average charge per hole, the blast monitoring program and the blast monitoring equipment and seismographs.
 - 3.** No more than one hole shall be fired in the same delay period.
- C.** Test blasting in WMATA's ZOI is required, starting from 100 feet horizontal distance from WMATA's facilities or utilities. A test blast must start with a low weight per charge for the initial blast, which will serve as a "test blast". Depending on results of seismograph reading after the test blast, an increase in the weight of

the charge may be allowed. The maximum weight of charge shall not exceed 5 pounds /hole/delay.

3.21 Certification and Documentation

- A.** Submit a copy of request to utility companies owning or agency controlling services and appurtenances affected by demolition work for discontinuance of services along with certificates of severance. The ODC must ensure that WMATA's facilities are not impacted by demolition operations whether due to adjacent utility damage and/or temporary service discontinuation.
- B.** Submit a copy of the demolition permit from the jurisdictional agency and owner.

3.22 Blasting Operations / Administrative Procedures / Prior Blasting Notifications

- A.** Blasting operations shall be restricted to the hours of 9:30 AM to 3:30 PM weekdays. A request may be submitted for blasting outside of these hours for review and approval. Seismograph instrumentation is required to monitor the blasting operation in the vicinity of existing WMATA facilities. Seismograph instrumentation should be installed inside or on the WMATA facilities as close as to the blasting as feasible.
- B.** Once the blasting plan is approved, the ODC is to notify the Construction Inspection Facilitator in accordance with the approved WMATA Blasting Notification Procedures Plan developed for each project.
- C.** The ROCC Superintendent shall also be contacted five minutes before each blasting event so that train movement through the area can be halted temporarily, when WMATA deems it necessary. Train movement would generally be required to be stopped during test blasts. Normally the movement of trains will not be required to halt if the peak particle velocity recorded by the seismograph is below 2 inches per second. Blasting may only be conducted with the approval, via radio or telephone, by the ROCC Superintendent or his designee. If problems are experienced, WMATA monitoring personnel on site are authorized to immediately stop the blasting and notify the ROCC (202-962-1652).
- D.** Procedures for obtaining WMATA support and WMATA supervision of ODC personnel required for the location of a seismograph in an underground tunnel or station must be submitted for approval prior to initiation of blasting activities. The ODC requesting support of WMATA personnel will be required to compensate WMATA for the personnel costs associated with the support.
- E.** Roadway entry requests, track rights requests, Roadway Worker Protection safety training, operational support and Site Specific Work Plans for WMATA structural monitoring program(s) are to be as required by this Manual. The Blasting Schedule must be included in the WMATA weekly "General Order" to enable internal communication of such activity with other WMATA offices (such as Rail Transportation / Station Managers).

- F. Use of any WMATA land or right-of-way will require a real estate permit. The WMATA Office of Real Estate and Station Planning will establish the fair market value or fee for the use or temporary lease of WMATA property.

3.23 Civil Criteria

- A. Refer to WMATA's Civil Criteria ([Appendix 6](#)) for submission of real estate plat and survey documentation.
- B. Refer to WMATA's Design Criteria for standard fencing plans, details, and specifications.
- C. Refer to WMATA's Design Criteria for at-grade standards for installation of right-of-way utility markers.
- D. WMATA's Design Criteria, Standard Design Drawings and Specifications are available on CD. Request must be made in writing to the CE who will issue the CD in accordance with current WMATA Policies and Procedures.
- E. Underground utilities on WMATA property being proposed for abandonment shall be either removed or filled with permanent flowable fill. This requirement shall be identified on all design plans.

3.24 Mechanical Criteria

- A. Existing services to WMATA facilities, including chilled water and condenser water piping, potable and fire water, fire stand pipes, drainage pump stations, discharge pipes, and storm and sanitary sewers, are not to be interrupted nor disturbed without written approval of WMATA. The ODC must ensure that future access to WMATA utilities is maintained and illustrated in the proposed design modifications.
- B. Surface openings of ventilation shafts, emergency exits serving WMATA underground facilities, and ventilation system openings of surface and elevated facilities shall not be blocked or restricted. Construction dust shall be prevented from entering WMATA facilities.
- C. Hot or foul air, fumes, smoke, steam, etc. from adjacent new or temporary facilities shall not be discharged within 25 feet of existing WMATA ventilation system intake shafts. Tunnel ventilation shafts are both intake and discharge structures.
- D. Clear access for the fire department to the WMATA fire standpipe system shall be maintained at all times. Construction signs shall be provided to identify the location of WMATA fire stand pipes. The ODC must contact WMATA's assigned CE and Field Facilitator at least forty-eight (48) hours in advance for coordination of any approved interruption to fire standpipe water service or water service.
- E. Modifications to existing WMATA mechanical systems and equipment, including ventilation shafts, required by new utility connections into the WMATA System, shall be permitted with approval by WMATA, providing:

1. The ODC submit design calculations, drawings, specifications, catalog cuts and any other information necessary to fully describe the proposed modification.
2. If the ODC wishes to permanently enclose any WMATA fan, emergency exit, exhaust/ventilation units, the enclosure must be designed with appropriate clearances and openings to accommodate the air circulation volumes equal to the design capacity of the particular shaft. The proposed construction above WMATA's ventilation units must include projected air flow calculations accounting for the specific shaft type. This information shall be submitted to WMATA for approval.

The calculations shall be signed and stamped by a licensed mechanical engineer practicing in the jurisdiction where the construction is proposed. A permanent emergency path shall be provided and maintained at all times between the nearest public street and the shaft to accommodate fire and rescue, WMATA emergency ingress / egress, and WMATA maintenance access. Panic hardware is to be provided on all door(s) / gate(s) servicing the proposed enclosure.

3. The ODC obtains a WMATA Real Estate Permit.
4. At the option of WMATA, the ODC may be requested to perform the field tests necessary to verify the adequacy of the modified system and the equipment performance. Where a modification is approved, the ODC shall be responsible for maintaining original operation capacity of the equipment and the system impacted by the modification.

3.25 Electrical and Communication Criteria

- A. No interference with existing WMATA ductbanks for electrical services shall be allowed for:
 1. 13.8KV service from PEPCO
 2. 34.5KV or 13.8KV service from Virginia Power
 3. 480V service to Chiller Plant from PEPCO, Virginia Power or from WMATA Substations.
 4. 480V service to lighting in Parking Lots, Kiss and Ride areas, and 120V service to Bus Shelters.
- B. If ductbanks are affected by the adjacent construction, all information must be submitted to WMATA and utility company for review and approval.
- C. For the non-wayside work impacting WMATA facilities a scheduled power outage and WMATA support requests must be submitted to WMATA for:
 1. All emergency /corrective / modification work as reviewed, coordinated and approved by WMATA, and

2. Any work adjacent to energized cables and other electrical equipment. Except for emergency situations, the ODC must comply with scheduling of power outage(s) and escort personnel request procedures.
- D. No interference with existing WMATA ductbanks shall be allowed for:
1. Telephone cables from Verizon
 2. WMATA train control and communications cables.

3.26 Redesign of WMATA Facilities

Refer to Section 5.7 for other related information / rules.

- A. The design for relocation or modification to existing WMATA chiller plants, drainage pumping stations, parking garages, parking lots, or Kiss & Ride areas, escalator passageways, vent shafts, bus shelters and any other facilities shall be done in accordance with the WMATA Design Criteria, Directive Drawings and Standard Specifications. To minimize interruption of WMATA operations, a construction phasing plan shall be developed and submitted for approval.
- B. Proposed relocation of light fixtures, if any, shall be submitted for WMATA approval. Temporary lighting shall be provided in the interim.
- C. Existing ground-grids and ground conductors from ground-grids to WMATA facilities shall not be disturbed. No digging or cutting into existing WMATA facilities (ductbanks, wall, floor or ceiling) shall be permitted.
- D. Access to personnel and equipment hatches for underground facilities shall not be blocked. In case any structure is built over an equipment access hatch, adequate passageway shall be provided for entry of a heavy truck and clearance for the use of a crane to lower equipment from the truck into the hatch.
- E. In case any structure is built adjacent to WMATA at-grade facilities (traction power substations, tiebreaker stations, train control or communications rooms) passageways for heavy trucks and adequate clearance shall be provided for the use of cranes to move equipment from trucks into and out of the equipment hatches and facilities.
- F. Emergency access gates for at-grade or aerial sections of WMATA roadway shall not be blocked. Adequate passage from the gates to public streets shall be provided.
- G. As-Built documentation shall refer to Section 1.7.

3.27 Energized Roadway / WMATA Right-of-Way Fencing

- A. WMATA maintains high standards for right-of-way fencing securing the high voltage operating railroad and other energized facilities.

- B.** Modifications to WMATA fencing must meet the design standards whether modifications are temporary or permanent.
- C.** Fence modifications must be reviewed, approved and coordinated with WMATA. The ODC must clearly delineate operating stationing where fencing is to be modified. WMATA will evaluate whether there is impact to existing Intrusion Detection Warning Systems.

3.28 Grounding and Bonding - WMATA Structures

- A.** Grounding of WMATA fencing, personnel safety, service equipment, facilities, etc. will be as per WMATA Specifications.
- B.** Bonding for stray current and cathodic protection will be as per WMATA Specifications.
- C.** Ground Connections - WMATA requires exothermic process in accordance with ANSI / EEE80-2000 (exothermic is defined as the use of powdered metals contained in a mold to form a molecular bond between materials to be connected without application of an external source of heat or power).

3.29 Lighting Standards - Impacting WMATA Structures/Property

- A.** For proposed temporary and/or permanent modifications lighting criteria shall be as per WMATA's Design Criteria for all construction.
- B.** WMATA lighting criteria were developed as an integral part of the architectural concept, with the purpose of providing comfort, safety and accessibility to patrons, as well as lighting system reliability and efficiency. Lighting design and installation must be closely coordinated with the following:
 - 1.** Safety and security requirements.
 - 2.** ADA Regulation.
 - 3.** CCTV systems.
 - 4.** Maintenance Factors.
 - 5.** Landscaping.
- C.** Temporary lighting modifications shall be maintained by the developer/contractor.
- D.** Requirements for temporary and permanent lighting modifications impacting WMATA structures and/or property will be conveyed in WMATA design reviews and through a real estate entry permit.
- E.** Impact on any WMATA emergency lighting is to be as per WMATA's Design Criteria for all construction.

3.30 Corrosion Protection

- A.** Stray Current Protection. The ODC must be aware that, since WMATA transit cars are powered by direct current (750 volts DC) electricity, direct current can enter the earth through unintentional leakage from WMATA's negative ground return system. The leakage or stray current may flow to and discharge from underground metallic elements (i.e. steel reinforcing, pipelines, ground systems, etc.) that are in contact with any electrolyte, including earth, in the vicinity of WMATA's facilities and systems. Because stray current may be corrosive to metal at locations where it flows into an electrolyte, the ODC is further cautioned to investigate the site for stray current and to provide the means for stray current mitigation when needed. This may include bonding all adjacent structures subject to corrosion in close proximity to WMATA's energized roadway.
- B.** Further information concerning stray current mitigation can be obtained by contacting The National Association of Corrosion Engineers (NACE), P.O. Box 218340 Houston, Texas 77812 (281-228-6200) or website located at www.nace.org.
- C.** Casing, pipe, tunnel, sleeve or similar structure(s) that will be subject to corrosion, when installed under any WMATA facility, structure, or at-grade roadway, will require corrosion protection. The proposed corrosion protection design scheme should be submitted to WMATA for approval and specifically identified/highlighted as proposed corrosion protection measures.
- D.** Underground casing, pipe, tunnel, sleeve or similar structure(s) that will be subject to corrosion, when installed on the sides adjacent to any WMATA structure, may require corrosion protection. Coordinate with WMATA the necessity of such structure, and if it is required the proposed corrosion protection design scheme should be submitted to WMATA for approval.

3.31 Certification of Design, Installation, and Monitoring

The ODC will provide written certification that designs, installations, and monitoring are completed and implemented per approved drawings and plans.

3.32 WMATA Vent Shaft Protection

- A.** Where demolition or construction will take place in close proximity to a WMATA vent shaft, the vent shaft shall be protected with a wooden structure constructed of fire retardant materials. The protection design must be approved by WMATA. Reference [Appendix 3](#), Plate L-1.
- B.** When WMATA vent shafts are located in a sidewalk adjacent to the construction site and are located within the 'protected walkway', the vent shafts may be covered with an expanded metal screen to provide a better walking surface when pedestrian traffic is forced by the curb and the construction fence to walk across the vent grate. The construction fence adjacent to the vent shaft shall be walled with exterior plywood for the entire length of the vent plus four feet extra at each end and laterally braced for wind loads.

- C. Expanded metal screen shall not be used to cover a grate where it will restrict the opening for an intake or an exhaust fan.

3.33 WMATA Escalator Overhead Protection

Where demolition or construction will take place over a WMATA escalator, protection must be installed. The protection design must be submitted and approved by WMATA. Reference [Appendix 3](#), Plate E-1 and E-2.

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Section 4 - Monitoring, Instrumentation and Contingency Plans

4.1 General

- A. The ODC is required to design, submit for approval, and implement a monitoring program.
- B. Selection, design, installation, reading, and documentation of the monitoring program are to be conducted by a licensed Land Surveyor or a Professional Engineer registered in the jurisdiction of the proposed project. All monitoring data and reports requiring optical surveying submitted to WMATA must be signed, sealed and certified by a licensed Land Surveyor or a Professional Engineer registered in the jurisdiction of the proposed project. It is the responsibility of the ODC to document and convey compliance of their proposed monitoring system with WMATA's minimal requirements.
- C. Instrumentation and monitoring of WMATA structures, utilities and track are required to ensure that structural or functional inadequacy does not develop as a result of the proposed adjacent construction. Monitoring is done by measurement of displacement, deformation, strain, stress, crack width, joint separation, water leaks, and observation of the formation of new cracks, etc. In addition, monitoring will be required to ensure the adjacent construction support of excavation system is functioning as designed and the loads on WMATA structures remain within design limits. If changes are observed, the frequency of monitoring will be increased. If the changes exceed the established threshold limits, the ODC will implement contingency measures.
- D. The ODC will be required to develop a written plan for procedures to ascertain structural condition(s) of WMATA facilities and proposed procedures for monitoring potential movement; these procedures shall be submitted and approved prior to entry onto WMATA property. The plan will contain contingency measures listing the immediate remedial action to be taken in the event movement reaches the established threshold limits and/or damage is observed. The contingency monitoring plan for each adjacent construction project will be evaluated for acceptable threshold limits for WMATA structures or facilities.
- E. All instrumentation, monitoring work, documentation, monitoring reports, and any contingency measures required as a result of the adjacent construction shall be the sole responsibility of the ODC for the adjacent construction project.

4.2 Monitoring Stages

- A. **Stage 1 - Initial Pre-Construction Monitoring:** Stage 1 requires a survey of conditions within the WMATA structure or facility and obtaining initial readings at established monitoring points.

The first stages of monitoring shall be done before construction and excavation begins in WMATA's ZOI. However, monitoring phases of soldier beams, top supports and heel blocks shall be completed immediately after installation. The

initial readings shall be based on an average of two (2) sets of initial readings, taken at least 30 days in advance of the adjacent construction work. However, the ODC is encouraged to obtain more than two (2) sets of pre-construction data.

The ODC will provide the preconstruction survey, a summary report, and photographs of findings for WMATA review and record.

- B. Stage 2 - Project Monitoring during Construction:** Stage 2 includes monitoring during demolition, excavation and construction and will be done at WMATA-approved frequency intervals, normally every week. The monitoring frequency will be increased as necessary during critical construction activities such as blasting or tunneling.

The ODC may request, in writing, to suspend monitoring when the slab-at-grade level or the first slab above grade is placed and concrete has acquired at least 85% design strength along with backfill zones completed to grade level. The request must show a minimum of four (4) weeks consecutive reports showing no movement after these conditions are met. After WMATA has agreed movements have ceased and/or stabilized Stage 2 monitoring may be stopped.

Any request to remove the monitoring equipment will be evaluated on a project by project basis.

- C. Stage 3 - Post-Construction Monitoring:** Stage 3 includes final survey monitoring performed after substantial construction completion to determine changes to the alignment, document the post-construction condition, and provide photographic records. In addition to structural monitoring, a final alignment survey of the rail/tracks will be required for comparison with the initial survey data.

The ODC shall examine each property to determine/assess changes from original conditions as established by preconstruction inspection(s). These post-construction engineering assessments shall be furnished in a written report in addition to final monitoring data results.

The ODC shall also provide written remedial or corrective measures to be taken should any deviations and/or damage occur as a result of the adjacent construction project and/or monitoring phases.

4.3 Monitoring Plan

- A.** The monitoring plan for the WMATA facility should be coordinated with the overall project design. Project design plans should be reviewed and approved by WMATA prior to submission of a structural monitoring plan. The monitoring and contingency plans must be prepared and certified by a Professional Engineer or a licensed Land Surveyor registered in the jurisdiction of the proposed project. As a minimum, the plans are to include:
1. A key plan with north arrow illustrating WMATA track stationing, the limits of the structural monitoring program and monitoring locations.

2. Instrumentation details including accuracy, technical specification from manufacturer, survey field procedures, calibration requirements and certifications (see [Appendix 4](#) example). ODC is required to use the "Monitoring Plan Instrumentation Checklist" provided in [Appendix 4](#).
 3. Schedule of surveying / monitoring.
 4. Data reduction, presentation, and evaluation, and details of the monitoring report.
 5. Threshold / limiting values.
 6. Contingency Plan.
- B.** In order to detect movement of buildings or structures affected by construction, the ODC will, prior to excavation, establish a system of vertical and horizontal control points on or about potentially affected buildings or structures, tied to stable survey control points located beyond the ZOI, preferably in WMATA's design datum. WMATA has a network of survey control points which will be made available to the ODC upon request.
- C.** The ODC will employ Certified Survey Technicians to perform survey work in accordance with the FGCC "Standards and Specifications for Geodetic Control Networks" (http://www.ngs.noaa.gov/FGCS/tech_pub/1984-stds-specs-geodetic-control-networks.htm) using First Order, Class 1 specifications for horizontal movement detection and Second Order, Class 1 specifications for vertical movement detection, or other WMATA approved standards and procedures. All vertical movement detection requires precise or semi-precise single-piece rods used in conjunction with a digital level or automatic level of sufficient accuracy. A plan of the proposed system including survey equipment, survey procedures and markers will be submitted for approval. (See [Appendix 4](#))

4.4 Instrumentation

- A.** The extent of the instrumentation and monitoring will depend on the size and type of the WMATA facilities and the adjacent construction. A detailed instrumentation plan for the monitoring program will be prepared by the ODC for each structure potentially affected by the work. Instrumentation scope and selection will be based on the requirements of the specific project including groundwater levels and pressures, strut, tieback and anchor loads, anticipated horizontal and vertical movement of the WMATA facilities and the adjacent construction support of excavation elements, and the sensitivity of the soil or rock between the support of excavation system and WMATA facilities.
- B.** WMATA strongly encourages the ODC to use instrumentation solutions that include remote and automated monitoring systems that are capable of reporting and post processing monitoring data to a password protected web site that only

authorized users have access to. Please note, access to many areas of the system are restricted.

- C.** All proposed methods of instrumentation installation and operation will be in accordance with the recommendations of the instrument manufacturer, unless otherwise approved by WMATA.
- D.** Inspection, installation, reading, and removal of instrumentation within WMATA structures may require closure of adjacent tracks, de-energization of adjacent third rail, and flag protection. All such activities will be planned in a timely manner and coordinated with WMATA's assigned CIF/CE.
- E.** For monitoring programs not utilizing automated and remote monitoring, setup of instruments and surveying of points shall be from a single control point for all readings. In the event this is not possible, a procedure is to be established where a cross check is viable to reduce errors due to multiple setup of instruments.
- F.** The ODC is responsible for ensuring immediate replacement of damaged instruments. When possible, readings for the damaged instrument will be plotted continuously, without an offset at the time of damage. The time of damage and replacement must be documented on the plot and / or data reports.
- G.** Security and Safety: Instrumentation installed (affixed) in any WMATA facility (ies) shall accompany a small identification placard illustrating ownership information. The placard shall be securely and safely affixed to the instrumentation at eye level and labeled with ODC's name, phone number, WMATA project affiliation, adjacent construction project number, and WMATA contact person / phone number.

4.5 Guidelines - Monitoring & Instrumentation Minimum Requirements

- A.** The ODC is required to provide monitoring reports to WMATA.
- B.** The report of results of all instrumentation readings and movement detection surveys is to include:
 - 1.** WMATA adjacent construction project name and number.
 - 2.** Statement of who performed the work with contact information and a point of contact who WMATA may contact to discuss technical aspects of the report.
 - 3.** Last observation(s) date and time and date and time of next scheduled observation(s).
 - 4.** Observer(s).
 - 5.** Interpretive summary of monitoring findings relative to the current construction activities (e.g., excavation is 2 feet below the top level support) or significant events that affect the readings.

6. Other pertinent data including weather and temperature or other events that may affect the observation(s).
7. Drawing showing a plan view of instrument occupied station(s), survey instrument backsight(s), other survey control point(s) and monitoring point(s) locations.
8. Current readings.
9. Initial readings.
10. Total movement for each monitoring point computed by subtracting the current readings from the initial readings.
11. Graphical representation of reduced data plotted against approved baselines which may include time, initial readings or fixed features such as centerline of tracks/structures. Graphical arrows can also be used to show direction and magnitude of movement using exaggerated scales.
12. Summary of survey instrument and accuracy, survey and or geotechnical equipment description, and survey procedures.

C. The movement detection report will:

1. Identify all values in English units, except crack gauges and/or crack calipers which may be measured in millimeters.
2. Identify the applicable tunnel section and WMATA stationing (Inbound or Outbound / utility marker number, etc.).
3. Indicate the direction of movement (sign convention) for all monitoring points. For example, (+) = toward the excavation or away from WMATA's centerline of track. Graphical arrows can also be used to show direction and magnitude of movement.

D. Movement Detection Report Format

1. Provide field data and reduced data, summarized in tables, in Adobe Acrobat (PDF) format.
2. Provide data in Excel spreadsheet format when requested.
3. In general, the report should include 5 basic parts:
 - i. Part 1 - a cover sheet which contains project details as listed in Section 4.5.B.1-6; (sample shown in [Appendix 4](#))
 - ii. Part 2 - a project layout drawing as described in Section 4.5. B.7;

- iii. Part 3 - monitoring data in tabular or spreadsheet format as described in Section 4.5.B.8-10;
 - iv. Part 4 - monitoring data in graphical formats as described in Section 4.5.B.11;
 - v. Part 5 - summary of equipment and procedures as described in Section 4.5.B.12. (sample shown in [Appendix 4](#))
4. Inclinator data will be provided in tabular form and in graphs showing cumulative total displacement vs. elevation in WMATA's design datum (see [Appendix 4](#)).

E. Report Schedule

- 1. All data below Level 2 threshold values (see Section 4.8) will be provided in hard copy or in digital format no later than 3:00 P.M. on the day following the data collection date.
- 2. When the specified reporting date is interrupted by weekends or holidays, the due date will be increased by an equivalent period.
- 3. When Level 2 threshold values have been exceeded, reports will be submitted on the date of reading.

F. Report Certification: All reports submitted must be certified by the Engineer or Surveyor of Record providing assessment of readings and necessary action resultant from the readings based on the requirements of the approved monitoring plan.

4.6 WMATA Administrative Requirements

- A.** Entrance to WMATA property for inspection or monitoring will require a real estate permit issued by the WMATA Office of Real Estate and Station Planning (LAND), an approved SSWP and all ODC personnel must be in possession of a valid WMATA contractor ID badge.
- B.** ODC indemnification and insurance policies and certificates of insurance (including Railroad Protective Liability Insurance) must be submitted and approved by the WMATA Office of Risk Management (RISK) prior to entering WMATA property. The ODC must maintain current insurance policies certifications with WMATA.
- C.** Inspection and monitoring work inside WMATA facilities will require WMATA operational support. Work performed within the track bed will require a third-rail power outage. The support or outage request, indicating the desired dates for entry into WMATA facilities, must be submitted on a JDAC Support Request form (JSR) at least thirty (30) days in advance of the date requested.

D. JDAC Support Request Forms must be submitted to the WMATA CIF/CE at least thirty (30) days prior to the WMATA Operating Week of the requested date(s). The WMATA Operating Week begins Saturday morning at 0001 hours (12:01 AM). JDAC Support Request forms shall not be submitted until the ODC has obtained approval of a monitoring plan, approved SSWP and a fully executed real estate permit from WMATA LAND.

E. The ODC must comply with Section 1.6

F. All work within WMATA's roadway must be performed during nonrevenue hours or as approved in advance by WMATA. WMATA nonrevenue hours* are currently:

00:30 A.M. - 04:30 A.M.	Monday through Friday
03:30 A.M. - 06:30 A.M.	Saturday and Sunday

*** Nonrevenue hours are subject to change without notification. WMATA cannot guarantee that the ODC will be able to work within the times above. Work time available is scheduled through the General Orders Track Rights System (GOTRS) and specific schedules are evaluated on a project by project basis as well as operational needs. Operational emergencies and maintenance requirements may impact scheduled work in the General Orders Track Rights System.**

G. The ODC must maintain compliance with the Letter Agreement, permit and funding in place. Failure to do so will prevent ODC from obtaining track access and staff support from WMATA.

4.7 Minimum Monitoring Requirements

A. The extent of the instrumentation and monitoring program will depend on the size and type of both, the adjacent construction project and the WMATA facility potentially affected, as well as the anticipated loads imposed on the WMATA structures. Instrumentation of the excavation support system for the new construction, the surrounding ground, and the WMATA facilities will normally be required.

B. Excavation support systems for the portion of the adjacent construction within the WMATA ZOI will be instrumented and monitored to:

1. Measure the movement and deflection of the sheeting/cofferdam wall, etc. by optical surveying or other WMATA approved means. The top of the sheeting/cofferdam wall or soldier beams, and the top level of support will be monitored for horizontal and vertical movement. The spacing of survey points at the top and at first support (Tier One) shall not be greater than 25 feet.
2. Monitor the horizontal and vertical movement of heel blocks where lateral support to the sheeting/cofferdam wall is provided by rakers.

3. Monitor movement of the ground between the WMATA facility and the support of excavation system by means of inclinometers, movement detection points, or other WMATA approved instruments.
4. Measure pre-load values and changes within struts, ground anchors, rakers, and other elements of the support system, by load cells or WMATA approved instruments, so the support system can be kept within the limits established in design.
5. Measure groundwater levels to ensure compatibility with support of excavation design(s).
6. In addition to the establishment of the initial baseline data, monitoring of support of excavation system shall be started after the wale and the lateral support system at the first support level from the top (Tier One) is installed.

C. WMATA Structures

1. Structures within the WMATA ZOI will be instrumented and monitored to measure horizontal and vertical movements.
2. Stress and strain monitoring of WMATA structures may be required for complex projects.
3. Monitoring of groundwater levels and pressures may be required and will be coordinated with WMATA.
4. Seismograph monitoring of peak particle velocities at WMATA facilities will be required whenever blasting is within 100 feet of the WMATA ZOI. Monitoring will be required for each blast.
5. Structural monitoring must extend a minimum of 75 feet beyond the limits of excavation or the depth of excavation plus 25 feet on each side (whichever is greater). The distance between monitoring sections shall be 25 feet.
6. A monitoring section will consist of four points located at crown, invert, and at spring line on each side of the tunnel - for tunnels and similar underground structures. Monitor horizontal and vertical movement by optical surveying or by other method approved by WMATA, such as tape extensometer. Provide a typical section of the monitoring points and identify the direction of movement relative to the location of construction.
7. Dome relief vaults, vent shafts, etc. shall be monitored with survey points at four corners of the top of the WMATA structures.
8. The condition of the WMATA structure located within the ZOI should be noted and monitored, including provision of a photographic record. Existing

cracks will be monitored for change in width and length extension, and the formation of new cracks. Crack and/or caliper gauges should be mounted on significant structural cracks prior to demolition, excavation or other construction activities. Crack and/or caliper gauges may be used for crack monitoring. The width of the existing crack at the monitoring location should be recorded. The ends of each monitored crack shall be clearly marked to determine the extent of crack prior to the start of construction.

9. The monitoring of conditions within the WMATA facility should normally be done on a weekly basis, and the readings provided in accordance with the plan.

D. Tunnel Monitoring

1. Monitor and record any movement of the WMATA tunnels by inside measurement, using a system of instrumentation, during the adjacent construction excavation and initial construction. Submit data as stipulated on a case-by-case basis. The monitoring of tunnel movements shall be done at 25 foot intervals. The extent of monitoring shall start 75 feet before and finish 75 feet after/beyond the limits of excavation and construction affecting the WMATA tunnel or tunnels. For a bored flexible tunnel the data should include the three point convergence readings and the lateral movement of the tunnel. For a cut and cover box section and bored rigid tunnel, the horizontal and vertical movements of four points (one each in the side walls, one at the roof slab and one on the invert) should be monitored (see Plate B-1). In case of floating slabs in the tunnels an alternate point for monitoring shall be determined and coordinated with WMATA.
2. Survey the tunnels from the inside and note all the existing open cracks. Install crack gauges on the cracks, with epoxy, or use caliper methods to monitor. Existing crack widths at crack gauge locations shall be recorded, photographed and submitted to WMATA prior to demolition, excavation, or any other construction activities.
3. A system of monitoring any vertical **and** horizontal movement of the excavation support structure must be submitted for approval prior to construction. The submitted information is also to include a sample chart and methods of data collection.
4. Installation of inclinometers at suitable locations is recommended between the tunnels and the adjacent excavation. Follow the manufacturer's recommendations for installation locations of inclinometers relative to adjacent structures.
5. Prior to commencing construction, the WMATA tunnel structure shall be surveyed. The survey shall include vertical and horizontal alignment data.

6. Right-of-way entry requests, track rights requests, Roadway Worker Protection safety training, operational support and Site Specific Work Plans for WMATA structural monitoring program(s) must be in accordance with the requirements in this Manual.
7. Use of any WMATA land or right-of-way will require a real estate permit. The WMATA LAND will establish the fair market value or fee for the use or temporary lease of WMATA property.

4.8 Monitoring Threshold or Limiting Values

- A. Level 1 requires increasing the monitoring frequency. Level 1 values serve as an alert that change (displacement, crack widening, etc.) is occurring.
- B. Level 2 requires remedial action. When Level 2 values are reached, the developer/contractor will stop work in the WMATA ZOI, and any other work considered causing excessive movement.
- C. Table 4-1 are suggested threshold values to be used for monitoring and implementation of contingency measures and are provided as a guide in assisting the developer/contractor in preparing job-specific structural monitoring tolerances:

Table 4-1 Limiting Values

	Level 1 (Threshold Limit Values)	Level 2 (Remedial Action Limit Values)
Track/Rail (Horizontal and Vertical)	0.0625" (1/16") in any 25' length, but not to exceed a total of 0.25" from the existing location.	0.125" (1/8") in any 25' length, but not to exceed a total of 0.50" from the existing location.
Station and Tunnel (Horizontal and Vertical)	0.125" (1/8") in any 25' length, but not to exceed a total of 0.25" from the existing location. Movement includes displacement, deformation and rotation of the tunnel.	0.125" (1/8") in any 25' length, but not to exceed a total of 0.50" from the existing location. Movement includes displacement, deformation and rotation of the tunnel.
Other structures (Horizontal and Vertical)	0.25" (unless otherwise noted)	0.5" (unless otherwise noted)
Change in Crack Width	0.02" (0.5 mm)	0.04" (1.0 mm)
Pier supporting Aerial Structure	0.125" Horizontal and Vertical	0.25" Horizontal and Vertical
Support of Excavation	0.50" (at top)	0.75" (at top)
Soldier beam	0.25" (at top bracing)*	0.50" (at top bracing)*
Support of Excavation	0.25" (at top between supports)	0.5" (at top between supports)
Slurry Wall	0.125" (at top bracing)*	0.375" (at top bracing)*
Support of Excavation Heel-block	0.125" ❖	0.25" ❖
Blast Vibration at WMATA Structure	Not applicable	2.0 inches per second (Peak Particle Velocity)
Shaft/Dome Relief Vault (Horizontal and Vertical)	0.125" (1/8") in any 25' length along shaft, but not to exceed a total of 0.25" from the existing location.	0.125" (1/8") in any 25' length along shaft, but not to exceed a total of 0.5" from the existing location.

Key

- * Displacement after bracing pre-loading.
- ❖ Horizontal displacement after pre-loading.

4.9 Contingency Plan

- A.** The need for implementing a contingency plan will be established by WMATA on a case-by-case basis. A contingency plan will be required for all major projects adjacent to an underground tunnel. Prior to commencing construction, the ODC shall submit a contingency plan with the details of the corrective action to be taken in case of an emergency involving the following:
- 1.** Ground or structure movement exceeding the limits or threshold values.
 - 2.** Cracking of concrete structures.
 - 3.** Excessive opening of joints, movement and translation of joints in tunnel liners.
- B.** Settlement or horizontal movement of WMATA tunnels resulting from adjacent construction activity, or ring deformations in bored tunnels, shall not deviate from the pre-construction survey by more than the criteria specified in Table 4-1.
- C.** The corrective actions/measures necessary or the repairs necessary to WMATA structures due to the adjacent construction including excavation shall be the responsibility of the ODC.
- D.** Approval of the support of excavation system will be given when the monitoring and contingency plans have been reviewed and approved by WMATA.
- E.** Measures for Level 1 (Limit Values) - When the monitoring data reach or exceed Level 1 values, WMATA will be notified within 24 hours. The ODC will increase the frequency of monitoring to ascertain if a trend exists, as required by WMATA.
- F.** Measures for Level 2 (Remedial Action) - When the monitoring data reach or exceed Level 2 values, the ODC will immediately notify WMATA, stop all construction activities and implement the approved contingency measures. When the readings have stabilized, construction work may be resumed with the approval of WMATA.
- G.** Examples of contingency measures to protect WMATA structures from deformation or change in condition are:
- 1.** Maintaining an adequate supply of structural steel at the job site to enable bracing of the support of excavation system at additional points and /or levels.

2. Maintaining equipment on-site for compensation or compaction grouting to stop movement and stabilize the WMATA structure or track.
3. Backfill as necessary.

4.10 ODC Monitoring Responsibilities

- A. The ODC has sole responsibility for providing monitoring until WMATA agrees in writing that monitoring may be terminated. The ODC is responsible for:
 1. Requesting necessary site access to all monitoring instrumentation.
 2. Furnishing, installing, protecting and maintaining all equipment required for monitoring, including readout devices.
 3. Collection, interpretation and storing the monitoring data obtained. In addition to the requirements specified herein, the ODC is responsible during the course of the work to install, monitor and interpret additional instrumentation deemed necessary to ensure the safety of the public.
 4. Certification and prompt submission of all monitoring data to WMATA.
 5. Promptly responding to threshold values specified herein or as approved by WMATA and implementing agreed upon changes to construction.
 6. When requested, providing safe access for WMATA representatives to all instrument locations. Safe access will include stopping work activities, temporary relocation of obstructing materials and equipment, provision of ladders, working platforms and hoisting services, and any other needs in the opinion of WMATA representatives are necessary to ensure safety. Furnish safety equipment including respirators and harnesses for use by WMATA representatives during site visits.
 7. Restoration of areas affected by the monitoring program to the satisfaction of WMATA at completion of the work.
 8. Monitoring targets should be installed using epoxy or other methods. Disruption of substrate mounting surface is prohibited. Installation of monitoring targets in public areas and surfaces with architectural treatment must be specifically approved by WMATA.

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Section 5 - Safety, Operational Requirements and Compliance

5.1 General

- A.** Each ODC should review: 1) WMATA's Construction Safety and Environmental Manual and 2) Metrorail Safety Rules and Procedures Handbook prior to contemplating any work on or adjacent WMATA. Each manual is available upon request from the project CE. The prevention of accidents in the course of completing any joint development or adjacent construction project is of primary importance to everyone connected to WMATA. WMATA is an organization totally committed to safety - safety in construction and operations. It is the Authority's responsibility to the general public to assure them of an organization which is not only innovative but also effectively implementing the highest safety standards.
- B.** The ODC shall request and conduct a pre-construction field meeting with WMATA's Construction Inspection Facilitator prior to scheduling any work in WMATA's ZOI (work adjacent to, over, or on WMATA property, or which could potentially endanger, impact, or impair the Authority's revenue operations or facilities). These meetings are typically held on site and notification of such a meeting request must be scheduled a minimum of ten (10) work days in advance.

5.2 Safety, Construction, and WMATA Operational Considerations

- A.** The ODC must initiate and complete the administrative forms included with [Appendix 5](#) when WMATA operational support functions and/or electrical power outage(s) are required. The administrative forms shall be submitted to WMATA for processing in WMATA's GOTRS. Appropriate administrative requests / forms for WMATA operational support for wayside work (non-power outage) and/or a scheduled power outage must be submitted to the WMATA CE at least thirty (35) days prior to the WMATA Operating Week of the requested date(s). The WMATA Operating Week begins Saturday morning at 0001 hours (12:01 AM). The thirty (35) day advance notification is necessary to allow WMATA sufficient notice to schedule personnel and/or support equipment, and to adjust WMATA operations and maintenance to accommodate the developer's/contractor's request wherever possible.

A Site Specific Work Plan (SSWP) must be submitted a minimum of 60 days prior to desired start of work date. No track access will be permitted without approved access and SSWP.

- B.** ODC personnel are bound by WMATA's Safety Rules and Procedures while on or within WMATA's Roadway and/or air space.

- C.** The ODC is required to submit a detailed construction sequence and equipment staging plan for all work that will impact WMATA interests. This plan shall include necessary Maintenance of Traffic plans or similar plans required by local agencies. The ODC shall maintain both vehicular and pedestrian traffic, and existing streets and sidewalks within and adjacent to the project site at all times during the duration of the project.
- D.** Construction Safety, Fire Signage and Traffic Control Devices on WMATA property (for pedestrian and/or vehicular traffic)
- 1.** The ODC shall maintain traffic and erect and maintain traffic control devices, as required by approved plans.
 - 2.** Safety signage and markers are to be included as part of the construction sequence and staging plans submitted to WMATA for review and approval.
 - 3.** Safety signage and markers are to be fabricated in accordance with the codes and regulations of the local jurisdictional authorities where the project is proposed.
 - 4.** ODC shall install and maintain any temporary safety signage and/or markers placed on WMATA property during construction.
 - 5.** Access shall be maintained to fire hydrants, stand pipe/siamese connections and fire alarm boxes. Free access must be given to each fire hydrant, stand pipe/siamese connections, and fire alarm boxes as approved by local jurisdictional fire departments and WMATA whenever work is being carried on. Obstructions shall not be piled at any time or placed within 10 feet of any fire hydrant, stand pipe/siamese connection, or fire alarm box. The position/ location of hydrants, stand pipes/siamese connections, and/or fire alarm boxes must be indicated by suitable signage and lights that are readily seen and accessible in both day and night when materials are placed in the vicinity of fire equipment (as approved by the local Fire Marshal in the jurisdiction of the proposed project).
 - 6.** The ODC shall erect and maintain signs, fences, barricades, lighting and pedestrian bridges and provide watchmen for the protection of public travel, the work site, adjoining WMATA property and adjoining public places.
 - 7.** The ODC, in complying with OSHA standards on WMATA property, shall barricade all work area(s) or close excavations and openings in floors, walls and other parts of structures while openings are not protected full time. Barricades shall be substantial in character, neat in appearance,

constructed of approved materials and of approved size. See also, Section 5.4.D and 5.4.E.

8. ODC's are to take approved positive measures on WMATA property to prevent unauthorized entry into the construction site of the work and storage areas. Protective devices shall be in accordance with codes and regulations of jurisdictional agencies.

5.3 Operational Requirements

- A. WMATA's fire escape routes shall not be obstructed. Metrorail Emergency Response Maps will be used to determine if the proposed development and/or the related construction activities will have a potential impact to existing WMATA emergency routes and local fire department access route(s).
- B. Projects that require working over or adjacent to WMATA station entrances shall develop their construction procedures and sequences of work to meet the following minimum requirements:
 1. Construction operations on or directly adjacent WMATA facilities must be planned, scheduled and carried out in a way that will afford WMATA customers (and the general public) a clean, safe and orderly access to and from the station entrance during revenue hours.
 2. Construction activities that involve swinging a crane and suspended loads over pedestrian areas, WMATA station entrances and escalators, Roadway and WMATA passenger areas shall not be performed during revenue hours *, but must be performed during the non-revenue hours of 00:30 AM to 04:30 AM on weekdays; 03:30 AM to 06:30 AM on Saturdays and Sundays.

*** Nonrevenue hours are subject to change without notification. WMATA cannot guarantee that the ODC will be able to work within the times above. Work time available is scheduled through the General Orders Track Rights System (GOTRS) and specific schedules are evaluated on a project by project basis as well as operational needs. Operational emergencies and maintenance requirements may impact scheduled work in the General Orders Track Rights System.**

5.4 Overhead Protection

- A. Overhead Protection - Station Entrances and Public Areas. Overhead protection shall be provided whenever there is a possibility of overhead fall hazards from construction material, personnel, dunnage, etc. Overhead protection is required on or around WMATA station entrances, WMATA bus stops, WMATA roadway,

WMATA elevators, and areas designated for public access to WMATA facilities. Erection/ installation of the overhead protection or shield for these areas will be executed during WMATA's non-revenue hours *:

00:30 AM to 04:30 AM on weekdays

03:30 AM to 06:30 AM on Saturdays and Sundays

*** Nonrevenue hours are subject to change without notification. WMATA cannot guarantee that the ODC will be able to work within the times above. Work time available is scheduled through the General Orders Track Rights System (GOTRS) and specific schedules are evaluated on a project by project basis as well as operational needs. Operational emergencies and maintenance requirements may impact scheduled work in the General Orders Track Rights System.**

B. Structural design criteria:

1. The design live load for all shields shall be 150 pounds per square foot minimum. The design wind load on the temporary structures shall be 20 pounds per square foot, on both the windward and leeward sides of the structure a total of 40 pounds per square foot in any one direction. The roof of the shield shall also be designed for an uplift pressure of 25 pounds per square foot (due to wind).
2. The shield(s) must be constructed of fire retardant materials. Materials and equipment shall not be stored on the completed shield. The roof of the shield shall be constructed and maintained watertight.

C. Lighting design / criteria:

1. Lighting in public areas and around affected WMATA facilities must be provided under the temporary shield(s) to maintain a minimum illumination level of ten (10) foot-candles at the escalator treads or at walking surfaces. The temporary lighting is to be maintained and power source provided by the developer / contractor during all construction phase(s). ODC shall demonstrate in the field to WMATA that required illumination levels are being maintained throughout construction.
2. Temporary disruption in WMATA's existing electrical systems (lighting) will require temporary lighting and maintenance of the current standard illumination levels. Electrical staging plans are required for WMATA review and approval. WMATA's design criteria for facility lighting is identified in the Manual of Design Criteria which is available upon request.

- D.** Construction barricades shall be provided around all temporary construction areas and WMATA property to prevent public access in accordance with OSHA standards. Temporary barricades / fencing must be a minimum of six (6) feet in height and secured and maintained to withstand wind loads and public vandalism. Use of wooden fences will require material with a minimum of (1) hour fire-rating.
- E.** An unrestricted public access path shall be provided at the upper landing of the entrance escalator way in accordance with the following:

 - 1.** Vertical clearance between the walking surface and the lowest projection of the shield shall be a minimum of seven (7) feet.
 - 2.** A clear pedestrian runoff area extending beyond the escalator newel shall be provided, the least dimension of which shall be twenty (20) feet.
 - 3.** A fifteen (15) foot wide strip (other than the sidewalk) shall be maintained on the side of the escalator for circulation when the escalator is pointed away from a street corner.
 - 4.** A clear direct path from any WMATA emergency exit to the public street shall be maintained at all times.
- F.** Temporary sidewalks or pedestrian ways which will be in use more than 10 days shall be constructed of four (4) inch thick Portland cement concrete or four inches of asphaltic concrete placed and suitably finished for pedestrian traffic. Temporary sidewalks are to be a minimum width of five (5) feet wide.
- G.** All modified or temporary pedestrian access paths shall be ADA compliant.

5.5 Overhead Protection - Operating Roadway

- A.** A construction project that will require work over, under or adjacent to WMATA at grade or aerial segments, including machinery operation, construction of scaffolding or any other potentially hazardous adjacent work, shall be done during non-revenue hours with a "supervisory" power outage, or as otherwise approved by WMATA.
- B.** Work may be approved to be performed during revenue hours with conditions such as constructing a temporary protective shield to protect WMATA's operating Roadway and facilities in accordance with the above minimum design load and other requirements of this Manual. The shield shall have solid sides and both sides and deck shall be designed to withstand the air pressures generated by a moving train unless otherwise noted by WMATA's Manual of Structural Design Criteria.

The shield shall be constructed or installed with a WMATA power outage in the construction area during non-revenue hours. Reference [Appendix 5](#) for WMATA power outage requirements. The design and field installation for the protective shield must be certified in writing by a registered professional engineer practicing in the jurisdiction of the project and shall be approved by WMATA. The certification must be obtained prior to putting the shield in field use. A visual inspection is also required.

Once written certification is received, work may proceed above the shield during revenue hours. Crane(s) shall not swing over the shield. [Reinforcing steel may be tied, but not swung over the shield using a crane during revenue hours.]

- C.** Crane operators working in areas adjacent to WMATA facilities where encroachments are possible shall possess a current National Commission for The Certification of Crane Operators certification for the type of crane being operated.
- D.** Equipment used for sheeting and shoring operations shall be positioned and operated so that the equipment is precluded from overturning and falling onto or fouling WMATA roadway. Soldier piles must not be swung over the WMATA roadway during revenue hours. Auguring or pile driving equipment shall be oriented parallel to the roadway and in such a field set-up to prevent piles or equipment from falling or fouling WMATA roadway.
- E.** Construction cranes shall not swing over the operating roadway during revenue operations. Crane certification and inspection documents shall be available for review by WMATA's Department of System Safety and Environmental Management (SAFE) and the Office of Risk Management (RISK) personnel at any time.
- F.** WMATA operational support will be required to monitor the Roadway for all auguring, pile driving or other work that can impact WMATA's operating system. The ODC shall make a formal request for any operational support by submitting a JDAC Support Request form to the CIF/CE. Costs associated with the support shall be borne by the ODC.
- G.** The ODC shall request access rights or track rights to perform work during WMATA's non-revenue hours of operation. The ODC shall make a formal request for access and support by submitting a JDAC Support Request form to the CE. Costs associated with the request shall be borne by the ODC.

5.6 Other WMATA Facilities

- A. Access from public streets to WMATA fan shafts, vent shafts and emergency exits shall be maintained at all times. WMATA shafts shall be protected from dust and debris. Reference [Appendix 3](#) for details.
- B. Use hand excavation and/or approved alternative method in the vicinity of communication lines or WMATA, PEPCO, and Dominion Virginia Power lines feeding the Metro system.
- C. Flammable liquids shall not be stored over, under, or within 25 feet horizontally of any WMATA facility. If installation by the project is required within 25 to 100 feet horizontally of the structure protective encasement of the tanks will be required. Existing underground tanks located within 100 feet horizontally of WMATA facilities and scheduled to be abandoned shall be removed and properly disposed. New underground tanks shall be designed to current applicable codes.

5.7 Modifications & Direct Connection to a WMATA Station / Facility

- A. Modifications To Structures
 - 1. Design must allow for positive drainage around WMATA structures where impact or modifications are necessary.
 - 2. Drawings and specifications illustrating the details of required changes shall be prepared by the ODC. Normally, to meet sidewalk grades, six or eight inches of the vent or shaft is removed, the existing steel is bent to accommodate the new steel and new angles are installed to hold the grate. The grates shall be reinstalled after the concrete has set. Grates are designed for AASHTO H-25 live loading.
 - 3. The ODC will be required to increase the height of the affected WMATA facility or take preventive measures as required by WMATA if the adjacent construction (including modifications to existing grade elevations) would cause a change in hydrology (ponding of water, increase in water runoff adjacent to WMATA facilities, etc.).
 - 4. A photometric study (site lighting plan with projected lighting illumination levels, wattage, etc.) will be required for temporary and / or permanent lighting modifications 'to' and 'around' existing WMATA facilities. The plans must be reviewed and approved prior to any field modifications beginning. The developer/contractor and WMATA personnel must coordinate and field verify illumination levels provided on the study plans prior to placing the

facility in service. ODC inspection of the temporary lighting will be regularly required to ensure that the approved illumination levels are maintained.

B. Direct Connections

1. Connections to WMATA structures and/or facilities shall be designed, built and paid for by the ODC (or entity, person, etc.) requesting the connection in accordance with WMATA Policy Instruction 4.4/0 and Board Resolution (2011-31), or through a Direct Connection Agreement which usually, in addition to the fees associated with WMATA staff time, a connection fee will be charged. In certain cases, WMATA's Office of Real Estate and Station Planning may require documentation of such property requirements through a Maintenance and Operations Agreement. WMATA's Policy Instruction 4.4/0 and Board Resolution (2011-31) are available upon request.
2. Underground passageways connecting to a WMATA facility (e.g. station, structure, passageway, etc.) must be sloped away from WMATA property in such a way as to provide positive drainage around WMATA facilities. The developer/contractor must design and install a drain system that is separate from WMATA's utilities in the event that the proposed passageway cannot be sloped away from the existing WMATA facility. The drain system design (to be reviewed and approved by WMATA) must preclude water from entering WMATA's facilities. Hydraulic pumps, if required, shall be sized to handle the fire sprinkler runoff, in the event of a fire.
3. The connection shall have a bronze flexible roll-down gate installed between the two passageways. The gate shall be keyed on both sides with separate locks and a concealed manual pull chain for WMATA to open gate. Where the connection has 24-hour manned security on the non-WMATA side of the connection, glass doors may be used in lieu of a gate. If doors are used, each door shall be lockable from both sides.
4. When required, a Closed-Circuit Television (CCTV) shall be installed at the ODC's expense and connected to the WMATA Kiosk. Power for the cameras shall be run from the CCTV to the Electrical Room servicing the Metrorail station. The existing conduit runs and spare breaker locations can be found in the WMATA "As Built" drawings. It is the ODC's responsibility to have the plans for this work prepared by a licensed professional engineer with expertise in this type of work. Intrusion alarms shall be installed on the gate or door and control wires installed between the gate or door and the communications room by the developer's

contractor. Final connection will be made by WMATA to the WMATA security system.

5. Finishes on the interior of the WMATA side of the connection shall be to WMATA's standards and specifications.
6. The power source for lighting and lights in the new passageway shall be run to the ODC's electrical facility and included in the development's emergency power panel. The Authority does not want any liability from electrical loss and/or maintenance.
7. Normally the Direct Connection tunnels are designed to be compatible with the building of which they are a part; however, in the event that a Direct Connection is to be maintained by WMATA, the design shall be in accordance with WMATA Design Criteria and construction will be required to meet WMATA's standard construction specifications.
8. Before removing the knock-out panel, the contractor shall have an approved dust protection system in place and fully functional. Typically, a dust protection system shall consist of a stationary partition that isolates the knock-out panel from the station. The dust partition shall be constructed using only fire rated materials. All joints shall be sealed with tape. The partition shall be constructed during non-revenue hours.
9. Adjacent construction with a connecting passageway(s) to WMATA facilities shall require special features to isolate one facility from the other for fire-safety as required by the local fire code, and may include automatic fire doors and dampers, sprinkler systems, smoke removal and ventilation systems and detection and alarm systems.
10. Specific operations and use agreements will typically be required when connecting with WMATA facilities.

5.8 Americans with Disabilities Act / WMATA Compliance Requirements

WMATA's ADA General Guidelines - Comply with the rules and regulations found in 49 C.F.R Part 37 Transportation Services for Individuals with Disabilities, promulgated by the US Department of Transportation, and the ADA Accessibility Standards for Transportation Facilities Adopted by the FTA on 2006.

The Accessibility Standard for non-federally funded and non-transportation projects is: 2010 ADA Standards, issued by the Justice Department.

Connecting paths to Metro stations must also be reviewed and accepted by WMATA's Office of ADA Policy and Planning.

Parking structures and parking lots that are designed for the use of Metro customers must also comply with WMATA's more stringent standards and must be accepted by WMATA's Office of ADA Policy and Planning.

5.9 Demolition

- A.** Demolition of structures adjacent to WMATA facilities by blasting, or by implosion of the structure by blasting shall not be allowed.
- B.** During piece-by-piece demolition, WMATA escalators shall be protected from dust generated by the demolition. The WMATA escalators shall be covered with polyethylene sheets during demolition to prevent dust from entering the escalator bearings. Demolition adjacent to a WMATA station entrance, that requires protection from dust, shall be done during non-revenue hours.
- C.** During demolition WMATA vents located adjacent to the site shall be protected with a vent cover. See [Appendix 3](#), Plate L-1.
- D.** The ODC must provide the complete demolition plan for WMATA review and approval. Based on the demolition plan and the nature of adjacent WMATA structure, WMATA may require the ODC to check the structural adequacy of the WMATA structure due to the effects of the impact of the demolition.

5.10 Safety & Security Certification Program Plan

- A.** System safety and security play important roles in achieving and maintaining the Washington Metropolitan Area Transit Authority (WMATA) mission to provide exceptional service in a safe and secure operating environment. WMATA has implemented a Safety and Security Certification Program to help in the achievement of this mission.
- B.** The goal of safety and security certification is to ensure that Metrorail extensions, new and rehabilitated facilities and vehicles; and new and rehabilitated Metrobus facilities and equipment are operationally safe and secure for customers, employees, and the general public. To this end, the Safety and Security Certification Program verifies, through a formal process, that safety and security requirements are incorporated into design, construction/ installation, procurement, and testing activities; training programs; and operations and maintenance procedures.

- C.** ODC's will be required to participate in the program for those projects identified as requiring certification. The Safety & Security Certification Program Plan is available upon request.

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Section 6 - Real Estate and Insurance Requirements

6.1 Real Estate General Requirements

- A. Clearly depict impact to WMATA real property and/or easements on design plans submitted for WMATA review.
- B. Real estate transactions with WMATA are handled directly through the Office of Real Estate and Station Planning (LAND). The Office of Joint Development and Adjacent Construction (JDAC), for purposes of ODC's work, coordinates all design plans, engineering disciplines and real estate entry permit(s) for temporary and/or permanent real estate rights, leases, etc., with LAND.
- C. WMATA may grant permits, easements, licenses or other rights, on a case-by-case and first-come, first-served basis in response to third party requests to use or occupy WMATA real estate where it is determined that the proposed use will not adversely impact WMATA operations or existing or planned WMATA facilities.
- D. JDAC will review requests to use WMATA property (either temporary and/or permanent use) to determine the compatibility with existing or planned WMATA facilities. Review of requests will be coordinated by JDAC **after** design review phases are complete.
- E. WMATA/LAND is responsible for selecting the appropriate property interest that accommodates the requested use of WMATA property, for determining the fair market value for the real estate interest and for preparing the requisite documents.
- F. A completed WMATA real estate permit application is required for all temporary and permanent property interest requests that impact WMATA property. Impact is considered to include any property interest (including areas of tieback installations) and access by the ODC. WMATA requires payment of fair market value for any property interest used and requires payment of WMATA's costs associated with review of requests for permits, easements, licenses and other rights. Reference also Section No. 6.2.E for requirements for permanent impact to WMATA property. A real estate permit application and supportive documentation are required for:
 - 1. Property screening whereby temporary access on WMATA property is required.
 - 2. Providing operational support for structural monitoring of WMATA facilities.

3. Temporary access by construction personnel, equipment or devices for surveying and monitoring.
 4. Temporary support of excavation system on WMATA property (whether to be left in place or removed at the end of the project).
 5. Overhead protective structures that impact WMATA property.
 6. Placement of siltation devices and/or construction clearing and grading zones.
 7. New installations on WMATA property.
 8. New underground utilities within WMATA underground easements.
 9. New installations over WMATA facilities that encroach into WMATA air space and upper limits of surface and aerial easements.
 10. Encroachments into WMATA underground easements from underpinning structures and/or soil anchoring systems (such as tiebacks).
 11. Storm drainage runoff directed onto WMATA property from new construction.
 12. Encroachment onto any WMATA property including surface easements such as slope easements or access easements.
 13. Modification(s) to existing WMATA right-of-way fencing at surface levels.
- G.** The ODC shall plan and coordinate project design and construction on and adjacent to WMATA facilities/structures in advance of any property use considerations. WMATA design guidelines highlighted under Section No. 3 & 4 of this Manual may require structural monitoring of WMATA facilities, structures, etc. should construction impact WMATA's ZOI. Such impact and structural monitoring requirements typically necessitate the need for a WMATA real estate permit for purposes of gaining access onto WMATA property to design, survey, install, implement and/or execute monitoring programs.
- H.** Requests for new installations on WMATA property that will require WMATA to incur maintenance, security or other costs will normally be denied, unless the requesting party agrees to pay such costs and demonstrates the financial capability to pay such costs.

6.2 Procedures and Application Process

- A. Once the engineering design review phase has been completed by WMATA, and plans are approved or conditionally approved, the ODC is required to complete and submit the necessary real estate permit application and supporting documentation.
- B. The completed real estate permit application is submitted to WMATA. Click on the following link for additional information:

http://www.wmata.com/business/joint_development_opportunities/forms.cfm
- C. Provide the assigned CE a draft of the permit application for initial review prior to submission.
- D. WMATA will review all incoming requests on a first-come, first-served basis. Requests for use of real property will be coordinated with WMATA LAND.
- E. LAND, upon receipt of JDAC certification of the Permit Application will:
 - 1. Determine the required property interest.
 - 2. Establish the value of the property interest.
 - 3. Prepare and coordinate the requisite legal documents.
 - 4. Obtain WMATA Board of Directors and Federal Transit Administration approval when required.
 - 5. Issue, approve and sign the permit, easement, license, requisite legal documents, etc.
 - 6. Arrange to collect required compensation.
 - 7. LAND will coordinate with WMATA's Office of RISK to review and approve insurance policies and certificates of insurance in advance of delivery of the executed permit or conveyance document to applicant.
- F. Real estate requests that will permanently impact WMATA real property or easements (whether exclusive or non-exclusive easements) will generally require supportive documentation for property acquisition and/or conveyance. Reference [Appendix 6](#) for detailed WMATA criteria for property surveys and submission

documentation. Plan submissions for real property use shall include, at a minimum:

1. A certified plat of survey (and/or exhibit), prepared, signed and sealed by a licensed surveyor, suitable for recordation which clearly illustrates property interrelation to WMATA's property and facilities. The certified plat should represent a survey of the property being impacted and include all necessary units of measure for WMATA's real estate appraisal (e.g. proposed total areas, easement lengths, easement widths, upper and lower easement limits, etc.)
 2. Certified legal property description(s) of property or easements with metes and bounds, signed and sealed documentation by a licensed Land Surveyor practicing in the jurisdiction of the proposed project.
 3. Deed Book and Page Number of property/parcel identified on the plat and legal descriptions.
 4. Confirmation that survey is closed and tied to WMATA's existing control (limit of right-of-way to the property lines).
 5. Clarification of specific maintenance responsibilities and/or future access to such permanent at-grade or underground structures.
- G.** NOTE: Conveyances governed by the WMATA Board Regulation Concerning the Use by Others of WMATA Property, Joint Development Agreements and leases/permits which are specifically entered into for purpose of generating revenue for WMATA will be handled in accordance with the procedures established for those actions.

6.3 Real Estate Responsibility

- A.** Documentation of impact to WMATA real property: The ODC shall plan, document, develop and coordinate real estate interests with WMATA.
- B.** The ODC shall coordinate permit requests with WMATA. It is preferred and less expensive for the ODC to coordinate all impact to WMATA's real property from joint and/or adjacent construction development in one (1) real estate entry permit application under one (1) applicant. This process requires advance planning and coordination on the part of the Developer/Contractor prior to interface with WMATA.

6.4 Indemnification and General Insurance Requirements and Procedures

- A.** The ODC will be responsible for complying with all applicable indemnification and insurance requirements for work activities impacting WMATA.
- B.** WMATA's indemnification and insurance requirements for joint development and adjacent construction are referenced in [Appendix 6](#) of this Manual. Any on-site work which could cause or with potential to cause impact to WMATA facilities or operations may not begin without proper insurances in place. Work will be suspended in the event insurance is not maintained current by the ODC. WMATA is to be named as an additional insured on all insurance relative to joint and adjacent construction work.
- C.** Insurance policies and certificates of insurance from the ODC are reviewed and processed by WMATA's Office of Risk Management (RISK) during permitting phases (along with LAND).
- D.** Copies of applicable insurance policies and certificates of insurance should be forwarded to WMATA as soon as the ODC is informed of the requisite insurance coverages for the project.
- E.** Contact may be made directly with WMATA's Office of Risk Management (202-962-1118) for any specific insurance issues/requirements/questions while working on, over, below or adjacent to WMATA facilities.

6.5 Insurance Responsibility

- A.** The ODC shall keep insurance policies and certificates of insurance current with WMATA during the full duration of each project.
- B.** All policies shall include a special cancellation provision which reads "The Authority is interested in the maintenance of this insurance, and it is agreed that this insurance will not be cancelled, materially changed or not renewed without at least thirty (30) days prior written notice to the Authority". Notice is by: (a) Certified Mail, Return Receipt Requested; (b) hand delivery; (c) a nationally recognized overnight courier service for next business day delivery; or (d) any telecommunications device capable of creating a written record of such notice and its receipt. Addressed to: Program Manager, Office of Real Estate and Station Planning, Washington Metropolitan Area Transit Authority, 600 Fifth Street, NW, Room 5B, Washington, DC 20001.

- C.** At least two (2) weeks prior to the expiration of the original policies or any renewals thereof, evidence of renewal or replacement policies of insurance, with the same terms and limits as expiring, shall be delivered to WMATA.

Section 7 - As-Built Documentation and Close Out

7.1 As Built Documentation General Requirements

- A.** During construction, the ODC shall maintain a record set of contract drawings annotated to illustrate changes incorporated as work progresses.
- B.** As-built drawings shall be prepared and provided by the ODC of the work for WMATA record. As-built records will be required for new facilities, structures, utilities, property rights related to WMATA structures and / or property resulting from the adjacent construction / joint development project. As-built drawings will include recordation of impacts within the WMATA ZOI.
- C.** Project as-built drawings must use WMATA's as-built drawings for the base layer, as applicable.
- D.** Drawings, plans, and calculations approved by WMATA and revised by the ODC must be resubmitted for approval.
- E.** The as-built documentation shall include, but not limited to, the following:
 - 1.** Depths of various elements of foundations in relation to survey data.
 - 2.** Horizontal and vertical locations of underground electrical and utility facilities.
 - 3.** Field changes of dimensions and details.
 - 4.** Changes accomplished by change orders.
 - 5.** Construction left in place, such as temporary support systems, and concrete left outside neat lines of permanent structures, including notes defining types and locations of items.
 - 6.** Any necessary Operations and Maintenance Manuals if WMATA is to maintain such facilities / equipment constructed by others.

7.2 As-Built Drawings

- A.** Drafting shall be performed by skilled drafters using AutoCAD and shall match original contract drawings in line weights, symbols and lettering style and size.

- B.** ODC shall submit one set of as-built prints for review and approval using WMATA's As-built Documentation Format (Appendix 7) not later than two (2) weeks after final WMATA acceptance of the work.
- C.** Completed as-built drawings shall bear the signature of an officer of the ODC's organization, certifying compliance with as-built conditions, using a rubber stamp to the effect of:

<p>AS BUILT</p> <p>Date</p> <p>_____</p> <p>I certify that this drawing accurately depicts the work as constructed</p> <p>Signed - Officer of the Developer / Contractor</p> <p>Developer / Contractor's Printed Name and Company</p>
--

7.3 As-built Drawing Submission Requirements

- A.** Construction impact to WMATA easements shall be documented in as-built records. As-built records submitted to WMATA shall be formatted as follows:
 - 1.** Submit two (2) CDs with the individual drawing as-built files to WMATA in PDF (portable document format) and DWG (AutoCAD) formats in accordance with WMATA's current CADD Standards.
 - 2.** ODC shall update the WMATA electronic as-built files, where the ODC project has modified WMATA facilities, if applicable.
 - 3.** Submit one (1) hard copy of 1/2-size as-built documents to WMATA. These records are to be signed and certified by the engineer of record as "as-built".

7.4 Closeout of Project

- A.** The ODC is responsible for coordinating any required certifications with local jurisdictions and/or other agencies.
- B.** WMATA will verify that all punch list items are completed.
- C.** The ODC shall contact WMATA CE/CIF once all engineering / field support and interface functions are completed within the WMATA ZOI.
- D.** WMATA will issue a closeout letter to the ODC representing technical, fiscal, and administrative closeout of the project.

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Appendices

[Appendix 1 - General Procedures/Review Process](#)

[Appendix 2 - Not Used](#)

[Appendix 3 - Design Requirements and Considerations](#)

[Appendix 4 - Monitoring, Instrumentation and Considerations](#)

[Appendix 5 - Safety Requirements & Compliance](#)

[Appendix 6 - Real Estate, Insurance & Design Criteria Section 9 – Right-of-Way](#)

[Appendix 7 - As-Built Documentation & Closeout](#)

[Abbreviations](#)

[Glossary](#)

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Appendix 1 - General Procedures/ Review Process

[WMATA Design & Coordination Checklist](#)

Click on the link to obtain the following documents:

http://www.wmata.com/business/joint_development_opportunities/adjacent_construction_information.cfm

- Adjacent Construction Project Flow Chart for Owner/Developer/Contractor (ODC)
- Consumer Authorization for Release of Personal Information
- Certification for Issuance of Metro SmarTrip Contractor Badge
- Document Request Form

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Typical WMATA Design & Coordination Checklist (for Applicant's Use)

PROJECT Control No. _____

Phase 1 - Application:

- Project Number established for proposed project by WMATA (All documents shall reference project number.)
- Reviewed WMATA's Adjacent Construction Project Manual (ACPM)
- Reviewed WMATA's Safety Manual
- Submitted Document Request Form & Consumer Authorization for Release of Personal Information Form
- Received and reviewed any WMATA applicable reference material (as-builts, right-of-way plans, etc.)
- Agreement executed
- Payment of review and support fee

Phase 2 - Design / Drawings / Calculation Review:

- Project Impact Statement completed
- Bus Impacts
- Sections showing foundations and WMATA structures
- Site Plan (detailing impact to WMATA, easements provided)
- Pertinent drawing/zone of influence diagram provided detailing level of impact on WMATA facilities
- Sheeting and shoring drawings
- Drainage area map(s) with calculations
- Architectural drawings
- Civil drawings
- Electrical drawings / photometric studies (as applicable)
- Structural drawings / calculations
- Column load tables
- Geotechnical report
- Finite element analysis
- All drawings / calculations signed and sealed
- Submit Real Estate Permit Application

Phase 3 - Pre-Construction Design Verification:

- Structural monitoring and contingency plans
- Construction schedule / sequence plan identifying specific WMATA impact
- Construction layout of equipment relative to WMATA's right-of-way/roadway

- Equipment certifications for equipment working in WMATA's Zone of Influence
- Temporary safety plans and measures
- Structural monitoring and contingency plans
- Permanent easement / utility easement w/ plat and metes and bounds of prospective property

Phase 4 - Pre-Construction Field Coordination & Verification:

- Certification for Issuance of METRO SmarTrip Contractor Badge
- Safety training course required
- Site Specific Work Plan completed and submitted
- Submit JDAC Support Request Form
- JDAC Daily Support Tracking Form
- Right-of-entry and/or utility permit applied for / executed
- Indemnification /certification of insurance requirements
- Other local jurisdictional approvals/permits and forwarded
- Operational support arrangement(s)
- Locate any WMATA monumentation. Coordinate relocation/replacement with WMATA Survey Office.
- Utility location / identification and protection
- Pre-construction meeting with WMATA's Construction Inspection Facilitator
- WMATA field contact(s) information and communication chain established
- Pre-construction survey requirement met
- Boundary survey tie-in to WMATA coordinate system

Phase 5 - Post Construction Coordination:

- Post-construction survey requirement
- Punch List / Out-processing

Phase 6 - Project Close Out:

- As-Built requirement(s)
- Other requirement(s) provided _____

NOTE: This list is provided as a suggested reference for requirements which may be imposed on an Owner/Developer/Contractor in coordinating and developing their construction plans which may or may not impact WMATA facilities. Under no circumstance is there a guarantee that construction plans will expedited for review and approval. Planning, scheduling and coordination of the adjacent developer/contractors' project is at his/her sole expense and responsibility.

Appendix 2 - Design Review Procedures

Not Used

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Appendix 3 - Design Requirements and Considerations

Plates

Plate A-1A:	Soil Pressure Diagram for Two or More Levels of Support
Plate A-1B:	Soil Pressure Diagram for Cantilever and One Level of Support
Plate A-2A,	B, C, D & E: Zone of Influence Diagrams
Plate A-3A:	Tunnel Underpinning Requirements (Case A)
Plate A-3B:	Tunnel Underpinning Requirements (Case B)
Plate A-4:	Distribution of Vertical Pressures
Plate A-5A:	Short Term Loading - Concrete Box Tunnel and other Cut & Cover Structures
Plate A-5B:	Short term Loading- Bored Tunnel
Plate A-6A:	Traffic and Construction Equipment Loads
Plate A-6B:	Building or Construction Loads
Plate A-7A:	Long Term Loading Concrete Box Tunnel/Cut & Cover Structures
Plate A-7B:	Long Term Loading Bored Tunnel
Plate A-8A, B, C:	Loading Condition- Running Tunnel in Rock & Stations
Plate A-8D & E:	Loading Condition - Stations
Plate A-9:	Rigid Support of Excavation System
Plate L-1:	Vent Cover
Plate E-1:	Overhead Protection – Escalators Toward Street
Plate E-2:	Overhead Protection – Escalators Away from Street

Tables

Table 3-1:	AVERAGE VERTICAL LOAD ON ROCK TUNNELS
Table 3-2:	MODULUS OF SUBGRADE REACTION
Table 3-3:	Soil Properties for Design
Table 3-4:	Generalized Strata Descriptions

Specifications

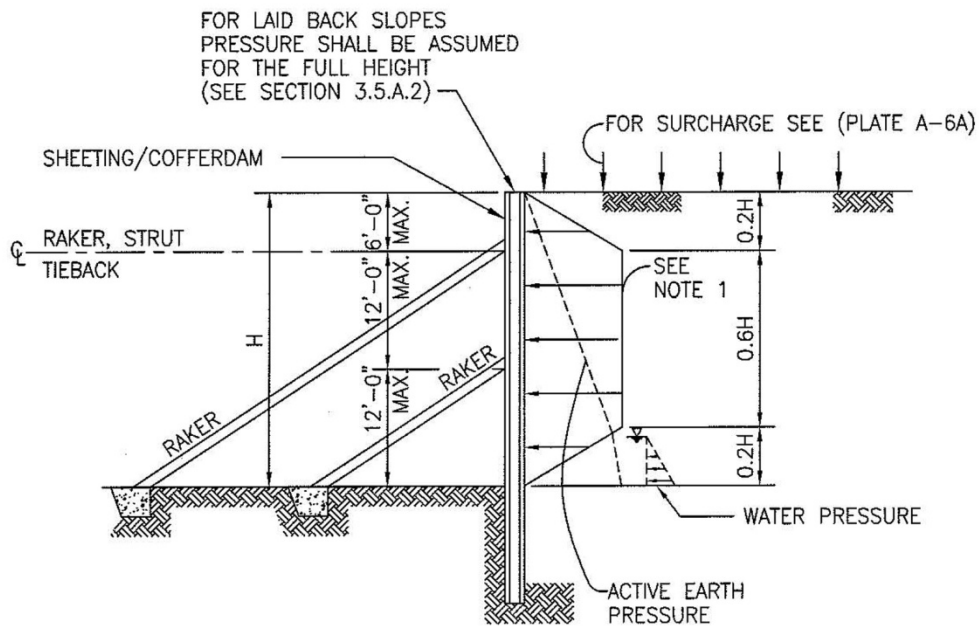
[02820 Fencing](#)

Drawings

[Fence Details](#)
[At Grade Utility Markers](#)

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PLATE A-1A



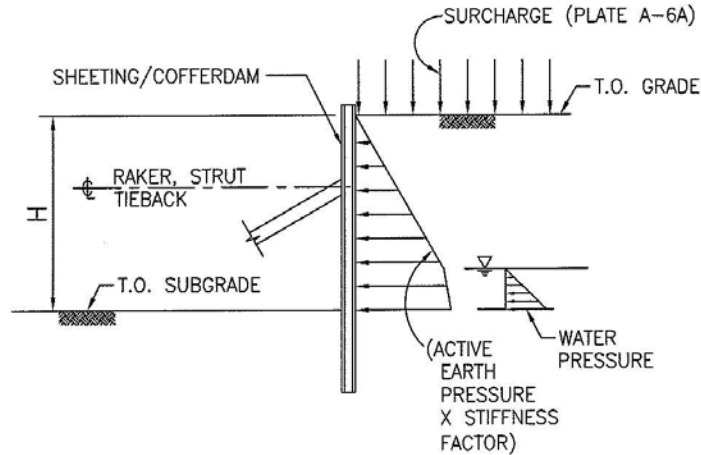
NOTES:

1. TRAPEZOIDAL PRESSURE DIAGRAM IS EQUAL TO THE AREA OF THE ACTIVE EARTH PRESSURE DIAGRAM TIMES A STIFFNESS FACTOR OF 1.25 TO 1.50. PER SECTION 3.6.A
2. SHEETING/COFFERDAM WALL CAN BE ASSUMED TO BE HINGED AT THE RAKER BRACE POINTS FOR SIMPLE ANALYSIS.
3. SHEETING/COFFERDAM WALL SHALL BE CHECKED FOR PARTIALLY EXCAVATED CONDITIONS.
4. THE WATER PRESSURE IS GENERALLY NOT INCLUDED FOR A LAGGED SOLDIER PILE WALL.
5. PRESSURE DIAGRAM IS ALSO FOR THE DESIGN OF WALERS, RAKERS, AND TIEBACKS.
6. SOLDIER PILE OR COFFERDAM WALL ABOVE TOP RESTRAINT SHALL BE DESIGNED AS A CANTILEVER
7. HEEL BLOCK DESIGN PER SECTION 3.7.M

SOIL PRESSURE DIAGRAM
FOR TWO OR MORE LEVEL SUPPORT OF EXCAVATION

WMATA ENGINEERING STANDARDS

PLATE A-1B



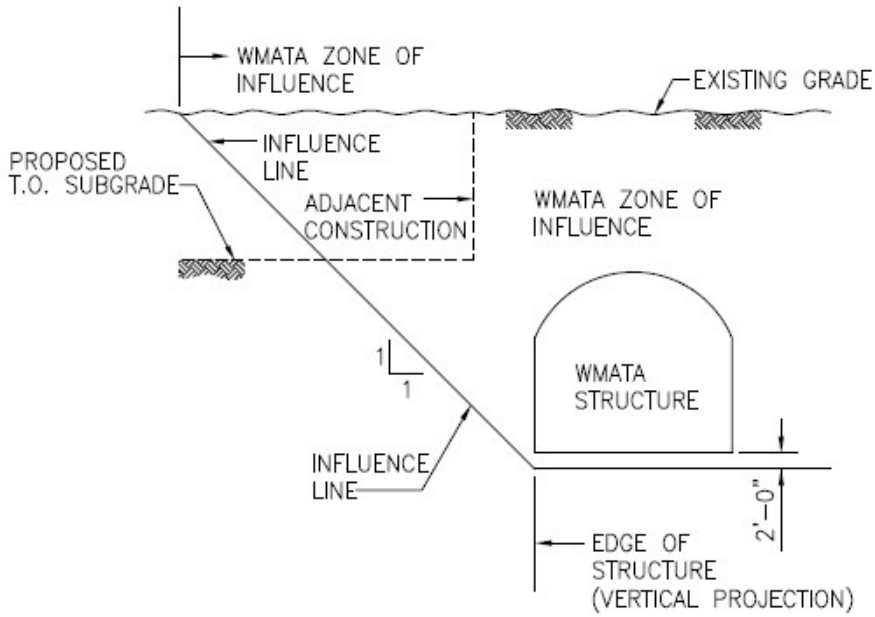
NOTES:

1. STIFFNESS FACTOR OF 1.25 OR 1.50 SHALL BE USED PER SECTION 3.6.A
2. SHEETING/COFFERDAM WALL SHALL BE CHECKED FOR PARTIALLY EXCAVATED CONDITION.
3. THE WATER PRESSURE IS GENERALLY NOT INCLUDED FOR A LAGGED SOLDIER PILE WALL.
4. PRESSURE DIAGRAM IS ALSO FOR THE DESIGN OF WALERS, STRUTS, RAKERS, AND TIEBACKS, FOR ONE LEVEL OF SUPPORT FOR THE EXCAVATION SUPPORT SYSTEM.
5. THE MAXIMUM DEPTH OF CANTILEVER SUPPORT SYSTEM SHALL NOT EXCEED 7 FEET. FOR THE CANTILEVER SUPPORT SYSTEM THE EMBEDDED DEPTH OF THE TOE SHALL BE TAKEN AS 1.3XTHEORETICAL EMBEDDED DEPTH REQUIRED.
6. FOR LAID BACK SLOPES SEE SECTION 3.5.A.2.
7. ASSUMPTION OF A HINGE POINT, AT OR BELOW SUBGRADE, SHOULD NOT BE USED IN THIS CASE WHERE A SINGLE EXTERNAL SUPPORT IS USED, UNLESS OTHERWISE APPROVED BY WMATA.

SOIL PRESSURE DIAGRAM FOR CANTILEVER AND FOR ONE LEVEL SUPPORT OF EXCAVATION

WMATA ENGINEERING STANDARDS

PLATE A-2A



WMATA ZONE OF INFLUENCE
(CASE A)

BELOW GRADE WMATA FACILITY AND
WMATA FACILITY BELOW ADJACENT CONSTRUCTION

WMATA ENGINEERING STANDARDS

PLATE A-2B

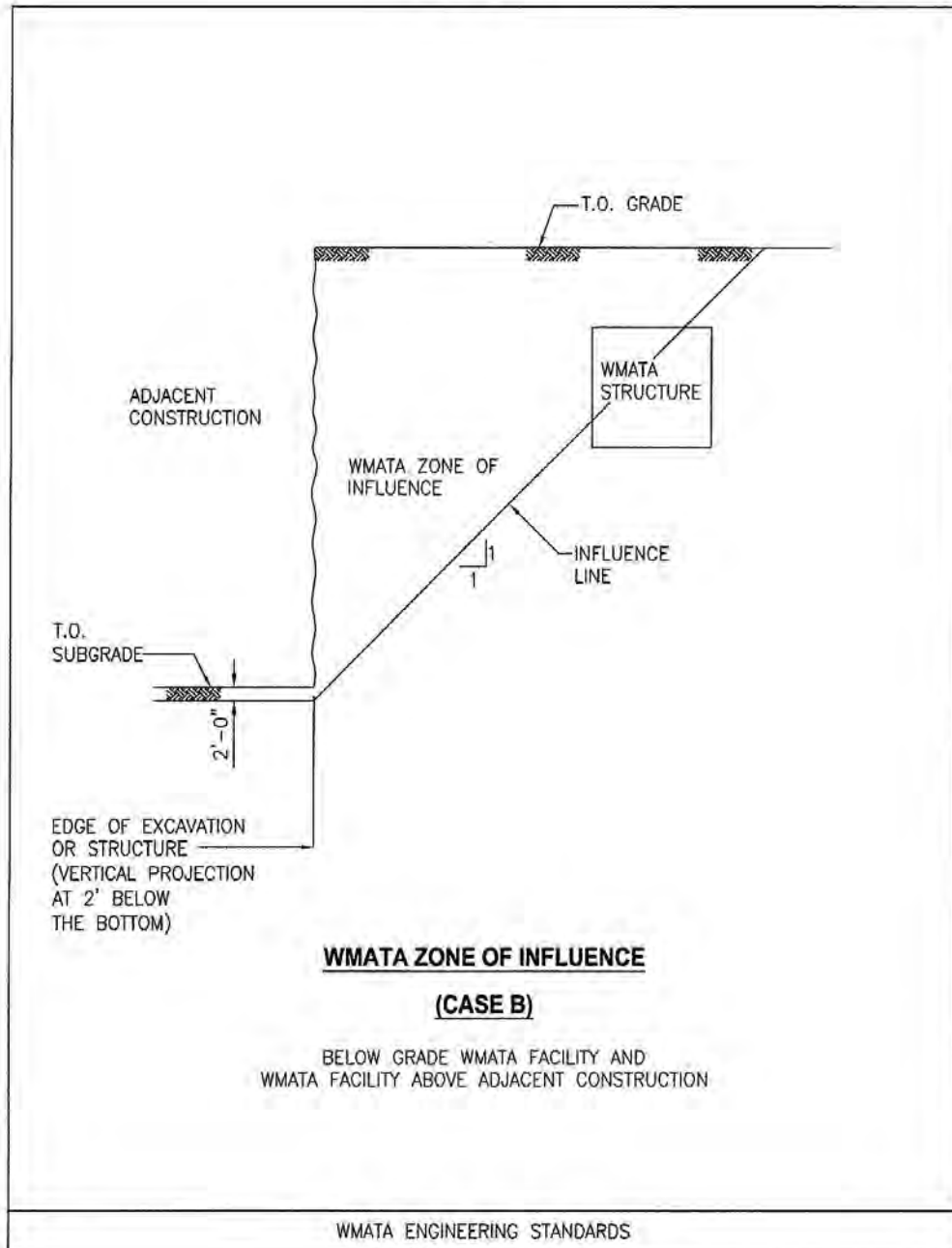
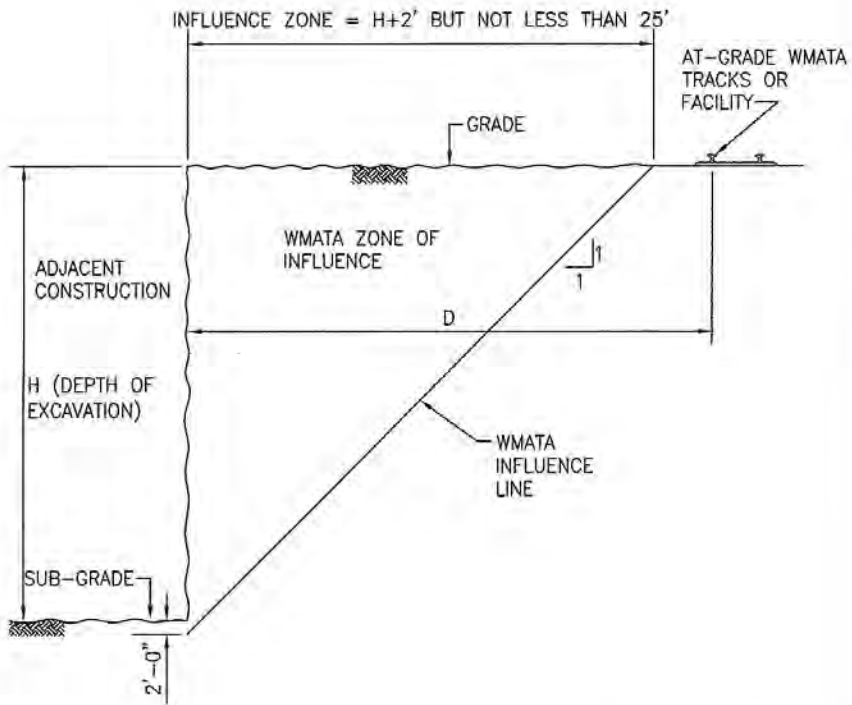


PLATE A-2C



THE EXCAVATION WILL BE CONSIDERED TO BE IN THE WMATA ZONE OF INFLUENCE IF 'D' IS LESS THAN THE LARGER OF (H+2) FEET OR 25 FEET.

WMATA ZONE OF INFLUENCE

(CASE C)

ADJACENT CONSTRUCTION NEAR
AT-GRADE WMATA TRACKS OR FACILITY

WMATA ENGINEERING STANDARDS

APPENDIX -3

PLATE A-2D

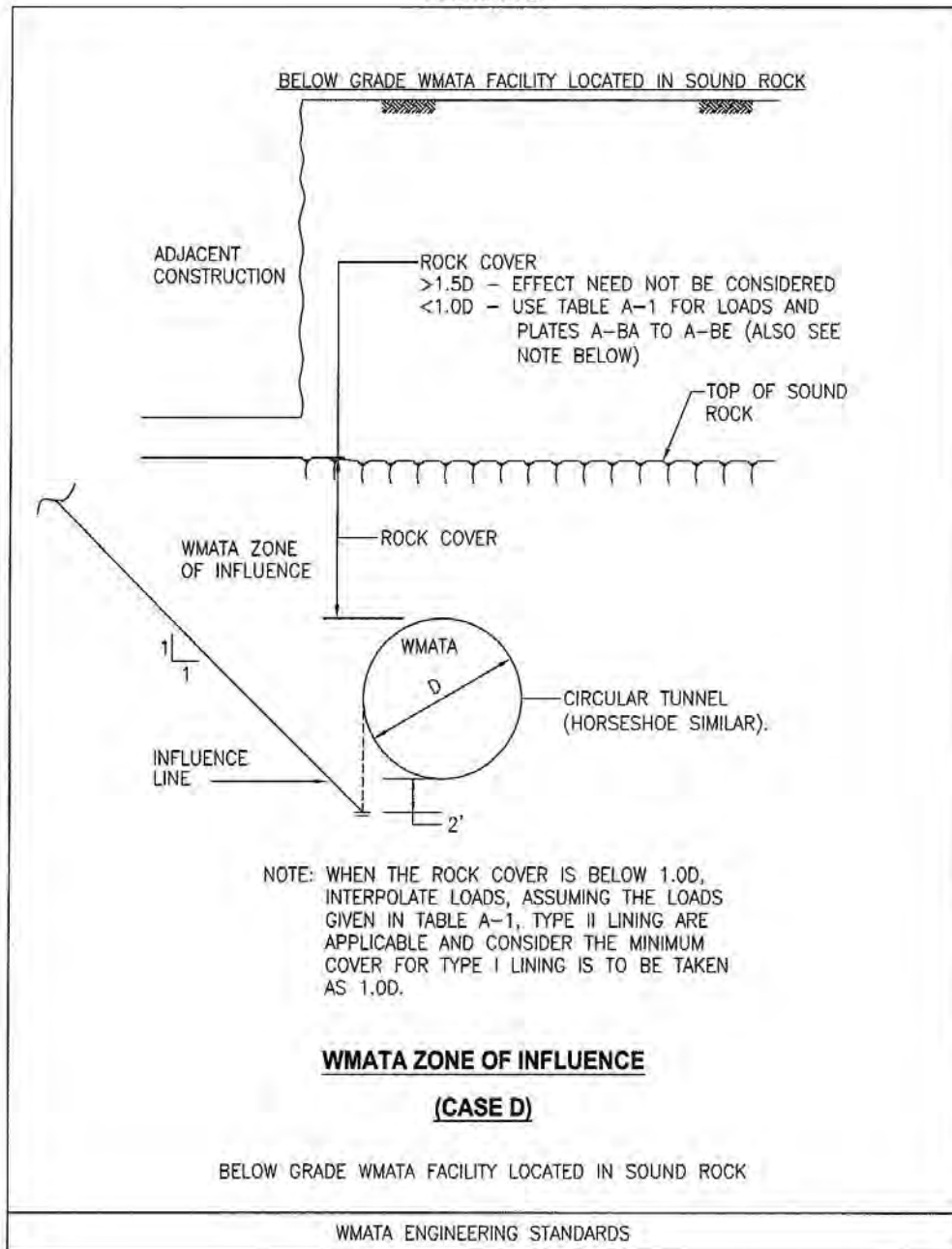
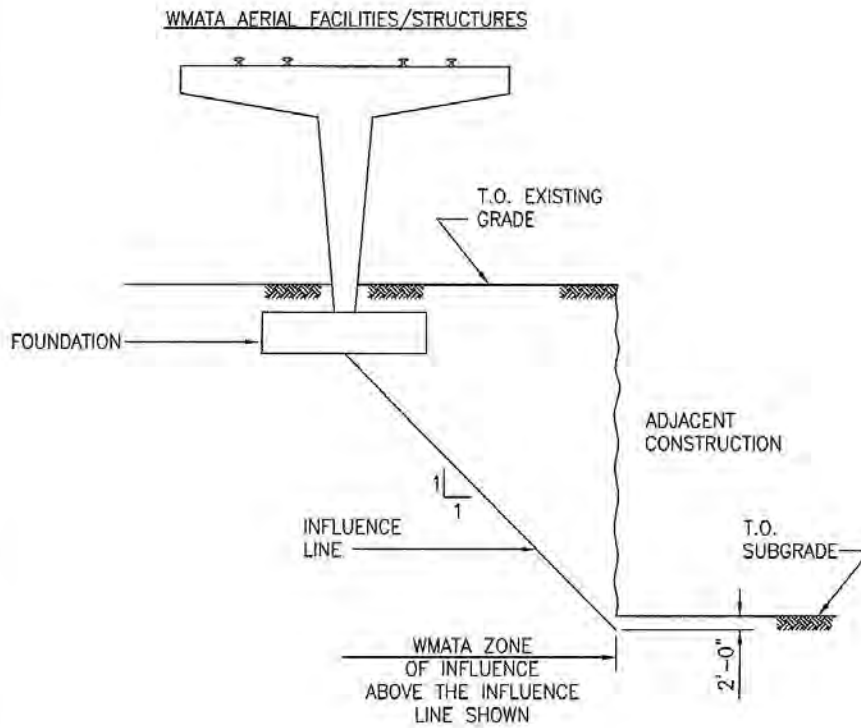


PLATE A-2E



FOR A SITUATION LIKE THE ONE SHOWN HERE, UNDERPINNING WOULD BE REQUIRED PER PLATE A-3A OR PLATE A-3B, UNLESS THE FOUNDATION IS ON PILES EXTENDING AT LEAST 10 FEET BELOW THE 1:1 LINE. ALSO CHECK SLOPE STABILITY.

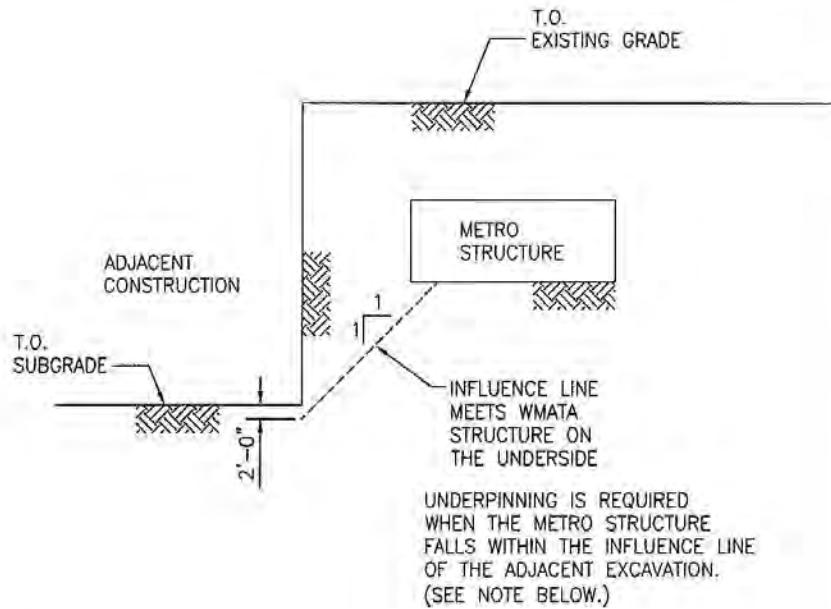
WMATA ZONE OF INFLUENCE

(CASE E)

ADJACENT CONSTRUCTION NEAR WMATA AERIAL FACILITIES OR STRUCTURES

WMATA ENGINEERING STANDARDS

PLATE A-3A

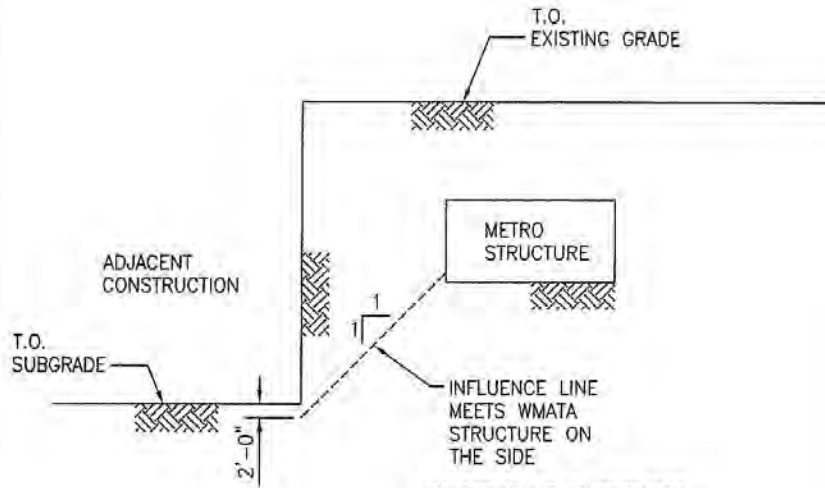


NOTE: WHEN THE INFLUENCE LINE HITS THE UNDERSIDE OF THE WMATA STRUCTURE, IT WILL REQUIRE UNDERPINNING. THE UNDERPINNING STRUCTURE MUST RECEIVE THE SUPPORT AT LEAST 5 FEET BELOW THE LINE OF INFLUENCE.

TUNNEL UNDERPINNING REQUIREMENTS
(CASE A)

WMATA ENGINEERING STANDARDS

PLATE A-3B



UNDERPINNING IS REQUIRED WHEN THE METRO STRUCTURE FALLS WITHIN THE INFLUENCE LINE OF THE ADJACENT EXCAVATION. (SEE NOTE BELOW.)

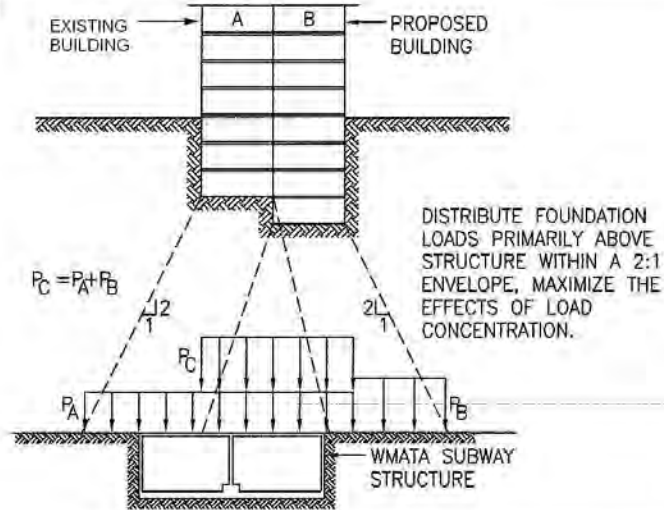
NOTE: WHEN THE INFLUENCE LINE HITS THE SIDE OF THE WMATA STRUCTURE, UNDERPINNING IS REQUIRED. THE UNDERPINNING STRUCTURE MUST RECEIVE THE SUPPORT AT LEAST 5 FEET BELOW THE LINE OF INFLUENCE. ALTERNATELY FOR PLATE A-3, CASE B, RIGID SUPPORT OF EXCAVATION MAY BE USED WITH WMATA APPROVAL, IN LIEU OF UNDERPINNING.

TUNNEL UNDERPINNING REQUIREMENTS
(CASE B)

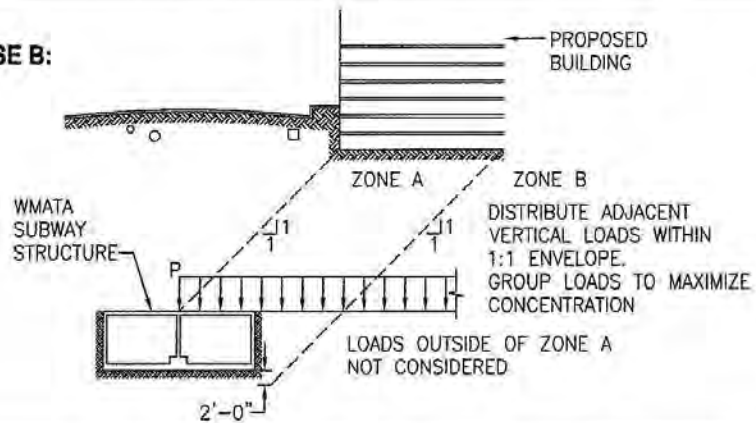
WMATA ENGINEERING STANDARDS

PLATE A-4

CASE A:



CASE B:

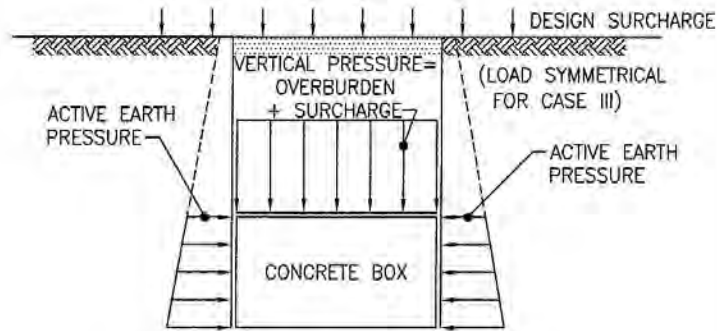
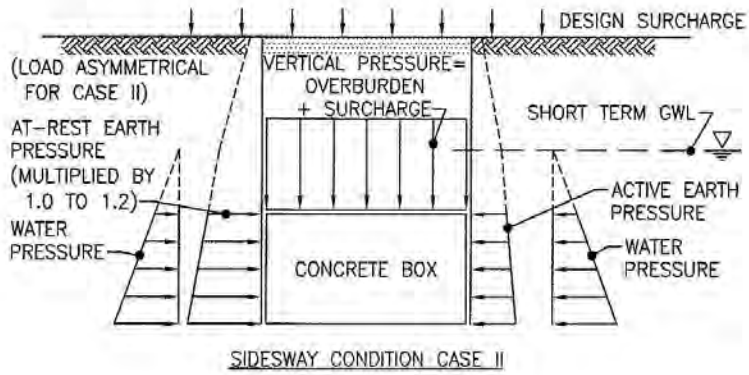


NOTE: EFFECTS OF THE LATERAL LOADS, DUE TO THESE VERTICAL LOADS, SHALL BE CONSIDERED ALONG WITH THE VERTICAL PRESSURES SHOWN HERE ON WMATA STRUCTURES.

DISTRIBUTION OF VERTICAL PRESSURES

WMATA ENGINEERING STANDARDS

PLATE A-5A



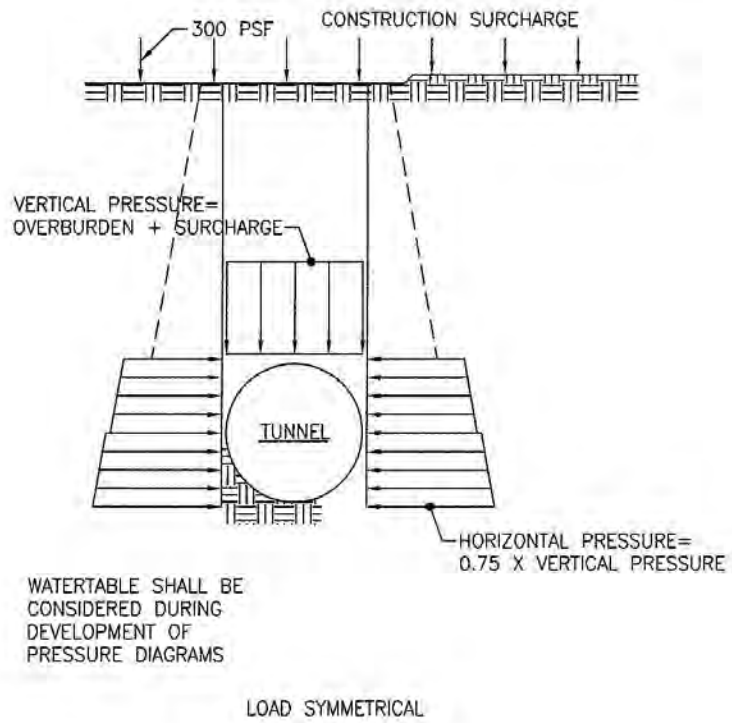
SIDESWAY CONDITION CASE III
 FOR SHORT TERM LOADING, CASE III, USE
 SYMMETRICAL ACTIVE EARTH PRESSURES
 ON SIDES, ASSUMING NO WATER PRESSURES.

SHORT TERM LOADING
CONCRETE BOX TUNNEL AND OTHER CUT & COVER STRUCTURES

(SEE DESIGN CRITERIA SECTION V.5.04 FOR DETAILS)

WMATA ENGINEERING STANDARDS

PLATE A-5B

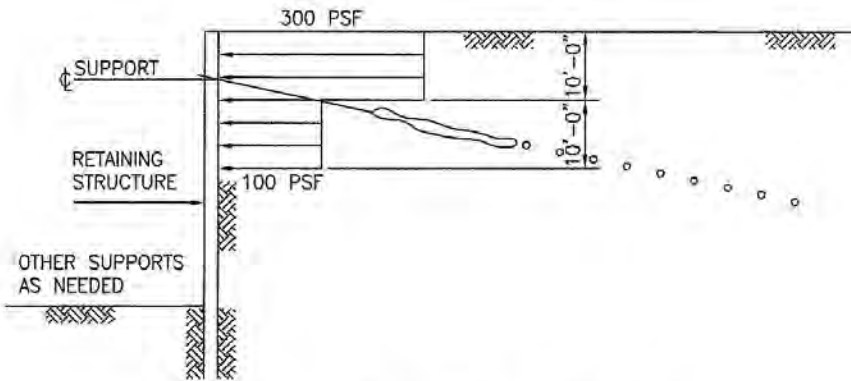


SHORT TERM LOADING
BORED TUNNEL

WMATA ENGINEERING STANDARDS

APPENDIX -3

PLATE A-6A



THIS LATERAL PRESSURE IS BASED UPON AN ASSUMED TRAFFIC AND CONSTRUCTION EQUIPMENT SURCHARGE OF 600 PSF.

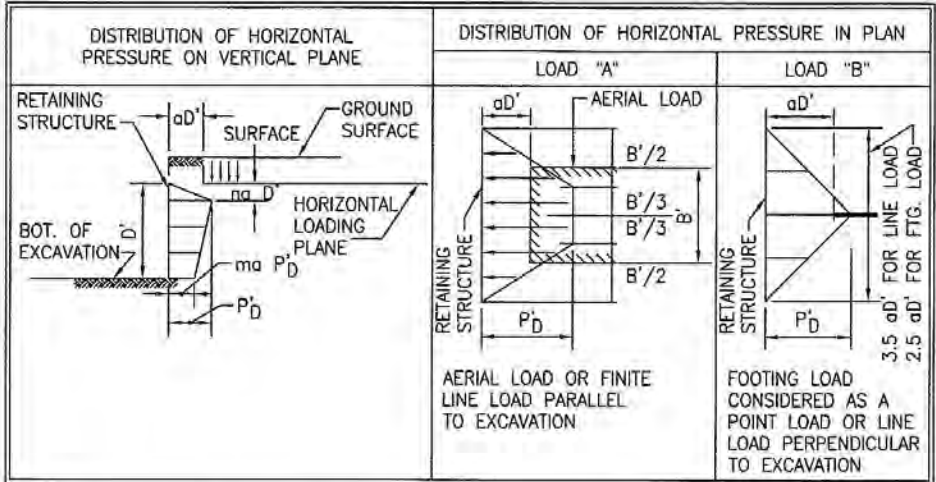
A SPECIAL ANALYSIS MUST BE MADE FOR MORE SEVERE CONSTRUCTION LOADS.

NOTE: A MINIMUM LATERAL LOAD FROM TRAFFIC AND CONSTRUCTION EQUIPMENT SHALL BE AS SHOWN IN PLATE A-6A. FOR HEAVIER LOADS, THE LATERAL LOADS AS SHOWN IN PLATE A-6B SHALL BE USED, UNLESS A MORE RIGOROUS ANALYSIS IS DONE WITH THE APPROVAL OF WMATA.

TRAFFIC AND CONSTRUCTION EQUIPMENT LOADS

WMATA ENGINEERING STANDARDS

PLATE A-6B



PARAMETERS	n	m	P'_D	LOAD TYPE
ISOLATED (INDIVIDUAL) FOOTING CONSIDERED AS POINT LOAD	0.6	0.4	$(2.1-1.8a) Q'/D'^2$	LOAD "B"
CONTINUOUS FOOTING CONSIDERED AS LINE LOAD PARALLEL TO RETAINING STRUCTURE	0.4	0.25	$(1.1-0.5a) Q'/D'$	LOAD "A"
AERIAL LOAD	0.4	0.25	$(0.8-0.5a) Q'/D'$	LOAD "A"
CONTINUOUS FOOTING CONSIDERED AS LINE LOAD PERPENDICULAR TO RETAINING STRUCTURE	0.6	0.4	$(1.4-1.2a) Q'/D'^2$	LOAD "B"

SURCHARGE LOADING PARAMETERS

LEGEND

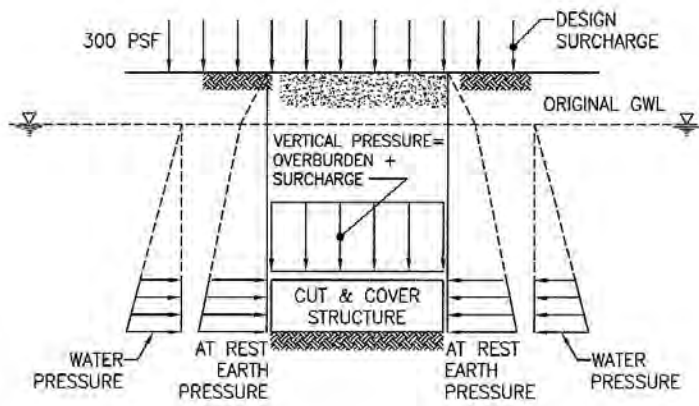
- aD' = DISTANCE OF RETAINING STRUCTURE TO NEAREST EDGE OF SURCHARGE LOAD
- Q' = TOTAL LOAD PER FOOT OF LENGTH PARALLEL WITH RETAINING STRUCTURE (LOAD "A"), OR TOTAL FOOTING LOAD (LOAD "B")
- a, n, m = DIMENSIONLESS FACTORS

HORIZONTAL PRESSURE ON RETAINING STRUCTURE NEED NOT BE CONSIDERED FOR SURCHARGE LYING AT A DISTANCE OF $D'+2'$ OR MORE, FROM THE RETAINING STRUCTURE.

BUILDING OR CONSTRUCTION LOADS

WMATA ENGINEERING STANDARDS

PLATE A-7A

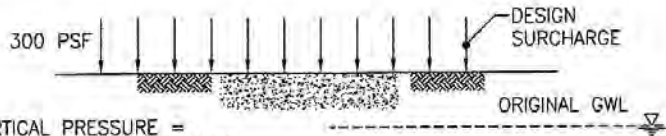


MULTIPLY AT REST EARTH PRESSURE BY FACTOR 1.0 OR 1.2,
(WHICHEVER PRODUCES THE MOST CRITICAL STRESSES)

LONG TERM LOADING
CONCRETE BOX TUNNEL AND OTHER CUT & COVER STRUCTURES

WMATA ENGINEERING STANDARDS

PLATE A-7B

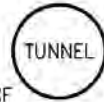


VERTICAL PRESSURE =
OVERBURDEN + SURCHARGE
IN COMPACT GRANULAR
MATERIALS. IN FINE
GRAINED SOILS APPLY
VERTICAL PRESSURE
AT THE SPRING LINE.



SYMMETRICAL LOADS

OVERBURDEN UNIT WEIGHT
INCLUDING WATER = 130#/CF



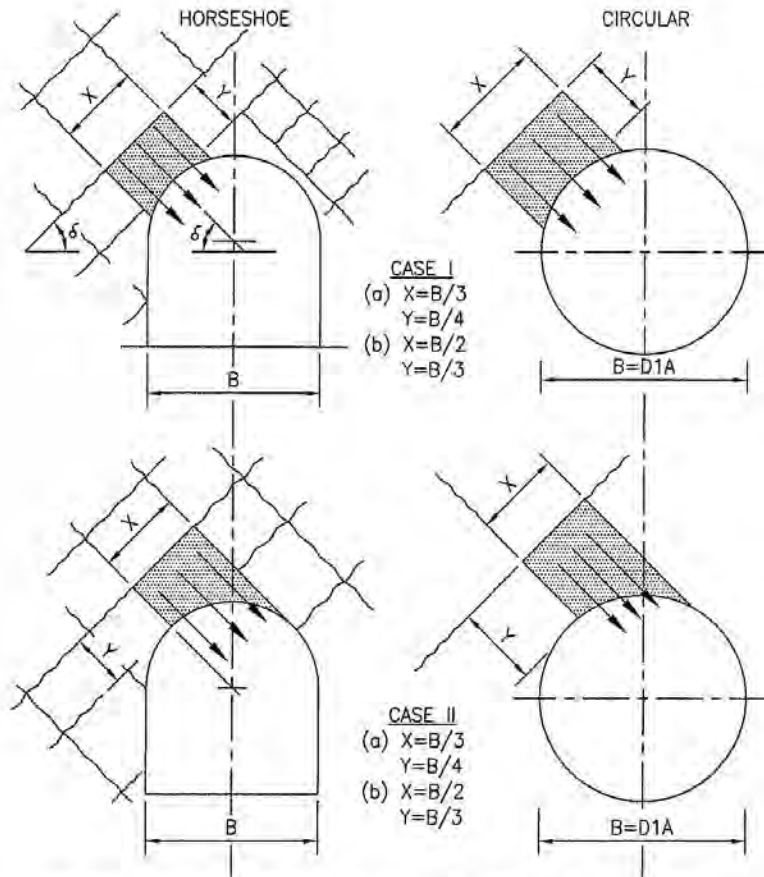
HORIZONTAL PRESSURE
0.85/APPLIED VERTICAL
PRESSURE

NOTE: FOR ADEQUACY CHECK OF ALL TWO-PASS SYSTEM
TUNNELS, THE FINAL LINER ONLY SHALL BE
CONSIDERED AS RESISTING LOADS.

LONG TERM LOADING
BORED TUNNEL

WMATA ENGINEERING STANDARDS

PLATE A-8A

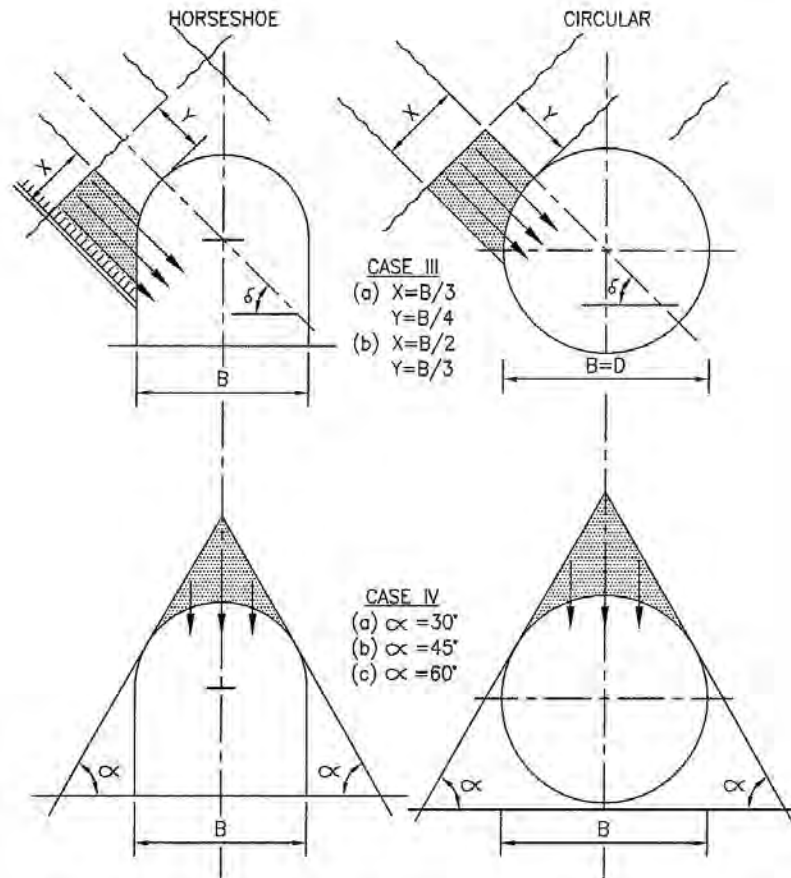


FOR CASES I & II, ANGLE δ TO BE DETERMINED FROM SUBSURFACE DATA
 NOTE: FRICTION ANGLE OF 15° AT SLIDING JOINTS CASE I THRU III.

LOADING CONDITIONS - RUNNING TUNNELS IN ROCK

WMATA ENGINEERING STANDARDS

PLATE A-8B

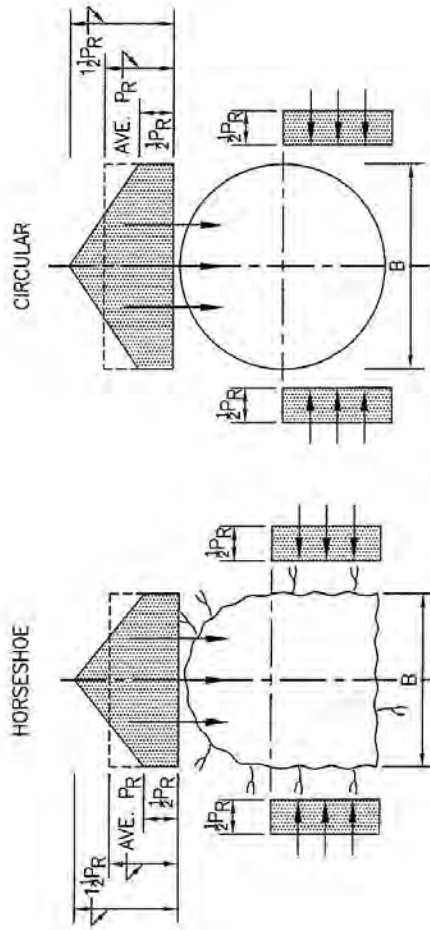


FOR CASES III, ANGLE δ TO BE DETERMINED FROM SUBSURFACE DATA

LOADING CONDITIONS - RUNNING TUNNELS IN ROCK

WMATA ENGINEERING STANDARDS

PLATE A-8C



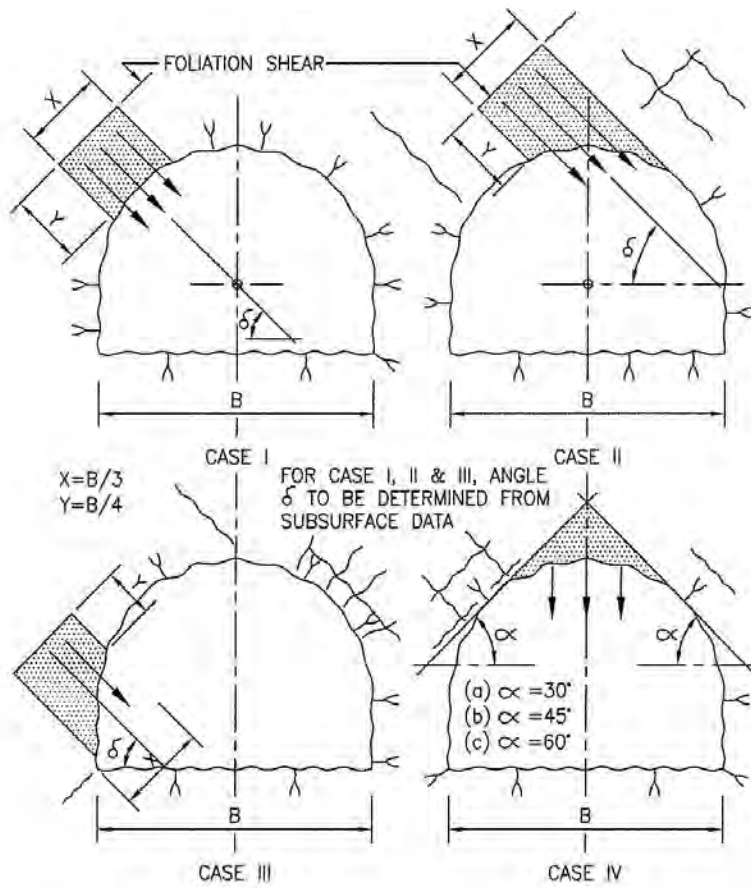
CASE V

P_R = TABULATED AVERAGE VERTICAL ROCK PRESSURE, SEE TABLE A-1

LOADING CONDITIONS - RUNNING TUNNELS IN ROCK

WMATA ENGINEERING STANDARDS

PLATE A-8D



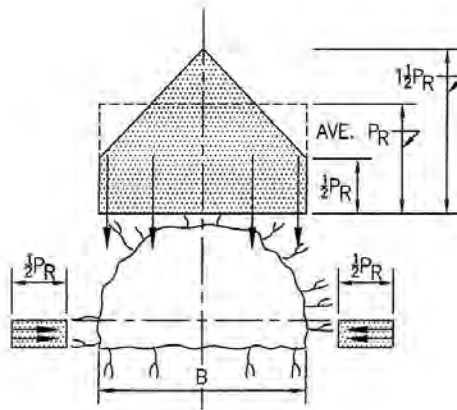
NOTE: FRICTION ANGLE OF 15° AT SLIDING JOINTS(CASE I THRU III)

LOADING CONDITIONS - STATIONS

WMATA ENGINEERING STANDARDS

APPENDIX - 3

PLATE A-8E



CASE V

P_R = TABULATED AVERAGE VERTICAL ROCK PRESSURE, SEE TABLE A-1

LOADING CONDITIONS - STATIONS

WMATA ENGINEERING STANDARDS

APPENDIX - 3

PLATE A-9

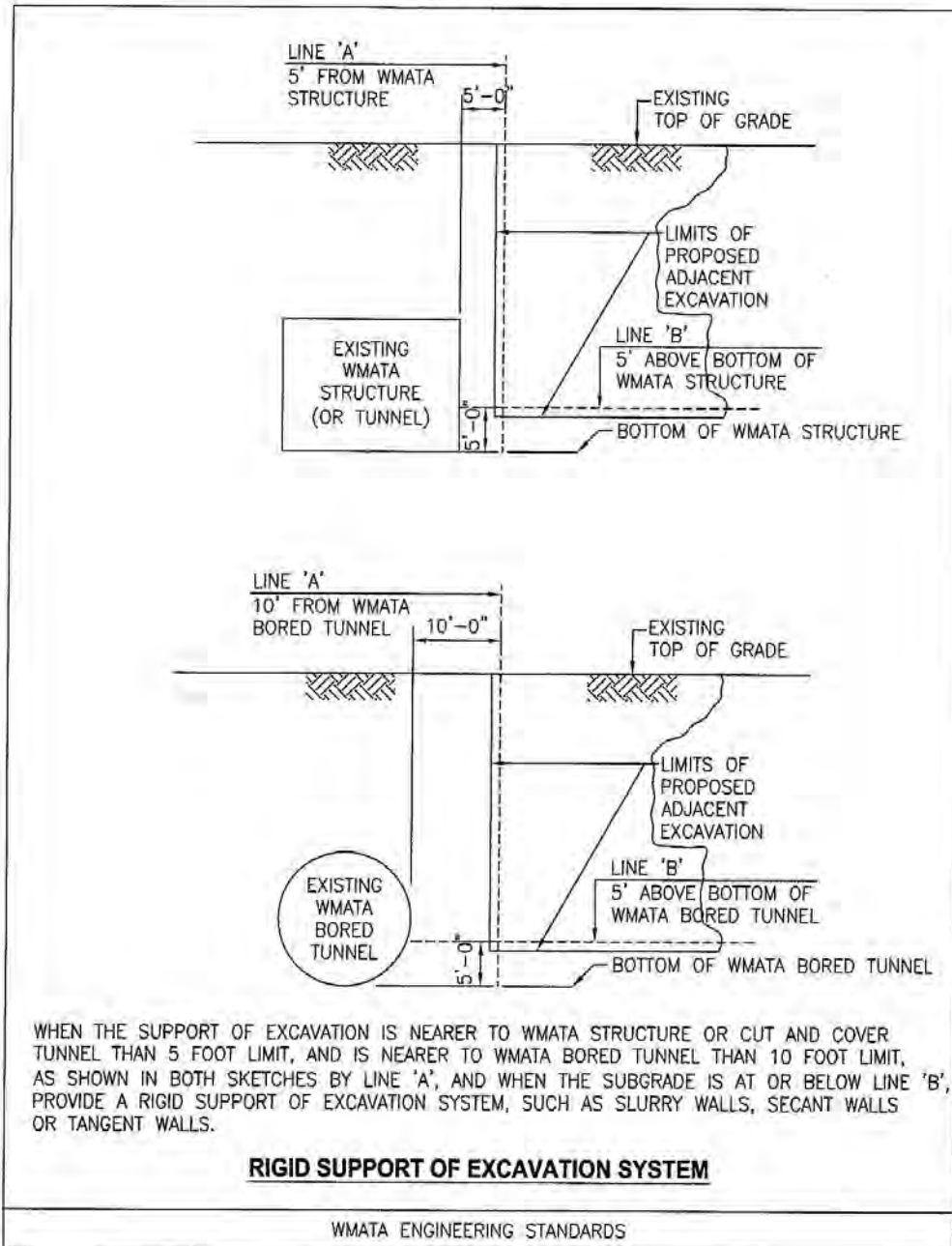


PLATE L-1

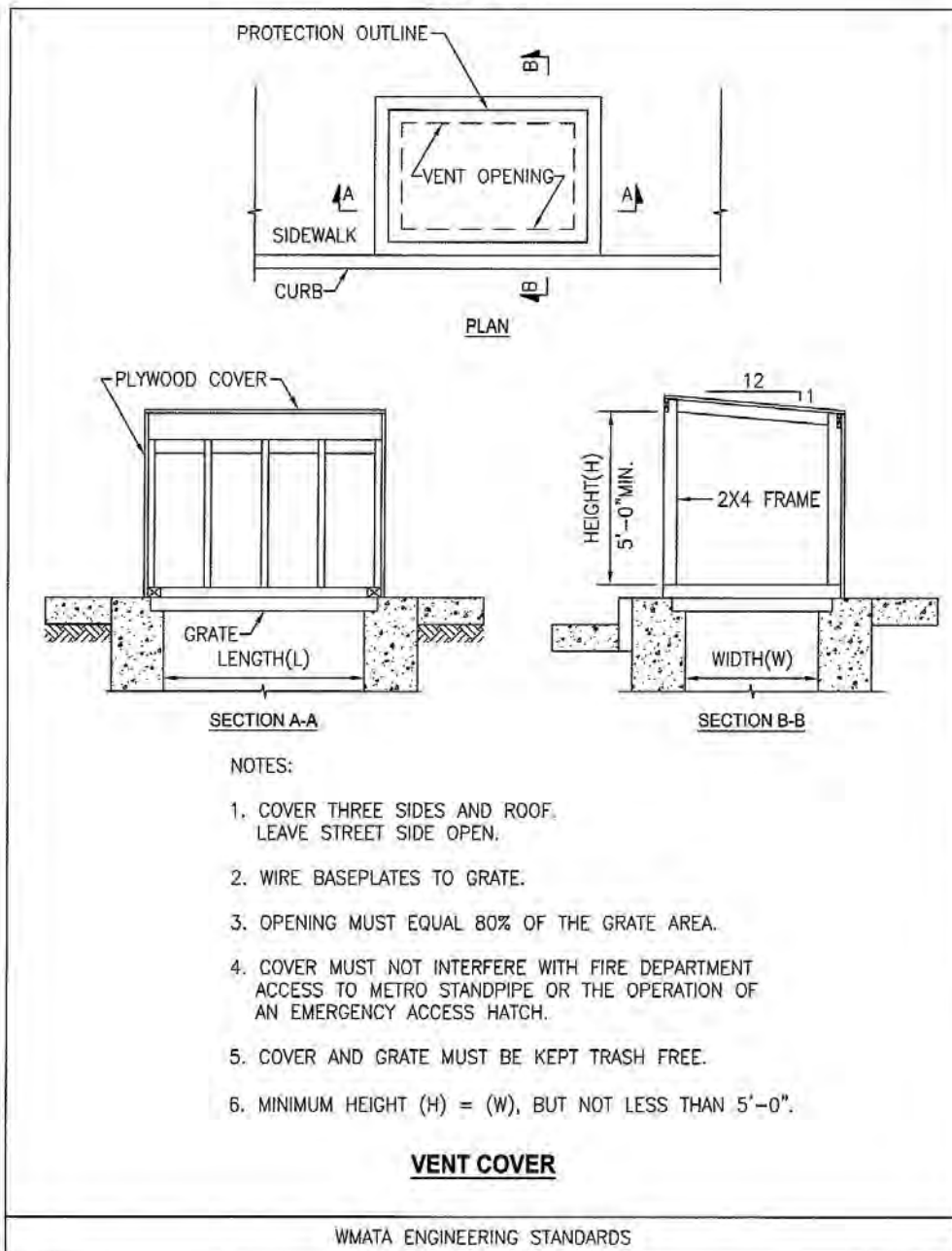
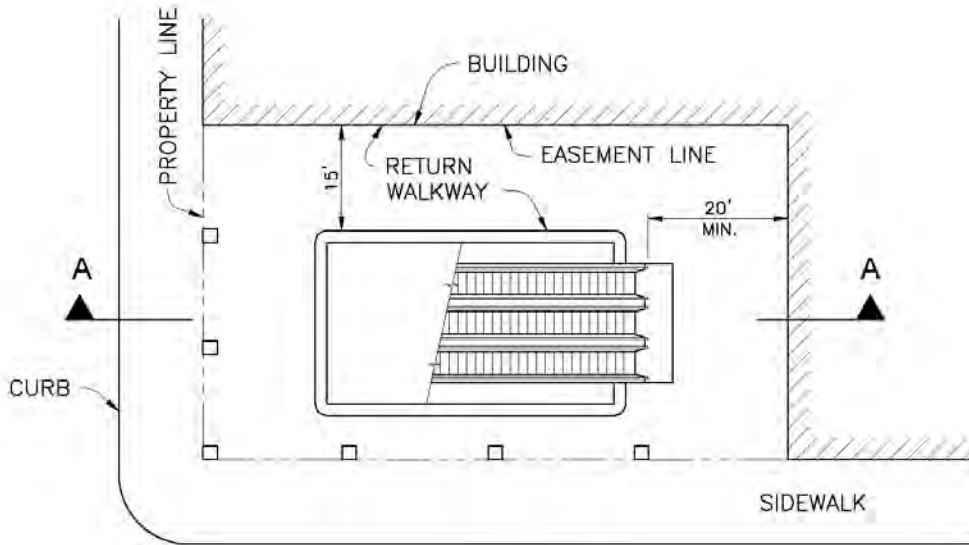
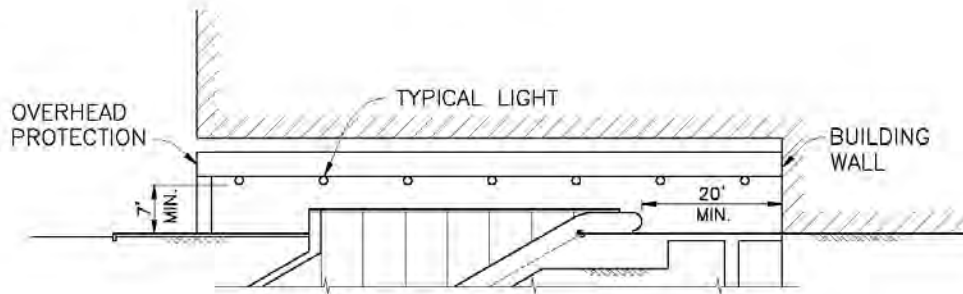


Plate E-1



PLAN

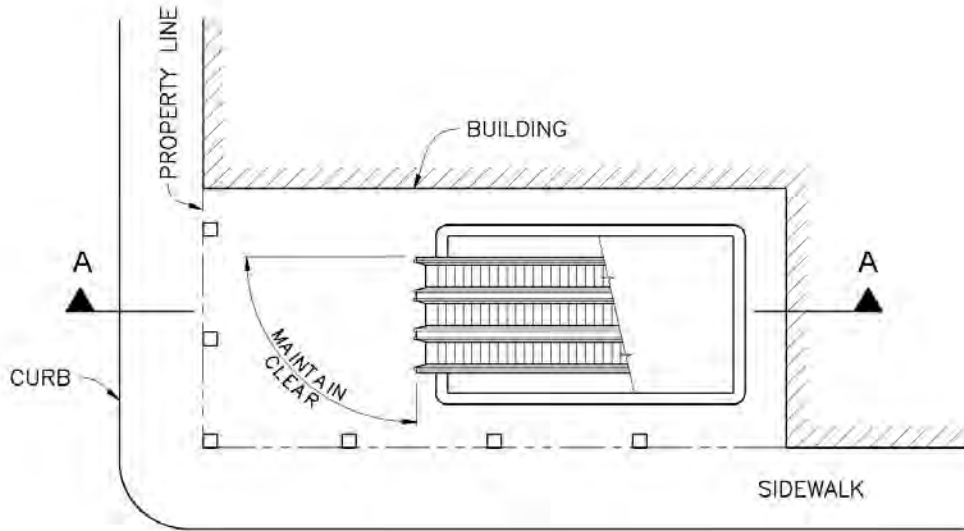


SECTION A-A

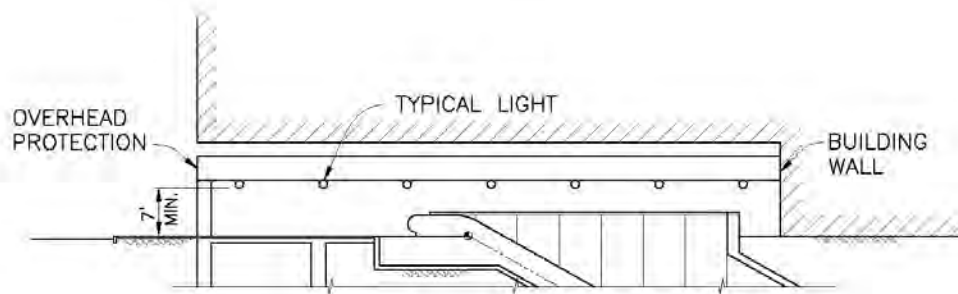
1. MAINTAIN 15'-0" RETURN WALKWAY WIDTH FOR PEDESTRIAN ACCESS.
2. MAINTAIN 20'-0" WALKWAY FROM TOP OF ESCALATOR TO SIDEWALK.
3. MAINTAIN A LIGHT LEVEL OF 10 FOOT CANDLES AT ESCALATOR TREADS, OR WALKING SURFACE.

OVERHEAD PROTECTION ESCALATORS AWAY FROM STREET

Plate E-2



PLAN



SECTION A-A

1. MAINTAIN CLEAR WALKWAY FROM TOP OF ESCALATOR TO SIDEWALK.
2. MAINTAIN A LIGHT LEVEL OF 10 FOOT CANDLES AT ESCALATOR TREADS, OR WALKING SURFACE.

OVERHEAD PROTECTION ESCALATORS TOWARD STREET

Table 3-1: AVERAGE VERTICAL LOAD ON ROCK TUNNELS

TUNNEL TYPE		Single Track	Double Track	Station
Excavation Dimensions		20' Wide 18' High	35' Wide 24' High	70' Wide 40' High
Type I Lining: Minimum Cover of "Relatively Sound or sound Rock" required for Type I lining. (See Note 4)		10'	15'	30'
Type II Lining: Type II lining is used for the following conditions		AVERAGE VERTICAL LOAD P_R		
(A)	Portal Sections, or where rock cover of any quality is ≤ 0.4 of minimum rock cover for Type 1 lining, or where thicker rock cover is highly jointed and weathered.	Full Overburden ΣV	Full Overburden ΣV	Full Overburden ΣV
(B)	Rock cover "relatively sound or sound" is ≥ 0.4 , but is ≤ 0.6 of minimum rock cover for Type I lining.	$(0.15) \times (\Sigma V)$	$(0.30) \times (\Sigma V)$	$(0.60) \times (\Sigma V)$
(C)	Rock cover "relatively sound or sound" is ≥ 0.6 , but is ≤ 0.8 of minimum rock cover for Type I lining.	$(0.10) \times (\Sigma V)$	$(0.20) \times (\Sigma V)$	$(0.40) \times (\Sigma V)$
(D)	Rock cover "relatively sound or sound" is ≥ 0.8 , but is ≤ 1.0 of minimum rock cover for Type I lining.	$(0.05) \times (\Sigma V)$	$(0.10) \times (\Sigma V)$	$(0.20) \times (\Sigma V)$
(E)	Rock cover ≥ 1.0 of minimum rock cover for Type I lining, but is not "relatively sound or sound" at tunnel top.	0.5 ksf	1.0 ksf	2.0 ksf

Notes:

- (1) ΣV = Total pressure of overburden, soil plus rock, above tunnel top.
- (2) Rock described in D. U. Deer report of November 1, 1967 as "good to excellent" with RQD values greater than 65 to 75 percent generally qualifies as "relatively sound or sound" rock cover.
- (3) Rock described on the geological sections in the WMATA soils reports prepared by MRCE, as "relatively sound or sound", with RQD values greater than 60 to 70 percent generally qualifies as "relatively sound or sound" rock cover
- (4) No vertical load is considered for the design of the tunnel lining, in "relatively sound or sound" or better rock and is called Type I lining.

Table 3-2: MODULUS OF SUBGRADE REACTION

STRATUM	MODULUS OF SUBGRADE REACTION - KCF
Fill, organic soils, T0, T1 Clays with Shear Strength of 1.5 KSF or less.	75
Stiff T1 Clay, Coarse-grained Pleistocene Terrace Materials	150
Cretaceous Strata	200
Decomposed Rock, Thoroughly Weathered Rock	300

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TABLE 3-3: SOIL PROPERTIES FOR DESIGN

TABLE V-2 SOIL PROPERTIES FOR DESIGN											
UNIFIED SOIL CLASSIFICATION	SHORT DESCRIPTION	MRWJ SYMBOLS	FULL DESCRIPTION/SOURCE	SEAR STRENGTH AND CONSOLIDATION CONDITION OF A COHESIVE STRATA	MIN. UNIT WEIGHT (PCF)	COEF OF SUBGRADE REACTION (KCF)	UNDRAINED SHEAR STRENGTH (KSF)	YOUNG MOD. OF SUBGRADE (RSI)	COEF. OF AT REST PRESS.	MAX. EFFECTIVE ANGLE OF FRICTION (DEGREES)	MAX. ALLOWABLE BEARING CAPACITY (TSD)
PRIMARY	SECONDARY										
			FILL								
ML & SM	SC & CL	F	FILL GENERALLY COMPOSED OF INORGANIC SOIL OBTAINED FROM NEAR BY NATURAL TERRACE. CRETACEOUS SOIL OR DECOMPOSED ROCK.	PLACED OVER MARSH, MIXED WITH CINDERS. NO CONSOLIDATION	120					28	NONE, ORDINARILY
				FROM PLEISTOCENE SOILS	130					30	1.0 TO 1.50
				FROM DECOMPOSED ROCK (NW OF ROCK CREEK)	130					30	1.5 TO 2.0
				FROM CRETACEOUS CLAYS (NEAR UNION STATION). MAX. SHEAR STRENGTH, COHESIVE STRATA: 0.8 KSF	130					25	0.75
				MIXED WITH ORGANIC SOILS (SOUTH OF ROSSLYN)	120					28	
				OTHER LOCATIONS	130					30	1.0 TO 1.50
				RIVER ALLUVIUM OF POST GLACIAL TIMES.							
CL, CH, OH	OL & PT	A1	VERY SOFT TO MEDIUM STIFF DARK GRAY ORGANIC CLAY WITH LENSES OF HIGHLY ORGANIC MATERIAL (WHERE LOCATED UNDER WATER). SOFT TO STIFF MOTTLED GRAY-BROWN SLIGHTLY ORGANIC SILTY OR SANDY CLAY (WHERE LOCATED IN LAND).	BENEATH FILL OVER CONSOLIDATED 0.2 TO 0.3 TSE. STRENGTH 0.5 TO 0.7 KSF.	120					23	NONE, ORDINARILY
				BENEATH WATER OVER CONSOLIDATED AS MUCH AS 8.2 TSE. STRENGTH 0.2 TO 0.3 KSF.	110					23	NONE
				MAX. SHEAR STRENGTH, COHESIVE STRATA: 0.9 KSF	120					23	0.75
SM	SP	A2	LOOSE TO MEDIUM COMPACT GRAY OR DARK BROWN SILTY FINE TO MEDIUM SAND WITH OCCASIONAL POPCKETS OR LENSES OF SMALL GRAVEL. MAY BE SLIGHTLY TO MODRATLY ORGANIC.		130					30	2 TO 2.5
					130					30	2

TABLE 3-3: SOIL PROPERTIES FOR DESIGN

TABLE V-2 SOIL PROPERTIES FOR DESIGN											
UNIFIED SOIL CLASSIFICATION	SHORT DESCRIPTION	MRV#* SYMBOLS	FULL DESCRIPTION/SOURCE/AGE	SHEAR STRENGTH AND CONSOLIDATION CONDITION OF A COHESIVE STRATA	MIN. UNIT WEIGHT (pcf)	COEF OF SUBGRADE REACTION (kcf)	UNDRAINED SHEAR STRENGTH (ksf)	YOUNG MOD. OF SUBGRADE (ksf)	COEF. OF AT REST PRESS. (ksf)	MAX. EFFECTIVE ANGLE OF FRICTION (DEGREES)	MAX. ALLOWABLE BEARING CAPACITY (ksf)
			PORTIONS OF THE "25-FOOT" "50-FOOT" AND "90-FOOT" TERRACES, DEPOSITED BY RIVERS IN PLEISTOCENE TIMES.								
CL & OH		T0	MEDIUM STIFF TO STIFF DARK GRAY ORGANIC CLAY WITH NUMEROUS WOOD FRAGMENTS, USUALLY FOUND INTERLENSED WITH STRATUM T4.	MAX. SHEAR STRENGTH, COHESIVE STRATA: 1.4 KSF	130					25	1.2 TO 1.5
CL, CL& CH		T1	STIFF TO MEDIUM STIFF LIGHT BROWN OR GRAY OR MOTTLED BROWN-GRAY SILTY CLAY OR CLAYEY SILT WITH LENSES OF BROWN SILT FINE SAND. IN SOME AREAS, SEVERAL SEPARATE LAYERS OF PLEISTOCENE CLAYS HAVE BEEN ENCOUNTERED, WHICH ARE DISTINGUISHED BY A LETTER SUFFIX: T1A, T1C, ETC.								
	SILTY SAND			(DEPTH: 0 TO 40 FT) MAX. SHEAR STRENGTH, COHESIVE STRATA: 1.0 KSF TO 1.5 KSF	130					25	1.5 TO 2.0
	SILTY SAND			(DEPTH > 40 FT) MAX. SHEAR STRENGTH, COHESIVE STRATA: 1.0 TO 1.5 KSF	130					25	1.0 TO 1.5
	SILTY CLAY	T1 (A) & (G)		OVERCONSOLIDATED 3 TO 5 TSF. STRENGTH 1.5 TO 2.5 KSF, HIGHER NEAR SURFACE.	130					25 TO 28	1.50 TO 2.50
	ORGANIC CLAY	T1 (B)		OVERCONSOLIDATED 1.5 TO 2.5 TSF. STRENGTH 2 TO 3 KSF.	130					25	2
	SILTY CLAY	T1 (C) & (F)		OVERCONSOLIDATED 0.5 TO 1 TSF. STRENGTH 0.7 TO 0.9 KSF, HIGHER AT SURFACE.	130	150				25	1 OR LESS
	PLASTIC CLAY	T1 (D)		OVERCONSOLIDATED 2.5 TO 3.0 TSF. STRENGTH 2.5 TO 3.5 KSF.	130					25	2.0 TO 3.0
	MEDIUM PLASTIC CLAY	T1 (E)		OVERCONSOLIDATED 3.0 TSF. STRENGTH 2 TO 3 KSF.	130					25	2.0 TO 2.50
SM & SC	SILTY SAND	T2	MEDIUM COMPACT TO VERY COMPACT BROWN AND RED-BROWN SILTY OR CLAYEY FINE TO MEDIUM SAND WITH TRACES OF GRAVEL AND OCCASIONAL BOULDERS		130					34	2.0 TO 3.0
SW & SM	GRGELY SAND	T3	RED BROWN FINE TO COARSE SAND WITH SOME SILT AND SMALL GRAVEL AND VARIABLE AMOUNTS OF COBBLES AND BOULDERS.		130	170				34-38	3.5 TO 4.0
SM & SP	SILTY SAND	T4	MEDIUM COMPACT TO COMPACT GRAY AND GRAY-BROWN FINE TO MEDIUM SAND WITH SOME SILT AND SMALL GRAVEL, CONTAINING LENSES OF DARK GRAY CLAY, OCCASIONALLY SLIGHTLY ORGANIC.		130					30 TO 34	2.0 TO 3.0

TABLE 3-3: SOIL PROPERTIES FOR DESIGN

TABLE V-2 SOIL PROPERTIES FOR DESIGN										
UNIFIED SOIL CLASSIFICATION	SHORT DESCRIPTION	MRV'S SYMBOLS	SHEAR STRENGTH AND CONSOLIDATION CONDITION OF A COHESIVE STRATA	MIN. UNIT WEIGHT (PCF)	COEF OF SUBGRADE REACTION (KCF)	UNDRAINED SHEAR STRENGTH (KSF)	YOUNG MOD. OF SUBGRADE (KSD)	COEF. OF AT. FRICTION PRESS.	MAX. EFFECTIVE ANGLE OF FRICTION (DEGREES)	MAX. ALLOWABLE BEARING CAPACITY (TSF)
SW & SM SP & GM	GRAVELLY SAND	T ₁	FULL DESCRIPTION: SOURCE OF GRAVELLY SAND WITH SOME TRACES OF SILT AND VARIABLE AMOUNTS OF COBBLES AND BOULDERS, OFTEN CONCENTRATED AT BASE OF LAYER.	130					32 - 38	2.5 TO 4.0
SM & SC	SILTY SAND	Q ₁	BRANDYWINE FORMATION OF EARLY PLEISTOCENE OR PLOCENE TIMES.							
SM & SC	GRAVELLY SAND	Q ₂	LOOSE TO MEDIUM COMPACT LIGHT BROWN SILTY OR CLAYEY FINE TO MEDIUM SAND WITH TRACE OF SMALL GRAVEL.	130					30	2.5
			LOOSE TO MEDIUM COMPACT LIGHT BROWN OR TAN SILTY OR CLAYEY MEDIUM TO FINE SAND WITH SOME SMALL GRAVEL.	130	180	0.01-0.02	12-15	0.4	33	3.0
SM & CH		C	MARINE DEPOSITS OF TERTIARY OR UPPER CRETACEOUS PERIODS							
		C ₁	MEDIUM COMPACT GRAY AND TANSILTY FINE SAND OR MEDIUM STIFF TO STIFF DARK GRAY TO OLIVE-GREEN CLAY. CALVERT FORMATION OF MIOCENE AGE.	130	100	1.5-2.5	6-8	0.55	25	1.5-2.0
		C ₂	PLASTIC CLAY, SILTY AND SANDY CLAY OR CLAYEY SILT	130	140		8-10	0.5	30-32	1.5 -2.0
MH & CH	ML & CL	E	FINE SAND, TRACE TO SOME SILT. CLAY AND CLAYEY FINE SAND							
		E ₁	AQUIA FORMATION OF EOCENE AGE.							
		E ₂	MEDIUM STIFF DARK GREEN OR BROWN CLAY AND SILTY CLAY. AQUA FORMATION OF EOCENE AGE.	130	140		8-10	0.5	30-32	1.5-2.0
				130	100	2.0-3.5	6-8	0.55	25	1.5 -2.0
MH & CH	MH & CH	M	UPPER CRETACEOUS PERIOD							
		M ₁	MEDIUM STIFF TO STIFF GREEN OR BROWN SILT AND CLAY. MONMOUTH FORMATION OF UPPER CRETACEOUS AGE.	130	120	3.0-3.5	8-10	0.6	25	2.0-4.0
		M ₂	SLIGHTLY ORGANIC FINE SANDY SILT AND CLAYEY SILT	130	160		10-12	0.45	32-34	2.0-4.0
		MS	SLIGHTLY ORGANIC MICA CE OUS SILTY OR CLAYEY FINE SAND							
			POTOMAC GROUP OF CRETACEOUS PERIOD,							

TABLE 3-3: SOIL PROPERTIES FOR DESIGN

TABLE V-2 SOIL PROPERTIES FOR DESIGN											
UNIFIED SOIL CLASSIFICATION	SHORT DESCRIPTION	MRWJ* SYMBOLS	FULL DESCRIPTION/SOURCE/AGE	SHEAR STRENGTH AND CONSOLIDATION CONDITION OF A COHESIVE STRATA	MIN. UNIT WEIGHT (PCF)	COEF OF SUBGRADE REACTION (KCF)	UNDRAINED SHEAR STRENGTH (KSF)	YOUNG MOD. OF SUBGRADE (KSD)	COEF. OF AT REST PRESS.	MAX. EFFECTIVE ANGLE OF FRICTION (DEGREES)	MAX. ALLOWABLE BEARING CAPACITY (TSF)
CH	CL	P1	HARD MOTTLED RED-BROWN AND GRAY LIGHT GRAY AND TAN PLASTIC CLAY WITH OCCASIONAL POCKETS OF FINE SAND. GENERALLY CONSISTS OF PATAFSCO FORMATION BUT MAY INCLUDE RARITAN FORMATION AT UPPER LEVELS.	NORTH & WEST OF NEW JERSEY AVE. OVERCONSOLIDATED 15 TO 20 TSF. STRENGTH 4 TO 5 KSF BUT ERRATIC.	130	200	3.0 TO 5.0	10-15	0.6	25	3.0 TO 5.0
	CL				130	200	4.0-4.5		0.5	30	3.0-5.0
				PARTIALLY WEATHERED ALONG R60 RIGHT-OF-WAY IN PHASE VII PROVIDE STRENGTH AND BEARING CAPACITY IN LOWER PORTION OF THE RANGE NOTED.	130					25	2.0 TO 5.0
SM & SP	SP	P2	COMPACT TO VERY COMPACT LIGHT GRAY OR TAN SILTY OR CLAYE FINE TO MEDIUM SAND WITH POCKETS OF SILTY CLAY AND TRACE OF SMALL GRAVEL, OCCASIONAL LIGNITE FRAGMENTS. ALSO INCLUDES MAGOTHY FORMATION OF UPPER CRETACEOUS AGE.		130	200			0.5	33 TO 34	3.5 TO 6.0
G					130	200			0.5	34	3.0 TO 6.0
					130	200				33 TO 36	3.0 TO 6.0
				OVERCONSOLIDATED 15 TO 20 TSF. STRENGTH 4 TO 6 KSF.	130					34	4.0 TO 7.0
SM & SH	SP & GM	P4	VERY COMPACT MOTTLED LIGHT GRAY, TAN SILT OR SILTY FINE TO MEDIUM SAND WITH SOME GRAVEL AND SCATTERED LIGNITE FRAGMENTS. FREQUENTLY WITH DENSE NESTS AND POCKETS OF ANGULAR ROCK FRAGMENTS, COBBLES AND BOULDERS.		135					34 TO 38	4.0 TO 7.0
			WEATHERED IN-SITU FROM CRYSTALLINE BEDROCK								
			DECOMPOSED ROCK; HARD ORANGE-BROWN OR YELLOW-BROWN MICACEOUS FINE SANDY SILT OR VERY COMPACT LIGHT GRAY AND GREEN MICACEOUS SILTY FINE TO MEDIUM SAD WITH VARIABLE AMOUNTS OF HARD, INCOMPLETELY DECOMPOSED ROCK FRAGMENTS AND LANSSE S. PROPORTION OF HARD ROCK FRAGMENTS INCREASES WITH DEPTH TOWARD THE BEDROCK SURFACE.		140					36	5
ML & SM	MH	D	DECOMPOSED ROCK	HIGH-QUASE OVERCONSOLIDATED STRENGTH INCREASE WITH DEPTH: 15 KSF TO 3.5 KSF AND MORE.							

TABLE 3-3: SOIL PROPERTIES FOR DESIGN

TABLE V-2 SOIL PROPERTIES FOR DESIGN											
UNFIELD SOIL CLASSIFICATION	SHORT DESCRIPTION	MRWJ* SYMBOLS	FULL DESCRIPTION/SOURCE/AGE	SHEAR STRENGTH AND CONSOLIDATION CONDITION OF A COHESIVE STRATA	MIN. UNIT WEIGHT (PCT)	COEFF OF SUBGRADE REACTION (K/CF)	UNDRAINED SHEAR STRENGTH (KSF)	YOUNG MOD. OF SUBGRADE (KSI)	COEFF. OF AT REST PRESS.	MAX. EFFECTIVE ANGLE OF FRICTION (DEGREES)	MAX. ALLOWABLE BEARING CAPACITY (TSF)
REQUIRE DIAMOND CORE DRILLING TO ADVANCE BOREHOLE			TRANSITION ZONE								
	WEATHERED & JOINTED BEDROCK	WR	WEATHERED AND JOINTED BEDROCK. WEATHERING ALONG JOINTS AND ALSO AFFECTING THE MINERAL FABRIC. RQD GENERALLY LESS THAN 50%.	BE COMING MORE ROCK LIKE WITH DEPTH, TOO HARD TO OBTAIN SOIL SAMPLE FOR TEST.	150 TO 100					32 TO 38	5.0 TO 15.0
	JOINTED BEDROCK	J	JOINTED TO MODERATELY JOINTED BEDROCK. WEATHERING ON JOINTS BUT RELATIVELY SMALL EFFECT ON MINERAL FABRIC. RQD GENERALLY BETWEEN 50% TO 75%.	MODERATELY JOINTED TO RELATIVELY SOUND. COMPRESSIVE STRENGTH 5 TO 25 KSI.	170					45	30.0 TO 60.0
	BEDROCK	R	RELATIVELY SOUND TO SOUND BEDROCK, OCCASIONALLY MODERATELY JOINTED. WEATHERING CONFINED PRINCIPALLY TO JOINTS. RQD GENERALLY GREATER THAN 75%.	MODERATELY JOINTED TO RELATIVELY SOUND. COMPRESSIVE STRENGTH 5 TO 25 KSI.	170					45	30.0 TO 60.0

1. THIS TABLE IS INTENDED PRIMARILY FOR USE IN DESIGN OF PERMANENT STRUCTURES. IN ANY CASE, SPECIFIC BORING AND LABORATORY TEST INFORMATION AT THE LOCATION OF INTEREST SHOULD BE CONSULTED IN SELECTING THE PARAMETERS FOR DESIGN SINCE THE VALUES TABULATED ABOVE ARE GENERALIZED OVER A WIDE AREA.

2. "SHEAR STRENGTH" TABULATED FOR "COHESIVE STRATA" IS APPROXIMATE UNDRAINED COHESION AND IS NOT INTENDED TO BE COMBINED WITH OR SUPERPOSED ON THE "EFFECTIVE FRICTION ANGLE" FOR DRAINED SHEAR.

3. IN EVALUATING APPLIED PRESSURES OR STABILITY CONDITIONS IN THE TRANSITION ZONE AND VARIOUS BEDROCK ZONES, THE BORING INFORMATION ON ATTITUDE AND CHARACTER OF THE DISCONTINUITIES SHOULD BE TAKEN INTO CONSIDERATION. IF THERE IS EVIDENCE OF SLICKENSIDES, SHEARED ZONES OR SURFACES OR SMOOTH JOINTS DIPPING UNFAVORABLY INTO THE EXCAVATION, EFFECTIVE FRICTION ANGLES ON THESE DISCONTINUITIES CAN BE IN A RANGE OF 10 DEGREES TO 20 DEGREES.

NOTES: a) TABLE IS BASED ON MRW&J* GEOTECHNICAL INFORMATION FOR THE METRO PREVIOUS PROJECTS.

b) INFORMATION (ALLOWED LIMITS) NOT GIVEN IN THE TABLE SHALL BE PROVIDED BY DESIGNER/DESIGN-BUILDER FOR SPECIFIC PROJECT AS NECESSARY

*MEUSER RUTLEDGE WENTWORTH & JOHNSTON

Updated: September 6, 2000

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GENERALIZED STRATA DESCRIPTIONS

SYMBOL	DESCRIPTION	UNITED SOIL CLASSIFICATION		SOURCE AND AGE	SYMBOL	DESCRIPTION	UNITED SOIL CLASSIFICATION		SOURCE AND AGE
		PRIMARY	SECONDARY				PRIMARY	SECONDARY	
(F)	FILL, GENERALLY OF INORGANIC SOIL OBTAINED FROM NEARBY SOILS OR DECOMPOSED ROCK.	ML, SM	SC, CL	MAN MADE IN HISTORIC TIMES	(C)	MEDIUM COMPACT GRAY AND TAN SILTY FINE SAND OR MEDIUM TO FINE SAND WITH OLIVE GREEN CLAY, CALVERT FORMATION OF MIOCENE AGE.	SM, CH	SP, CL	MARINE DEPOSITS OF TERTIARY OR UPPER CRETACEOUS PERIODS
(A1)	SOFT TO MEDIUM STIFF DARK GRAY AND BROWN ORGANIC CLAY WITH LENSES OF HEAVY ORGANIC MATERIAL UNDER WATER AND MOTTLED GRAY-BROWN SLIGHTLY ORGANIC SILTY OR SANDY CLAY ON LAND.	CL, OH	OL, PL	RIVER ALLUVIUM OF POST-GLACIAL TIMES	(E)	MEDIUM STIFF DARK GREEN OR BROWN CLAY AND SILTY CLAY, AOCIA FORMATION OF EOCENE AGE.	MH, CH	ML, CL	
(A2)	LOOSE TO MEDIUM COMPACT DARK BROWN OR GRAY SILTY FINE TO MEDIUM SAND WITH OCCASIONAL POCKETS OR LENSES OF SMALL GRAVEL.	SM	SP		(N)	MEDIUM STIFF TO STIFF DARK GREEN OR BROWN SILT AND CLAY, MORMOUTH FORMATION OF UPPER CRETACEOUS AGE.	MH, CL	ML, CH	
(T1)	STIFF TO MEDIUM LIGHT BROWN OR GRAY OR MOTTLED BROWN-GRAY SILTY CLAY OR CLAYEY SILT WITH LENSES OF BROWN SILTY FINE SAND.	CL, ML	LENSES OF SM OR SC	PORTIONS OF THE "25-FOOT" "50-FOOT" AND "90-FOOT" TERRACES, DEPOSITED BY RIVERS IN PLEISTOCENE TIMES	(P1)	HARD MOTTLED RED-BROWN AND GRAY OR LIGHT GRAY AND TAN PLASTIC CLAY WITH OCCASIONAL POCKETS OF FINE SAND-GENERALLY CONSISTS OF PATAPSCO FORMATION BUT MAY INCLUDE RAULTAN FORMATION AT HIGHER LEVELS.	CH	CL	POTOMAC GROUP OF CRETACEOUS PERIOD
(T2)	MEDIUM COMPACT TO COMPACT BROWN AND ORANGE-BROWN SILTY OR CLAYEY FINE TO MEDIUM SAND WITH TRACES OF SMALL GRAVEL.	SM, SC	SP, SM		(P2)	COMPACT TO VERY COMPACT LIGHT GRAY OR TAN SILTY OR CLAYEY FINE TO MEDIUM SAND WITH POCKETS OF SILTY CLAY AND TRACE OF SMALL GRAVEL, OCCASIONAL LIGNITE FRAGMENTS. INCLUDES ALSO MAGOTHY FORMATION OF UPPER CRETACEOUS.	SM, SP	SP	
(T3)	COMPACT TO VERY COMPACT BROWN AND RED-BROWN FINE TO COARSE SAND WITH SOME SILT AND GRAVEL, OR SAND AND GRAVEL WITH A TRACE OF SILT AND NUMEROUS BOULDERS.	SM, SN	SP, GH		(P3)	HARD GRAY-GREEN OR GRAY-BLUE SILTY OR SANDY CLAY AND SANDY SAND AND SANDY SILT AND SILTY OR CLAYEY FINE SAND WITH OCCASIONAL SMALL GRAVEL.	CL, SC	ML, SM	
(T4)	MEDIUM COMPACT TO COMPACT GRAY AND GRAY-BROWN FINE TO MEDIUM SAND WITH SOME SILT AND SMALL GRAVEL CONTAINING LENSES OF DARK GRAY CLAY, OCCASIONALLY SLIGHTLY ORGANIC.	SM, SP	SM		(P4)	VERY COMPACT MOTTLED LIGHT GRAY, TAN, BUFF OR WHITE SILTY OR CLAYEY FINE TO MEDIUM SAND WITH SOME GRAVEL AND SCATTERED LIGNITE FRAGMENTS.	SM, SM	SP, GM	
(T5)	COMPACT TO VERY COMPACT GRAY AND GRAY-BROWN FINE TO COARSE SAND WITH SOME GRAVEL AND SOME TO TRACE SILTY, OR SAND AND GRAVEL WITH NUMEROUS BOULDERS.	SM, SM	SP, GH		(D)	HARD ORANGE-BROWN OR YELLOW-BROWN MICACEOUS FINE SANDY SILT OR VERY COMPACT LIGHT GRAY AND GREEN MICACEOUS SILTY FINE TO MEDIUM SAND, DECOMPOSED BEDROCK.	ML, SP	MH	WEATHERED IN SITU FROM FINE BEDROCK
(Q1)	LOOSE TO MEDIUM COMPACT LIGHT BROWN SILTY OR CLAYEY FINE TO MEDIUM SAND WITH TRACE SMALL GRAVEL	SM, SC	SP	BRANDYME FORMATION OF EARLY EOCENE OR PLEIOGENE TIMES	(M)	MODERATELY TO HIGHLY WEATHERED AND JOINTED ROCK, REQUIRES CORE RECOVERY GENERALLY LESS THAN 70%.			ROCKS PALEOZOIC OR PRECAMBRIAN AGE
(Q2)	LOOSE TO MEDIUM COMPACT LIGHT BROWN OR TAN SILTY OR CLAYEY FINE TO MEDIUM SAND WITH SOME SMALL GRAVEL.	SM, SC	SP		(R)	BEDROCK, PRIMARILY MISSISSIPPIAN SCHISTOSE GNEISS, IN SOME AREAS ALTERED BY INTRUSION, AND VARIOUS IGNEOUS ROCK IN-CLUDING GRANITE, DIORITE, AND GABBRO, WITH SOME RECOVERY GREATER THAN 80% CORE RECOVERY, GENERALLY GREATER THAN 80% CORE RECOVERY.			

**TABLE 3-4:
GENERALIZED STRATA
DESCRIPTIONS**

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SECTION 02820

FENCING

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. This section specifies providing chain-link fencing, gates and fan guards.
- B. Related Work Specified Elsewhere:
 - 1. Cast-in-place Structural Concrete: Section 03300.
 - 2. Grounding: Section 16060.

1.02 SUBMITTALS:

- A. Submit the following for approval in accordance with the General Requirements and with the additional requirements as specified for each:
 - 1. Shop Drawings:
 - a. Manufacturer's product data and installation instructions for fence, posts, fabric, gates, hardware and accessories.
 - b. Site plan with fence showing locations of bracing, fan guards, gates, ground rods, depression closures and other special fence construction.
 - c. Details of gates, depression closures and other special construction showing fabrication and installation.
 - d. Details for installation of accessories.
 - 2. Samples:
 - a. Chain link fabric: One of each width and type, each 24 inches long.
 - b. Posts, railing, braces, gate frames: One of each size and type, each 24 inches long.
 - c. Truss rod and turnbuckle: One each.
 - d. Tension wire: One, 24 inches long.
 - e. Barbed wire: One, 24 inches long.
 - f. Tension bar: One, 24 inches long.
 - g. Gate corner assembly: One.
 - h. Fabric ties: Four each.
 - i. Rail and brace ends and post caps: Two each.
 - j. Barbed wire extension arms: One each.
 - k. Other materials and accessories: One each.
 - 3. Certification.

1.03 QUALITY ASSURANCE:

- A. Codes, Regulations, Reference Standards and Specifications:
 - 1. Comply with codes and regulations of the jurisdictional authorities.
 - 2. AWS: D1.1.
 - 3. MS: MIL-P-21035.
 - 4. FS: FF-T-791, RR-F-191/2D, RR-F-191/3D, RR-F-191/4D.
 - 5. ASTM: A121, A392, A413/A413M-01, C1107/C1107M-07a, F668.

1.04 JOB CONDITIONS:

- A. Right of Access to Adjacent Private Property: As shown.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Fabric:
 - 1. Steel, hot-dip galvanized after weaving, ASTM A392; Class 2 coating, two-inch mesh, No. 9 gauge wire, height shown, both top and bottom selvage twisted and barbed unless otherwise indicated on Contract Drawings. ¹
 - 2. PVC-coated steel: ASTM F668 Class 2b; two-inch mesh, 0.148-inch diameter zinc coated steel core wire, height as shown, black color PVC; top and bottom selvages twisted and barbed, unless otherwise shown on Contract Drawings.

- B. Posts, Top Rails and Braces:
 - 1. FS RR-F-191/3D, with the following additional requirements:
 - a. Posts: Class 1, Grade. Size in accordance with Table I unless otherwise shown.
 - b. Top rails: Class 1, Grade A; Size SP1.
 - c. Bracing: Class 1, Grade A; Size SP1.
 - d. Color coating: Where PVC-coated fabric is specified, provide matching PVC color ASTM F668 Class 2b coating.

- C. Accessories:
 - 1. FS RR-F-191/4D, with the following additional requirements:
 - a. Hot-dip galvanized, unless otherwise specified.
 - b. Wire ties:
 - 1) Fabric: No. 9-gauge steel.
 - 2) Tension wire: No. 11-gauge steel.
 - c. Tension wire: No 7-gauge Steel. ¹
 - d. Color coating: Where PVC-coated fabric is specified, provide matching PVC color ASTM F668 Class 2b coating.

- D. Barbed Wire:
 - 1. ASTM A121, Chain Link Fence Grade, 12-1/2 gauge steel wire with 14-gauge, four-point round barbs, five inches on center.

- E. Turnbuckle:
 - 1. FS FF-T-791, Type 1, Form 1, Class 8, Size 3/8 by six, hexagonal heads, UNC threads, hot-dip galvanized. Where PVC-coated fabric is required, provide matching PVC color coating thermally fused to the galvanized steel substrate.

- F. Latch:
 - 1. Plunger bar full height of gate, to engage stop at double gates.

- G. Security Chain:
 - 1. ASTM A413, Grade 43 High Test Chain, case-hardened carbon-steel, 3/8-inch diameter; hot-dipped galvanized at exterior locations.

- H. Padlock:
 - 1. WMATA Station areas - Corbin Russwin, Catalog No. PL5090 IC high security or equal. All keys are to be turned over to the Engineer or WMATA Representative.
 - a. Removable interchangeable core; with two keys, keyed and master-keyed as directed.
 - b. Body: Solid extruded brass.
 - c. Six-pin tumblers.
 - d. Shackle: Hardened steel, zinc-plated, 2-5/8 inch shackle length, ball bearing locking heel and toe.
 - 2. WMATA Track & Line chain-link fence gates areas - Master Lock #5KA, Key A389 with two keys. All keys are to be turned over to the Engineer or WMATA R Representative.
- I. Concrete: Section 03300, Class 3500, air-entrained
- J. Grout: Non-shrink, in accordance with ASTM C1107.
- K. High Zinc-Dust Content Paint: MS MIL-P-21035.

2.02 SWING-TYPE GATES:

- A. Provide swing-type gates, size as indicated on the Contract Drawings, complete with latches, stops (if required by the manufacturer), keepers, hinges and three strands of above the fabric (if shown on the Contract Drawings).
- B. Conform to Federal Specifications RR-F-191/2D, Single Swing Type I, Double Swing Type II, and as follows:
 - 1. Hot-dipped galvanized.
 - 2. Fabrication:
 - a. Fabricate gate perimeter frame from Class 1, Size SP2 pipe per Federal Standard RR-F-191/3D.
 - b. Fabric: Same fabric as used on the fence. Attach fabric securely to the gate frame at intervals not exceeding 15 inches.
 - c. Barbed wire: As specified in 2.1.D above.
 - d. Fan Guard: Materials and fabrication as specified for fencing.
 - 3. Hardware:
 - a. Hinges: Two or more galvanized steel or malleable iron, to suit the gate size: non-lift type, offset to permit 180 degrees opening.
 - b. Latch: Galvanized steel or malleable iron, combination type with provision for padlock.
 - c. Gate stops and center rest: Manufacturers' standard.

2.03 CANTILEVERED SLIDE GATE:

- A. Conform to Federal Specification RR-F-192/2D, Type III.
- B. Barbed Wire: As specified in 2.01 D. above.

PART 3 - EXECUTION

3.01 FENCE INSTALLATION:

- A. Perform necessary clearing, grubbing, excavation and filling to provide clear line-of-fence runs.
- B. Set posts in concrete footings, sized as shown. All end, corner, pull and intermediate posts are to be embedded a minimum of 3 foot below final grade. Footing depth shall be a minimum of 3 feet 6 inches.
- C. Extend concrete to two inches above ground line at posts and slope to drain away from posts. Form top 12 inches of footing, with remainder poured against excavated hole.
- D. Space posts at 10 feet maximum and eight feet minimum on centers. Place additional posts at each abrupt change in grade.
- E. Where rock is encountered, drill holes two inches deeper than depth shown and two inches greater than outside diameter of post. After post is placed, as shown, specified, and supported, fill remaining void with one-to-three grout mixture of cement and sand.
- F. Where fence is located on concrete structure, weld post to base plate, thickness and size as shown on Contract Drawings. Erect fence post truly vertical, where necessary using shims of approved alloy. Secure to structure with anchor bolts; number, diameter and length as shown on Contract Drawings. Fill void under base plate with non-shrink grout. Bolts, base plate and weld to be hot-dipped galvanized.
- G. Space pull posts at approximately 500-foot intervals for straight runs and at each vertical angle point. Install corner posts at each horizontal angle point. Provide corner, end and pull posts with horizontal braces and tie rods on each side of posts extending to and connecting to adjacent line posts.
- H. After posts are installed and grout has set, install top rail or tension wire and securely anchor at ends and to line posts before hanging fabric.
- I. Secure ends of fabric by tension bars threaded through loops in fabric and secured to posts by bands with bolts and nuts or other approved devices.
- J. Attach fabric outside framing system, away from Authority property. Stretch fabric by securing one end and applying sufficient tension by mechanical fence stretchers. Fasten fabric to line posts, tension wire and top railing with tie wires at spacing shown.
- K. Hold bottom of fabric as uniformly as possible to, but in no case to exceed, two inches above finished grade.
- L. Provide barbed wire where shown. Install support arms at 45 degrees upward and outward from Authority property; extend corner, gate and end posts as shown. Stretch barbed wire to remove kinks and sags and secure to bracket arms, using tension bands for attachment to posts.

- M. Install gates, gate stops and fan guards as shown.
- N. Set gate stops in concrete accurately so that plunger can be fully engaged.
- O. Furnish one chain with one padlock for each gate.
- P. Grounding: Section 16060.

3.02 GATE INSTALLATION

- A. Install gates plumb, level and secure for full opening without interference. Install ground-set items in concrete for anchorage, as detailed on the Contract Drawings. Adjust the hardware for smooth operation and lubricate where necessary.
- B. Attach barbed wire as shown on the Contract Drawings.

3.03 DEFECTIVE WORK:

- A. Remove and replace fencing which is improperly located and is not true to line and grade, and posts which are not plumb.
- B. Repair damaged galvanizing by thoroughly wire brushing damaged area to remove loose and cracked zinc coating, and paint with two coats of high zinc-dust content paint. Allow first coat to dry thoroughly before applying second coat.

PART 4 -MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

- A. Measurement of work specified in this Section will be made in the following manner:
 - 1. No separate measurement.

4.02 PAYMENT

- A. Compensation for work specified in this Section will be made in the following manner:
 - 1. Included in the price of the work of which it is a part.

SEE ENDNOTES BELOW. THEY ARE AN ESSENTIAL PART OF THIS SECTION UNTIL EDITED BY SECTION DESIGNER.

ENDNOTES

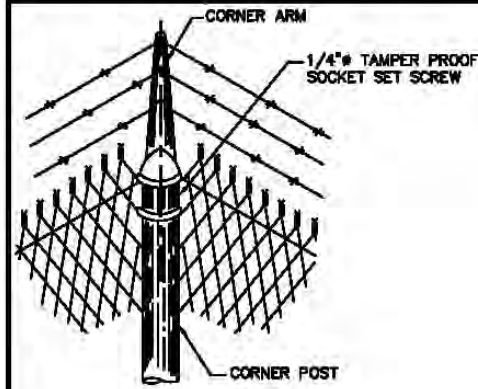
*1. Please verify that Standard Drawings conform to the revised Specifications for Section 02820; particularly that Utility Standard Drawing ST-U-34 contains Note 8 stating that fabric on Type A & A-1 fences less than 72 inches high have both top & bottom selvages knuckled, and that Note 8 is referenced on applicable section of CHART; and contains notes to Details 2 & 3 indicating maximum height of bottom tension wire above grade is 6 inches.

END OF SECTION

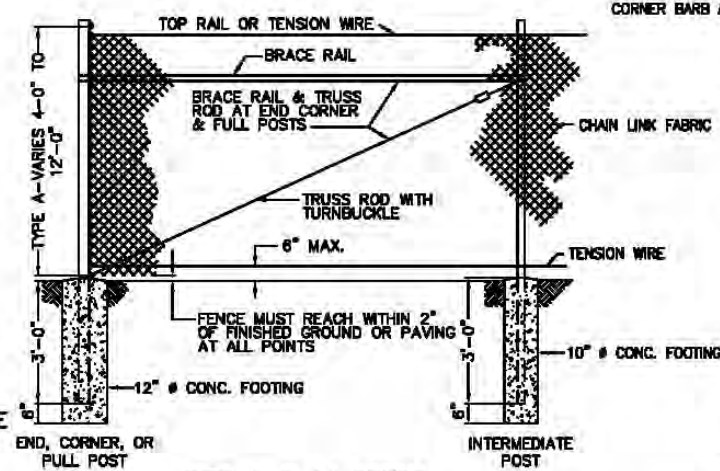
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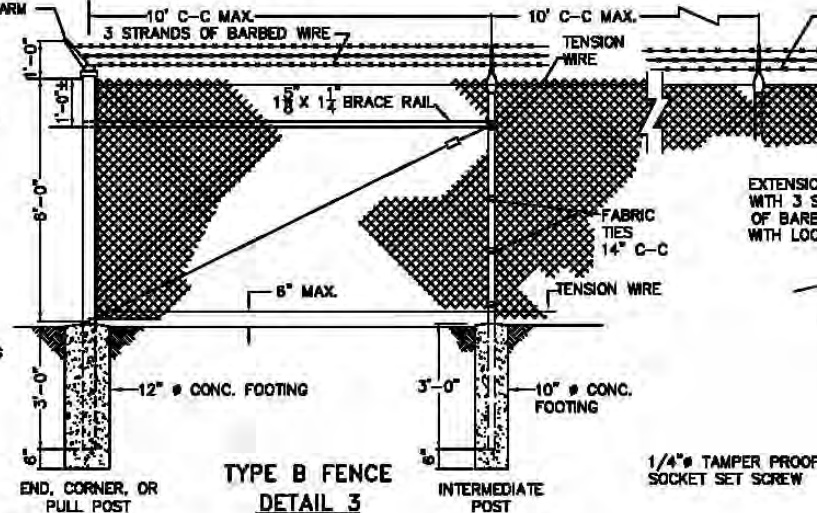
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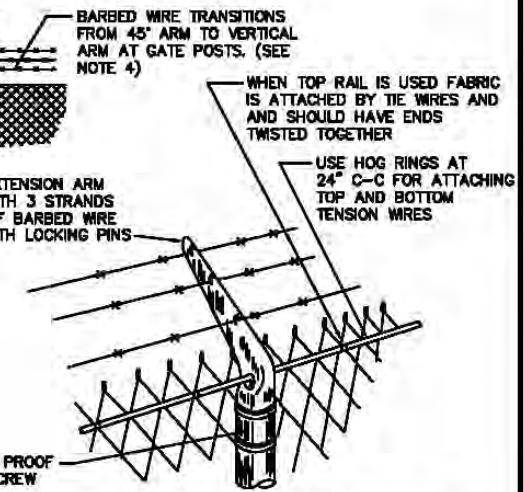
CORNER POST AND ARM FOR TYPE B FENCE
DETAIL 1



TYPE A & A1 FENCE
DETAIL 2

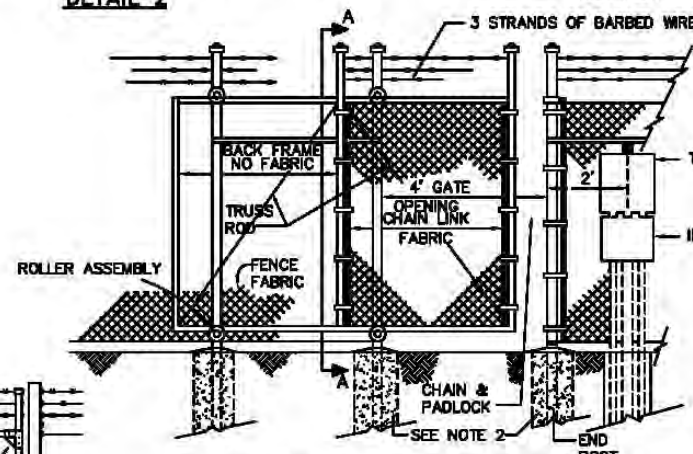


TYPE B FENCE
DETAIL 3



TYPE B INTERMEDIATE POST TOP
DETAIL 7

CHART					
TYPE	FENCE HEIGHT	TOP LINE	BOTTOM LINE	SERVAGE	REFERENCE
A	4' TO 12'	TENSION WIRE	TENSION WIRE	TOP TWISTED & BARBED TOP & BOTTOM KNUCKLED	DETAIL 2
A-1	4' TO 12'	TOP RAIL	TENSION WIRE	TOP TWISTED & BARBED TOP & BOTTOM KNUCKLED	DETAIL 2
B	6" WIDTH BARBED WIRE	TENSION WIRE	TENSION WIRE	TOP TWISTED & BARBED TOP & BOTTOM KNUCKLED	DETAIL 3

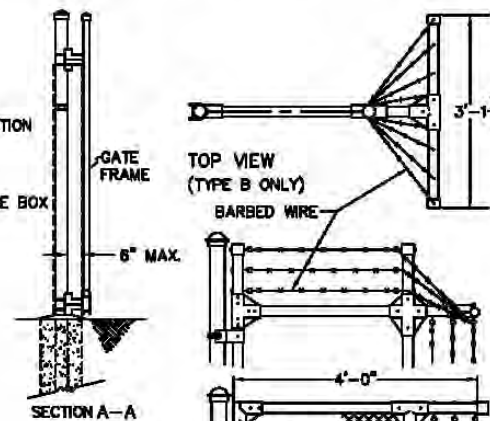


SLIDING GATE - ELEVATION
(VIEW FROM WITHIN METRO PROPERTY)

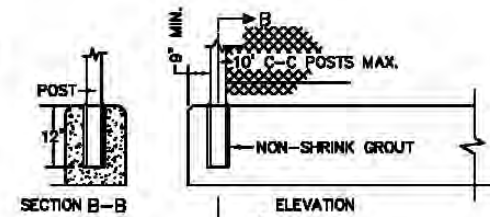
SLIDING GATE - PLAN
DETAIL 5

NOTES

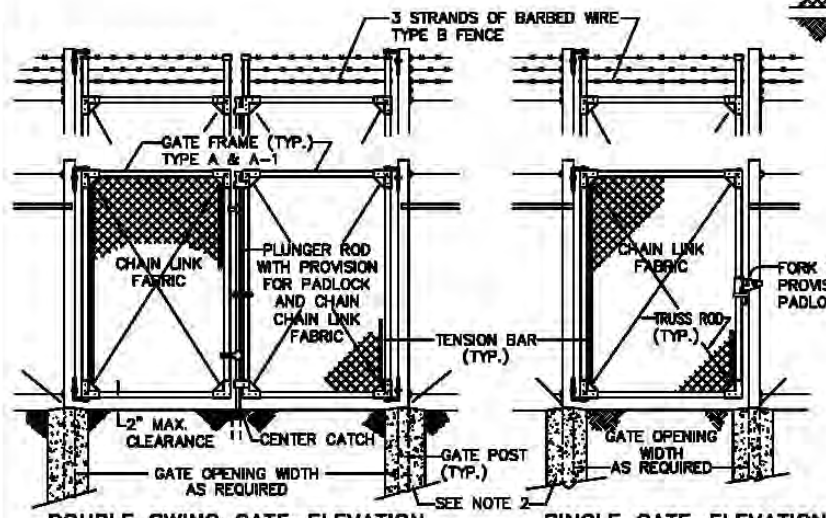
- GATE FABRIC SHALL BE KNUCKLED ON TOP SELVAGES
- SIZE OF CONCRETE FOUNDATIONS AT GATES, AS RECOMMENDED BY THE GATE MANUFACTURER
- FENCE, GATE POSTS, AND FRAMES SHALL BE GROUNDED IN ACCORDANCE WITH WMATA STANDARD SPECIFICATION No. 16060
- WHEN 3-STRAND BARBED WIRE IS TO BE ADDED TO TOP OF FENCE, POST EXTENSIONS AND BARBED WIRE ARMS ON THE GATE SHALL BE VERTICAL
- DETAILS OF THE SELECTED FENCE POSTS, GATES AND ACCESSORIES MAY NOT AGREE WITH THIS DRAWING BUT MUST CONFORM TO FS RR-F-191
- POSTS, RAILS AND RODS TO BE INSTALLED INSIDE FENCE FABRIC



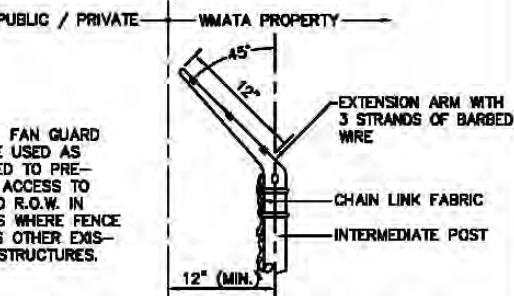
FAN GUARD - TYPE A, A-1 & B FENCE
DETAIL 6



FENCE ON RETAINING WALL
DETAIL 8



SWINGING GATES
DETAIL 4



TYPICAL LOCATION OF TYPE 'B' FENCE
ALONG WMATA PROPERTY
DETAIL 9

DESIGNED	A.M. NATH	DATE	1-8-70	REFERENCE DRAWINGS		REVISIONS		
				NUMBER	DESCRIPTION	DATE	BY	DESCRIPTION
DRAWN	HICKS	DATE	1-8-70			06/2007	ENGA	REVISED AND ISSUED BY THE AUTHORITY
CHECKED		DATE						
APPROVED	R.S. O'NEIL	DATE	3-20-70					

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

OFFICE OF ENGINEERING SUPPORT SERVICES

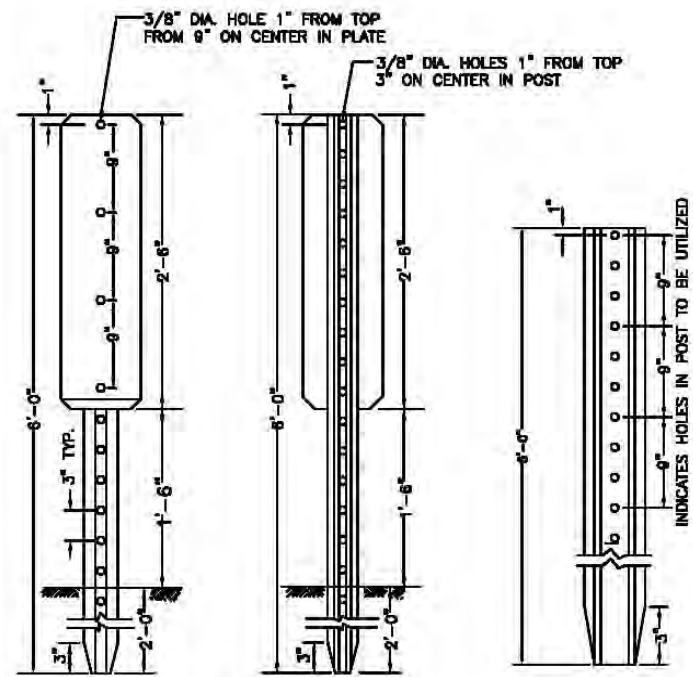
SUBMITTED *12/20/07* 10/2007 DATE

APPROVED *[Signature]* 10/2007 DATE

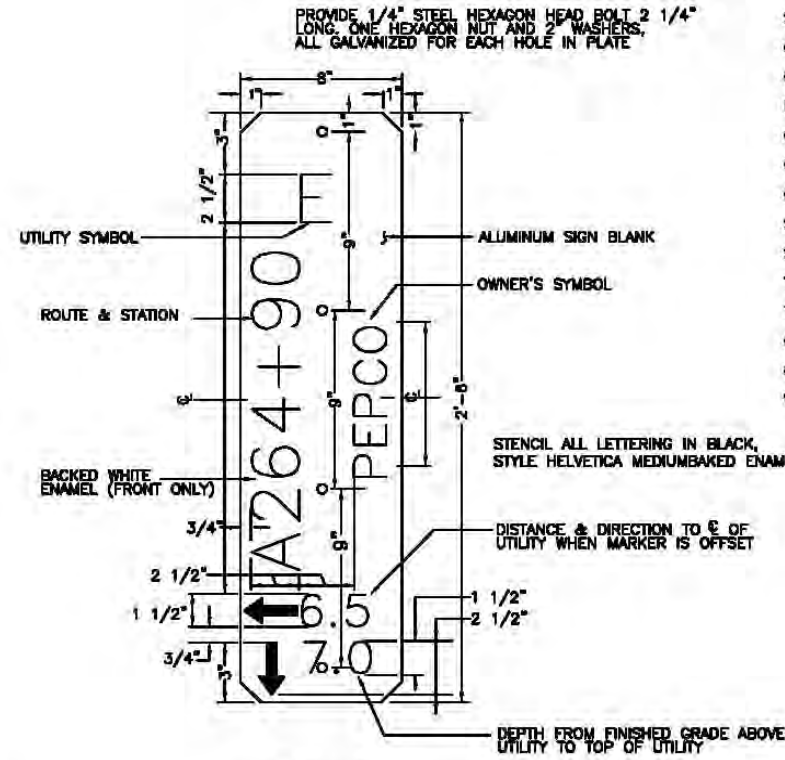
CIVIL STANDARD DRAWING
FENCE DETAILS

SCALE NOT TO SCALE DRAWING NO. ST-C-034

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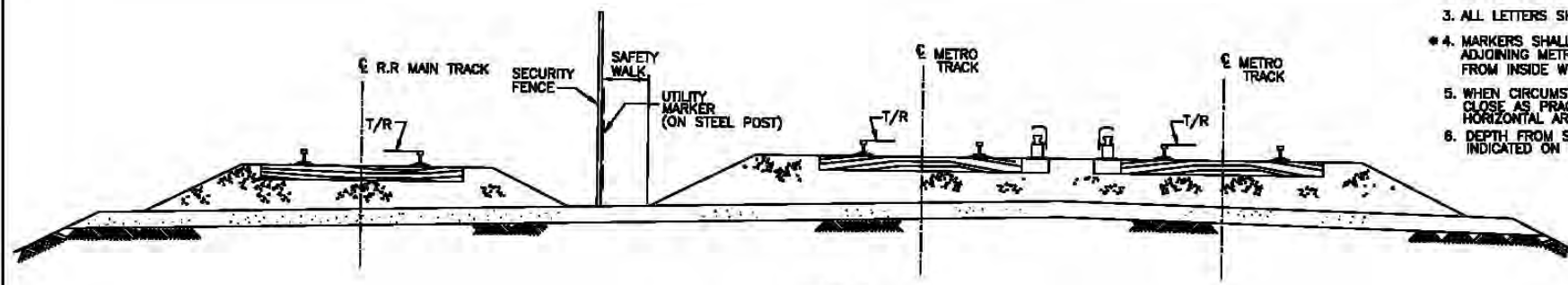
FRONT REAR
DETAIL 1
ELEVATION
SCALE 1 1/2"=1'



DETAIL 3
TARGET PLATE LAYOUT
SCALE 3"=1'

UTILITY	SYMBOL	OWNER	SYMBOL
STEAM TUNNEL	ST	DISTRICT OF COLUMBIA	DC
STEAM LINE	S	CHESAPEAKE & POTOMAC TELEPHONE COMPANY	C & P
OIL OR GASOLINE LINES	F	POTAMAC ELECTRIC POWER COMPANY	PEPCO
GAS LINE	G	VIRGINIA POWER CO.	VEPCO
POWER LINE	E	WASHINGTON SUBURBAN SANITARY COMMISSION	WSSC
CABLE - STREET LIGHT	CS	ARLINGTON COUNTY	ARL CO.
CABLE - TRAFFIC LIGHT	CT	FAIRFAX COUNTY	FX CO.
COMBINED SYSTEM SEWER	SC	FAIRFAX COUNTY WATER AUTHORITY	FCWA
STORM SEWER OR CULVERT	SS	ALEXANDRIA	ALEX
SANITARY SEWER	SAN	FALLS CHURCH	FA CH
TELEPHONE LINE	T	MARYLAND-NATIONAL CAPITAL PARK AND PLANNING COMMISSION	M-NCPPC
TELEGRAPH LINE	TE	PENTAGON	PENT
CABLE - FIRE ALARM	CF	VIRGINIA DEPT. OF TRANSPORTATION	VDOT
CABLE - POLICE	CP	MONTGOMERY COUNTY	MONT CO.
WATER MAIN	W	PRINCE GEORGE'S COUNTY	PGCO
		CITY OF ROCKVILLE	ROCK
		MARYLAND STATE HIGHWAY ADMINISTRATION	MSHA
		WASHINGTON GAS LIGHT COMPANY	WGLCo
		BALTIMORE GAS & ELECTRIC	BGE
		WESTERN UNION	WU
		PLANTATION PIPE LINE	PPL
		GENERAL SERVICES ADMINISTRATION	GSA
		COLONIAL PIPE LINE	CPL
		WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY	WMATA
		TRANSCONTINENTAL GAS PIPE LINE CORP.	TRANSCO

- NOTES:
- UTILITY MARKERS SHALL BE PROVIDED TO INDICATE UNDERGROUND UTILITY LINES WHICH CROSS AT-GRADE AND EMBANKMENT SECTIONS OF THE METRO RIGHT-OF-WAY (ROW); EXCEPT METRO OWNED FACILITIES WHICH ARE PARALLEL WITH OR ENTIRELY WITHIN THE ROW, OR OTHER CROSSINGS HAVING VISIBLE MANHOLES, INLETS, OR OTHER UTILITY STRUCTURES
 - MARKERS SHALL BE AS SHOWN ON THIS SHEET WITH STATIONING TO THE NEAREST FOOT.
 - ALL LETTERS SHALL BE HELVETICA MEDIUM.
 - MARKERS SHALL BE PLACED AS SHOWN IN DETAIL 4 WITH TARGETS FACING AND PARALLEL WITH ADJOINING METRO TRACK. TWO MARKERS ARE REQUIRED FOR EACH STEEL POST SO MARKER IS VISIBLE FROM INSIDE WMATA'S RIGHT-OF-WAY AND OUTSIDE FENCE.
 - WHEN CIRCUMSTANCES PROHIBIT PLACING MARKER ON CENTERLINE OF UTILITY IT SHALL BE LOCATED AS CLOSE AS PRACTICABLE. THE DIRECTION OF UTILITY FROM THE MARKER SHALL BE INDICATED BY A HORIZONTAL ARROW AND THE AMOUNT OF OFFSET TO THE NEAREST 0.5' AS SHOWN BY DETAIL 3.
 - DEPTH FROM SURFACE TO TOP OF UTILITY OR ITS CASEMENT PIPE SHALL BE TO NEAREST 0.5' AND SO INDICATED ON MARKER TARGET.



DETAIL 4
TYPICAL LOCATION OF UTILITY MARKER
NO SCALE

DESIGNED	CA. PRESS	7-3-74	DATE	NUMBER	DESCRIPTION	DATE	BY	DESCRIPTION
DRAWN	CMV / NER	7-10-74	DATE			06/2007	ENGA	REVISED AND ISSUED BY THE AUTHORITY
CHECKED	A. RYMER	10-6-75	DATE			07/2007	GENP	UPDATED NOTE 4 & 6
APPROVED	R. MEERS	10-9-75	DATE					

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY		OFFICE OF ENGINEERING SUPPORT SERVICES	
SUBMITTED	10/2007	APPROVED	10/2007
	DATE		DATE

UTILITY STANDARD DRAWING		AT GRADE STANDARD UTILITIES MARKERS	
SCALE	DRAWING NO.	SCALE	DRAWING NO.
NOT TO SCALE	ST-U-066	NOT TO SCALE	ST-U-066

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Appendix 4 - Monitoring, Instrumentation & Contingency Plans

[Plate B-1: Location of Monitoring Points](#)

[Sample - Instrumentation details including accuracy](#)

[Monitoring Plan Instrumentation Checklist](#)

[Metrorail System Design Datums](#)

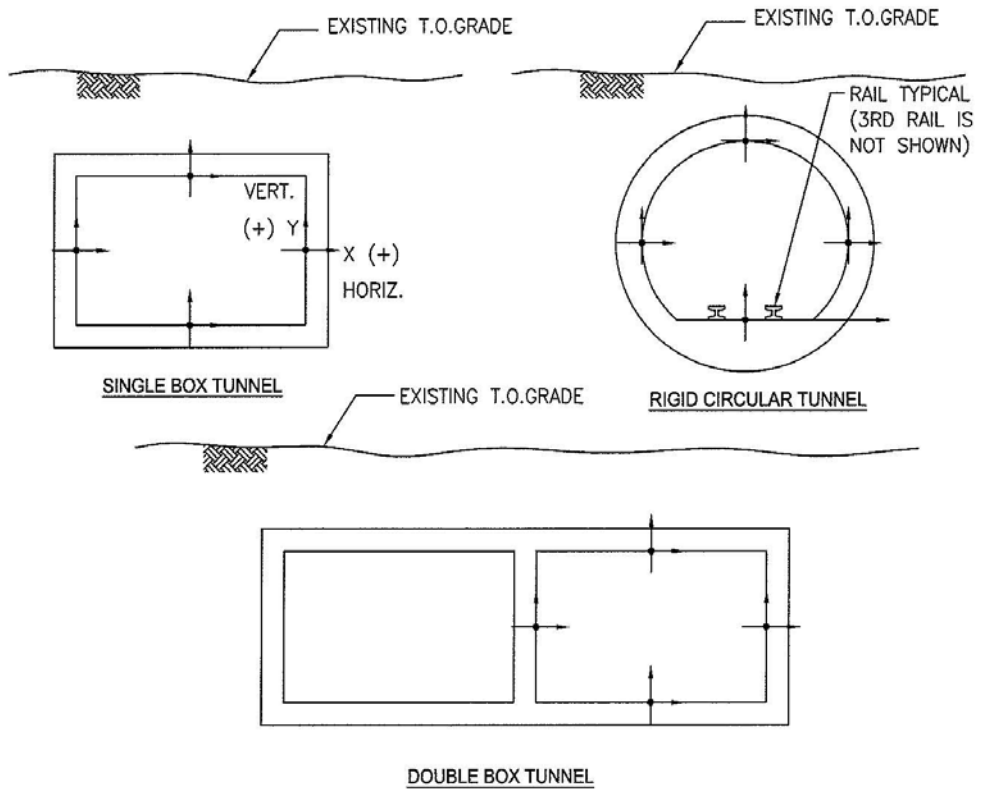
[Sample - Movement Detection Report Cover Sheet](#)

[Sample - Movement Detection Report Summary](#)

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PLATE B-1

POSSIBLE LOCATIONS OF MONITORING POINTS. RECORD BOTH VERTICAL (Y AXIS) AND HORIZONTAL (X AXIS) MOVEMENT OF EACH POINT.



THE CASES SHOWN HERE ARE FOR GUIDANCE IN PREPARING THE MONITORING PLAN. SOME ADJUSTMENTS MAY BE NECESSARY BASED ON SPECIFIC STRUCTURE AND LOCATION. FOR OTHER STRUCTURES ALSO USE THESE CASES AS GUIDANCE.

X AND Y INDICATE THE DIRECTION OF THE MOVEMENTS OF POINTS ON STRUCTURE.

LOCATION OF MONITORING POINTS

WMATA ENGINEERING STANDARDS

Sample Instrumentation details and accuracy

LEICA TCA1800 • TCA2003 • TC2003

Technical specifications

Models and options

	TCA1800	TCA2003	TC2003
Angle measurement	•	•	•
Distance measurement (IR)	•	•	•
Motorized	•	•	•
Automatic target recognition (ATR)	•	•	•
Guide light (EGL)	○	○	○
Remote control RCS1100	○	○	○

• Standard ○ Optional



Angle measurement

		TCA1800	TCA2003	TC2003
Accuracy (standard deviation, ISO 17123-3)	Hz, V	1" (0.3 mgon)	0.5" (0.15 mgon)	0.5" (0.15 mgon)
	Display resolution	1" (0.1 mgon)	0.1" (0.01 mgon)	0.1" (0.01 mgon)
Compensator	Method:		absolute, continuous, diametrical	
	Working range:	4' (0.07 gon)	4' (0.07 gon)	4' (0.07 gon)
	Setting accuracy:	0.3" (0.1 mgon)	0.3" (0.1 mgon)	0.3" (0.1 mgon)
	Method:		electronic dual axis compensator	



Distance measurement (IR)

Range (average atmospheric conditions)	Round prism (GPR1):		2500 m	
	360° reflector (GRZ4):		1300 m	
	Mini prism (GMP101):		900 m	
	Reflective tape (60 mm x 60 mm)		200 m	
Accuracy / measurement time (standard deviation, ISO 17123-4)	Standard mode:	1 mm + 2 ppm / 3.0 s	1 mm + 1 ppm / 3.0 s	1 mm + 1 ppm / 3.0s
	Fast mode:		3 mm + 2 ppm / 1.5 s	
	Tracking mode:		5 mm + 2 ppm / 0.3 s	
	Display resolution:	0.1 mm	0.01 mm	0.01 mm
	Method:		Phase measurement (coaxial, invisible infrared laser)	



Guide light (EGL)

Range (average atmospheric conditions)	Working range:	5 m - 150 m
Accuracy	Positioning accuracy:	5 cm at 100 m



Motorized

Maximum speed	Rotating speed:	45° / s
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Automatic target recognition (ATR)

Range ATR mode / LOCK mode (average atmospheric conditions)	Round prism (GPR1):	1000 m / 500 m
	360° reflector (GRZ4):	500 m / 350 m
	Shortest measurable distance:	5 m
Accuracy / measurement time	Up to 200 m: 1 mm, > 200 m: as per angle measuring accuracy +1 mm / 3-4 s	
	Tangential (standard mode):	5 m / s at 100 m, 1 m / s at 20 m
Max. speed (LOCK-Modus)	Tangential (with EDM tracking mode):	1 m / s at 100 m, 0.2 m / s at 20 m
	Method:	Digital image processing (laser beam)



General data

Telescope		Laser plummet	
Magnification:	30x	Centring accuracy:	1.0 mm at 1.5 m
Free objective aperture:	42 mm	Laser dot diameter:	2.5 mm at 1.5 m
Field of view:	1°33' (1.72 gon) / 2.7 m at 100 m	Endless drives	
Focussing range:	1.7 m to infinity	Number of drives:	2 horiz. / 1 vert. (TCA), 1 horiz. / 1 vert. (TC)
Keyboard and display		Battery (GEB187)	
Display:	64*210 pixels, graphic LCD, with illumination	Type:	NiMH, rechargeable
Keyboard:	32 keys (6 function keys, 12 alphanumeric keys, 6 direct keys)	Voltage:	12 V
Angle display:	360° °, 360° decimal, 400 gon, 6400 mil	Capacity:	1.8 Ah
Distance display:	meter, int. ft, int. ft/inch, US ft	Operating time:	TCA 400, TC 600 distance measurements
Position:	keyboard in position I and II (standard)	Weight	
Data storage		Instrument:	7.5 kg
Internal memory:	S-RAM card (512 KB and 2 MB)	Battery:	0.3 kg
Number of data records:	-4000 per MB	Tribrach:	0.9 kg
Interface:	RS232	Working environment	
Circular bubble		Working temperature:	-20°C to +50°C
Sensitivity:	4' / 2 mm	Storage temperature:	-40°C to +70°C
		Dust / water (IEC 60529):	IP54
		Humidity:	95%, non-condensing

Monitoring Plan Instrumentation Checklist

Total station instrument type (circle one): conventional total station robotic total station

Total station manufacturer and model: _____

Instrument angle accuracy (circle one): .5" 1" 2" 3"

Instrument EDM accuracy (circle one): 1 mm 2 mm 3 mm (fill in) ppm +/- _____

Dual compensator (circle one): yes no

Instrument and tribrach centering accuracy (circle one): 1 mm 2 mm 3 mm

Instrument location (circle one): forced centered platform tripod

Monitoring prism type
(circle all that apply): stick on target model # _____
 mini 360 model # _____
 full size 360 model # _____
 mini circular model # _____
 full size circular model # _____

Level instrument type (circle one): automatic level digital level

Level instrument manufacturer and model: _____

Level rod type (circle all that apply): invar without struts model # _____
 invar without struts model # _____
 semi-precise single piece model # _____
 semi-precise sectional model # _____
 semi-precise folding model # _____

Description of other monitoring equipment:

Sample Movement Detection Report Cover Sheet

Title: "SESSION 29" Movement Detection Survey of a Line (Shady Grove Route) Abutment A4027, Piers A4035, A4045, A4055, Girders Ar4031, Al4031 and Ground Monitoring Points

WMATA adjacent construction contract (name) WSSC water tunnel under A line at Station 521+25 and (contract number) 254178.

This movement detection survey is being performed by "DEF Survey Firm" on behalf of the WSSC. Technical questions about this report can be directed to:

Mr. Professional
Professional@DEF.com
Office 202-894-1234
Fax 202-894-4321
DEF Survey Firm
125 Main St.
Washington, DC 20001

"Session 29" movement detection survey was performed on 11/04/08 at 8 AM and the next scheduled observation date is 11/07/08 at 8 AM.

All optical and robotic survey instrument observations were performed by Mr. BP Point and Ms. Accurate. Geotechnical instrument readings were obtained by remote communication link to the DEF Survey Firm office by Ms. Geotech.

Please note, ground monitoring point GMP-3 shows the greatest observed horizontal movement of 0.5". GMP-3 is on the east side of the WMATA track embankment and was installed 1/28/08. Another ground monitoring point, GMP-1 located on the west side the WMATA track embankment shows horizontal movement of 0.4".

One other ground monitoring point PMP-4 located on the north (CSX) side of the WMATA track embankment that was installed on 8/6/08 is also showing horizontal movement of 0.4". If the movement observed on PMP-4 continues at its present rate, then predicted movement of approximately X.X" might be expected over a X month period.

Additional movement at abutment monitoring points MP-7 and MP-8 is noted since Session 28 observations were made on 10/23/08.

Please note - 3.5 inches of rain fall was recorded at a nearby weather station on 10/25/08.

A graphical representation showing direction and magnitude of observed movement of all monitoring points to date is shown aspage 2 of 17

Spreadsheets showing results of all monitoring sessions 1 through 29 are shown as pages 3-16 of 17

Survey instrument accuracy, equipment description and procedures used for this survey is provided as page 17 of 17

Sample Movement Detection Report Summary of survey instrument and accuracy, survey and or geotechnical equipment description, and survey procedures

Survey Instrument and Accuracy:

Since 27-Dec-2007 a Leica TPS1200 PLUS (SN:238826) robotic instrument was used which has a horizontal and vertical angle measurement accuracy of 1" standard deviation ISO 17123-3 and an EDM accuracy of 1mm + 1.5 ppm standard deviation ISO 17123-4.

Survey Equipment Description:

LEICA TPS1201 PLUS is a robotic total station which consists of precision angle measurement systems that provide instant horizontal and vertical circle readings. The instrument automatically corrects for any out of level condition by use of a centrally located twin-axis compensator. This instrument has a coaxial EDM and uses an infrared laser to measure distances to monitoring prisms.

All prisms used in this survey are permanently mounted Leica GMP104 L-Bar Monitoring Mini Prism, Part No: 641762. The GMP104 Mini Prism is fixed in a metal housing providing a precise monitoring target.

Survey Procedures:

The survey instrument is set on a permanently mounted forced centered bracket (point P1) outside the ZOI. The instrument is run through an on-board collimation check prior to starting the observations. The instrument is initialized in its robotic mode and performs a backsight check on three permanently mounted mini prisms which are also outside the ZOI (points BA1, BA2 and BA3).

The HI of the instrument is established by "bucking in" a Leica NA-2 automatic differential level into the vertical axis of the robotic instrument as marked on the side of the instrument by the manufacturer. Differential elevations are transferred from a known WMATA benchmark (A-652) located outside the ZOI.

Once a backsight check is performed, the instrument begins making observations to all movement detection mini prisms which are also permanently mounted. Observations consist of 8 sets of direct and reverse angle and distance measurements to each of the foresight prisms. The data from these observations are reduced to one mean horizontal and vertical angle and slope distance per foresight point and is then used to compute a north and east coordinate with elevation. The coordinate from the current observation is compared with the initial coordinate observation to compute the difference and is then organized in the accompanying report.

Appendix 5 - Safety Requirements & Compliance

Click on the link to obtain the following documents:

http://www.wmata.com/business/joint_development_opportunities/adjacent_construction_information.cfm

Workflow: Support Request and Daily Support Tracking Form

Site Specific Work Plan (SSWP) Template

JDAC Support Request (JSR) Form

JDAC Daily Support Tracking Form

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Appendix 6 - Real Estate, Insurance & Design Criteria Section 9 – Right-of-Way

[WMATA's Indemnification and Insurance Requirements in Real Estate Permits](#)

[WMATA Design Criteria Section 9 - Right-of-Way](#)

Click on the link to obtain the following documents:

http://www.wmata.com/business/joint_development_opportunities/adjacent_construction_information.cfm

Real Estate Permit Application

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**WMATA'S INDEMNIFICATION AND INSURANCE REQUIREMENTS
IN
REAL ESTATE PERMITS**

WMATA reserves the right to make any changes it deems appropriate to the following indemnification and insurance requirements.

Defined Terms

Permit is the written legal agreement which allows entry onto WMATA property (Permitted Premises).

Permitted Premises is the WMATA property which is the subject of the Permit.

Permitted Parties are those individuals and entities entering upon the Permitted Premises to do work for the Permittee in accordance with the terms of the Permit.

Permittee is the Owner/Developer/Contractor/Consultant (ODC) or any combination thereof.

Indemnification

- A.** Permittee shall, and Permittee shall contractually require all other Permitted Parties to, indemnify, defend and hold harmless WMATA, its directors, officers, employees and agents from any and all claims, actions, proceedings, liabilities, losses, demands, damages, obligations, penalties, costs, charges and expenses, including, but not limited to, reasonable attorney's fees, of whatsoever kind and nature for injury, including personal injury or death of any person or persons, including employees of Permittee or any other Permitted Party, and for loss or damage to any property, occurring in connection with, or in any way arising out of the use, occupancy and performance of the work authorized by this Permit or related to this Permit or the Project, and/or any acts in connection with activities to be performed under this Permit resulting in whole or in part from the acts, errors or omissions of Permittee or any other Permitted Party, or any employee, agent or representative of Permittee or any other Permitted Party. Nothing in the preceding sentence shall be deemed to relieve Permittee from ultimate liability for any obligation of Permittee under this Permit.
- B.** Permittee shall, and Permittee shall contractually require all other Permitted Parties to, indemnify, defend and hold harmless WMATA, its directors, officers, employees and agents from all claims, actions, proceedings, liabilities, losses, demands, damages, penalties, costs, charges, remedial costs, environmental claims, fees or other expenses including attorney's fees, related to, arising from or attributable to any effluent or other hazardous waste or substance, toxic waste or substance, contaminant, pollutant, petroleum or petroleum-based product, asbestos, residue, contaminated soil or other similar material discharged from, removed from, or introduced on, about or under the Permitted Premises by Permitted Parties or anyone acting on their behalf.
- C.** If any claim, demand, action or proceeding relating to the indemnification required by this Section 21 is brought against WMATA, then upon written notice from WMATA to

Permittee, Permittee shall, at Permittee's expense, resist or defend such action or proceeding by counsel approved by WMATA in writing, such approval not to be unreasonably withheld, but no approval of counsel shall be required where the cause of action is resisted or defended by counsel of any insurance carrier obligated to resist or defend the same. WMATA reserves the right to use its own counsel under this indemnity at Permittee's sole cost and expense. Permittee shall be jointly and severally liable with any Contractor directly responsible for any claim, demand, action, proceeding, liability, loss, damage, obligation, penalty, cost, charge or expense arising under this Permit, and nothing in this Permit shall be deemed to relieve Permittee from ultimate liability for any obligation of Permittee under this Permit.

- D.** Permittee understands and agrees that it is Permittee's and all other Permitted Parties' responsibility to provide indemnification to WMATA pursuant to this Section 21. The provision of insurance, while anticipated to provide a funding source for this indemnification, is in addition to any indemnification requirements and the failure of insurance to fully fund any indemnification shall not relieve Permittee and other Permitted Parties of any obligation assumed under this indemnification.

Insurance

The following outlines the minimum insurance requirements, minimum insurance coverages, and minimum limits of insurance for those coverages that Permittee will be required to purchase and maintain as a means to gain access to WMATA property and/or perform work adjacent to WMATA property:

- A.** Permittee is required to maintain the insurance coverage(s) outlined herein through the completion of all construction and/or any activities in which Permittee may potentially need access to WMATA properties or is within WMATA's Zone of Influence.
- B.** The insurance coverage requirements and limits of insurance for those coverages outlined herein are minimum coverage and limits. Permittee is encouraged, at its sole cost and expense, to purchase any additional insurance coverages and or limits of insurance that Permittee deems prudent and necessary to manage Permittee's risk.
- C.** Upon written request from WMATA, Permittee shall provide copies of any and all policy(s), including all endorsement(s), within five (5) business days of such request.
- D.** Receipt, review and communications regarding Certificates of Insurance, insurance policy(s), endorsements or other vehicles utilized to document compliance with these minimum insurance requirements does not constitute acceptance by WMATA.
- E.** Insurance policies must be written on admitted paper, unless otherwise indicated herein or agreed to in writing by WMATA, with an insurance company reasonably acceptable to WMATA.
- F.** Unless otherwise noted, "claims made" insurance policies are not acceptable.

- G. Any insurance policy utilizing a self-insured retention (SIR) requires approval from WMATA.
- H. Permittee is required to incorporate these minimum insurance requirements into contract requirements of all subcontractors of every tier.
- I. Compliance with these minimum insurance requirements does not relieve Permittees from their respective liability to WMATA should their liability exceed the minimum insurance limits, or minimum coverage requirements outlined herein.

Workers' Compensation and Employer's Liability Required Minimum Limits of Coverage:

Workers' Compensation	Statutory	
Employers' Liability	\$1,000,000	Each Accident
	\$1,000,000	Disease Policy Limit
	\$1,000,000	Disease Each Employee

Required Minimum Coverage(s):

1. Workers' Compensation statutory coverage must be provided on "all states" basis.
2. Permittee and subcontractors of any tier performing work within 500 feet of navigable water must have their Workers' Compensation policy endorsed to provide coverage for both Jones Act Liability and Longshore and Harbor Workers' Compensation Act Liability.

Commercial General Liability Required Minimum Limits of Coverage:

Permittee and its Contractor(s): **[TBD by WMATA's Office of RISK]**

\$X,XXX,XXX	Each Occurrence Limit
\$X,XXX,XXX	General Aggregate Limit
\$X,XXX,XXX	Products and Completed Operations Limit

Required Minimum Limits of Coverage: Subcontractors of every tier:

\$X,XXX,XXX	Each Occurrence Limit
\$X,XXX,XXX	General Aggregate Limit
\$X,XXX,XXX	Products and Completed Operations Limit

Required Minimum Coverage(s) All Permittees:

1. Commercial General Liability (CGL) coverage form shall be ISO Occurrence Form CG0001 (12/04) or its equivalent. Equivalency determination shall be made in WMATA's sole and unreviewable discretion.
2. Required minimum limits of coverage may be achieved through a

combination of the aforementioned CGL coverage form and umbrella excess liability coverage form(s), provided that the umbrella excess liability coverage form(s) provide the same or broader coverage than the prescribed CGL coverage form.

3. Policy shall be endorsed with Additional Insured Endorsement(s) in compliance with the Additional Insured Section 22.8 of this Permit. Commercial General Liability and Umbrella Excess Liability forms must provide defense coverage for additional insureds.
4. Policy shall be endorsed with a Waiver of Subrogation Endorsement(s) in compliance with the Waiver of Subrogation Section 22.9 of these minimum insurance requirements.
5. The definition of “insured contract” shall be modified to provide coverage for contractual liability for contracts for construction, demolition or any other operations that are within 50 feet of a railroad and sidetrack agreements.
6. Defense costs (allocated loss adjustment expense) must be included and in excess of the policy limits for all primary and umbrella excess policies.
7. Policy shall be endorsed with ISO endorsement CG 25 03 03 97; “Designated Construction Project(s) General Aggregate Limit”, and designate “any and all construction projects” as the designated construction project. This Section 22.3.7 applies only to the primary CGL policy.

Railroad Protective Liability Insurance (RRPL):

For work within 50 feet of WMATA railroad tracks or work within WMATA rail stations, Railroad Protective Liability Insurance is required with the following minimum limits of coverage: **TBD by WMATA’s Office of RISK]**

\$X,XXX,XXX	Each Occurrence Limit
\$X,XXX,XXX	Aggregate Limit

Required Minimum Coverage(s):

1. Railroad Protective Liability (RRPL) policy on a policy form that is acceptable to WMATA, issued by an insurance company that is acceptable to WMATA.
2. WMATA shall be the first named insured.

3. Cost of RRPL shall be the sole responsibility of Permittee or a Permittee appointed entity.
4. The “wet ink” original RRPL policy shall be sent to WMATA at the following address:

Washington Metropolitan Area Transit Authority
Office of Risk Management, Room 8F
600 Fifth Street, NW
Washington, DC 20001.

5. WMATA Blanket RRPL Program Option: WMATA may offer to waive the requirement for Permittee to procure a standalone RRPL insurance policy if: (1) the work can be covered under WMATA’s blanket RRPL program; and (2) Permittee prepays the premium which shall be determined by the rate schedule promulgated by WMATA’s insurer in effect as of the Effective Date of this Permit. Permitted Parties shall be advised of and pay the applicable premium or procure a standalone RRPL policy on WMATA’s behalf.

Business Auto Liability Required Minimum Limits of Coverage:

[TBD by WMATA’s Office of RISK]

\$X,XXX,XXX	Combined Single Limit
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Required Minimum Coverage(s):

1. Business Auto Liability shall be written on ISO Business Auto Coverage Form CA 00 01 03 06, or its equivalent. Equivalency determination shall be made in WMATA’s sole and unreviewable discretion.
2. Policy shall be endorsed with Additional Insured Endorsement(s) in compliance with the Additional Insured Section 22.8 of this Permit.
3. Policy shall be endorsed with a Waiver of Subrogation Endorsement(s) in compliance with the Waiver of Subrogation Section 22.9 of this Permit.
4. Business Auto Liability Minimum Combined Single Limit requirements may be obtained through the combination of a primary business auto liability policy and an umbrella excess liability policy provided that the umbrella excess liability policy complies with items 22.5.1 through 22.5.3 above.

Professional Liability Insurance:

Should Permittee be required by the scope of work being performed on or adjacent to WMATA property to provide design services, the services of a professional engineer, including, but not limited

to stamping, sealing, or certifying blueprints or other construction-related documents, Permittee is required to maintain Professional Liability Insurance as follows:

1. Minimum Policy Limits of \$2,000,000, each claim.
2. Actual coverage or tail coverage must be purchased and maintained for a period of time equal to the statute of repose.
3. Coverage can be written on an “occurrence” or “claims made” basis.
4. Coverage can be written on ‘non-admitted” paper.

Pollution Liability Insurance:

Should Permittee be required by the scope of work being performed on or adjacent to WMATA property, to perform demolition of any pre-existing structures, moving, removal, or handling of any hazardous materials, Permittee is required to maintain Pollution Liability Coverage as follows:

1. Minimum Policy Limits of \$2,000,000, each claim.
2. Coverage can be written on an “occurrence” or “claims made” basis.
3. Coverage can be written on ‘non-admitted” paper.
4. Policy shall be endorsed with Additional Insured Endorsement(s) in compliance with the Additional Insured Section 22.8 of this Permit.
5. Policy shall be endorsed with a Waiver of Subrogation Endorsement(s) in compliance with the Waiver of Subrogation article of this Permit.

Additional Insured(s):

Permittee is required to add WMATA and the WMATA Board of Directors as Additional Insured(s) on all insurance policies purchased by Permittee with the exceptions of Workers’ Compensation and Professional Liability.

1. Coverage provided to any Additional Insured shall be primary and non-contributory to any other insurance available to the additional insured, including coverage afforded to WMATA as an Additional Insured by subcontractors, and from other third parties.
2. Coverage provided to any Additional Insured shall be for claims arising out of both ongoing operations and products and completed operations hazard. The coverage provided by the additional insured endorsement shall be at least as broad as the Insurance Service Office, Inc.’s Additional Insured Form CG 20 26 11 85 as determined by WMATA.

3. Coverage available to any Additional Insured under the products and completed operations hazard can only be limited to the applicable statute of repose in the jurisdiction where the contract scope of work takes place.
4. Coverage available to the Additional Insured shall not be limited to the minimum limits of coverage outlined in this document.

Waiver of Subrogation

Permittee is required to have all insurance policies purchased by all Permittees endorsed to waive the insurance company's rights of recovery against WMATA, the WMATA Board of Directors, and all Permittees. Coverage shall be provided on an endorsement that is acceptable to WMATA.

Certificate of Insurance (COI)

Permittee shall provide WMATA an ACORD Certificate of Insurance (COI) as evidence that the insurance requirements in this Permit have been satisfied. Certificates of Insurance shall be emailed to COI@WMATA.com. The "Description of Operations" box in the COI should reference the Permit PCN number located at the top of page 1 of this Permit and the "Certificate Holder" box should state:

Washington Metropolitan Area Transit Authority
Office of Risk Management, Room 8F
600 Fifth Street, NW
Washington, DC 20001

1. Proposed material modifications to insurance required under this section must be received by WMATA at least thirty (30) days prior to the effective date of the proposed modifications to such insurance.
2. WMATA's receipt of copies of any COI, policy endorsements or policies does not relieve Permittee of the obligation to remain in compliance with the requirements of this section at all times. Permittee's failure to so comply, and to continuously comply, with these insurance requirements shall constitute a material default of the terms of this Permit.
3. Receipt of the COI does not constitute acceptance of the insurance outlined above.

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SECTION 9 RIGHT-OF-WAY

9.1 GENERAL

9.1.1 Policy

Right-of-way is defined as the composite or total requirement of all real property interests and uses, both temporary and permanent, needed to construct, maintain, protect, and operate the Metro system.

WMATA's policy is to certify for acquisition the minimum right-of-way sufficient to construct, operate, and maintain the bus and rail transit system. The right-of-way plans approved by the WMATA Office of Chief Engineer Facilities (CENF) are used by the WMATA Office of Property Development and Management (LAND) as a basis for acquisition of property interests. LAND will make the final determination of the quantum of the estate in the land to be acquired.

For permanent easements, the Section Designer shall determine a right-of-way envelope which encompasses all permanent construction, drainage, future maintenance requirements, access roads, fire protection, utilities, rock bolts and any other permanent improvements or projections necessary for the construction, operation and maintenance of the system. In developing a right-of-way envelope, the cost of the land to be acquired should be factored into the proposed easement acquired.

The acquisition envelope is influenced by the topography, drainage, ditches, retaining walls, service roads, utilities, the nature of the structure and the slopes required. The limit of right-of-way shall be shown as an unbroken line which delineates the right-of-way with simple curves and connecting tangents. Chords may be used in lieu of large radius curves.

9.2 Right-of-way Staging

The Section Designer shall identify the minimum limits of the right-of-way during the design of the first or "structural" contract developed for a design section. Any subsequent contracts should not identify additional or new right-of-way required for that contract.

The first contract should identify the land that will be available for the first contract, the land that will be made available for any sequential contracts,

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and when in the construction cycle one contractor will make the land available for another contractor.

The contract drawings for the second contract need only identify the work areas that the second contractor will have available. The complete set of right-of-way drawings need not be inserted in subsequent contract drawing sets.

9.3 DEFINITIONS OF RIGHT-OF-WAY EASEMENTS

9.3.1 Permanent Surface Easement

A permanent surface easement shall provide sufficient space for the construction, operation, protection and maintenance of the Metro facility at the ground surface. The recommended easement width must incorporate basic track width, drainage, supporting slopes and utilities. Typical examples of permanent surface easements are sites for stations, traction power substations, chiller plants, vent and fan shafts, and other at-grade structures, in addition to at-grade tracks.

9.3.2 Permanent Surface Easement with an Upper Limit

A permanent surface easement with an upper limit shall provide space for the transit structures and for their future maintenance. This easement is applicable where structures such as a railroad or highway pass over Metro facilities. The easement shall have definite upper and lateral limits. A lower limit shall be described only when required.

9.3.3 Permanent Underground Easement

A permanent underground easement shall encompass the total Metro facility located beneath the surface of the ground. It shall have definite upper and lateral limits. Lower limits shall be described only where special limiting features exist.

9.3.4 Permanent Aerial Easement

A permanent aerial easement shall completely envelop the aerial portion of the Metro facility, with lower and lateral limits. An upper limit shall be described only where special limiting features exist.

9.3.5 Utility Easement

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A utility easement shall provide space for the relocation of existing utilities or the installation and maintenance of required or relocated utilities.

9.3.6 Construction Easement

A construction easement is a temporary easement or short term lease that provides sufficient space to allow for the temporary use of property by the Contractor during construction.

9.3.7 Slope Easement

A slope easement is a permanent surface easement for a cut or fill side slope to the tracks. A slope easement can be made revertible to the adjacent property owner if acceptable provisions are made for future support of the slope.

9.3.8 Drainage Easement

A drainage easement is a permanent surface easement for drainage of water along a prepared course.

9.3.9 Electric Grounding Grid Easement

The electric grounding grid at substations and tie breaker stations should be designed to be located in any permanent surface easements at the station. If such an arrangement is unworkable, then the grounding grid shall be located in an identifiable grounding grid easement. The grounding grid location should be monumented.

9.3.10 Access Easement

9.4 DRAWING DETAILS

Right-of-way drawings shall be 1" = 40' scale showing the relationship of the right-of-way to the street system and properties affected by construction. All existing topographic features shall be screened on the base sheets.

Show property lines and delineate affected parcel ownership along the right-of-way. When a property appears on more than one sheet of the right of-way plans, the total area of the easement required shall be shown in the Property Disposition Table on the first sheet on which the property appears. The property shall be listed in the property disposition table on

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each sheet on which it appears and shall be cross referenced to the sheet which delineates the area of the easement.

The right-of-way drawings shall have a designated grid system and north arrow reflecting the appropriate datum of WMATA's project grid or related USC&GS datum as appropriate for the area concerned.

9.4.1 Format

All right-of-way plans shall conform to the format established in the most current WMATA Right-of-way Design Drawings and Contract Drawing Standards.

9.4.2 Graphic Symbols

Graphic symbols used to describe easements shall be uniform and shall conform to the standard right-of-way legend ([see FIGURE 9.I](#)). Each sheet shall contain a legend describing only the symbols used on that sheet. The edge of each easement shall be marked with a neat line to mark the limit of the easement and to aid in distinguishing it from existing facilities or other easement symbols. The street system shall be clearly shown and identified by street names as well as Federal, State and/or County route numbers.

9.4.3 Centerline

The right-of-way plans shall show the centerline of the tracks and the outline of the structure, in addition to the limits of right-of-way which describes the right-of-way envelope. Stationing and station equations shall be shown in addition to contract limits. The beginning and ending points for curves and spirals on the centerline of both tracks shall be shown, as well as the dimension between tangent track centerlines. Show the outbound centerline stationing at property lines.

9.4.4 Contractors' Work Areas

Delineate on the drawings the property required for the contractors' use and show the limits of any additional easements, temporary or permanent, that are required to accommodate access, temporary roads, drainage and utilities. Show all structures that require razing prior to construction. Show temporary fencing or barriers around contractors' work areas. Determine the property owners of record affected by the above

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limits and show the property dispositions in table form with areas involved by type easement required.

Coordinate all of the requirements for the contractors' work areas at each end of the design section. The contractor's work areas for one design section shall not cross over into the adjacent section. If construction staging allows the use of an area in an adjacent design section, its use must be coordinated with WMATA and the adjacent section designer to avoid contractor confusion and claims.

9.4.5 Property Surveys in the District of Columbia

In the District of Columbia, the right-of-way envelope shall be dimensionally tied to existing copper corners. Copper corners, which are generally offset from the square corners or property lines, can only be established by the D.C. Surveyor, or a surveyor registered in D.C. After establishing a copper, the surveyor then prepares and records a plat showing the relationship between the established copper and the property line. Ties from the proposed limit of right-of-way to the property lines are also required.

The following procedure is to be followed when requesting copper corners:

- 9.4.5.1 The General Plans shall be reviewed by the Section Designer to determine the location of the copper corners needed to complete the design.
- 9.4.5.2 A search of the District of Columbia's survey records shall be conducted to determine the exact field location of each existing copper in the affected area.
- 9.4.5.3 A field check shall be made to determine the accuracy of all coppers located based on the copper locations taken from the D.C. survey records.
- 9.4.5.4 Coppers located and verified by the field check may be used in the design.
- 9.4.5.5 If additional copper corners are required to complete the right-of-way design, the Section Designer will provide a list of the desired corners to WMATA-CENF. WMATA shall request the D.C. Surveyor to mark the corners. WMATA shall monitor the D.C. Surveyor's progress.

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9.4.5.6 WMATA shall establish the location of the coppers with respect to the Metro grid and place the coordinate values on the plats prepared and signed by the D.C. Surveyor. Plats with the coordinated copper corners shall be used in the design and the coordinated values of the copper corners shall be shown on the right-of-way plans. (It is emphasized that copper corners be requested as early as possible to avoid delay in design.) When calculating areas of required rights-of-way, each square affected by the right-of-way envelope must be considered separately.

9.4.5.7 Written descriptions shall be in the D. C. meridian.

9.4.6 Property Surveys in Maryland and Virginia

The WMATA right-of-way envelope on the plans shall be described by bearings and distances, ensuring that the pertinent portions of all tracts, subdivisions, U.S. lands, parcels, and other areas which are affected by the envelope are similarly described. Coordinates and elevations further describing the right-of-way limits and existing property corners shall be shown on the plans. Coordinates shall be provided for all angle and curve points along the limits of right-of-way. Properties that are affected by WMATA's right-of-way shall be shown in their entirety. Smaller scale (e.g. 1" = 200') drawings may be used.

The Section Designer shall prepare plats of survey for recordation in accordance with the requirements found in Section 9.4.7 and the minimum technical standards of the appropriate jurisdiction. The final plats shall comply with the requirements of the jurisdiction in which the property is situated. It is required in Arlington County (and strongly recommended for other jurisdictions) that the Section Designer submit the plats to the County (or City) having jurisdiction for their approval and comments. The plats shall be coordinated with WMATA prior to their submittal to the County (or City). Final plats shall be certified by a Land Surveyor registered in the applicable jurisdiction.

In 1974, the National Geodetic Survey (formerly the United States Coast and Geodetic Survey) adjusted the values of the horizontal control coordinates of all first order Triangulation Stations in Maryland and Virginia. WMATA mapping and control was generally based on the NAD27 1971 field geographic positions and coordinate values of these stations. One small section of WMATA's mapping and control (A-14 to A-17) was based upon

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NAD27 1974 adjustment. In either case, the Section Designers shall include on the right-of-way plans, and on the plats of recordation, a note that describes the coordinate datum and adjusted values which are the basis for the coordinates shown. Survey consultants performing surveys for WMATA shall endeavor to use the NAD27 1971 and 1974 positions where historically these positions have been used in the past. NAD83 1991 positions shall be used for all extensions beyond the 103 Mile System. Adjustment of existing control shall be limited to avoid complications due to the differences of accuracy, and its relationship to previously set rail centerline control points and right-of-way monuments.

9.4.7 Plat of Survey Requirements

- 9.4.7.1 A surveyor performing any boundary survey for WMATA shall follow the minimum technical jurisdictional requirements and the WMATA technical standards during the performance of the work. Deviation from these requirements shall require WMATA approval.**
- 9.4.7.2 All original plats of boundary surveys shall be provided on durable reproducible film, drawn at a jurisdictionally approved suitable scale clearly indicating the compiled results of the field work, computations, research, and record information.**
- 9.4.7.3 All plats shall be submitted to WMATA in the latest AutoCAD® and Portable Document Format (PDF) file formats. PDF files shall include seal and signature of the surveyor of record. All legal descriptions shall be submitted to WMATA in the latest Microsoft Word® and Portable Document Format (PDF) file formats. All plats and legal descriptions shall include separate area closure sheets output from the computational software showing computed coordinates, bearing and distances, areas and closure error for each parcel and shall be submitted as an ASCII text and Portable Document Format (PDF) file formats.**
- 9.4.7.4 All plats and legal descriptions shall be signed and sealed by the record surveyor.**
- 9.4.7.5 Plats may not be smaller than 8 ½ x 11 inches. Plats shall be prepared in multiples of 8 ½ x 11 inches or 8½ x 14 inches. Tic marks shall be placed on the plat to**

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indicate the corners of the multiple rectangles. The scale of the plat shall be 1 inch = 100 feet or smaller. Excess blank space shall be avoided.

- 9.4.7.6** Dimensions, bearings, or angles, including sufficient data to define curves, shall be neatly and legibly shown with respect to each property boundary line. Tables of dimensions, bearings and angles shall be avoided.
- 9.4.7.7** All bearings shall be shown in a clockwise direction.
- 9.4.7.8** Building street address numbers, as displayed on the premises, or so noted if no numbers are displayed.
- 9.4.7.9** Markers shall be labeled as "found" or "set", with a brief description of the marker and relevant reference markers, if any, along with their positions in relation to the corner.
- 9.4.7.10** Natural or artificial features, where relevant, such as water courses, streets, curb lines, pavement lines and visible utilities, shall be labeled, dimensioned, and referenced to the nearest property boundary line or represented by a symbol on the plat in its proper location. Each symbol shall clearly indicate what is represented or shall be labeled for identification either individually or in a separate key of symbols or legend.
- 9.4.7.11** A statement indicating the origin and method of determination of the bearings shall be made on each plat, and the origin of the bearings shall include a reference to the WMATA approved local coordinate system with the controlling station names listed along with coordinate values.
- 9.4.7.12** Separate intricate details, blowups, or inserts may be used for clarity. They shall be properly referenced to the portion of the plat where they apply, particularly in areas where lines of occupation do not conform to the deed lines, and or where a comparison of adjoining deeds indicates the existence of a gap or overlap.
- 9.4.7.13** When record bearings or angles or distances differ from measured bearings, angles or distances, both the record and measured bearings, angles, and distances shall be clearly indicated. If the record description fails to form a

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mathematically closed figure, the surveyor shall so indicate.

- 9.4.7.14** Cemeteries and burial grounds found by the surveyor within the premises being surveyed shall be noted on the plat.
- 9.4.7.15** All evidence of monuments found beyond the subject tract, on which establishment of the corners of the subject tract are dependent, along with their application related to the survey shall be indicated.
- 9.4.7.16** Different line weights or delineating letters or numbers shall be used to clearly show the limits of the survey.
- 9.4.7.17** Easements and other physical encumbrances shown on the title shall be included on each plat along with all data necessary to establish or reestablish the location of the lines and the area of a strip or parcel of land designated on a tract of land for the specific use and benefit of others.
- 9.4.7.18** Upper and lower easement elevations and geometric delineation of easements required shall be shown on all plats.
- 9.4.7.19** WMATA structure lines and WMATA right-of-way lines shall be shown on all corresponding plats.
- 9.4.7.20** Permanent property interests required by WMATA shall be plainly and precisely identified on all corresponding plats.
- 9.4.7.21** The character of any and all evidence of possession shall be stated and the location of such evidence carefully given in relation to both the measured boundary lines and those established by the record. An absence of notation on the survey shall be presumptive of no observable evidence of possession.
- 9.4.7.22** Flood zone designation with proper annotation based on Federal Emergency Management Agency Flood Insurance Rate Maps or the state or local equivalent, by scaled map location and graphic plotting only shall be shown on each plat.

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- 9.4.7.23** The name of owner(s) of record and deed book reference where the acquisition was recorded shall be shown on all plats.
- 9.4.7.24** Adjoining properties will be shown and shall include record owner name(s), square number, block & lot number, parcel number, section number, and name of subdivision, as appropriate, or if not in a subdivision, Town/City and County. In addition, tax identification number and deed book & page shall also be shown on each plat.
- 9.4.7.25** Names and widths of streets and highways abutting the property surveyed and widths of right of way shall be shown on the plat. Distance to nearest intersection, based upon record data. If not available from record data, distance to nearest intersection may be determined from best available data, and so qualified.
- 9.4.7.26** Improvements such as any fixed permanent features including buildings, sheds, detached garages, structures, and fences shall be shown on each plat. The type of building construction shall be noted as brick, frame, steel, concrete, etc. All improvements shall be dimensioned (including number of stories and projections into public space) and shown on the plat. If no buildings exist a note shall be placed on the plat stating "No buildings".
- 9.4.7.27** Driveways and alleys on or crossing the property shall be shown. Where there is evidence of use by other than the occupants of the property, the surveyor must so indicate on the plat or map. Where driveways or alleys on adjoining properties encroach, in whole or in part, on the property being surveyed, the surveyor must so indicate on the plat or map with appropriate measurements.
- 9.4.7.28** A statement as to whether or not a current title report has been furnished to the surveyor along with title report number.
- 9.4.7.29** Building restriction line(s) per restrictive covenant, if shown on the record subdivision plat.

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- 9.4.7.30 All measured and record boundary line distances of parcels surveyed shall be shown.**
- 9.4.7.31 Date of plat certification (signing & sealing)**
- 9.4.7.32 Path & filename (digital)**
- 9.4.7.33 Survey contractor's project filename & number**
- 9.4.7.34 WMATA survey request number (if applicable)**
- 9.4.7.35 WMATA task order number (if applicable)**
- 9.4.7.36 WMATA line & section number (if applicable)**
- 9.4.7.37 CENF parcel number**
- 9.4.7.38 LAND parcel number**
- 9.4.7.39 QA review by signature block**
- 9.4.7.40 Date of field survey**
- 9.4.7.41 Revision date(s)**
- 9.4.7.42 Name of surveyor**
- 9.4.7.43 Survey company name**
- 9.4.7.44 Survey company address and the phone number**
- 9.4.7.45 Client's name (survey prepared for)**
- 9.4.7.46 Title of survey**
- 9.4.7.47 Title report reference**
- 9.4.7.48 Classification of the survey (urban, suburban, rural, mountain and marshland)**
- 9.4.7.49 Scale of drawing**
- 9.4.7.50 Basis of bearings**
- 9.4.7.51 Datum (NAD83 or other datum approved by WMATA)**

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- 9.4.7.52 Gridlines / grid ticks**
- 9.4.7.53 Coordinate station names**
- 9.4.7.54 Coordinate station values for base control**
- 9.4.7.55 Coordinate station scale factor(s)**
- 9.4.7.56 North arrow**
- 9.4.7.57 Legend**
- 9.4.7.58 Signature, seal, printed license number of the surveyor & date block**
- 9.4.7.59 Property description & location**
- 9.4.7.60 Vicinity map**
- 9.4.7.61 Land area for each parcel (acreage)**
- 9.4.7.62 Point of commencement/point of beginning**

9.4.8 Deliverables

- 9.4.8.1 In addition to the right-of-way drawings, plats of survey and written metes and bounds descriptions of the proposed permanent easements shall be prepared by the Section Designer. Digital and hard copies shall be submitted to WMATA. The plats shall show both the record and the measured distances and bearings. Area closure sheets shall also be submitted.**
- 9.4.8.2 Fee interests are normally taken from railroad companies, in lieu of permanent surface easement. Therefore, plats of railroad property where WMATA will require permanent surface easement shall be prepared to show fee takings. (The right-of-way plans shall still show permanent surface easement in the railroad properties.)**

9.4.9 Curve Data

The Section Designer shall reduce all spirals to circular curves at the limit of right-of-way. Circular curves are the only type of curves acceptable for recording purposes. Curve data shall be

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shown on the right-of-way plan sheet on which the curve appears in a table of curve data. Tangent sections shall be used in lieu of curves to show the limits of the right-of-way when curves are extremely flat.

9.4.10 Right-of-way for Aerial Structures

9.4.10.1 In determining right-of-way needs when dealing with aerial structures the Section Designer may use as a guide a horizontal distance of twenty-five feet (25'-0") from the centerline of the nearest track to the right-of-way line. This should provide sufficient space for fire protection and maintenance. Consideration shall be given to the location of adjoining buildings and property limits which could govern the extent of the right-of-way limits.

9.4.10.2 The upper elevation of an aerial easement shall be a plane parallel with the datum, the upper elevation controlled by the highest point of the Metro structure. The upper elevation plane shall be stepped as necessary to prevent excessive takings. The steps shall be co-located with property lines, or other land features acceptable in land description practice. A lower limit will be required in most cases. Typical examples are a railroad passing under the WMATA facilities, or where the Metro passes over Federal Aid Highways, parking lots, or other facilities. Future requirements of access for maintenance purposes from ground elevation shall be considered in designing aerial rights-of-way.

9.4.10.3 Within the aerial easement area the following rights are obtained as a minimum:

9.4.10.3.1 Support rights for foundations, piers and other structural members.

9.4.10.3.2 The right of unobstructed and unimpaired use of the aerial envelope.

9.4.10.3.3 The right to prevent the transfer of loads to any part of the structure or foundations.

9.4.10.3.4 Access rights for periodic inspection and maintenance of the structure and footings.

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9.4.10.3.5 The right to prevent the storage of flammables, explosives or other hazardous materials under the aerial envelope.

9.4.10.3.6 The right to install utilities beneath the surface of the ground within the easement area.

9.4.10.3.7 The right to use the area of the aerial easement as a contractor's work area during construction.

9.4.10.4 In property owned by the National Park Service (NPS) or by the General Services Administration (GSA), the areas for all easements required below the aerial easement shall be defined in the normal way.

9.4.10.5 In designing the WMATA right-of-way, the Section Designer shall take the above criteria into consideration and any existing local, state and Federal requirements.

9.4.11 Continuous Right-of-way

Even though WMATA may not require acquisition of public space, all plans shall show the right-of-way envelope as being continuous crossing public as well as private space.

9.4.12 Isolated Right-of-way

The easement areas supporting all new construction such as fan and vent shafts, substations, escalators, and chiller plants shall be geometrically delineated as is the right-of-way envelope, with ties shown where the location is not contiguous to the right-of-way.

9.4.13 Underground Vaults

Underground vaults (found mainly in the District of Columbia) that will be influenced by WMATA construction shall be shown and their disposition noted. The vaults shall be labeled in accordance with the following categories:

9.4.13.1 Category "A" are those vaults which must be physically removed during construction.

9.4.13.2 Category "B" are those vaults which lie within the influence line of construction, but may not require physical removal.

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9.4.13.3 The influence line may generally be considered to project upwardly on a 1:1 slope from a point two feet (2') below the lowest point of excavation nearest the property line. Vaults not in Category "A" but within the influence line could experience cracking and utility lines may be subject to rupture. The owner may be required to abandon use of vaults designated Category "B" during construction.

9.4.14 **Multilevel Easements**

Multilevel easements may be required by WMATA at station entrances located in buildings. In such instances the Section Designer shall prepare a separate detail drawing showing the interests on each floor level. The following points shall be adhered to:

9.4.14.1 Each floor level affected by the WMATA facility shall be so noted and separately illustrated. The area required on each level should be shown on each level of the detail, with the sum of the areas shown in the property disposition table for that property.

9.4.14.2 Each type of easement on a floor level shall be properly dimensioned and symbolized. All footing and column locations shall be shown.

9.4.14.3 The elevations of each floor easement shall be given and referenced to the project datum. Elevations shall normally be from the underside of the floor structure to the underside of the next higher floor structure.

9.4.14.4 Access to each level of the easements must also be included in the design.

9.4.15 **Explanatory Notes**

Explanatory notes shall be used, where applicable, to aid in clarification of right-of-way takings.

9.4.16 **Construction Easements**

9.4.16.1 Construction easements are temporary easements that are normally required only during construction. These easements do not need the detailed definition of permanent easements, as an agreement (lease) is normally entered into with the property owner. It is

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essential, however, that the Contractor be able to accurately locate the extent of the easement in the field. Thus, distances and ties to existing features are important.

- 9.4.16.2 If the proposed easement is isolated from the WMATA right-of-way, ties or coordinates sufficient to locate the easement in the field should be shown on the plans.
- 9.4.16.3 Where WMATA facilities will be built by cut-and-cover construction, a construction easement is required over the permanent underground easement that will envelope the structure. The area of the construction easement is to be noted in the property disposition table with an asterisk, which refers to a note of explanation: "*** INCLUDES AREA ABOVE PERMANENT UNDERGROUND EASEMENT**", placed above the Property Disposition Table. Plats are not required for construction easements, except in the event of condemnation. Plats used for condemnation are required to show construction easements by bearings and distances.

9.5 RIGHT-OF-WAY LIMITS

The Section Designer shall concurrently evaluate the right-of-way requirements for access, drainage, utilities, embankments, grades, alignments, and interfaces. The following criteria are provided as a guide for establishing the right-of-way limits. All right-of-way limits shall be defined as horizontal or vertical planes. The dimensions given herein are for general conditions and are to be modified where good sense, engineering, physical limitations, or real estate requirements dictate. The right-of-way limits will not always be concentric or parallel with the centerline of the tracks. Special attention shall be given to property takings, with the intent of avoiding takings where it is possible without adversely affecting the composite requirements of the Metro system. This may be accomplished by reducing or increasing the distance from the centerline of the tracks to the right-of-way limits or by stepping the limits around a certain property. The Section Designer shall establish the right-of-way limit to include the security fence and its support structure. Right-of-way limits should be developed which will allow minor adjustments as the design is refined.

The following distances are offered as a guide in establishing the final right-of-way requirements early in the design. Right-of-way

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widths at stations are based on 40'-6" track centers. Use of wider track centers will require additional right-of-way widths.

9.5.1 At-Grade Structure ([See Figure 9.2](#))

Upper Limit: Normally, an upper limit is not required. When an upper limit is required, the limit shall be described by the elevation of horizontal planes, stepped as required, locating the steps at existing property lines or prominent topographical features. The minimum distance from the top of the high rail to the horizontal plane is eighteen feet (18').

Lateral Limits: The Section Designer shall establish the right-of-way limits taking into account all requirements that apply to the alignment. The following distances shall be used as a guide:

9.5.1.1 Normal at-grade section, five feet (5') from the toe or top of slope.

9.5.1.2 Normal at-grade section with a drainage interceptor ditch, five feet (5') from the outside edge of the interceptor ditch.

9.5.1.3 Restrictive and retained sections as approved by CENF.

Lower Limit: When required, the lower limit shall be defined in a manner similar to the upper limit, using a minimum distance of fifteen feet (15') below the top of low rail or fifteen feet (15') below the lowest flow line of adjacent drainage channels, whichever is lower.

9.5.2 Aerial Structure ([See Figure 9.2](#), [Figure 9.10](#) and [Figure 9.11](#))

Lateral Limit: Single track minimum fifty feet (50') total; double track on fourteen feet (14') centers, sixty four feet (64'). A lateral distance of twenty five feet (25') from the centerline of each track is to be maintained on wider track centers.

Lower Limit: A lower limit will normally be required under the aerial structure. The limit will vary from 1' to 4' below the bottom of the structure. The limit is delineated by elevations of horizontal planes, stepped as required, locating the steps at existing property lines or prominent suitable topographical features. For clearance requirements see Section 11.11.

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Upper Limit: An upper limit is generally not required; however, if required, the upper limit should be set at eighteen feet (18') above the top of the high rail.

9.5.3 Rock Tunnel ([See Figure 9.2](#), [Figure 9.7](#), [Figure 9.8](#) and [Figure 9.9](#))

Dimensions given in the aforementioned figures and following paragraphs are minimum distances. Actual dimensions may increase due to the conditions of the rock.

Upper Limit: The limit of the right-of-way is described by elevations of horizontal planes, stepped as required, locating the steps at existing property lines or prominent suitable topographical features. As a guide, a horizontal plane shall be used that is thirty five feet (35') above the top of the high rail for single track, forty feet (40') for double track, and seventy feet (70') at stations.

Lateral Limit: Vertical planes shall be used that are thirty feet (30') from the centerline of the nearest track. In station areas, use sixty feet (60') from the centerline of the station.

Lower Limit: Lower limits are normally not prescribed for rock tunnels. Where used, the lower limit shall be configured in a like manner to the upper limit, using a distance of fifteen feet (15') below the low rail.

9.5.4 Earth Tunnel ([See Figure 9.2](#) and [Figure 9.6](#))

Upper Limit: The limit of the right-of-way is described by elevations of horizontal planes, stepped as required, locating the steps at existing property lines or prominent suitable topographical features. As a guide, a horizontal plane twenty five feet (25') above the top of the high rail shall be used.

Lateral Limit: Fifteen feet (15') from the centerline of the nearest track.

Lower Limit: Where required by local jurisdictions or field conditions, a lower limit shall be configured in a manner similar to the upper limit using a distance of fifteen feet (15') below the top of the low rail.

9.5.5 Cut and Cover ([See Figure 9.2](#), [Figure 9.3](#), [Figure 9.4](#) and [Figure 9.5](#))

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Upper Limit: Twenty five feet (25') above the top of the high rail for single track, double track or triple track, and forty feet (40') at stations. The limit is delineated by elevations of horizontal planes, stepped as required, locating the steps at existing property lines or prominent suitable topographical features.

Lateral Limit: Fifteen feet (15') from the centerline of the nearest track. In station areas, forty feet (40') from the centerline of the stations.

Lower Limit: Where required by local jurisdiction or conditions.

9.5.6 Storm Drainage

Local requirements shall be adhered to where applicable. If there are no applicable local requirements, then the following shall apply:

9.5.6.1 Open Ditches

A minimum strip ten feet (10') wide is required for ditches where the design requires surface drainage. (See standard drawings for other ditch dimensions and slopes.) A two foot (2') wide clean-out shelf is required where the ditch is unpaved.

Back and Front Slopes: In soils, a maximum back or front slope of 2 1/2:1 shall be used. Where soil conditions would require excessive maintenance of a 2 1/2:1 slope, use a suitable flatter slope.

9.5.6.2 Underground Drainage

Widths of public easements for underground drainage systems shall be approved by the local approving agency.

9.5.7 Stations

All station platforms are 600' long, with ancillary rooms as an additional requirement. Station platforms shall be shown on the plans with stationing at each end of the platform. Right-of-way dimensions are delineated in paragraphs 9.5.1, 9.5.2, 9.5.3, 9.5.4, and 9.5.5.

9.5.8 Projections in Public Space or Public Street Right-of-way

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The Section Designer shall submit to WMATA a written list of projections into public space which must be removed to accommodate the construction of the metro facilities. This list should be submitted as soon as possible, but no later than the intermediate review submittal.

The projections list shall identify the type of projection, the location of the projection by square and lot number or by the tax assessor's designations, the street address, and the owner's name and address. Types of projections include vaults, fire escapes, signs, display windows, footings, foundations, and stairways.

9.5.9 Escalator Requirements

In addition to the structural, mechanical and electrical requirements for escalator space, the requirements for pedestrian circulation space to and from the escalators must be satisfied. A fifteen feet (15') wide longitudinal walking strip on either side of the finished escalator portal is required. A twenty feet (20') distance from the newels must also be preserved for pedestrian circulation. Exterior escalators require overhead protection from the elements. See standard canopy design drawings DD-A-CP-001 through DD-A-CP-008. Provide a minimum 15'-0" maintenance easement above the top of the canopy structure. The minimum head room above the escalator is twelve feet (12'-0") for escalator truss removal.

9.5.10 Substations

At-grade substations require an access road that is a minimum of eighteen feet (18') wide, with a twenty feet (20') long parking area and a turnaround sufficient for a WB-50 vehicle. The requirement for land will vary with the type of substation. The substation area should be contiguous to the limit of right-of-way for the transit way, where possible, with a five feet (5') maintenance space between the limit of right-of-way and the face of the substation structure.

Underground substations require an underground easement extending out ten feet (10') from the outside face of the structure.

Provision shall be made for permanent right-of-way for the electrical and communications cable ducts between the substation and the tracks.

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The electric grounding grid at substations shall be located within the permanent surface easement at the substation. If such an arrangement is unworkable, then the grounding grid shall be located in an identifiable grounding grid easement. The grounding grid location should be monumented.

9.5.11 Tie Breaker Stations

At-grade tie breaker stations require an access road that is a minimum of eighteen feet (18') wide, with a twenty feet (20') long parking area and a turnaround sufficient for a WB-50 vehicle. The requirement for land varies with the type of tie breaker station. The tie breaker area should be contiguous to the limit of right-of-way for the transit way, where possible, with a five feet (5') maintenance space between the limit of right-of-way and the face of the tie breaker structure.

Underground tie breaker stations require an underground easement extending out ten feet (10') from the outside face of the structure.

Provision shall be made for permanent right-of-way for the electrical and communications cable ducts between the tie breaker station and the tracks. The electric grounding grid at tie breaker stations shall be located within the permanent surface easement at the tie breaker station. If such an arrangement is unworkable, then the grounding grid shall be located in an identifiable grounding grid easement. The grounding grid location shall be monumented.

9.5.12 Vent and Fan Shafts

Vent and fan shafts shall be located in public space where possible. The gratings shall not exceed forty percent (40%) of the sidewalk width. When located on private property, the limit of right-of-way shall be five feet (5') from the outside face of the structure. Access to the shaft is required from the public street right-of-way.

9.5.13 Chiller Plants

At-grade chiller plants require five feet (5') from the face of the structure to the limit of the right-of-way. Suitable access is required.

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Chiller plants require additional space for the cooling tower when the cooling tower is located beside the mechanical plant instead of on top of the plant building. When chiller plants are located on existing buildings, a pipe and conduit chase shall be provided and required easements delineated on the right-of-way plans.

9.5.14 Fencing

All construction sites and contractor's areas shall have temporary fencing and suitable barricades where required to protect pedestrians and vehicles. It shall be noted on the plans that the contractor is required to fence only the area he will need to conduct his operations. The fencing will generally follow the limit of a construction easement. Contractor work areas in public space will be indicated by the limit of the construction fence. Dimensions of fencing may be scaled.

9.5.15 Monumentation

9.5.15.1 The objective of WMATA's monumentation is to provide a broad network of survey control, right-of-way and boundary monuments from which WMATA's real property interests can accurately be identified.

9.5.15.2 Definitions

9.5.15.2.1 Survey control monument A Metro monument consisting of a brass or bronze disc inscribed "METRO-CONTROL SURVEY", as shown on Standard Drawings ST-C-3 and ST-C-19. These are geodetically established, georeferenced monuments placed within Metrorail corridors. This is the primary survey control used to design and construct the Metrorail system.

9.5.15.2.2 Right-of-way monument A Metro monument consisting of a brass or bronze disc inscribed "METRO-RIGHT-OF-WAY", as shown on Standard Drawings ST-C- 3 and ST-C-19. These are georeferenced monuments which document the boundary as determined by a registered surveyor.

9.5.15.2.3 Boundary monument A steel rebar rod with aluminum cap inscribed "Metro - Property Monument," as shown on Standard Drawings, ST-C-3 and ST-C-19, are to be used to mark a corner or

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point on a boundary line. The registered surveyor setting the monument is to inscribe the cap with their registration number, WMATA Real Estate parcel number and point number, and comply with all jurisdictional regulations.

- 9.5.15.2.4** Witness post a fiberglass flexible post about six feet in length (one and one-half to two foot burial depth) used to mark a survey control, right-of-way or boundary monument located in open space, and provide an easily visible identifying reference to the monument. Witness posts may also be used to locate points on property lines when the line is not readily identifiable. See Standard Drawings ST-C-3 and ST-C-19 for details of the decal that is to be applied to all witness posts.

9.5.15.3 Local Regulations

- 9.5.15.3.1** Right-of-way monuments shall be installed at property corners to mark the WMATA right-of-way when jurisdictional regulations require it.
- 9.5.15.3.2** Where jurisdictional regulations require a boundary monument to mark property acquisitions or divisions in property, the local regulations shall govern. If jurisdictional regulations do not require monuments to be set, then WMATA policies shall apply. Refer to Section 9.5.15.4.
- 9.5.15.3.3** The monumentation for the right-of-way of WMATA facilities shall be accomplished in such a manner that the right-of-way lines can be readily re-established by a registered surveyor.

9.5.15.4 Design Considerations

- 9.5.15.4.1** It is WMATA policy to monument all Metro right-of-way in such a manner that the right-of-way line can be readily re-established on the ground by a registered surveyor currently licensed to practice in the appropriate jurisdiction. In order to have consistency among the many surveys made, or that will be made in the future, the Metro control survey network shall be considered the basis for all Metro right-of-way monumentation.

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9.5.15.4.2 Right-of-way monuments shall be installed at property corners to mark the WMATA right-of-way. Right-of-way monuments shall be installed at all station entrances, on property lines adjacent to public spaces, and on property lines considered to be sensitive, as directed by WMATA. Setting the WMATA right-of-way lines shall be accomplished only after careful consideration has been given to adjacent property lines.

9.5.15.4.3 Coordinate values on boundary survey plats are to be shown in the applicable state plane system. Coordinate values on right-of-way plans are to be based on the project coordinate system in District of Columbia and Maryland and for part of the Huntington Route in Virginia. Coordinates in Virginia, except for part of the Huntington Route, are to be based on the Virginia State Plane Coordinate System, North Zone. State plane NAD83, 1991 coordinate values shall be utilized for various parts of the E-Route and the extension of the Outer G-Route.

9.5.15.5 Location of Monuments and Markers

9.5.15.5.1 It is WMATA's policy to set all property corners and to mark all underground utilities within the Metrorail right-of-way.

9.5.15.5.2 WMATA's control survey network shall be considered the basis for WMATA's right-of-way monumentation. Right-of-way monuments shall be set at angle points, at the beginning and ends of curves, and at intermediate points at intervals of not greater than 1000 feet.

9.5.15.5.3 Right-of-way monuments shall be placed where they would not normally be disturbed by WMATA maintenance operations, private grass cutting, future construction, and where their use would not create a hazard for the public or surveyors.

9.5.15.5.4 Boundary monuments shall be set in accordance with local laws, ordinances and regulations. Boundary monuments will not be set in the District

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of Columbia as this is the prerogative of the Surveyor, D.C.

9.5.15.5.5 Right-of-way monuments shall be set at Metrorail station entrances to define the limits of the WMATA surface property interests. Brass or other disks shall be used to mark the corners.

9.5.15.5.6 Control survey monuments shall be set following construction of WMATA concrete structures.

9.5.15.6 Monumentation of surface, underground, aerial and utility rights-of-ways

9.5.15.6.1 Surface right-of-way:

Right-of-way monuments shall be located outside of the WMATA security fence.

9.5.15.6.2 Underground right-of-way:

Right-of-way monuments shall not normally be used to mark WMATA underground occupancy of public space. On WMATA property, survey control monuments shall be set in readily accessible places such as entrances, dome relief curbs, elevator openings, and fan and vent shafts' concrete structures.

9.5.15.6.3 Aerial right-of-way:

Right-of-way monuments shall not normally be used to mark these rights-of-way.

9.5.15.6.4 Utility right-of-way:

All underground utility lines will be marked in accordance with Standard Drawing ST-U-66.

9.5.16 Underpinning Construction Easements

The Section Designer shall provide detailed plans of the right-of-way necessary for the underpinning required by the design. Separate drawings showing the easements required for the construction contractor shall be prepared and referenced in the Property Disposition Table under "Remarks". The underpinning

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detail shall show the dimensions of the easements and tie the easements to the WMATA right-of-way, the property line, and the supporting columns of the structures. All footing and column locations shall be shown. Proposed access to the work areas through the building and location of dust walls shall be shown (see Section 15.7).

9.5.17 Street Closings

Provide separate drawings showing the areas of public property to be closed and utilized for WMATA. These drawings shall be prepared in accordance with all local requirements. The local plat requirements generally conform to the requirements for subdivision plats.

9.5.18 Utility Easements

Utility easements shall be treated as rights-of-way. Bearings and distances along the centerline shall be shown as well as the lengths and widths of the easements, and ties to the limits of right-of-way. All easements and clearances shall be in accordance with the Federal, State, local, and utility regulations and policies. All easements for new or relocated utilities shall be described by a metes and bounds description based upon the required plat.

9.5.19 Elevators

Provide direct access from elevators to public space. The access shall be a minimum of fifteen feet (15') wide, in addition to the space required for the queuing area. Provide for access to machine rooms, hoistways, elevator pits, etc., as required by the applicable code. Right-of-way for required utility services to the elevators shall be provided in accordance with the local jurisdiction requirements.

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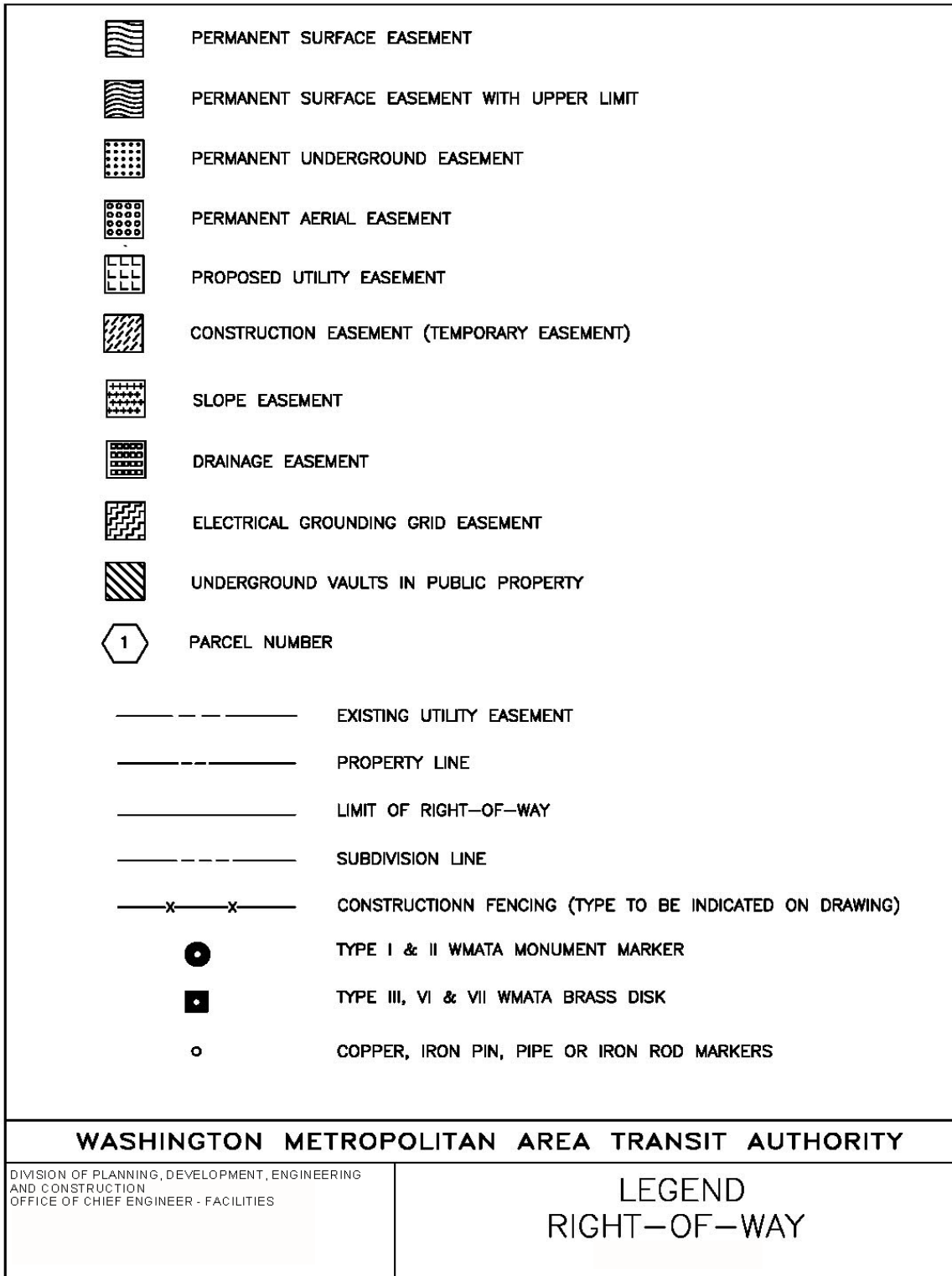


Figure 9.1

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TYPE CONSTRUCTION	AT GRADE		CUT & COVER	EARTH TUNNEL	ROCK TUNNEL	AERIAL
	SURFACE	SURFACE WITH UPPER LIMIT				
TYPE EASEMENT (PERMANENT)			UNDERGROUND	UNDERGROUND	UNDERGROUND	AERIAL
UPPER LIMIT	N/A	18' ABOVE T/R _____ 13' ABOVE T/R UNDER BRIDGES	SINGLE TRACK-25' ABOVE T/R DBL OR TRPL-25' ABOVE T/R STATIONS-40' ABOVE T/R	25' ABOVE T/R	1. SINGLE TRACK 35' ABOVE T/R 2. DOUBLE TRACK 40' ABOVE T/R 3. AT STATION 70' ABOVE T/R	18' ABOVE T/R
LOWER LIMIT (WHERE REQUIRED BY JURISDICTIONS)	15' BELOW T/R		15' BELOW T/R _____ STATIONS-20' BELOW T/R	15' BELOW T/R	15' BELOW T/R	VARIES 1' TO 4' BELOW BOTTOM OF STRUCTURE
LATERAL LIMITS	EXCLUSIVE ROW VARIES (SEE DESIGN DRAWINGS)		15' FROM $\text{\textcircled{C}}$ NEAREST TRACK _____ 40' FROM $\text{\textcircled{C}}$ STATIONS	15' FROM $\text{\textcircled{C}}$ NEAREST TRACK	30' FROM $\text{\textcircled{C}}$ NEAREST TRACK _____ 60' FROM $\text{\textcircled{C}}$ STATIONS	SINGLE TRACK 50' _____ DOUBLE TRACK 25' FROM $\text{\textcircled{C}}$ EACH TRACK
	RESTRICTIVE ROW AS APPROVED (SEE DESIGN DRAWINGS)					
<p>NOTES:</p> <ol style="list-style-type: none"> DISTANCES SHOWN ARE MINIMUM AND ARE TO BE INCREASED WHERE ENGINEERING REQUIREMENTS SUCH AS ROCK BOLTS, SERVICE ROADS OR DRAINAGE DICTATE ADDITIONAL NEEDS. ALL LIMITS OF RIGHT-OF-WAY ARE TO BE VERTICAL OR HORIZONTAL PLANES. FOR UNDERGROUND EASEMENTS, WHERE THE DISTANCE SPECIFIED FOR THE UPPER LIMIT EXTENDS ABOVE THE GROUND SURFACE, USE THE GROUND SURFACE AS THE UPPER LIMIT. 						

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

DIVISION OF PLANNING, DEVELOPMENT, ENGINEERING AND CONSTRUCTION
OFFICE OF CHIEF ENGINEER - FACILITIES

MINIMUM RIGHT-OF-WAY

Figure 9.2

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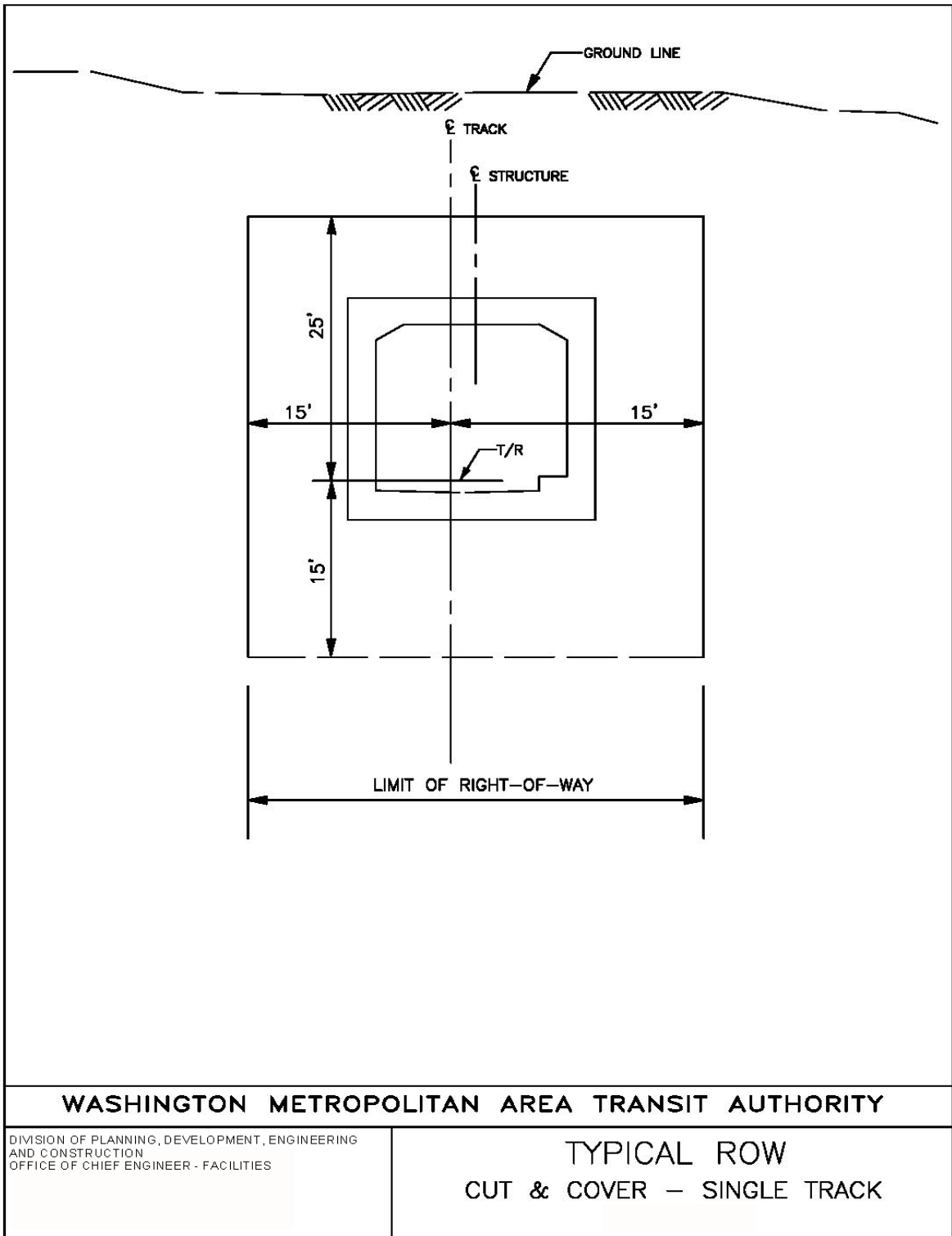


Figure 9.3

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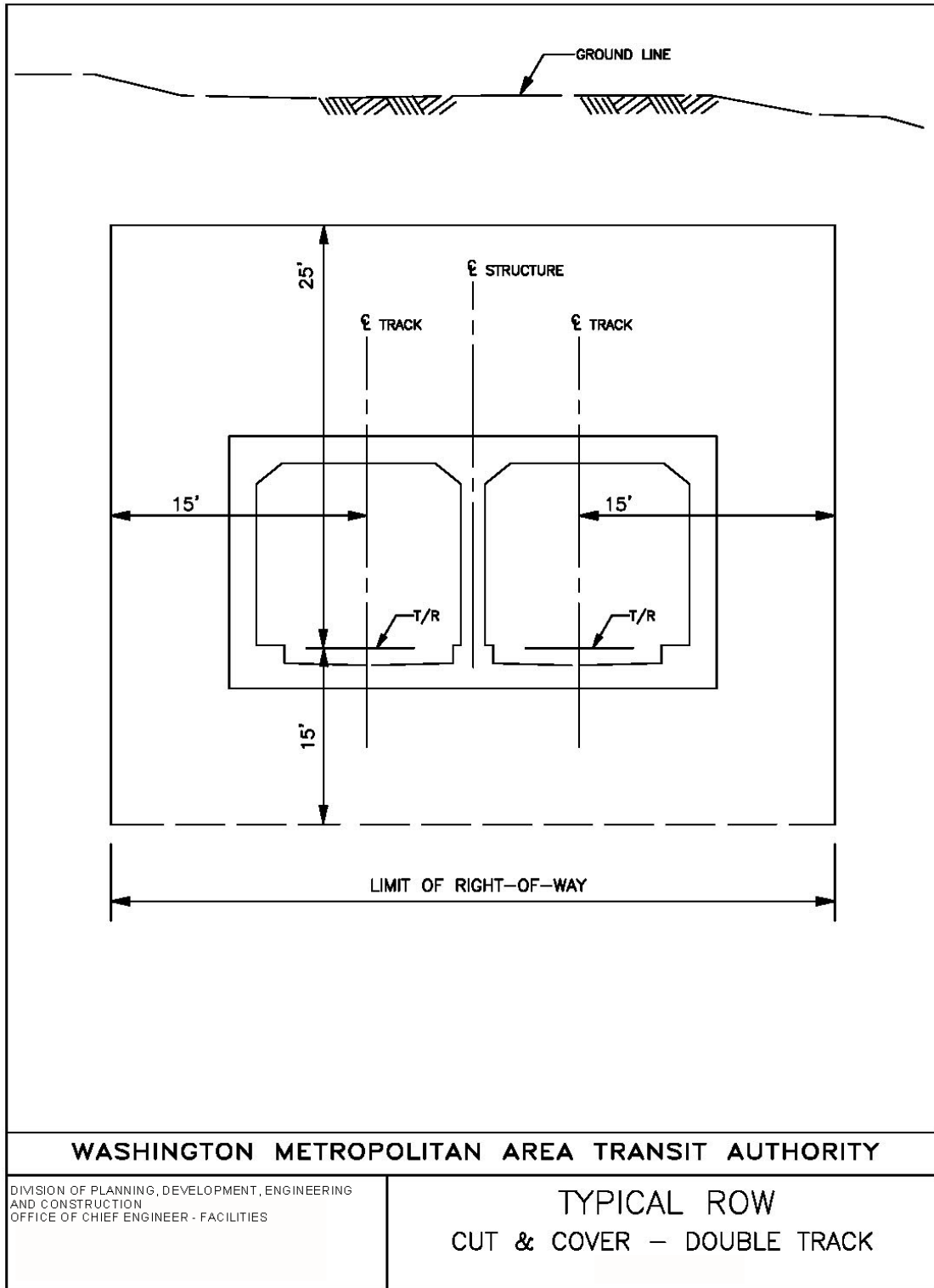
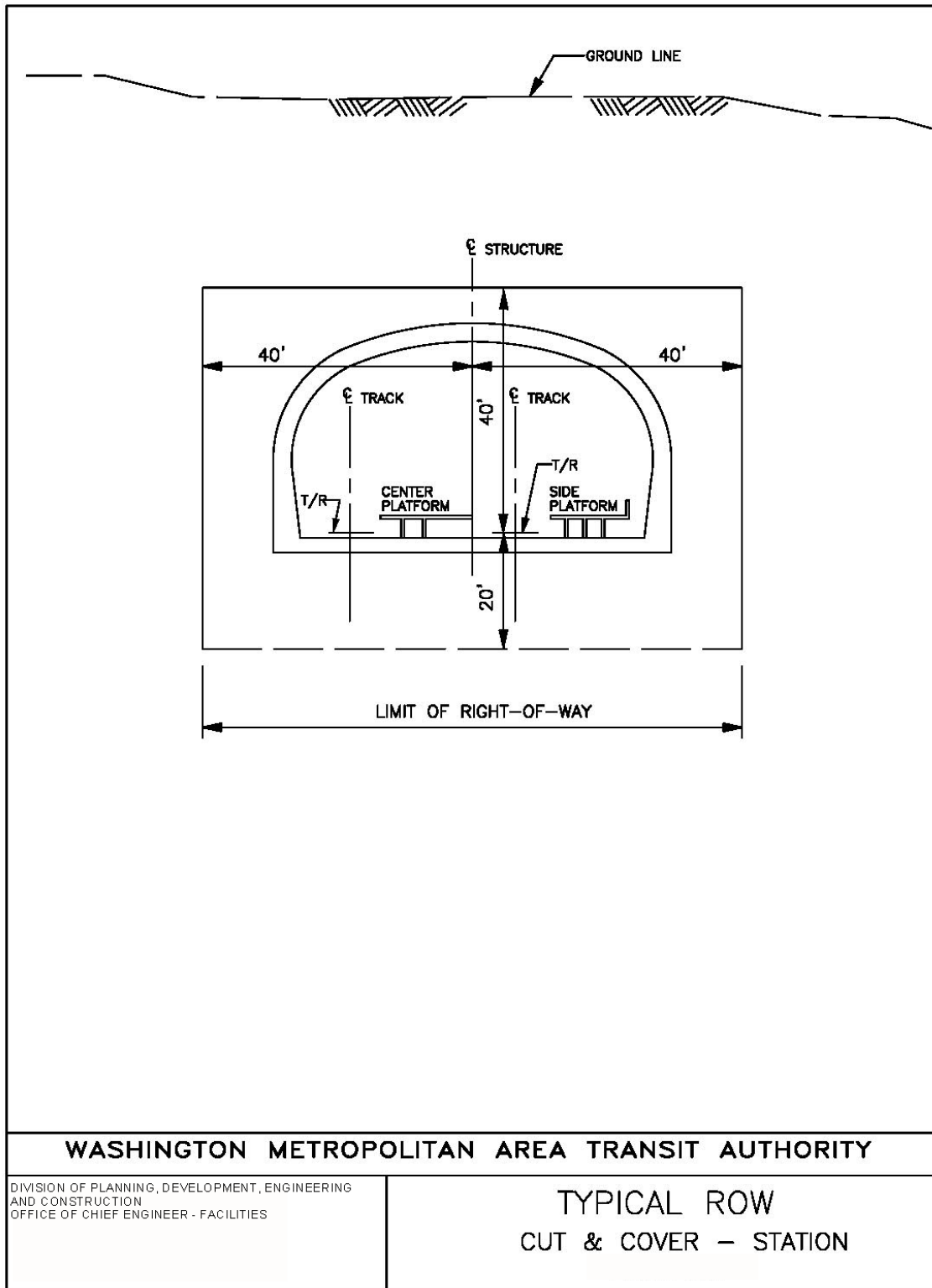


Figure 9.4

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WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

DIVISION OF PLANNING, DEVELOPMENT, ENGINEERING
AND CONSTRUCTION
OFFICE OF CHIEF ENGINEER - FACILITIES

TYPICAL ROW
CUT & COVER - STATION

Figure 9.5

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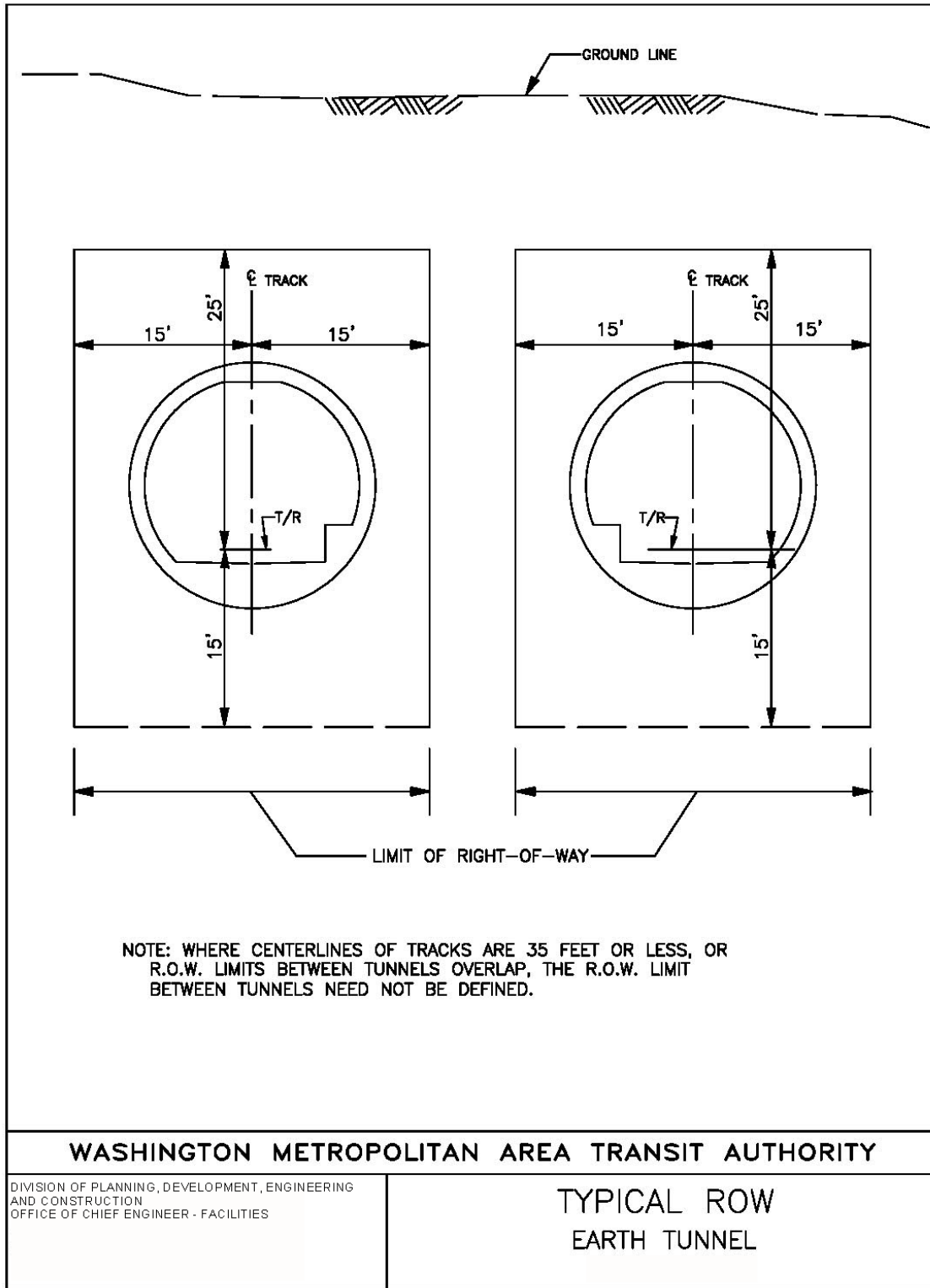


Figure 9.6

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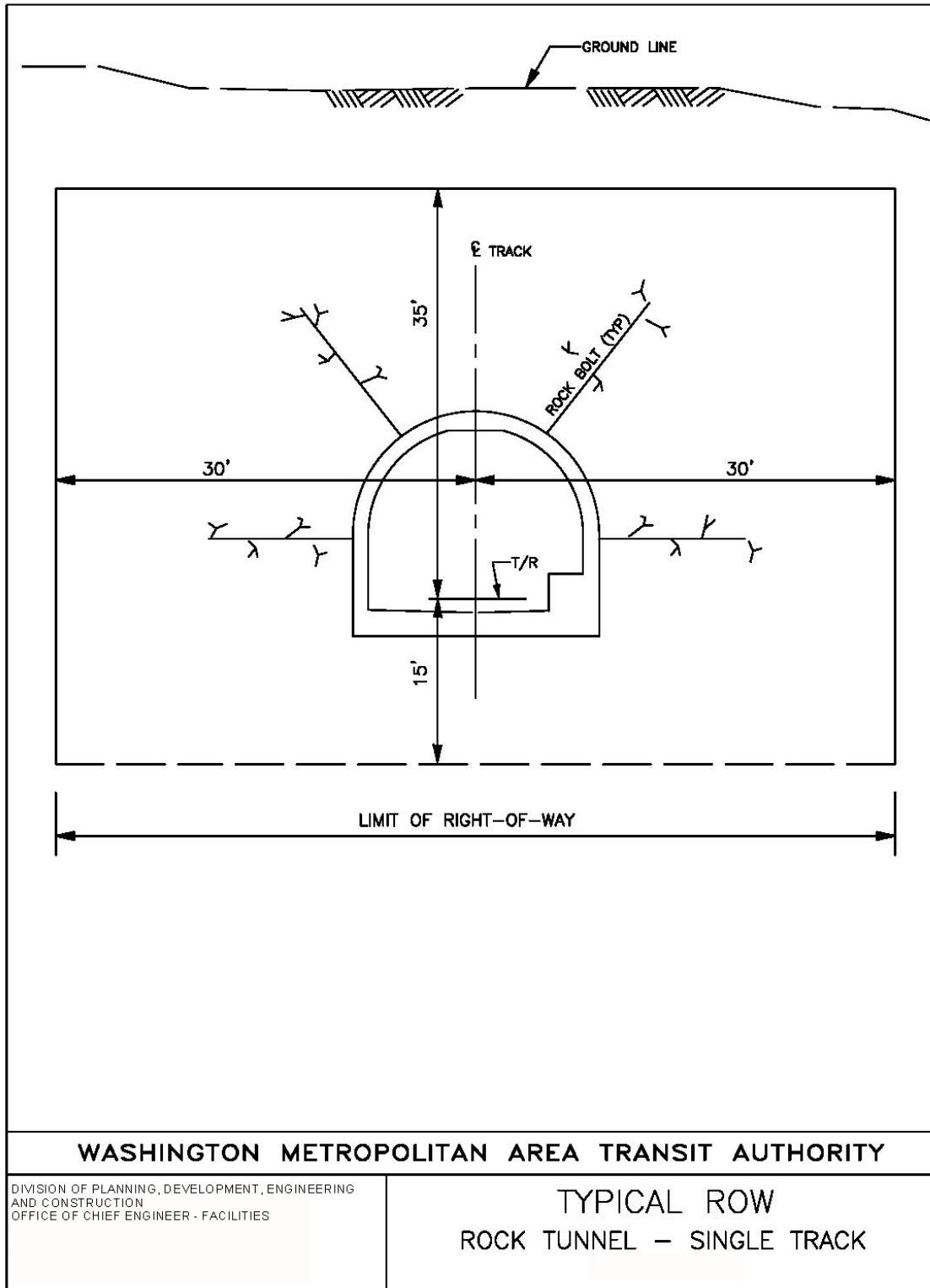


Figure 9.7

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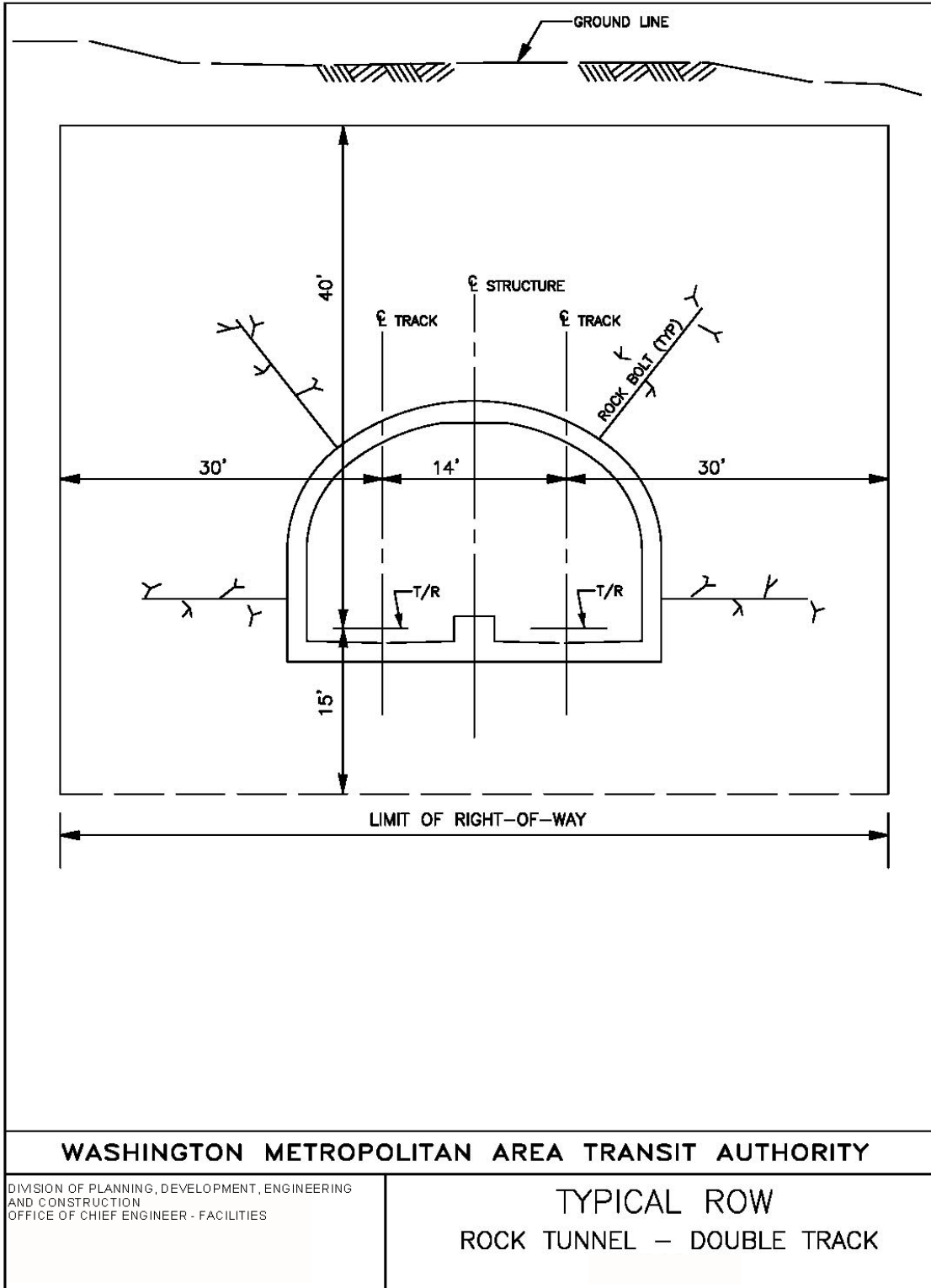


Figure 9.8

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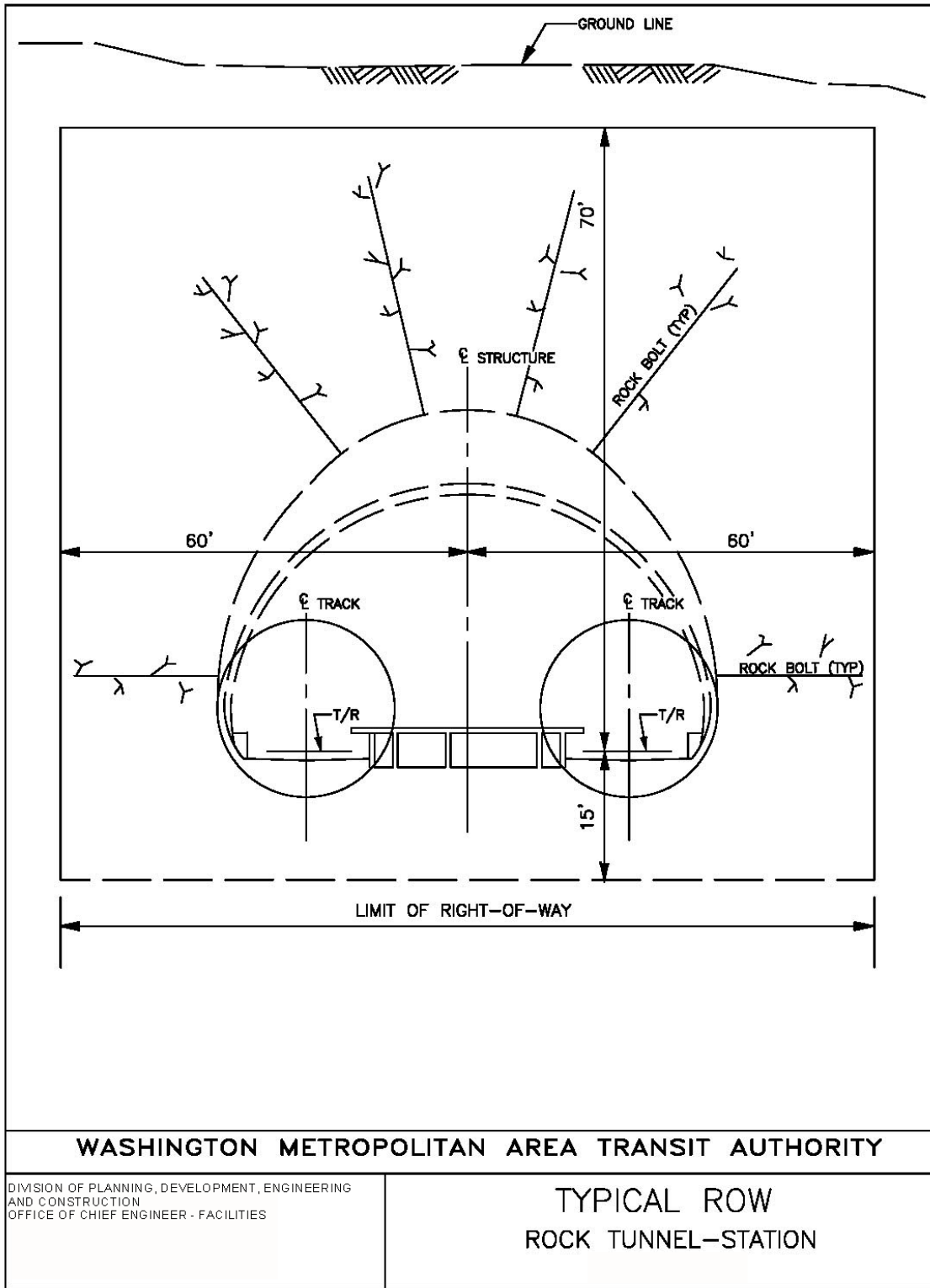


Figure 9.9

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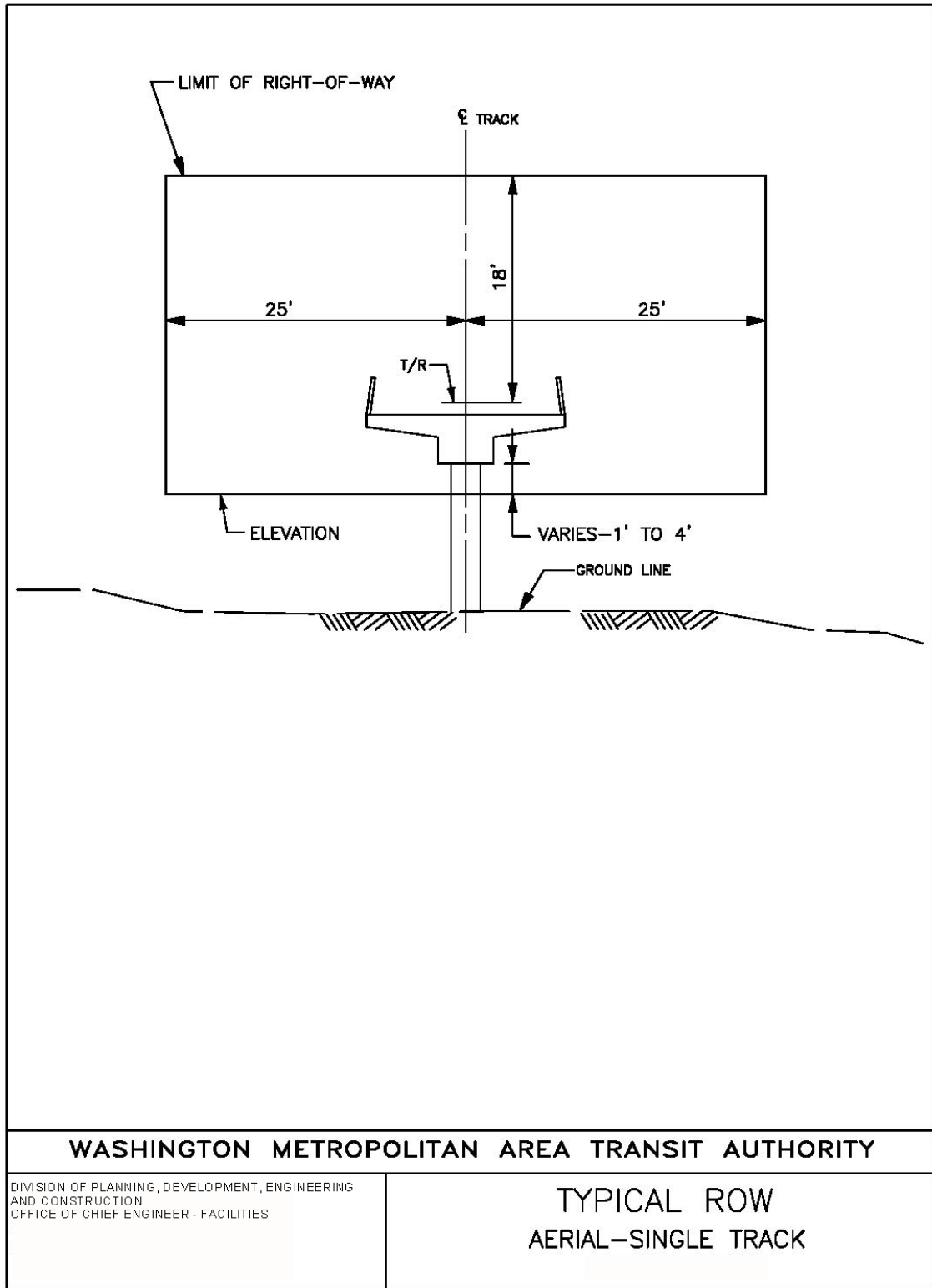


Figure 9.10

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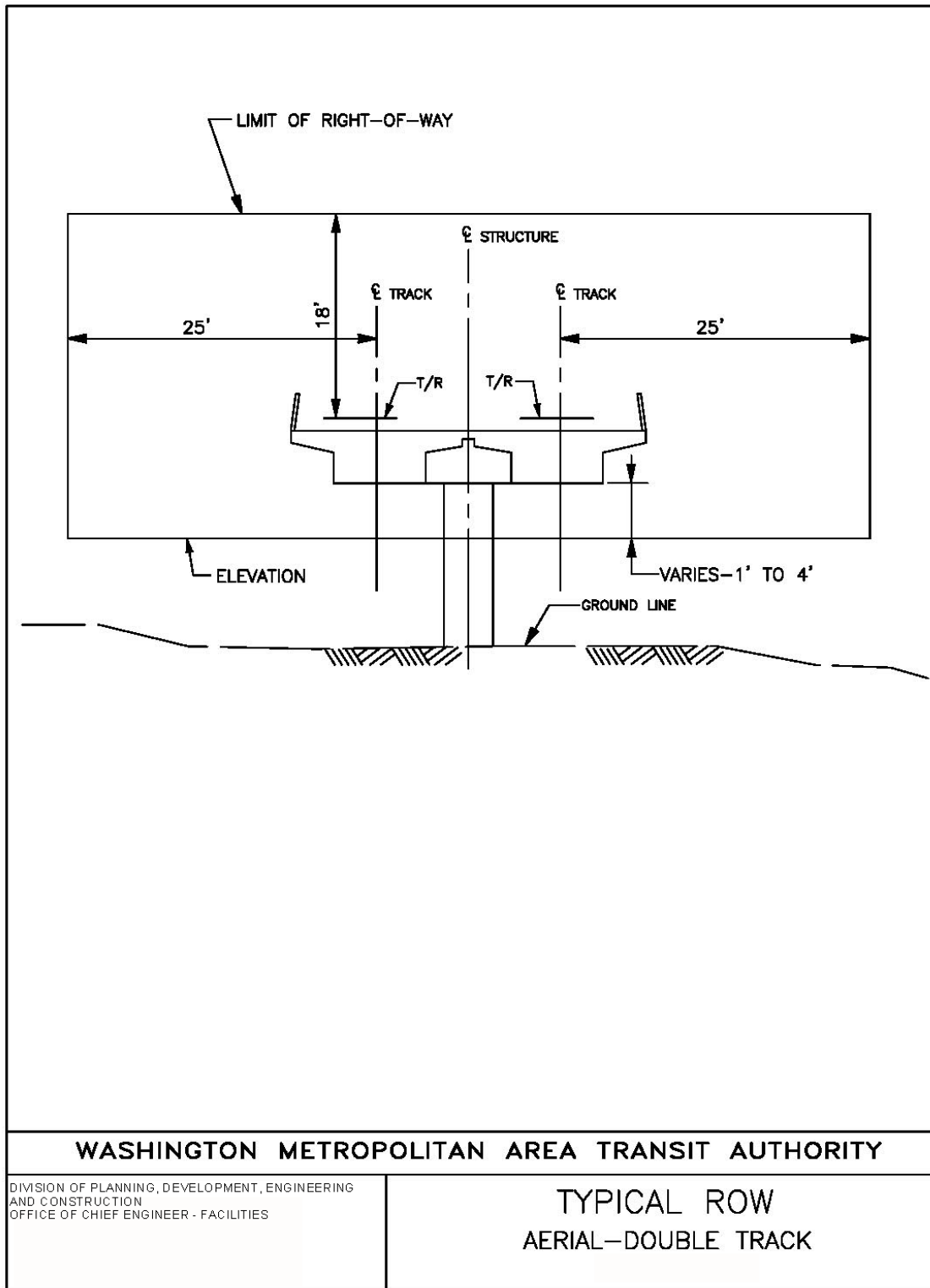


Figure 9.11

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Appendix 7 – As-Built Documentation and Closeout

WMATA's As-Built Documentation Format

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WMATA's As-Built Documentation Format

NOTES:

1. The WMATA Section Designation must be identified. Example: Medical Center Project is **A10**.
2. All As-built documentation shall be provided in required formats with applicable Professional Engineer seal.
3. All As-built drawings sheets shall be individually provided in both .pdf format and CADD format.
4. The .pdf and CADD files shall be accompanied with an Excel Spreadsheet that lists all pertinent information about each document. A sample of the Excel Spreadsheet form is shown below.
5. The title blocks on all drawings should correlate with the information that appears on each row of the spreadsheet.
6. Other Miscellaneous WMATA Documentation includes all issued reports, calculations, etc.

SAMPLE

Document Designation/ Number	Document Revision No.	Discipline	Sub-Discipline	Sub-Sub Discipline (if applicable)	Title of Document	Document Issue Date	Document Final Status	Document Description / Type	AutoCAD File Name	PDF File Name	WMATA Location
A10-A-932	5	ARCHITECTURE	SYSTEM WIDE	WAYSIDE BUILDINGS	EXTENSION TO WIEHLE AVE WAYSIDE BUILDINGS TYPICAL DETAILS	4-Feb-14	IFC - issued for Construction	Drawing	A10-A-932. AutoCAD extension	A10-A-932.pdf	A10 - Medical Center
A10-ATC-400	0	AUTOMATIC TRAIN CONTROL	SYSTEM WIDE	CONDUITS	AS-BUILT EXTENSION TO WIEHLE AVE - DIRECT FIXATION INTERLOCKING ATC CONDUIT REQUIREMENTS (FOR REFERENCE)	31-May-14	IFC - issued for Construction	Drawing	A10-ATC-400. AutoCAD extension	A10-ATC-400.pdf	A10 - Medical Center
A10-C-001	2	CIVIL	PLANS		EXTENSION TO WIEHLE AVE SYSTEM WIDE SYSTEM KEY PLAN AND VICINITY MAP	11-Jun-14	IFC - issued for Construction	Drawing	A10-C-001. AutoCAD extension	A10-C-001.pdf	A10 - Medical Center
A10-C-014	5	CIVIL	GENERAL NOTES	GENERAL NOTES	EXTENSION TO WIEHLE AVE SYSTEM WIDE CIVIL ABBREVIATIONS	18-Dec-14	IFC - issued for Construction	Drawing	A10-C-014. AutoCAD extension	A10-C-014.pdf	A10 - Medical Center
A10-C-022	2	CIVIL	SURVEY		EXTENSION TO WIEHLE AVE SYSTEM WIDE SURVEY CONTROL	18-Jun-14	Issued	Drawing	A10-C-022. AutoCAD extension	A10-C-022.pdf	A10 - Medical Center
Geotechnical Report	0	GEOTECHNICAL			Insert - Title of Report		Issued	Report		Filename.pdf	A10 - Medical Center
Structural Calculations	0	STRUCTURAL			Insert - Title of Calculation		Issued	Calculation		Filename.pdf	A10 - Medical Center

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Abbreviations

ACPM	Adjacent Construction Project Manual
AASHTO:	American Association of State Highway and Transportation Officials
ADA:	American Disability Association
AISC:	American Institute of Steel Construction
ANSI:	American National Standards Institute
BPLN:	Bus Planning
CCTV:	closed circuit television
CD:	compact disk
CE:	Construction Engineer
EOR:	Engineer of Record
FGCC:	Federal Geodetic Control Committee
GOTRS:	General Orders Track Rights System
GUTS:	guaranteed ultimate tensile strength
IDW:	intrusion detection warning
JDAC:	Office of Joint Development & Adjacent Construction
LAND:	Office of Real Estate & Station Planning
MSDS:	Material Safety Data Sheet
MOC:	Maintenance Operation Center
NACE:	National Association of Corrosion Engineers
NATM:	New Austrian Tunneling Method
NCCCO:	National Commission for the Certification of Crane Operators
NFPA:	National Fire Protection Association
ODC:	Owner Developer Contractor
OSHA:	Occupational Safety and Health Administration
PCN:	Project Control Number
PDF:	portable document format
PEPCO:	Potomac Electric Power Company
PPV:	peak particle velocity
RWIC:	Roadway Worker in Charge
ROCC:	Rail Operations Control Center
ROW:	Right-of-Way
RWPT:	Roadway Worker Protection Training
SAFE:	Department of Safety and Environmental Management
SSWP:	Site Specific Work Plan
TAMC:	Track Access for Maintenance and Construction
TIF:	Tagged Image Format
UFAS:	Uniform Federal Accessibility Standards
WMATA:	Washington Metropolitan Area Transit Authority
ZOI:	Zone of Influence

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Glossary

ACTUAL WORK AREA: The specific location of work on WMATA's railroad contained in the protected work area that has boundaries established by reflective rubber mats.

ADJACENT CONSTRUCTION: Any project by others which include WMATA-owned or controlled real property or rights-of-way pursuant to an easement, lease, license or permit granted by WMATA.

ATC: Automatic Train Control

AUTOMOBILE LIABILITY INSURANCE: A commercial auto insurance policy covering the use of all owned, non-owned, hired, rented or leased vehicles bearing valid license plates appropriate for the circumstances for which the vehicles are being used.

BUILDER'S RISK INSURANCE: An insurance policy covering all risk of physical damage to property under construction.

CCTV: Abbreviation for WMATA's closed circuit television security cameras.

CE: Construction Engineer. The point of contact for project reviews and approvals, real estate entry permit, interface and coordination with operations and maintenance offices, and field coordination.

CHAINMARKER: WMATA's wayside signage displaying unit of measure and distance of the operating roadway.

COMMERCIAL GENERAL LIABILITY INSURANCE (CGL): An insurance policy covering the liability of the Contractor for all work or operations under or in connection with this Project; and all obligations assumed by the Contractor under this Contract.

CONSIST: The quantity of cars coupled together to make up a rail vehicle. See also "Revenue Train"

CONSTRUCTION INSPECTION FACILITATOR: Provides construction inspection coordination and oversight of Authority contractors. Ensures contractor compliance with WMATA construction plans, specifications, and regulations.

CONSTRUCTION SEQUENCE PLAN & STAGING PLAN (includes EQUIPMENT PLAN): A general plan to be prepared by the Owner/Developer/Contractor indicating the safe positioning of major construction equipment, particularly cranes, within the WMATA Zone of Influence, and/or crane positions, which operate with the boom encroaching or approximate to WMATA Roadway, pedestrian and vehicular access areas.

CONTACT RAIL: See "Third Rail".

CONTRACTOR'S POLLUTION LEGAL LIABILITY INSURANCE (Also called: Environmental Impairment Liability): An insurance policy covering the liability of the Contractor during the process of removal, storage, transport and disposal of hazardous waste

and contaminated soil and or asbestos abatement. The policy should also include coverage for bodily injury, and loss of, damage to, or loss of use of property, directly or indirectly arising out of the discharge, dispersal release or escape of smoke, vapors, soot, fumes, acids, alkalis, toxic chemicals, liquids, or gas, waste materials or other irritants, contaminants or pollutants into or upon the land, the atmosphere or any water course or body of water, whether it be accidental, gradual or sudden.

COVERBOARD: A fiberglass cover over the contact/third rail to protect personnel from accidental contact with the rail.

CROSSLEVEL: The relationship in altitude that the two rails of a track section have in relation to each other. Where both rails treads are of equal altitude, the track is considered as having a zero crosslevel at that point.

CTF: Carmen E. Turner Maintenance and Training Facility located at 3500 Pennsy Drive, Landover, MD 20785

CUT AND COVER: A method of constructing an underground structure, mostly tunnels, by excavating from the surface, placing the structure, and then backfilling and restoring the original surface.

dBA: The momentary magnitude of sound weighted to approximate the sensitivity of the human ear to certain frequencies; the dBA value describes a sound at a given instant, a maximum sound level or a steady state value.

DESIGN AND COORDINATION CHECKLIST: A detailed checklist provided in WMATA's Adjacent Construction Manual that provides Owners/Developers/Contractors, and Consultants with the rudiment phases of construction coordination and interface with WMATA. The list is also provided to assist Owners/Developers/Contractors, and Consultants in preparing project time schedules which are specific to WMATA impact.

DEVELOPMENT PLAN: A graphic representation which depicts the nature and character of the development proposed for a specific land area: information such as topography, location and size of proposed structures, location of streets trails, utilities, and storm drainage are generally included on a development plan.

EASEMENT: A right to or interest in property owned by another for a specific and limited purpose. Examples: access easement, utility easement, construction easement, slope easement, aerial easement, etc. Easements may be for public or private purposes.

ENGINEER OF RECORD: The professional engineer who develops the design criteria and concept for a particular project and discipline, and who prepares or causes to be prepared under his/her immediate personal supervision the corresponding drawings, specifications, reports, or other documents, shall be designated the engineer of record for the project and discipline.

EMBANKMENT: A raised structure constructed of natural soil from excavation or borrow sources.

ENCROACHMENT: Use of an existing easement or property without proper authorization.

ESCORT: A WMATA employee assigned the responsibility of ensuring contractor forces or WMATA personnel comply with the Metrorail Safety Rules and Procedures Handbook (MSRPH) and the approved Site Specific Work Plan while performing maintenance or construction in or around WMATA property. These individual or individual(s) are trained to set-up necessary protective equipment during times of authorized and approved access by Contractor personnel.

FLAG PROTECTION: A method of protecting revenue or non-revenue track using colored flags or radio to notify a train or work consist of a situation ahead.

FLAGPERSON: 1. The person assigned to ride the front of a rail vehicle while the vehicle is being operated from other than the lead end. This person acts as the operator's eyes during train movement. 2. The person in charge and who's only duty is providing flagging protection to a work area.

FOUL TIME: A method of Roadway protection in which all trains and/or track equipment are STOPPED. The RWIC requests ROCC to stop all traffic until the RWIC reports clear of the track. This is used only for short time periods in specific segments of track such as work areas, blind spots and no clearance zones.

FOULING a TRACK: The placement of an individual or equipment in such proximity to a track that the individual or equipment could be struck by a moving train or on-track equipment.

FS: Factor of Safety

GENERAL ORDERS (WMATA): WMATA's official Document that lists all of the approved track rights requests. This information is broken down by day and includes the location by track and chainmarkers, the organization(s) authorized track rights, and the type of power outage (supervisory or red tag) if required.

GEOREFERENCE: To define points, lines, polygons or images in a WMATA specified coordinate system. Specific reference is made to AutoCad Drawings provided to WMATA showing improvements by ODC in or around WMATA facilities.

GEOTECHNICAL REVIEW: An engineering study of the geology and soils of a site which is submitted to determine the suitability of a site for development and recommends construction techniques designed to overcome development on problem soils.

GOTRS: General Orders Track Rights System. The General Orders and Tracks Rights System is a mainframe computer program that is used by WMATA employees only, to enter requests for track rights and power outages for coordination of all wayside work and third rail power outages.

JGB: Jackson Graham Building. WMATA's Headquarters Building located at 600 5th Street, NW, Washington, DC 20001

LEVEL OF SERVICE (LOS): An estimate of the effectiveness of a roadway to carry traffic, usually under anticipated peak traffic conditions. Level of Service efficiency is generally characterized by the letters A through F, with LOS-A describing free flow traffic conditions and LOS-F describing jammed or grid-lock conditions.

MAINLINE: All roadway on the operating railroad, except yards and those terminals which are governed by Terminal Supervisors.

MAINTENANCE OPERATIONS CONTROL (MOC): The facility located at WMATA's Headquarters Building, 600 5th Street, NW, Washington, DC 20001 from which all maintenance for the system is primarily tracked and reported to.

MONITORING AND CONTINGENCY PLAN: A written plan designed, implemented by the Owner/Developer/Contractor that includes, but is not limited to, how the Owner/Developer/Contractor plans to provide surveillance of WMATA facilities potentially impacted by proposed construction. The plan must include criteria for threshold values or deformations, or movements. The plan shall also outline the contingency procedure that will be followed when strains, deformations or movements of WMATA facilities approach or exceed the specified limits. The plan will also contain detailed personnel contact information of both Contractor and WMATA personnel involved with implementing the monitoring program.

MONUMENT: A permanent WMATA survey marker/benchmark accurately defining a point from which the surrounding WMATA structures were plotted (elevation and horizontal distances).

NO CLEARANCE AREA: An area where the minimum safe distance between all points on a moving vehicle and fixed wayside structures or appurtenances is not sufficient to allow personnel to occupy this area during passage of a train.

ODC: Owner, Developer, Contractor or Consultant.

OPERATIONAL SUPPORT: Any support provided by WMATA's operational departments.

RAIL OPERATIONS CONTROL CENTER (ROCC): The center designated to control the movement of trains and other track equipment.

PHOTOMETRIC STUDY: A site lighting plan prepared by a registered Professional Engineer which conveys projected illumination levels, wattage levels, maintenance criteria and input values.

PIEZOMETER OR OBSERVATION WELLS: A drilled casing or standpipe (instrumentation) in the soil used to measure porewater pressure.

POST-CONSTRUCTION SURVEY: A detailed written and certified follow-up technical survey and analysis of a WMATA facility or facility(s) that were potentially impacted by ongoing construction. The post-construction survey is to be completed when all work is completed, or when construction has progressed to a construction phase whereby there is no future possibility of any movement/damage/impact to WMATA structures. The survey may be supported with comparison engineering or technical

analysis of pre-construction photographs and/or wayside instrumentation. Written analysis of the post-construction survey must also be submitted to WMATA for approval prior to the Contractor mobilizing from the site.

PRE-CONSTRUCTION SURVEY: A detailed written & certified technical survey & analysis of a WMATA facility or facility(s) that will potentially be impacted by upcoming construction. The survey may require the necessity of photographs and/or safe placement of wayside instrumentation for purposes of continued and periodic surveillance/protection of WMATA facilities. The outline of the pre-construction survey is to be developed by the Contractor and submitted to WMATA for approval before commencing any work within WMATA's ZOI.

PRE-DEVELOPMENT PROJECT AGREEMENT: A legal agreement between WMATA and the Developer/Contractor executed at the beginning of a project which documents that the Developer/Contractor agree to read and comply with all WMATA administrative, design, operational, safety requirements set forth in the WMATA Adjacent Construction Manual. No project will be supported unless this agreement is executed.

PROFESSIONAL ERRORS AND OMISSIONS LIABILITY INSURANCE: A separate insurance policy to pay on behalf of the Contractor all costs the Contractor shall become legally obligated to pay as damages due to any claim caused by any negligent act, error or omission of the Contractor or any other person for whose acts the Contractor is legally liable arising out of the performance of work under a permit.

PROJECT IMPACT STATEMENT: A statement completed by the Owner/Developer/Contractor, or Consultant which describes in detail the impact to WMATA facilities, with locations, from all upcoming proposed construction. The statement is prepared by the Owner/Developer/Contractor, or Consultant seeking work in the vicinity of WMATA facilities and requires prior review of WMATA As-built documentation.

PROTECTED WORK AREA: Area designated as extreme limits (chainmarker stationing) in approved SSWP within which work will be performed.

RAIL SERVICE ADJUSTMENT (RSA): A temporary adjustment to the Metrorail passenger train operating schedule in order to accommodate maintenance or construction activities on the Metrorail main line during revenue service.

RAILROAD PROTECTIVE LIABILITY INSURANCE: An insurance policy issued to WMATA for bodily injury and property damage liability of the Contractor resulting from the Contractor's performance of project work within 50 feet of WMATA's Roadway. Project work within 50 feet is defined as: work performed on, adjacent to (North-South-East-West), above or beneath WMATA's owned / operating railroad property.

RED TAG: A red tag outage is issued by MOC to responsible Supervisor of work area/location when a specified section(s) of third rail or electrical equipment is de-energized by physically disconnecting the specified equipment from its source of power, and is secured and verified. This outage should be used for the maintenance, repair installation and test of energized equipment. A red tag outage

must be used whenever work is done directly on the third rail or its connected equipment.

REVENUE OPERATION (hours of): Time(s) which WMATA runs scheduled passenger rail service.

REVENUE TRAIN: Assemblage of WMATA rail cars designated to carry passengers. Length of Revenue Train is typically 4, 6, or 8 cars.

RIGHT OF ACCESS: The right of an abutting land owner, or its contractor(s), for entrance to or exit from a WMATA facility or structure for purposes of construction or planning.

Right-of-Way (ROW): The land occupied by a railroad, the physical facilities, track, tunnels, surface and elevated structures through which Metrorail trains operate.

ROADWAY: All track on the operating railroad, except yards and those terminals which are governed by Terminal Supervisors.

SHUNT STRAP: A jumper, for shunting rail to rail to simulate the presence of a train axle to safely protect a work area.

SITE SPECIFIC WORK PLAN (WMATA): Abbreviated 'SSWP'. A detailed time scaled, resource loaded work plan prepared by the Contractor that is specific to WMATA property which describes the construction and/or installation and associated schedule of work to be performed at specific locations. The plan is to outline all personnel and work to be completed during approved track access. The plan encompasses: 1) a site plan, 2) track rights approval information, 3) a work zone protection plan, 4) identify an assigned Contractor's on site safety foreman, and 5) a detailed summary of work to be completed including work procedures and potential job related hazards with protection methods. Required where requested track usage or other interface with the operating rail road occurs.

SURVEYOR OF RECORD: The professional surveyor who develops the criteria and concept for a particular project and discipline, and who prepares or causes to be prepared under his/her immediate personal supervision the corresponding survey results, drawings, specifications, reports, or other documents, shall be designated the surveyor of record for the project and discipline.

SWITCH ORDER: Detailed set of instructions that directs WMATA's power personnel on how to isolate power circuits from a specific piece of equipment, i.e. third rail, lighting circuit, etc.

TBS: WMATA Tie Breaker Station. See Tiebreaker.

TECHNICAL SUBMISSION (Submittal): A minimum of seven (7) complete sets of documents required for WMATA review of the anticipated or proposed construction. In submitting, the Owner/Developer/Contractor or Consultant has confirmed that all documents being provided for WMATA review meet the requirements of the WMATA Adjacent Construction Manual, Design Criteria, Specifications, or specific agreement as applicable. Content of submittals to be specific to WMATA interest.

THIRD RAIL: The electrical conductor steel rail section mounted on insulators adjacent to the running rail for supplying D.C. traction power to the transit vehicles, sometimes referred to as “contact rail”.

THIRD RAIL GAP: The distance between sections of third rail where no third rail is present. These locations are usually of sufficient length to be bridged by a train and are used as a limit for either a Supervisory Third Rail Power Outage or a Red Tag Third Rail Power Outage.

THIRD RAIL POWER:

RED TAG OUTAGE: A procedure for removal of energy from the third rail which requires that track feeder breakers which feed a specific section of third rail be removed from their operating cubicles and specific verification and coordination procedures involving ROCC and MOC and the Red Tag holder. Under Third Rail Power Red Tag Outages work is permitted on the third rail and its connecting components. Red Tag outages are also used for work on Low Voltage AC power equipment and circuits.

SUPERVISORY: A third rail power outage that may be implemented from ROCC for work that might result in incidental contact with the third rail. Work on, or that requires contact with the third rail requires a Third Rail Power Red Tag Outage.

TIEBREAKER: A redundant source for traction power distribution by electrically connecting one Traction Power Substation to another by using the third rail and circuit breakers in the tiebreaker station. The tiebreaker station is also used in conjunction with the traction power substation to isolate power from a section of third rail.

TPSS: WMATA Traction Power Substation. See Traction Power Substation.

TRACK RIGHTS: Exclusive use permission for a specific section of track. Permission is requested through GOTRS, and approved by WMATA OPER, General Superintendent OCC.

TRACTION POWER SUBSTATION: The facility which transforms and rectifies local utility high voltage alternating current to 750 VDC propulsion current and supplies it to nearby third rails via Track Feeder Breakers and conductors to/on the R.O.W.

WORK TRAIN: Any vehicle designated for maintenance purposes or to transport non-public passengers. A work train is a train that is engaged in railway maintenance, repair work or support thereof.

WAYSIDE SAFETY ALARM DEVICE: Safety device which provides work crews with an alarm in the form of both siren and strobe light if the third rail to which it is connected becomes energized or if the device is accidentally disconnected or knocked over. Device is connected (after confirmation of a power outage) between the de-energized third rail and the negative return rail, within the work zone, by the assigned WMATA escort.

WMATA: All WMATA Office's that provide submittal reviews and operational support.

WMATA REAL ESTATE IMPACT: Temporary or permanent construction impact to WMATA's existing real property or easement(s).

WMATA Real Estate Entry Permit: A legal document issued by WMATA's Office of Station Area Planning and Asset Management when it has been determined that there is temporary or permanent construction impact to WMATA. Developer/Contractor(s) will be required to complete the WMATA Real estate entry permit application to obtain legal access to WMATA property or easement(s). Certified survey exhibits, plats and/or legal descriptions of property impacted may be required.

WMATA's ZONE OF INFLUENCE (ZOI): Designated area adjacent or within specific distance approximate to WMATA structures and interests, which if construction activity is performed within the Zone, may cause influence or impact to WMATA. Limits of Zones for various conditions of adjacency are depicted in [Appendix 3](#), Plates 2A thru 2E.