GOVERNMENT OF THE DISTRICT OF COLUMBIA

DEPARTMENT OF TRANSPORTATION

INFRASTRUCTURE PROJECT MANAGEMENT ADMINISTRATION

SPECIFICATIONS

INVITATION NO.: DCKA-2009-B-0183-JBW

RECONSTRUCTION OF EASTERN AVENUE BRIDGE OVER KENILWORTH AVENUE, N.E.

F.A.P. NOS.: ARA-3207(003) AND ARA-3207(004)

Bids Will Be Publicly Opened By The Office Of Contracting and Procurement,
2000 14th Street, N.W., 3rd Floor, Washington, D.C. 20009

Bids Will Be Opened On _____ At 2:00 P.M.

GOVERNMENT OF THE DISTRICT OF COLUMBIA
DEPARTMENT OF TRANSPORTATION

TITLE PAGE - SPECIFICATIONS

ISSUING OFFICE:
Department of Transportation
Office of Contracting and Procurement Bid Room
Frank D. Reeves Municipal Center
2000 14th Street, N.W., 3rd Floor
Washington, D.C. 20009

Requests for clarification or interpretation of Bid Documents prior to date of Bid Opening:

ADDRESS TO: Chief Transportation Officer
Infrastructure Project Management Administration
Department of Transportation
64 New York Avenue, N.E., 1st Floor
Washington, D.C. 20002

Prospective Bidders

To bid this contract, detach the Bid Form package which is bound to the back of this book, fill out all forms along with Bid Guaranty as required, and submit it to the Issuing Office prior to the time of bid opening.

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The "STANDARD SPECIFICATIONS FOR HIGHWAYS AND STRUCTURES, 2005 Revised 2007" and amendments thereto, and the "REQUIRED CONTRACT PROVISIONS FEDERAL-AID CONSTRUCTION CONTRACTS" (FHWA-1273) are incorporated herein by reference and are made a part of the requirements of this contract.

SPECIAL PROVISIONS

This document contains provisions, requirements, and instructions pertaining to this contract:

Reconstruction of Eastern Avenue Bridge over Kenilworth Avenue, N.E.

Invitation No.: DCKA-2009-B-0183-JBW

F.A.P. Nos. ARA-3207(003) and ARA-3207(004)

This document consists of:

- **SPECIFICATIONS:** pages i thru v and pages 1 thru 113, and appendices with number of pages in parentheses listed on page v.
- **BID FORMS AND PROPOSAL:** pages a thru d, and pages 1 thru 39, including **PAY ITEM SCHEDULE**.
- **CONTRACT PLANS:** consisting of sheet 1 thru 242.

Bidders should satisfy themselves that they have a complete document. Missing pages will not constitute the basis for a valid claim.

This is a Federal-Aid Contract; **REQUIRED CONTRACT PROVISIONS, FEDERAL-AID CONSTRUCTION PROJECTS**, applies.

ADDENDA, issued prior to bid opening date, further supplement and modify the proposed contract.

This document supplements and modifies:

- **STANDARD CONTRACT PROVISIONS FOR USE WITH SPECIFICATIONS FOR DISTRICT OF COLUMBIA GOVERNMENT CONSTRUCTION PROJECTS, 1973 AND AMENDMENTS THERETO;**
- **DISTRICT OF COLUMBIA, DEPARTMENT OF TRANSPORTATION, STANDARD SPECIFICATIONS FOR HIGHWAYS AND STRUCTURES, 2005 AND REVISED 2007; AND**
- **CONTRACT PLANS.**

Reference to Division Numbers, Section Numbers, and Article Numbers refers to the **STANDARD SPECIFICATIONS FOR HIGHWAYS AND STRUCTURES, 2005 AND REVISED 2007.**

In the **PAY ITEM SCHEDULE**, the first three digit portion of each pay item number refers to the section of the **STANDARD SPECIFICATIONS** in which the item is described. The S.P. number refers to the section of these **SPECIAL PROVISIONS** in which the item is further described.

Reference made to the D.C. Department of Public Works (DCDPW) in the drawings and in this document is one and the same as the District of Columbia Department of Transportation (DDOT).

1. SCOPE OF WORK

Work under this contract consists of the Reconstruction of Eastern Avenue Bridge over Kenilworth Avenue, N.E., Washington, District of Columbia. Rehabilitation of a pumping station east of the existing bridge along Eastern Avenue is also included in this contract. The work includes, but is not limited to, the following items:

A. Providing a construction schedule for the project and making adjustments to keep the schedule updated.

B. Implementation and monitoring of vehicular traffic and its maintenance for the construction period.

C. Mobilization and demobilization, provision and maintenance of work and storage areas, Engineer's Field Facilities and performance of Employee Training.

D. Implementation of sediment and erosion control measures.

E. Selective clearing and grubbing, as directed by the Chief Engineer, within the limits indicated in the contract documents.

F. Installation of protection shields required while demolishing portions of the existing abutments and retaining walls, reconstructing portions of the existing abutments and retaining walls and constructing the proposed bridge superstructure.

G. Demolition consisting of the following:
- Removal and disposal of the existing superstructure and portions of the existing abutments and retaining walls.
- Removal and disposal of selected areas of existing roadway and service ramps to the extent and depth shown in the Contract Plans.

H. Design and installation of temporary excavation supports for bridge pier foundation construction and demolition/reconstruction of portions of existing abutments and retaining walls.

I. Design and construction of all necessary temporary supports for construction described or shown in the Specifications, Contract Plans and Addenda (if issued).

J. Work for the proposed bridge includes, but is not limited to:
- Reconstruction of the existing abutment and retaining wall;
- Construction of bridge pier foundation and barrier;
- Fabrication and installation of prefabricated pier units;
- Fabrication and installation of reinforced elastomeric bearings;
- Fabrication and installation of prefabricated superstructure units;
- Construction of cast-in-place superstructure; and
- Construction of superstructure parapets, barriers and medians.

K. Roadway work, including reconstruction of the service ramps and approaches to the bridge.

L. Installation of new pavement markings and static signs.

M. Modifications to the existing storm drainage system along Kenilworth Avenue in the vicinity of the bridge and along Eastern Avenue at the east approach to the bridge.

N. Installation of streetlights and under bridge lighting along with the required conduits and cables.

O. Modifications to the traffic signal system at the Eastern Avenue Bridge and along Nannie Helen Burroughs N.E. in the vicinity of Kenilworth Avenue N.E...

P. Re-grading and restoration work in the shoulder areas and elsewhere on the project.

Work also includes all other work and various incidentals required as shown in the Contract Plans and/or as specified in the Specifications and Special Provisions.

The Contractor is also required to produce design calculations as well as all shop/working drawings in connection with his chosen systems for temporary support structures or devices, protection shields, and other significant temporary work affecting the traveling public or project workers.

The Contractor shall be fully responsible for protection against damage for the duration of the contract of all the utility structures within the contract limits and adjacent thereto. The utilities include but are not limited to public and/or private water, sewer, electricity, gas, and communications lines. No separate measurement or payment will be made. Cost of this protective work shall be reflected and distributed among the contract pay items.

2. PRE-BID CONFERENCE

Prospective bidders are invited to attend a meeting to discuss the proposed work under this contract. Representatives of the Department will be available to answer questions relative to the work. Bidders who expect to attend should inform the Department prior to the meeting date. Any pertinent data or change resulting from the conference will be included in any addendum issued to all perspective bidders after the conference; however the importance of attending the meeting is stressed. Any questions or conflict identified prior to bid should be brought out during this meeting.

The date, time and location of this pre-bid conference will be identified through an addendum to the contract.

3. CONTRACTOR IDENTIFICATION

All contractors doing business with the District of Columbia Government shall have a Federal Identification Number.

A DUNS number can be obtained at no cost to the contractor via telephone from the local or national Dun and Bradstreet Corporation. The requirements are that the contractor must give its legal or proper business name, business or remittance address, and Standard Industry Classification (S.I.C.). No additional information is required, and Dun and Bradstreet will forward the number by mail within three (3) days.

Please refer any questions regarding this matter to the office of the Chief Financial Officer, (202) 671-2300, D.C. Department of Transportation.

4. CONTRACT TYPE

In accordance with Title 27 DCMR, Chapter 24, the contract type shall be a fixed price contract.

5. CONTRACT ADMINISTRATION

CONTRACT ADMINISTRATION

Contracting Officer: Contracts may be entered into and signed on behalf of the District Government only by contracting officers. The contracting officer is the only District official authorized to contractually bind the District. The contracting officer is the Agency Chief Contracting Officer (ACCO), Department of Transportation, 2000 - 14th Street, NW, Washington, DC 20009, telephone number (202) 671-2270.

Authorized Changes by the Contracting Officer:

A. The Contracting Officer is the only person authorized to approve changes in any of the requirements of this contract.

B. The Contractor shall not comply with any order, directive or request that changes or modifies the requirements of this contract, unless issued in writing and signed by the Contracting Officer

C. In the event the Contractor effects any change at the discretion of any person other than the Contracting Officer, the change will be considered to have been made without authority and no adjustment will be made in the contract price to cover any cost increase incurred as a result thereof.

Contracting Officer's Technical Representative (COTR): The COTR is Name: Mr. Michael Jelen, Program Manager, Agency:District Department of Transportation,

Infrastructure Project Management Administration, 64 New York Avenue, N.E., 1st Floor, Washington, D.C. 20002, (202) 671-4542.

The COTR will have the responsibility of ensuring that the work conforms to the requirements of this contract and such other responsibilities and authorities as may be specified in the contract. The COTR will act as the contracting officer's representative for technical matters, providing technical direction and discussion, as necessary with respect to the specifications or statement of work, and monitoring the progress and quality of the contractor's performance. Other responsibilities include the following:

A. Keeping the CO fully informed of any technical or contractual difficulties encountered during the performance period and advising the ACCO of any potential problem areas under the contact;

B. Coordinating site entry for Contractor personnel, if applicable;

C. Reviewing and approving invoices for fixed-price deliverables to ensure receipt of goods and services. This includes the timely processing of invoices and vouchers in accordance with the District's Payment provisions; and

D. Maintaining a file that includes all contract correspondence, modifications, records of inspections (site, data, equipment) and invoices/vouchers.

It is understood and agreed, in particular, that the COTR is not a contracting officer and does not have the authority to:

A. Award, agree to, or sign any contract, delivery order or task order. Only the ACCO shall make contractual agreements, commitments, or modifications;

B. Grant deviations from or waive any of the terms and conditions of the contract;

C. Direct the accomplishment of effort, which is beyond the scope of the statement of work in the contract;

D. Increase the dollar limits of the contact or authorize work beyond the dollar limit of the contract, or authorize the expenditure of funds by the Contractor;

E. Change the period of performance; and

F. Authorize the furnishing of District property, except as specified under the contract.

When in the opinion of the contractor, the COTR requests effort outside the existing scope of the contract, the contractor shall promptly notify the contracting officer in writing. The contractor under such direction shall take no action until the contracting

officer has issued a modification to the contract or until the issue has been otherwise resolved.

ORDERING AND PAYMENT

The contractor shall not accept orders for items under this contract unless a purchase order has been issued. The participating agency shall be the Department of Transportation.

Invoices shall be submitted in duplicate to the D.C. Department of Public Works, Office of the Chief Financial Officer, Customer Care Division, 2000 - 14th Street N.W., 6th Floor, Washington, DC 20009, Telephone (202) 671-2300.

Each invoice must provide the following minimum information:

1. Contractor's name, address, invoice number and date;
2. Contract line item number (CLIN) being billed for payment and total amount due;
3. Purchase order and contract number;
4. Addressee's name and address;
5. Period of service;
6. Description of services and deliverables provided;
7. Name, title, signature and phone number of preparer; and
8. Name of the contracting officer's technical representative.

Payment may be delayed for improperly prepared invoices.

6. PRE-AWARD APPROVAL

Pursuant to Section 2201 of the Fiscal Year 2003 Budget Support Amendment Congressional Review Emergency Act of 2003, D.C. Act 15-27, effective February 24, 2003, the Mayor must submit to the Council for approval any contract action over one million dollars.

7. COORDINATION WITH OTHERS

Other contracts of different scope either have been, will be, or may be let for work in the vicinity of the project area.

The Contractor shall coordinate his work and cooperate fully with all others in order to eliminate or curtail delays and interference of any kind. Particular attention shall be made with regard to proper maintenance of highway traffic through the project areas. The Contractor shall perform his lane closings and openings so as not to cause interference with others or to be in conflict with performance of traffic maintenance by others. The District assumes no liability for contract delays or costs resulting from performance or non-performance of others.

The district will not consider any claims for compensation due to delay, other than written authorized time extensions.

8. VALUE ENGINEERING CHANGE PROPOSALS

This Special Provision modifies 104.03 of the Standard Specifications.

(A) **GENERAL.** This contract allows the use of Value Engineering Change Proposals (VECPs) which are initiated and developed by the Contractor to change the Contract Drawings and Specifications, or other requirements of this Contract for the purpose of **reducing the total construction duration** and reducing the total cost of construction without reducing design capacity or quality of the finished product.

(B) **VECP REQUIREMENTS.** A detailed estimate of the construction duration reduction that would result from the proposed change. This shall require the development of construction schedule for the entire project which takes into account the proposed changes.

9. BID GUARANTY

This Special Provision supplements Article 12.A. of 102.01 Instructions to Bidders in the Standard Specifications.

The bid guaranty period shall be **ninety (90) calendar days** after bid opening.

10. AWARD OF CONTRACT

The Department of Transportation intends to award this contract within (90) calendar days. However, if for administrative reasons, we are unable to make an award within this time period, the Department will request the Contractor and his/her surety to extend the bid bond for an additional thirty (30) days.

11. PARTNERING, Item 000 520

The DC Department of Transportation (DDOT) invites the Contractor, subcontractors and suppliers to actively participate in a formal project partnering with the District and other parties involved (Note: This activity will not constitute a legal "partnership"). This partnership draws on the strengths of each organization to identify and achieve reciprocal goals. Partnering strives to resolve problems in a timely, professional, and non-adversarial manner. If problems result in disputes, partnering encourages, but does not require, alternative dispute resolution instead of the formal claim process. The objectives are effective and efficient Contract performance, completion within the Contract bid price, on schedule, and in conformance with the Contract Documents. This partnership will not change the legal relationship of the parties to the Contract nor relieve any party from any of the terms of the Contract.

DDOT's representatives and the Contractor's management representatives will meet, plan, and organize a partnering development team. FHWA and key local government personnel will also be invited to attend as necessary. The initial workshop team meeting will be held between the time of award and the notice to proceed. Follow-up workshops may be held regularly as agreed by the Contractor and the Administration,

All partnering costs will be shared equally by the Contractor and DDOT.

12. RECORD OF MATERIALS, SUPPLIES, AND LABOR (FHWA 47 SUBMISSION)

This Special Provision supplements the **Required Contract Provisions, Federal-Aid Construction Contracts**.

Under Section VI, Record of Materials, Supplies and Labor, delete the first paragraph and replace it with:

"The provisions of this section are applicable to all contracts for Federal-Aid primary, urban, and Interstate highway projects involving construction performed under contracts awarded by competitive bidding, except projects for which the total construction cost of roadway and bridge is less than $1,000,000, and projects consisting primarily of:

1. The installation of protective devices at railroad grade crossings; or

2. Highway beautification."

For contracts of $1,000,000 or more, the completion and submission of the FHWA 47 is a contract requirement. The form must be completed and submitted as soon as fieldwork is completed. Final payment will not be made until the Contractor files his report.

13. APPLICABLE WAGE DECISION/WAGE RATES

This Special Provision supplements 103.02 A of the Standard Specifications.

In accordance with the applicable provisions of 29 CFR, Part 1 which requires that the correct wage determination and the appropriate wage rates therein be incorporated into this contract. General Decision No. DC080001, Modification No. 16, dated 03/20/09 is bound herein and contains the specific applicable wage rates which are:

Work items pertaining to bridge reconstruction shall be performed under:

HEAVY CONSTRUCTION RATES

Work items pertaining to roadway construction and all other associated work shall be performed under:

Further, as set forth in 29 CFR, Part 1, Section 1.6(c) (3) (IV), if the intent to award letter is not issued within ninety (90) days of bid opening, all intervening modifications (or new wage decision) are applicable. The contractor will be reimbursed this added labor cost.

14. PROTESTS

Any actual or prospective bidder, offerer or contractor who is aggrieved in connection with the solicitation or award of a contract, must file with the D.C. Contract Appeals Board (Board) a protest no later than ten (10) business days after the basis of the protest is known or should have been known, whichever is earlier. A protest based on alleged improprieties in a solicitation which are apparent prior to bid opening or the time set for receipt of initial proposals shall be filed with the Board prior to bid opening or the time set for receipt of initial proposals. In procurement in which proposals are requested, alleged improprieties which do not exist in the initial solicitation, but which are subsequently incorporated into this solicitation, must be protested no later than the next closing time for receipt of proposals following the incorporation. The protest shall be filed in writing, with the Contract Appeals Board, 717 14th Street, N.W., Suite 430, Washington, D.C. 20004. The aggrieved persons shall also mail a copy of the protest to the Contracting Officer for the solicitation.

15. SPECIALTY ITEMS

This Special Provision supplements 108.01 of the Standard Specifications.

In accordance with Section VII.1.b of the **Required Contract Provisions, Federal-Aid Construction Contracts**, the following items as listed in the Pay Item Schedule are designated Specialty Items.

ITEM NO.	DESCRIPTION
795 001	Membrane Waterproofing Special Item
616 800	Traffic Control Special Item Construction Newsletter
616 804	Traffic Control Special Item Courtesy Patrol Service
619 800	Mechanical Work Special Item Pumping Station Rehabilitation
621 800	Miscellaneous Electrical Work Special Item Pumping Station Rehabilitation
621 801	Miscellaneous Electrical Work Special Item Communication Web Based
621 802	Miscellaneous Electrical Work Special Item Upgraded Electrical Service

16. CONTRACTOR'S SUBMITTALS

This Special Provision supplements 105.02(B)(2) of the Standard Specifications.

All shop and working drawings, material certifications, laboratory test reports and other required submittals shall be transmitted to the following D.C. Department of Transportation Office:

Team Leader – Team 4
Infrastructure Project Management Administration
District Department of Transportation
64 New York Avenue, N.E.
Washington, DC 20002

17. CONSTRUCTION SCHEDULING

This Special Provision supplements 108.03 of the Standard Specifications and is referenced to the Special Provision entitled CONSTRUCTION COMPLETION TIME by adding:

A. CRITICAL PATH METHOD (CPM) REQUIRED

The Contractor shall produce and submit a progress schedule, based on the Critical Path Method (CPM) of scheduling, to the Chief Engineer for approval before commencing any work.

B. SYSTEM REQUIREMENTS

The Contractor shall submit a construction schedule at least seven (7) calendar days prior to the start of construction. CPM computer software shall be Primavera. A CD-R shall be provided with each submittal.

C. ORDER OF WORK

The Contractor shall schedule his/her construction work so that the requirements of MAINTENANCE OF HIGHWAY TRAFFIC are satisfied. Scheduling shall include ordering of materials, preparation of shop and working drawings, and all other work as indicated in the contract documents and as directed by the Chief Engineer.

18. CONSTRUCTION COMPLETION TIME

This Special Provision supplements 108.03, 108.06 and is referenced to the Special Provision entitled CONSTRUCTION SCHEDULING.

The completion of the entire project and final acceptance by the District Department of Transportation (DDOT) shall be accomplished in **Three Hundred Twenty (320) calendar days** from the date specified in a written Notice to Proceed issued by the Contracting Officer.

The District Department of Transportation will not allow partial suspension or time extension due to inclement weather.

19. FAILURE TO COMPLETE ON TIME

This Special Provision replaces 108.07 of the Standard Specifications.

For each calendar day that contract work remains uncompleted after expiration of the contract time or main part thereof, the sum of $ 5,000.00 has been set by the Contracting Officer and will be deducted as liquidated damages from any money due the Contractor. The Contractor's operation after expiration of construction completion time as extended will in no way waive the District's rights under the contract.

20. INFORMATIONAL DRAWINGS

Contract drawings for the existing Eastern Avenue Bridge over Kenilworth Avenue, N.E. and currently under construction and proposed projects along Kenilworth Avenue, N.E. are available for examination in the DDOT Infrastructure Project Management Administration, 64 New York Avenue, N.E., Washington, D.C. 20002 during normal business hours.

Subsequent to the plan construction, undocumented modifications or additions may have been made to the facility. It is the Contractor's responsibility to verify the actual configuration of the facility.

Prior to preparation of shop drawings, demolition, and construction, the Contractor shall check the dimensions of the existing structure. If these dimensions do not agree with those shown on the drawings, the Contractor shall determine the necessary adjustments to dimensions and profile grades shown on the plans to insure that the new construction will properly fit the existing environs and obtain the approval of the Chief Engineer prior to making any changes. The District assumes no expense or liability for the accuracy of or the interpretation made from the drawings.

21. WORK AND STORAGE SPACE

This Special Provision supplements Article 17.B. of 103.01, General Provisions, of the Standard Specifications.

No work and storage area is being designated. The Contractor shall be fully responsible for seeking necessary space and undergoing all required negotiations with the owner of the property to secure its use and for restoring the area to its original condition and to the satisfaction of the Engineer.

22. UTILITIES

This Special Provision supplements 103.01 Article 17E of the Standard Specifications.

It is understood and agreed that the Contractor has considered in his/her bid all of the permanent and temporary utility appurtenances in their present or relocated positions. The District will not all any additional compensation for reasonable delays, inconveniences, or damage sustained by the Contractor due to any interference from the said utility appurtenances or the operation of moving them.

The Contractor shall be responsible for notifying all affected utility companies before performing any work on their utilities, and shall cooperate with them in achieving the desired result. The Contractor shall cooperate with the owners of any underground or overhead utility lines in their removal and rearrangement operations. This is in order that the operations may progress in a reasonable manner, that duplication or rearrangement work may be reduced to a minimum, and that services rendered by those parties will not be interrupted.

If utility services are interrupted because of accidental breakage or because of being exposed or unsupported, the Contractor shall promptly notify the proper authority and shall cooperate with the authority in the restoring service. No work shall be undertaken around fire hydrants until the local fire authority has approved provisions for continued service.

The Contractor shall maintain coordination with the public utility companies before the start of construction and during all construction phases of the project.

23. FEDERAL-AID PROJECT SIGN AND AMERICAN RECOVERY AND REINVESTMENT ACT SIGN, Item 620 040

This Special Provision supplements 620.04 of the Standard Specifications.

The Contractor shall furnish, erect, maintain and remove two (2) Federal-Aid Project Sign as directed in the Standard Specifications.

In addition, the Contractor shall furnish, erect, maintain and remove two (2) American Recovery and Reinvestment Act (ARRA) Signs. Each ARRA Sign shall be placed in close proximity to a Federal-Aid Project Sign and based on guidance provided in the appendix of these specifications. Details of the ARRA sign are provided in the appendix of these specifications.

24. TEST PIT, Item 212 003

DESCRIPTION.

Work consists of excavation, backfill, compaction and restoration as required to perform test pits necessary to locate or determine type and/or condition of materials of construction of gas line utility located under existing concrete sidewalk.

SUBMITTALS.

Each test pit location and estimated size shall be submitted to the Chief Engineer for approval.

MATERIALS.

Test Pit Excavated Material

CONSTRUCTION REQUIREMENTS.

Test pits will be required to determine the condition and material of the gas line service located underneath existing concrete sidewalk.

Pit size shall be approximately 2 ft. x 4 ft. or as directed by the Chief Engineer.

Pit depth shall generally be 4 ft. minimum and approximately 5 ft. maximum unless otherwise directed by the Engineer.

Test pits shall be scheduled as directed so that pit backfilling can be completed within the workday.

It may be necessary to hand excavate portions of test pits in order to protect utilities. Excavated material shall be stored and used for backfill unless the excavated material is unsuitable. Borrow fill shall be used only if the quantity of suitable excavated material is insufficient, and shall be included as part of the work.

When the test pit is within the roadway or sidewalk area, compaction shall be per 207.04.

MEASURE AND PAYMENT.

The unit of measure for Test Pits will be each.

Payment for Test Pits will be made at the contract unit price per each, which payment will include hand excavation as needed, backfill including borrow fill as needed, restoration including asphalt, concrete and sod as needed, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

25. PAVEMENT REINFORCING FABRIC FOR CRACK REPAIR, Item 403 003

DESCRIPTION.

This work shall consist of furnishing and installing pavement reinforcing fabric for crack repair on any transverse and longitudinal joints, pavement patching and bridge decks. Pavement reinforcing fabric for crack repair shall be placed on damaged surfaces prior to placement of the pavement reinforcing fabric for asphalt overlay in accordance with the details shown on the plans and/or as directed by the Engineer.

MATERIALS.

PG pavement reinforcing pavement fabric shall be manufactured from polypropylene nonwoven staple fiber needle-punched fabrics. Fabric shall be construction to absorb performance graded polymer modified asphalt cement. The fabric shall be a heat treated on one side and shall conform to the following:

Pavement Reinforcing Fabric Property & Standard Test

Mechanical Properties	**Test Method**	**Unit**	*Value*
Asphalt Retention[1]	ASTM D 6140	l/m2 (gal/yd2)	1.5 (0.30)
Mass/Unit Area	ASTM D 5261 / D 1776	g/m2 (oz/yd2)	204 (6.0)
Grab Tensile Strength after Asphalt Saturation[1] @ 50% elongation	ASTM D 4632	Lbs (kN)	150 (.67)
Elongation at Break, % after Asphalt Saturation[1]	ASTM D 4632	%	50

All property value shall be based on minimum average roll value (MARV) in the weaker principal direction.

(1) Modified for PG Grade Asphalts

A Certificate of Compliance for the fabric used on the project shall be furnished to the engineer. The fabric shall be furnished in protective cover capable protecting the fabric form ultraviolet rays, abrasion, and water. The paving fabric used on this project must meet or exceed the physical properties of Mirafi MPV 700.

Asphaltic Sealant: The asphalt tack coat shall meet the requirements of AASHTO MP 1 "Standard Specifications for Performance Graded Asphalt Binder." Elastomers shall be added to the base asphalt cement to achieve the specified performance grade and shall be

styrene-butadiene-styrene, tri-block copolymer without oil extension added

EQUIPMENT.

Fabric Interlayer Installer: The installer of a this polymer modified system must have a minimum of 3 years of experience and have installed a minimum of 1 million square yards of paving fabric

Asphalt Distributor: The distributor must be suitably metered, computer rate controlled (CRC) and capable of spraying the asphalt cement uniformly and at the prescribed application rate. No drilling or skipping shall be permitted.

Fabric Handling Equipment: A tractor or similar mechanical device with mounted laydown equipment that is capable of handling full rolls of fabric shall be used. The equipment shall be capable of laying the paving fabric smoothly without excessive wrinkles and/or folds.

Miscellaneous Equipment: The Installer shall provide stiff bristle broom to smooth fabric and a blade to cut the paving fabric A pneumatic-tire roller may be needed in some cases to smooth paving fabric into the asphalt cement.

INSTALLATION PROCEDURE.

Surface Preparation: The surface for placement of the paving fabric shall be free of dirt, water, vegetation and other foreign materials. Open cracks 3/8 inch or larger shall be filled with sand mixed asphalt as directed by the Engineer. Cracks larger than 1/2 inch or holes shall be filled with cold or hot mix asphalt. The use of a leveling course may be required prior to placing the paving fabric in pavements that are irregular.

Application of Sealant: The asphalt cement and binder must be uniformly spray-applied at the specified rate. The quantity required may vary with the surface condition of the existing pavement (e.g. degree of porosity), but shall be applied at less than a rate of 0.30 gallons per square yard of residual asphalt.

Application of asphalt cement will be performed by truck-mounted distribution equipment, with hand spraying kept to a minimum. The temperature of the asphalt cement must be sufficiently high to permit a uniform spray pattern. PG modified asphalt spread rates are higher than un modified asphalt therefore the recommended temperature will be increase in the area 325° F- 340° F.

The normal minimum recommended temperature for asphalt cement for fabric placement is 290° F. The heavier fabric will tolerate fabric placement with asphalt cement up to 300° F. It is necessary that the paving fabric be installed at a minimum distance of 50 ft behind the asphalt tack truck unless the tack coat temperature is close to 325° F. In the case of a distributor mounted fabric installation rig the fabric should be at its maximum distance from the fresh oil and at the lowest possible spreading temperature. The paving fabric shall be placed onto the asphalt cement with a minimum of wrinkles before the asphalt can cool or

lose its tackiness. The paving fabric shall be placed so that the non-heat treated (bearded or fuzzy) side is placed downward, into the sealant, thus providing optimum bond between fabric and pavement during the construction process. As directed by the Engineer, wrinkles severe enough to cause "folds" shall be slit and laid flat in the direction of paving operations. Brooming the paving fabric will assist it in making intimate contact with the pavement surface.

Any overlap of the paving fabric should be minimized, although an overlap of 1 to 3 inches is recommended to insure full closure of overlapping layers. Care must be exercised to prevent edge pickup by the paver on transverse joints they may be shingled (overlapped) in the direction of paving operations or secured by asphalt tack. The contractor installing the paving fabric must prove that they have at least 4 years experience in placing paving fabric.

In the event that asphalt cement should bleed through the paving fabric before the hot mix asphalt is placed, it may be necessary to absorb any visible sealant by spreading sand or hot mix asphalt over those areas. This should minimize the tendency for construction equipment tires to lift the paving fabric when driving over it. Turning of paving equipment and other vehicles on the paving fabric must be kept to a minimum to avoid movement or damage to the fabric. Overlay thickness shall be a minimum of 2 inches over fabric.

MEASURE AND PAYMENT.

Unit of measure for PAVEMENT REINFORCING FABRIC FOR CRACK REPAIR will be Linear Feet. Payment for PAVEMENT REINFORCING FABRIC FOR CRACK REPAIR will be made at the contract unit price per linear foot, which payment will include furnishing and installing all materials and all tools, equipment and incidentals needed to complete the work specified herein.

26. PAVEMENT REINFORCING FABRIC FOR ASPHALT OVERLAY, Item 403 004

DESCRIPTION.

This work shall consist of furnishing and installing pavement reinforcing fabric before placement of new asphalt overlay and/or asphalt wedge & level in accordance with the details shown on the plans and/or as directed by the Engineer.

MATERIALS.

The pavement paving fabric shall be furnished by an ISO approved manufacturer of polypropylene or polyester geosynthetics and is utilized extend the service life of pavement overlays. The paving fabric shall be needle punched, nonwoven and heat treated on one side and shall conform to the following physical and mechanical properties:

Property	Units	Test Method	Minimum Average Roll Value (MARV)
Mass Per Unit Area	oz/yd2/(gm/m2)	ASTM D 5199-01	4.1 (140)
Grab Tensile Strength	lb (N)	ASTM D 4632-91	102 (450)
Grab Elongation at Break	%	ASTM D 4632-91	50
Mullen Burst Strength	lb (kPa)	ASTM D 3786-87	200 (1378)
Asphalt Retention	gal/yd2 (l/m2)	ASTM D 6140-00	0.21 (0.95)

A Certificate of Compliance for the paving fabric used on the project shall be furnished by the manufacturer to the engineer. The paving fabric shall be supplied in protective a cover or wrap that is capable protecting the fabric form ultraviolet rays, abrasion, and water. Mirapave® 500 or approved equal paving fabric should be used. Mirapave® 500 is available from MIRAFI® Construction Products, 800-685-9990 or 800-333-6205.

Asphalt Sealant: The Engineer shall approve asphalt cement. A grade asphalt of the same type used in the manufacture of the hot mix asphalt for the overlay should be acceptable.

EQUIPMENT.

Asphalt Distributor: The distributor must be suitably metered and capable of spraying the asphalt cement uniformly and at the prescribed application rate. No drilling or skipping shall be permitted.

Fabric Handling Equipment: A tractor or similar mechanical device with mounted lay down equipment that is capable of handling full rolls of fabric shall be used. The equipment shall be capable of laying the paving fabric smoothly without excessive wrinkles and/or folds.

Miscellaneous Equipment: Stiff bristle brooms used to smooth, and scissors (or blades) used to cut the paving fabric shall be provided by the Installer. A pneumatic-tired roller may be needed in some cases to smooth paving fabric into the asphalt cement.

INSTALLATION PROCEDURE.

Surface Preparation: The surface on which the paving fabric is to be placed shall be free of dirt, water, vegetation and other foreign materials. Open cracks 1/4 inch or larger shall be filled with sand mixed asphalt as directed by the Engineer. Cracks larger than 1/2 inch or holes shall be filled with cold or hot mix asphalt. The use of a leveling course may be required prior to placing the paving fabric in severe cases.

Application of Sealant: The asphalt cement and binder must be uniformly spray-applied at

the specified rate. The quantity required may vary with the surface condition of the existing pavement (e.g. degree of porosity), but shall be applied at a nominal rate of 0.25 gallons per square yard of residual asphalt. Application of asphalt cement will be performed by truck-mounted distribution equipment whenever possible, with hand spraying kept to a minimum. The temperature of the asphalt cement must be sufficiently high to permit a uniform spray pattern. The minimum recommended temperature for asphalt cement is 290° F, and should not exceed 325° F.

Paving Fabric Placement: The paving fabric shall be placed onto the asphalt cement with a minimum of wrinkles before the asphalt can cool or lose its tackiness. The paving fabric shall be placed so that the non-heat treated (bearded or fuzzy) side is placed downward, into the sealant, thus providing optimum bond between fabric and pavement during the construction process. As directed by the Engineer, wrinkles severe enough to cause "folds" shall be slit and laid flat in the direction of paving operations. Brooming the paving fabric will assist it in making intimate contact with the pavement surface.

Any overlap of the paving fabric should be minimized, although an overlap of 1 to 3 inches is recommended to insure full closure of overlapping layers. Care must be exercised to prevent edge pick-up by the paver on transverse joints they may be shingled (overlapped) in the direction of paving operations or secured by asphalt tack. The contractor installing the paving fabric must prove that they have at least 4 years experience in placing paving fabric. In the event that asphalt cement should bleed through the paving fabric before the hot mix asphalt is placed, it may be necessary to absorb any visible sealant by spreading sand or hot mix asphalt over those areas. This should minimize the tendency for construction equipment tires to lift the paving fabric when driving over it. Turning of paving equipment and other vehicles on the paving fabric must be kept to a minimum to avoid movement or damage to the fabric. Satisfactory installation of hot mix asphalt can be accomplished at temperatures below 300° F. In no case should temperature of the hot mix asphalt concrete exceed 325° F at time of placement.

MEASURE AND PAYMENT.

Unit of measure for PAVEMENT REINFORCING FABRIC FOR ASPHALT OVERLAY will be Square Feet. Payment for PAVEMENT REINFORCING FABRIC FOR ASPHALT OVERLAY will be made at the contract unit price per square foot, which payment will include furnishing and installing all materials and all tools, equipment and incidentals needed to complete the work specified herein.

27. PCC WHEELCHAIR/BICYCLE RAMP , Item 609 200

This Special Provision modifies 609.

Add the following paragraph after 609.04 (E) (2)

609.04 (E) (3) DETECTABLE WARNING PAVERS

1. **DESCRIPTION.** This work shall consist of furnishing and installing detectable warning pavers in construction of new wheelchair ramps in accordance with the details shown on the plans and/or as directed by the Engineer.

2. **DETECTABLE WARNING PAVERS/TRUNCATED DOMES.** Detectable warning pavers/truncated domes for a width of 24" for the entire width of the ramp as indicated on plans, shall be installed on all wheelchair ramps.

   General – Detectable warning pavers shall consist of a surface of truncated domes aligned in a square grid pattern.

   Dome Size – Truncated domes in a detectable warning surface shall have a base diameter of 0.9 inches minimum to 1.4 inches maximum, a top diameter of 50% of the base diameter minimum to 65% of the base diameter maximum, and a height of 0.2 inches.

   Dome Spacing – Truncated domes in a detectable warning surface shall have a center-to-center spacing of 1.6 inches minimum and 2.35 inches maximum, and a base-to-base spacing of 0.65 inches minimum, measured between the most adjacent domes on square grid.

   Contrast – Detectable warning surfaces shall contrast visually with adjacent walking surfaces either light-on-dark, or dark-on-light.

   Size – Detectable warning surfaces shall extend 24 inches minimum in the direction of travel and the full width of the wheelchair ramp, landing, or blended transition.

   Sidewalk Ramps and Blended Transitions – The detectable warning surface shall be located so that the edge nearest the curb line is 6 inches minimum and 8 inches maximum from the curb line.

3. **MATERIALS.** Pavers will meet Americans with Disabilities Act (ADA) requirements for detectable warning pavers (truncated domes) either ASTM C 902 Pedestrian and Light Traffic Paving Block, Class SX, Type 1; or ASTM C 936 Solid Concrete Interlocking Paving Units; or ASTM C 1272 Heavy Vehicular Paving Brick, Type R.

   Acceptable manufacturers and products for detectable warnings and truncated domes pavers are:

Manufacturers	Products
Whitacre-Greer Fireproofing Company, 1400 S Mahoning Ave., Alliance, OH, 44601	ADA Paver, 4" x 8" x 2¼" Clear Red (Rustic) # 30
Hanover Architectural Products 240 Bender Rd., Hanover, PA 17331	Detectable Warning Paver, 11¾" x 11¾" x 2" Red or Quarry

	Red
Endicott Clay Products, PO Box 17, Fairbury, NE, 68352	Handicap Detectable Warning Paver, Nominal 4"x 8"x 2¼" Red Blend

Pavers will be laid on top of a 4" unreinforced concrete base. Setting bed and joints to be mortared in accordance with manufacturer's instructions or with a maximum ½" thick setting bed of latex modified cement mortar. Mortar joints to a width not greater than 5/32" and not less than 1/16". Pavers shall not be directly touching each other unless they have spacing bars.

Joints are to be flush with top surface and struck so as to give a smooth surface. Pavers shall be laid such that joints are level with adjoining joints so as to provide a smooth transition from brick to concrete surface. The top surface of any two adjacent units should not differ by more than 1/8" in height for mortared brick paving. Pavers that do not conform to the smoothness requirement shall be removed and replaced at the expense of the contractor as determined by the CO.

Stamping or imprinting systems when used must be capable of uniformly providing the specified texture and pattern, and provide the minimum dry static coefficient of friction, as defined by ASTM C-1028, shall be 0.80.

4. **CONSTRUCTION.** The Contractor shall submit literature describing the following to the CO at least 30 days prior to the proposed installation:

- The detectable warning paving material
- All associated materials
- Preparation requirements
- In addition, a minimum 12" x 12" sample of the detectable warning material shall be submitted.

The manufacturer shall demonstrate in writing and by providing references that the detectable warning paving materials have been satisfactorily used for roadway, path or flooring applications, in high pedestrian use and under weather conditions similar to those experienced in the District.

In no case shall the Contractor permit the application of any materials by untrained personnel or non-approved installers. The material manufacturer's certification of compliance with this requirement shall be provided to the CO.

Prior to the start of work, the Contractor shall show evidence of successful completion of similar installations and provide a job site sample for the approval of the CO. The sample size shall be 4' x 2', minimum, and constructed at a location selected by the CO.

As many test panels will be constructed as are necessary to achieve a sample panel that meets the satisfaction of the CO. All work shall conform to the appearance of the approved sample to the satisfaction of the CO. The sample shall not be incorporated into the work and will be removed when ordered by the CO.

Follow all applicable manufacturer's requirements for environmental conditions, surface preparation, installation procedures, curing procedures and materials compatibility. The Contractor is responsible for removing any material spatters from areas. The Contractor shall repair any damage that should arise from the installation or the clean-up effort.

Unless otherwise specified, the color of the detectable warning surface shall be yellow and shall be an approximate visual match to Munsell Book Notation 10YR 8/14. The color shall be uniform over the entire surface, and homogenous throughout the thickness of the material.

If a color other than yellow is specified in the Contract documents, the coloring material shall be an approximate visual match to the specified colors. The color shall be uniform over the entire surface and homogenous throughout the thickness of the material.

There shall be a minimum of 70% contrast in light reflectance between the detectable warning and adjoining surface. The detectable warning can optionally be "safety yellow". The material used to provide visual contrast shall be an integral part of the detectable warning surface. Both the domes and the underlying surface must meet the contrast requirement.

The contrast in percent shall be determined by:

Contrast = [(B1 – B2) / B1] x 100

where B1= light reflectance value (LRV) of the lighter area and B2= light reflectance value (LRV) of the darker area. Note that in any application both white and black are never absolute; thus, B1 never equals 100 and B2 is always greater than 0.

When visual contrast other than "safety yellow" is used, provide verification of contrast.

Add the following to 609.04 (E)

(4) Ramps shall be provided with detectable warning pavers, an ADA requirement. These pavers shall be paid under Item No. 609 204 as per specifications contained in S.P. 28.

609.04(F) and 609.04(G) are modified by the following:

5. **MEASURE AND PAYMENT.** Unit of measure for PCC WHEELCHAIR/BICYCLE RAMPS will be Square Yard. The area will be the actual area of PCC WHEELCHAIR/BICYCLE RAMPS constructed complete. Payment for PCC WHEELCHAIR/BICYCLE RAMPS will be made at the contract unit price per square yard, which payment will include furnishing and placing all materials and all tools, equipment and incidentals including Detectable Warning Pavers needed to complete the work specified herein.

28. MAINTENANCE OF HIGHWAY TRAFFIC, Item 616 001

This Special Provision supplements and modifies 104.02 and 616 of the Standard Specifications.

(A) GENERAL - Work consists of proper maintenance of vehicular and pedestrian traffic within and adjacent to the project and includes, but is not limited to the following for contract duration: safety officer, flaggers and watchmen; public convenience and safety; furnishing, placing, maintenance, removal and disposal of all traffic control devices as defined in the MUTCD (Manual on Uniform Traffic Control Devices for Streets and Highways, latest edition, U.S. Department of Transportation, Federal Highway Administration and subsequent revisions).

Minimum requirements are presented below. Work includes all operational needs for proper traffic maintenance and coordination with the District of Columbia Department of Transportation (DCDOT) traffic requirements outside the project area.

(B) TRAFFIC CONTROLS - The Contractor may use the traffic control plans in the contract plans without submitting them for approval. However, the Contractor shall schedule an appointment with Ms. Clarissa Byrd, Chief, Work Zone/Public Safety Branch, (202) 671-0581 to discuss how the plan will be implemented. If the Contractor wishes to use an alternative traffic control plan, a Traffic Control Plan (TCP) for each work phase shall be submitted to the Engineer for approval, based upon the requirements and intents of the contract documents, the MUTCD, the Work Area Traffic Control Manual 2000 and the traffic flow restrictions, found in this S.P., prior to starting any construction. These plans shall be submitted as shop drawings and shall include the arrangement, size and location of all appropriate warning signs, Type III Barricades, portable PCC barrier, etc. and any other devices deemed necessary. A copy of the approved TCP and permits must be on site at all times available for review by DDOT personnel.

With the exception of demolition and other authorized work, all work shall be performed within daylight hours. The Contractor shall obtain approval from the Engineer before working at any other times. Normal traffic flow shall be maintained during these times unless otherwise specified. The time required to implement and remove closures and install and remove traffic control devices shall be included within the stated time periods.

During the entire construction period, the Contractor shall minimize interference, as determined by the Engineer, with the adjacent neighborhood, including pollution, noise, safety and other effects. The Contractor must immediately remedy all interference determined by the Engineer.

During all phases of construction, at no time shall the project be left unattended. Proper security measures shall be taken to keep unauthorized persons from entering into the opened construction areas of the bridge.

The Contractor shall coordinate his maintenance of traffic work with other Contractors and utility companies working in the same general location to maintain continuity of traffic flow and minimize congestion.

Construction work zones shall be made safe for traffic and warning shall be provided by installing electronically illuminated traffic control devices such as flashing arrow panels and warning lights. Portable changeable message signs may be required to give the motoring public advance notification of road conditions and road work two weeks prior to start of work. These devices shall be used in conjunction with other traffic control devices, and their flashing sequence and light intensity shall meet the requirements as outlined in this S.P.

Work areas shall be delineated by barriers of a type and size necessary to provide adequate protection of workers, motorists and pedestrians. Except when necessary to provide ingress and egress for construction vehicles and equipment to/from the work area, open spaces between adjacent barrier sections shall not be permitted. At no time shall the approach ends of portable PCC safety barriers be left unprotected. The Contractor shall protect the approach ends of portable barriers with temporary impact attenuators.

Where traffic must travel adjacent to a lane under construction, the Contractor shall place temporary PCC safety barriers or moveable barriers near the edge of the traveled lane. Only J-Hook or Pin & Loop connections, or an approved equivalent, are allowed, slot and plate or tongue and groove connections are prohibited. PCC barriers are also required where the drop-off from the travel lane exceeds 6 inches. During asphalt surfacing operations, traffic drums or cones shall be used in lieu of PCC barrier to delineate the work area.

No material or equipment shall be placed or stored on the designated roadway during any phase of construction unless otherwise authorized.

The Contractor shall furnish all necessary flaggers, formally trained in flagging operations that may be required during the course of construction activities. They shall be equipped with safety vests, hard hats and hand signaling devices per section 6F-2 of the MUTCD. The devices shall be pole-mounted Stop/Slow paddles, 24 inches in diameter, with 6 inch Series C letters. The cost of providing flaggers is incidental. No measure will be made. Payment for providing flaggers shall be reflected in the bid for

Construction Lane Closing.

The Contractor shall furnish and install temporary pavement markings and shall remove these markings and existing markings without damaging the finished pavement surface, in accordance with this TCP and/or as directed by the Engineer.

Traffic control devices not in use during the current phase of work shall be removed from the work zone. Construction signs not in use shall be 100% covered. All traffic control devices used for maintenance of traffic shall remain the property of the Contractor and shall be removed from the project site upon completion of work.

(C) TRAFFIC FLOW RESTRICTIONS

1. General

- The contractor shall install adequate advance warning signs applicable for each phase before commencement of work and accommodate the traffic control devices for channeling the work zone approaches.

- No parking shall be permitted on the Kenilworth Avenue service roads adjacent to where temporary barrier is set or adjacent to where pavement reconstruction is underway. The contractor shall maintain safe access for businesses and emergency vehicles at all times during construction.
- For each phase, the contractor shall remove the existing pavement markings which conflict with temporary pavement markings or channelizing devices during construction.
- In addition to the allowable periods for work and lane restrictions listed in detail below, the contractor shall not close lanes or engage in work activity along mainline Kenilworth Avenue during Washington Nationals baseball games. Such restrictions shall be in place beginning two hours prior to the scheduled game time and continue until 2 hours after the completion of the game. DDOT reserves the right to provide notice 72 hours in advance of other special events during which the contractor must open all lanes and suspend other construction activities along mainline Kenilworth Avenue.

- Work is not permitted on the following holidays nor the preceding workday:

  - New Year's Day
  - Good Friday
  - Easter Weekend
  - Memorial Day
  - Independence Day
  - Labor Day
  - Thanksgiving Day
  - Christmas Day

- When closing or opening a lane on freeways, expressways, and roadways with posted speed ≥ 55 mph, a work vehicle shall be closely followed by a protection vehicle (PV) during installation and removal of temporary traffic control devices. The PV shall consist of a work vehicle with approved flashing lights, a truck-mounted attenuator (TMA) with support structure designed for attaching the system to the work vehicle, and arrow panel (arrow mode for multilane roadways and caution mode on two-lane, two-way roadways) The work vehicle size and method of attachment shall be as specified in the TMA manufacture's specification as tested under NCHRP Test Level 3.

- When a temporary lane or shoulder closure is in effect, work shall begin within one hour after the lane is closed. Any delay greater than one hour with no work in progress shall require the Contractor to remove the lane closure at no additional cost to DDOT or MSHA.

- All closures shall be in conformance with the approved traffic control plan and under the direction of the Contractor's Traffic Manager and the Engineer.

- Workers and equipment, including temporary traffic control devices needed for setting up a lane closure or restriction, are prohibited in the lane or shoulder to be closed or restricted before the time permitted in the Contract work restrictions unless otherwise noted in this document or approved by the Engineer (with consultation with the MSHA District 3 Traffic office if applicable).

- Temporary traffic control devices to be used for lane/shoulder closure may be placed on the shoulder of the roadway by workers no earlier than 30_minutes prior to actual time lane/shoulder closure or restriction is permitted. Temporary traffic signs may be displayed to traffic at this time.

- Workers shall not enter a lane open to traffic. Workers may be present on shoulders to prepare for lane closure setup no earlier than 30 minutes prior to actual time lane/ shoulder closure or restriction is permitted.

- All temporary lane or shoulder closures shall be restored at the end of the closure period. Prior to opening the closed lane or shoulder, the Contractor shall clear the lane or shoulder of all material, equipment, and debris.

- Failure to restore full traffic capacity within the time specified will result in a deduction being assessed on the next progress estimate in conformance with the following:

ELAPSED TIME, MINUTES	DEDUCTION
1 - 5	$ 50.00
Over 5	$ 50.00 per Minute (In addition to the Original 5 minutes)

- Meetings to discuss pending traffic switches should be held approximately two weeks prior to each phase change. Meeting invitees on behalf of MSHA shall include a representative from the District 3 Traffic office and the District 3 Construction office.

- Variable Message Signs (VMS) shall be provided a minimum of one week prior to implementation of each traffic phase where operations on mainline Kenilworth Avenue are changed, and a minimum of three workdays after the implementation of each such traffic phase. VMS messages will be discussed during the aforementioned traffic switch meetings. Locations of the VMS shall include southbound Baltimore-Washington Parkway, southbound MD 201 (Kenilworth Avenue), eastbound US 50, and westbound US 50.

2. Phase 1A – Construct improvements needed for Phase 1B Maintenance of Traffic

   - Maintain traffic at all intersections during construction as shown. Traffic flow at Eastern Avenue at Kenilworth Avenue and Nannie Helen Burroughs Avenue at Kenilworth Avenue intersections shall not be interrupted during peak hours (weekdays, 6:30 to 9:30 AM and 3:30 to 6:30 PM).

   - Close no more than one lane in each direction as needed on mainline Kenilworth Ave. during the following allowable periods:

     Northbound Kenilworth Avenue: 9:00 PM to 6:00 AM, Monday-Friday
     Southbound Kenilworth Avenue: 8:00 PM to 5:00 AM, Monday-Friday

   - Construct temporary ramp, ramp widening, and corner radius improvements as shown (some work may continue into Phase 1B if not required for detour).

3. Phase 1B – Remove existing Eastern Avenue bridge superstructure

   - Close Eastern Avenue at Kenilworth Avenue intersection, set detours as shown, and remove existing traffic signal.

   - Maintain traffic at all other intersections and on all mainline Kenilworth Avenue lanes as shown.

   - Detour pedestrian movements at the Eastern Avenue bridge to the pedestrian bridge over Kenilworth Avenue near Douglas Street and Polk Street.

   - Close no more than one lane in each direction as needed on mainline Kenilworth Ave. during the following allowable periods:

     Northbound Kenilworth Avenue: 9:00 PM to 6:00 AM, Monday-Friday
     Southbound Kenilworth Avenue: 8:00 PM to 5:00 AM, Monday-Friday

- During lane closures, remove existing bridge superstructure.

4. Phase 2A – Construct new storm drain manholes and pipes

   - Retain Eastern Avenue at Kenilworth Avenue intersection closure and associated detours. Divert the right lane of mainline Kenilworth Avenue in each direction onto the service roads as shown.

   - Construct storm drainage features under the right lanes of northbound and southbound mainline Kenilworth Avenue as shown. Construction activity shall not occur in the right lanes of Kenilworth Avenue during peak hours (weekdays 6:30 to 9:30 AM and 3:30 to 6:30 PM).
   - Close no more than one lane in each direction as needed on mainline Kenilworth Ave. during the following allowable periods:

     Northbound Kenilworth Avenue: 9:00 PM to 6:00 AM, Monday-Friday
     Southbound Kenilworth Avenue: 8:00 PM to 5:00 AM, Monday-Friday

5. Phase 2B – Construct Eastern Avenue bridge piers in median of Kenilworth Avenue

   - Retain Eastern Avenue at Kenilworth Avenue intersection closure and associated detours. Retain expressway lane diversion along mainline Kenilworth Avenue. Shift lanes to the right side on mainline Kenilworth Avenue under the Eastern Avenue bridge to create the work area in the Kenilworth Avenue median.

   - Maintain traffic at all other intersections and on all mainline Kenilworth Avenue lanes as shown.

   - Retain pedestrian detour at Eastern Avenue bridge to pedestrian bridge over Kenilworth Avenue near Douglas Street and Polk Street.

   - Construct new bridge piers. Construction activity shall not occur in the median of Kenilworth Ave. during peak hours (weekdays 6:30 to 9:30 AM and 3:30 to 6:30 PM.

   - Close no more than one lane in each direction as needed on mainline Kenilworth Ave. (providing at least one open normal expressway lane and one open diverted expressway lane) during the following allowable periods:

     Northbound Kenilworth Avenue: 9:00 PM to 6:00 AM, Monday-Friday
     Southbound Kenilworth Avenue: 8:00 PM to 5:00 AM, Monday-Friday

   - Close no more than two lanes in each direction as needed on mainline Kenilworth Ave. (directing all traffic to the diverted expressway lane) during

the following allowable periods:

Northbound Kenilworth Avenue: 12:00 AM to 5:00 AM, Monday-Friday
Southbound Kenilworth Avenue: 12:00 AM to 5:00 AM, Monday-Friday

- Place steel plates over areas left excavated during previous phases or sub-phases that are not within the construction areas shown. "Steel Plates" temporary warning signs shall be used in advance of the location when steel plates are in use.

6. Phase 3 – Complete Eastern Ave. bridge & begin reconstructing Kenilworth Ave. service roads

   - Retain Eastern Avenue at Kenilworth Avenue intersection closure and associated detours.

   - After completion of median bridge piers, remove diversion of expressway traffic lanes and restore mainline Kenilworth Avenue to original conditions.

   - Maintain traffic at all other intersections and on all mainline Kenilworth Avenue lanes as shown.

   - Retain pedestrian detour at Eastern Avenue bridge to pedestrian bridge over Kenilworth Avenue near Douglas Street and Polk Street.

   - Complete construction of Eastern Avenue bridge abutments and superstructure. Construct inside half of southbound Kenilworth Ave. service road to final grade. Construct temporary alignment of northbound Kenilworth Ave. service road to final grade.

   - Construction activity shall not occur in the median of Kenilworth Avenue during peak hours (weekdays 6:30 to 9:30 AM and 3:30 to 6:30 PM).

   - Close no more than one lane in each direction as needed on mainline Kenilworth Avenue (providing at least one open normal expressway lane and one open diverted expressway lane) during the following allowable periods:

     Northbound Kenilworth Avenue: 9:00 PM to 6:00 AM, Monday-Friday
     Southbound Kenilworth Avenue: 8:00 PM to 5:00 AM, Monday-Friday

   - Close no more than two lanes in each direction as needed on mainline Kenilworth Ave. (directing all traffic to the diverted expressway lane) during the following allowable periods:

     Northbound Kenilworth Avenue: 12:00 AM to 5:00 AM, Monday-Friday
     Southbound Kenilworth Avenue: 12:00 AM to 5:00 AM, Monday-Friday

7. Subphase 3A – Construct curb, gutter, and portions of sidewalk at Eastern Avenue / Kenilworth Avenue service road intersection

   - Concurrent with other Phase 3 work and near the end of Phase 3 just before proceeding to Phase 4, close the crosswalk across Eastern Avenue at the northbound Kenilworth Avenue service road and detour pedestrians to the crosswalk at Olive Street.

   - All other requirements for Phase 3 continue to apply as described above.

8. Phases 4-6 – Reconstruct Kenilworth Avenue service roads

   - Retain Eastern Avenue at Kenilworth Avenue intersection closure and associated detours. Provide additional detour during Phases 4 and 5 for right turn from northbound Kenilworth Avenue service road to Eastern Avenue.

   - Maintain traffic at all other intersections and on all mainline Kenilworth Avenue lanes as shown.

   - Retain pedestrian detour at Eastern Avenue bridge to pedestrian bridge over Kenilworth Avenue near Douglas Street and Polk Street. Retain pedestrian detour via Olive Street crosswalk from Subphase 3A through the end of Phase 5.

   - Phases 4 and 5 shall occur consecutively during a single weekend period, beginning no earlier than 6:30 PM Friday and ending no later than 5:00 AM Monday.

   - Complete construction of Kenilworth Avenue service roads and sidewalk to final grade. Construct temporary alignment of northbound Kenilworth Avenue service road to final grade. Install new traffic signal at Eastern Avenue / Kenilworth Avenue service road intersection.

   - Construct cantilever sign structure C-1 between northbound Kenilworth Avenue and off-ramp to Eastern Avenue. Other construction activity shall not occur along mainline Kenilworth Avenue. For sign structure C-1, the following lane closure times are applicable:

     Close no more than one lane on northbound mainline Kenilworth Avenue as needed between 9:00 PM and 6:00 AM, Monday-Friday

9. Phase 7 – Restore curb radius, traffic signal, and all other roadway features to existing conditions at the Nannie Helen Burroughs / Kenilworth Ave. service road intersections

- Activate new traffic signal at Eastern Avenue / Kenilworth Avenue service road intersection and open the new bridge to traffic.

- Maintain traffic at all intersections and on all mainline Kenilworth Avenue lanes. Traffic flow at Eastern Avenue at Kenilworth Avenue and Nannie Helen Burroughs Avenue at Kenilworth Avenue intersections shall not be interrupted during peak hours (weekdays, 6:30 to 9:30 AM and 3:30 to 6:30 PM).

- Restore all intersection geometry to original conditions and install all proposed signing and pavement markings.

- Maintain traffic at all intersections during construction as shown.

- Construction activity shall not occur along mainline Kenilworth Avenue.

Rush Hour Periods - Rush hour and non-rush hour periods shall be as presented above for each phase and facility.

Maintenance of traffic lane requirements for holidays shall be as determined by the Engineer on an individual basis, but shall not be less than the requirements for non-rush hours as stated herein.

The Contractor shall give seventy-two (72) hours prior notice to the District when making a change in traffic flow patterns.

No traffic lanes shall be less than 11 feet wide, except as shown on the plans.

Construction lane closings as specified in this S.P. will not be permitted during rush hour periods.

Pavement marking operations in the traveled way shall be performed only in non-rush hour periods 9:30 a.m. to 3:30 p.m. Monday through Friday, and holidays and weekends. When existing pavement markings are removed, the area shall be painted with emulsified or cut back asphalt. Traffic staging for each construction phase shall be completed in a continuous operation during the hours stated above.

Traffic access for all cross streets, driveways, garages, alleys and loading docks shall be maintained at all times. Access shall be maintained to all businesses, private or otherwise.

(D) TRAFFIC SAFETY OFFICER - The Contractor shall have a competent, full time, Traffic Safety Officer in accordance with the requirements of 616.02(B)(1). The Traffic Safety Officer shall assume maintenance of the Work Zone Transportation Management Plan (TMP) document incorporated as an attachment herein and shall be responsible together with the Project Engineer for implementation of the TMP. An electronic copy of the document will be provided to the contractor for this purpose.

Any changes to the way in which maintenance of traffic is implemented on the project or the way in which information about maintenance of traffic is disseminated to the public or to project stakeholders shall be incorporated into this document, which shall be submitted to the Project Engineer for review and approval before implementation.

The contractor shall coordinate with DDOT and its data collection contractors to allow monitoring of the implementation of the TMP. This may include traffic counts to determine the effectiveness of certain Public Outreach strategies. Refer the District of Columbia Work Zone Safety and Mobility Policy, dated October 2007, Appendix E.7.

The Traffic Safety Officer shall develop as part of the TMP the Contractor's Contingency Plan for incident management, consistent with the guidelines set forth in the District of Columbia Work Zone Safety and Mobility Policy, dated October 2007, Appendix E.9.

The Project Engineer may stop work if the TMP does not support the current construction phasing or traffic control. Work shall not continue until written approval has been received from the Engineer. Stopping of work shall not affect the Contractor's time and no additional compensation shall be provided.

(E) PEDESTRIAN SAFETY- The Contractor shall provide pedestrians with a continuous walkway past the construction work zone. The width of the walkway shall be 6 feet if space permits. A walkway as narrow as 4-feet wide may be used only where authorized by the Engineer for areas where a wider space is not available. The walkway shall be safe, convenient and replicate as nearly as possible the most desirable characteristics of sidewalks or footpaths. Pedestrians shall not be led into direct conflict with the work site operations or mainline traffic moving through or around the work site. All pedestrians including blind, hearing impaired and physically challenged shall be provided protection. All necessary signs and supports for closing sidewalks and detouring pedestrians and providing temporary ramps and/or protective walkways is the responsibility of the Contractor.

(F) FAILURE TO MAINTAIN ENTIRE PROJECT - Failure on the part of the Contractor, at any time, to comply with the provisions of 104.02, 616 and this S.P. will result in the immediate notification of the Contractor by the Engineer to comply with the required traffic maintenance provisions. In the event that the Contractor fails to make the needed corrections to unsatisfactory site maintenance so as to conform to the provisions of 104.02 and 616 within 24 hours after receipt of such notice, the Engineer may notify the Contractor to suspend all work at the contract work site until such time that the unsatisfactory site maintenance is corrected. In the event that the Contractor fails to respond to a notice of unsatisfactory site maintenance and correct the deficiency within 24 hours after receipt of such notice, the Engineer may immediately proceed with other forces and equipment to maintain the project. The entire cost of this maintenance by the District will be deducted from monies due the Contractor on the next monthly invoice.

A deduction of $200.00 will be made from the Contractor's next invoice for each day, or portion thereof, that traffic maintenance deficiencies exist and will continue until the deficiencies are corrected and accepted by the Engineer. Any portion of a day will be considered a full day deduction. The amount of monies deducted will be a permanent deduction and will not be recoverable.

(G) CONSTRUCTION LANE CLOSING AND TRAFFIC CONTROL DEVICES – All traffic control devices shall be in new or like new condition. All traffic control devices used on this project shall meet the testing and evaluation criteria specified in NCHRP (National Cooperative Highway Research Program) Report No. 350. Certifications that all traffic control devices meet said criteria shall be submitted to the Engineer for approval prior to use.

After completion of the project, all traffic control devices except those otherwise specified, shall remain the property of the contractor and shall be removed from the project site.

(H) TEMPORARY ASPHALT CONCRETE – All metal plates used for traffic shall be protected by asphalt concrete for smooth ride for the vehicles. This work shall be governed by Specification Section 411 except that this work will be considered as incidental to the items under Maintenance of Traffic and will not be measured for payment.

29. FLASHING AMBER WARNING LIGHTS, TYPE B, Item 616 016

GENERAL - Two Type B lights shall be placed on the approach end of each row of the temporary barriers or safety barrels. Type B lights shall also be placed on advanced warning signs where indicated on the plans.

30. PORTABLE PCC SAFETY BARRIER, Item 614 012

This Special Provision modifies 614.02(A) of the Standard Specifications.

Barrier ends shall have FHWA-approved interlocking configurations and/or mechanical devices to resist lateral movements, such as pin & loop and J-Hook connections. Tongue and groove and slot & plate connections are not acceptable.

Portable concrete barrier placed between the Kenilworth Avenue service roads and the removed existing Eastern Avenue bridge shall be securely attached to the existing concrete approach slab. The contractor shall submit a design for such attachment to the engineer for approval. The attachment shall be designed to prevent deflection of the barrier beyond the edge of drop-off when impacted by a WB-50 vehicle at an angle of 15 degrees traveling at 45 MPH.

31. REMOVE LANE MARKING, Item 616 006

This Special Provision supplements 616 of the Standard Specifications as follows:

All grinding marks on PCC Pavement shall be painted with a mixture of Concrete Slurry and Epoxy (Mix ratio to be determined by the Engineer). Work includes removal of the existing raised Reflective Pavement Marker lenses. Any damage done to the pavement shall be repaired, as required by the Engineer, at the contractor's expense.

32. CONSTRUCTION WARNING AND DETOUR SIGNS, Item 616 012

This Special Provision supplements and modifies 616.05 and 824.02 of the Standard Specifications.

All diamond shaped temporary warning signs shall be 48 inches by 48 inches. Fluorescent Orange High Performance Wide Angle Retroreflective Sheeting shall be used for all construction warning and detour signs on the project and shall conform to the requirements of FHWA Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects, D 4956 and the following retroreflective specifications:

MINIMUM REFLECTIVE INTENSITY VALUES FOR
HIGH PERFORMANCE WIDE ANGLE PRISMATIC LENS SHEETING
[Minimum Coefficient of Retroflection (R_a) cd/fc/ft^2 (cd × lx^{-1} × m^{-1})]

Observation Angle	Entrance Angle	White	Yellow	Red	Orange	Green	Blue	Fluorescent Orange
0.2	-4	800	660	215	450	75	43	200
0.2	+30	400	340	100	250	30	20	120
0.2	+50	35	23	6.6	16	1.8	1.0	50
0.5	-4	200	160	45	120	18	9.8	80
0.5	+30	100	85	26	70	10	5.0	50
0.5	+50	30	20	6.4	16	2.5	2.0	20

33. REFLECTIVE PAVEMENT MARKERS, Items 616 030, 616 032

This Special Provision modifies 616.11(C)(1) and 616.11(C)(2) of the Standard Specifications.

(C) CONSTRUCTION REQUIREMENTS – Temporary surface mount raised reflective pavement markers shall be used on all lane shifts on mainline Kenilworth Avenue during Phases 2A and 2B. Recessed, snow-plowable raised pavement markers shall be installed when final resurfacing occurs on mainline Kenilworth Avenue at the beginning of Phase 3.

34. REFLECTIVE BARRIER MARKERS

This Special Provision modifies 616.11(C)(3) of the Standard Specifications.

(A) GENERAL - Temporary reflective markers (white or yellow) shall be used to delineate barriers and guide traffic during the construction work zone. Top- and side-mounted markers shall be provided. Spacing of side-mounted reflectors shall be every 50 feet and shall conform to DDOT Std. Dwg. No. 614.06. Spacing of top-mounted reflectors shall be every 200 feet and shall conform to DDOT Std. Dwg. No. 614.07.

(B) MATERIALS - Temporary markers shall be, white or yellow as required, with adhesive suitable for direct application to the barrier surface, in general accordance with the S.P. for REFLECTIVE BARRIER MARKERS.

(C) METHODS - Install and remove markers as necessary for each construction phase at a maximum spacing of 7.5 meters for each direction of traffic in the adjacent lane. Stagger location of markers for each direction of flow as needed. Temporary markers may be reused if not damaged. Temporary Reflective Markers shall be installed on the traffic side of Portable PCC Barriers.

35. THERMOPLASTIC PAVEMENT MARKING, 4 INCH, Item 616 040 THERMOPLASTIC PAVEMENT MARKING, 6 INCH, Item 616 044 THERMOPLASTIC PAVEMENT MARKING, 12 INCH, Item 616 050

This Special Provision supplements 616.14 of the Standard Specifications.

(A) GENERAL - Work under these items consists of furnishing all materials for, and installation of, permanent thermoplastic lane markings for the project. Permanent markings shall be placed within 24 hours after placement of final surface, if roadway is opened to traffic.

(B) CONSTRUCTION METHODS -The newly applied markings shall be protected from intrusion by traffic by means of traffic cones, safety barrels or other approved means until such time as the material has dried sufficiently to bear traffic.

36. TRAFFIC CONTROL SPECIAL ITEM – CONSTRUCTION NEWSLETTER, Item 616 800

(A) DESCRIPTION – The contractor shall publish and distribute a construction newsletter to residents during construction. Editions of the newsletter shall be distributed at least seven days before the beginning of construction and seven days before the beginning of each temporary traffic control phase as shown in the maintenance of traffic plans. Where consecutive phases are anticipated to last less than seven days combined, information about consecutive upcoming phases may be combined in a single

newsletter.

The content of the newsletter shall include a description of the purpose of the project, timing of road closures and traffic switches, descriptions of detour routes and parking restrictions, information on relocated bus stops and pedestrian detours, and other information deemed pertinent by the Project Engineer for public awareness of the project's progress.

Distribution of the newsletter shall be to all residents and businesses along the Kenilworth Avenue service roads north of Nannie Helen Burroughs Avenue and south of the CSX rail line in Maryland. The newsletter shall also be distributed to all project stakeholders as identified in the project Transportation Management Plan (TMP).

37. TRAFFIC CONTROL SPECIAL ITEM – REMOVE & REPLACE LENSES FROM EXISTING RPMs, Item 616 803

(A) Description – The Contractor shall remove and store all lenses from existing raised pavement markers in areas where lanes are to be shifted but where later resurfacing is not proposed. The work shall occur concurrent with the removal of existing markings and installation of proposed temporary markings.

Upon completion of the applicable maintenance of traffic phases, the lenses shall be replaced in their original locations concurrent with lane closures to be used for adjacent areas that require milling, resurfacing, and remarking.

(B) MEASUREMENT AND PAYMENT - The removal and replacement of lenses from existing RPMs shall be measured and paid for at a unit cost per each lens. All labor, hardware, maintenance, and other incidentals shall be included in the work.

38. TRAFFIC CONTROL SPECIAL ITEM – COURTESY PATROL SERVICE, Item 616 804

(A) Description

This work consists of providing Courtesy Patrol Service (CPS) to motorists within the project area and surrounding roadways. The area of CPS coverage shall be along MD 201 (Kenilworth Avenue) from the U.S. 50 interchange to the Maryland/Washington, D.C. line and along DC 295 (Kenilworth Avenue) from the Maryland/Washington, D.C. line to the Nannie Helen Burroughs interchange. The area of coverage shall also include all detour routes described in the plans. The work includes locating, assisting, and clearing traffic related incidents. The use of the Courtesy Patrol shall be integrated into the Work Zone Transportation Management Plan (TMP).

(B) Materials

The Contractor shall provide tow truck vehicles needed to perform assistance services

as described in this specification. Each tow truck shall be a District of Columbia or Maryland licensed Class A vehicle with a minimum gross rating of 10,000 lbs. The truck shall have a dual wheel chassis and a four ton vehicle recovery rating. Each tow truck shall be equipped with the following:

(1) Wheel lift towing equipment, including high visibility safety straps with a minimum lift rating of 3,000 pounds.
(2) Hydraulic boom lift with a static rating of 5,000 pounds.
(3) Winch with an 8,000 pound rating.
(4) Cable with a 3,500 pound rating on the first layer of cable.
(5) Tow slings rated at 3,000 pounds each.
(6) Original Equipment Manufacturer (OEM) tow chains of 5/16 inch alloy.
(7) OEM JT hook assembly.
(8) Rear work lights.

One spare truck shall be provided. The spare truck shall be operational within 30 minutes of a breakdown of an onsite CPS truck.

The Contractor may use equivalent capacity flat bed trucks in lieu of tow trucks or a combination of both, as approved by the Engineer.

Each truck shall meet the following operating requirements:

(1) The truck's exterior and interior shall be cleaned periodically. The operator's personal articles or equipment shall be removed from the interior of the truck prior to the start of each shift. All damage to the truck, and damage to personal articles and clothing shall be repaired or replaced at the Contractor's expense. The tow truck shall be regularly maintained in accordance with the manufacturer's recommendations.
(2) The truck's exterior condition and color shall be approved by the Engineer.
(3) One DDOT supplied sign shall be mounted on each side of the tow truck and shall be displayed at all times during project working hours. No personal or corporate names or symbols will be permitted to be displayed during the hours the tow truck is being used for CPS services. Signs that are lost, stolen or damaged shall be replaced at the Contractor's expense.

Prior to start of CPS operations, the Contractor shall submit for approval a complete list of items that will be available in each tow truck. At a minimum, these items shall include the following:

(1) Three gallons of unleaded gasoline and three gallons of diesel fuel stored in approved and marked containers.
(2) Two gallons of ASTM and SAE approved standard radiator fluid.
(3) One flexible spout funnel.
(4) Four way metric lug wrench.
(5) Four way standard lug wrench.

(6) 2 Ton capacity floor jack on rollers.
(7) Rechargeable tire air pump (200 PSI capacity) with hoses and fittings.
(8) 12 Feet heavy duty booster cables.
(9) Ten traffic cones in accordance with Section 630.
(10) Three reflective triangular warning signs in accordance with MUTCD requirements.
(11) Three electric roadway flares.
(12) First aid kit compliant with OSHA and ANSI regulations for towing and emergency vehicles.
(13) 10 pound ABC fire extinguisher compliant with OSHA and ANSI regulations for construction zones.
(14) Hand broom with pan.
(15) 10 gallon plastic bucket with sealable lid for light debris.
(16) 20 pounds of traction sand properly stored.
(17) Four standard snow tire chains.
(18) Items necessary for winter conditions, including blankets, snow shovel, hand warmers, fresh drinking water, etc.

(C) Construction Requirements

(a) CPS Qualifications.

Each CPS operator shall be trained and certified in OSHA 10 Hour training and in basic first aid techniques, including CPR. The Contractor shall submit documentation confirming this training prior to the start of work.

(b) Service Requirements.

Upon acceptance of the Contractor's Contingency Plan for incident management (refer to Item 616 001(D) above), the CPS shall begin operation within seven calendar days prior to the start of Phase 1B work and shall operate until the end of Phase 6.

The CPS shall provide three types of service:

(1) At the owner's consent, relocate the disabled vehicle to a shoulder of roadway or an appropriate drop site for additional assistance or repairs.
(2) Assist local public agencies and law enforcement authorities as requested during a traffic related incident in the designated coverage area.
(3) Safely remove light debris from the incident area and inform appropriate authorities if debris is too large or unsafe to remove.

The CPS shall perform services up to the safe capacity of his equipment and experience. If a major traffic incident is beyond the capacity of the CPS, the Contractor shall immediately contact law enforcement and the Engineer. The CPS shall remain on site with emergency lights flashing and appropriate traffic control placed around the incident until local law enforcement arrives.

The CPS shall use discretion in providing cellular phone use to motorists. The Department will not remit the Contractor for phone calls made by motorists or calls made by the Contractor on behalf of the motorist.

The CPS shall inform the Engineer and the Contractor prior to responding to any incidents. The response shall include the location, time and estimated severity of the incident at a minimum.

The CPS operator shall maintain daily logs that include shift start and end times, roadways covered, and detailed incident data. Incident data shall include the date, type and time of incident, CPS arrival time, number of vehicles involved, motorist information, type of service provided, location of incident, number of lanes blocked and time lanes were cleared and opened to the traveling public. All logs shall be signed by the CPS and shall be submitted to the Engineer on a daily basis.

(c) Drop Sites.

The Contractor shall coordinate with local law enforcement agencies from both Maryland and the District of Columbia to determine if drop sites will be allowed for incidents occurring within their jurisdictions. If law enforcement denies the use of drop sites, the remainder of this section (c) will be null and void.

The Contractor shall establish at least two drop sites for vehicles within the project limits, or a reasonable distance from the project limits. The locations of the drop sites shall be clearly identified in the Contractor's Contingency Plan portion of the TMP. The drop sites shall be used as temporary parking and repair areas for vehicles towed from the project limits. The drop sites may also be used as accident investigation or motorist pullout area. If possible, the drop sites shall also serve as an area for stranded motorists to obtain additional assistance for vehicle repair. Preferably, the drop sites shall be well lit and shall have access to public telephones and public restrooms. The drop site shall be capable of providing adequate parking for a minimum of two vehicles. In addition, adequate space shall be provided for the tow truck to safely unload the disabled vehicle. The drop site shall be located at a safe distance away from the roadway, preferable outside the clear zone. Unless arrangements are made with local businesses, the drop sites shall be maintained daily to be free of snow, debris, and easily accessible. The maintenance of the drop sites will not be measured and paid for separately, but shall be included in the work.

Prior to moving a vehicle to the drop site, the Contractor shall obtain the following information from the driver or owner of the vehicle:

1) Motorist first and last name
2) Owners first and last name
3) Vehicles license plate number
4) Vehicle make and model

5) Condition of vehicle
6) Signature of driver

The Contractor shall maintain a daily log that includes the time the vehicle was placed at the drop site, removed from the drop site, and vehicle information collected prior to moving the vehicle to the drop site. Any claims or damages to vehicles while stored at the drop site shall be handled in conformance with section 107. The maintenance of the drop sites will not be measured and paid for separately, but shall be included in the work.

At the Contractor's discretion, local business parking areas may be used as drop sites. The Contractor shall coordinate with local businesses to ensure that the vehicles can be parked at designated locations free of charge for a maximum of 12 hours per vehicle. The Contractor shall be solely responsible for all motorist injury or vehicular damage that occurs during the transport, repair or storage of the vehicle during these 12 hours. The Contractor shall inform the motorist in writing to remove the vehicle from the drop site within 12 hours. All vehicles left longer than 12 hours at the drop site shall be moved to a local facility, upon approval of the Engineer. The Contractor shall be remitted for all towing costs in accordance with subsection 109.03. The Contractor shall ensure that some of the businesses at the drop site are open during the time the motorist is present, or the Contractor shall accompany the motorist to the vehicle for safe retrieval if requested by the motorist. The Contractor shall provide written documentation from the business owners indicating approval of the drop site, and if appropriate, maintenance of the drop site. Additional working relationships or contracts will not be permitted.

If the motorist or the CPS deems the drop site unsafe, the Engineer shall be contacted immediately to make alternate arrangements for the motorist.

(d) Courtesy Patrol Hours of Operation and Response Times.

The CPS shall cover all roadways and detours within the project limits, regardless of weather.

The Contractor shall provide one or more trucks that shall circulate along the proposed detour routes during peak hour periods of 6:00 AM to 9:00 AM and 3:30 PM to 6:30 PM, Monday through Friday during the entire duration that the detours are in place. During Phases 2A and 2B, one or more additional trucks shall be located on standby immediately downstream of the diverted expressway lanes to facilitate clearing them or the adjacent local service road lanes of vehicles or debris in the event of an incident. The additional trucks for Phases 2A and 2B shall be provided during the following hours:

Along northbound Kenilworth Ave.: 6:00 AM to 9:00 PM, Monday-Friday
Along southbound Kenilworth Ave.: 5:00 AM to 8:00 PM, Monday-Friday

Two trucks shall also be provided immediately downstream of the diverted expressway lanes on any holidays as defined above in 616 001(C)1 that occur while Phases 2A or 2B are in effect, during hours to be determined by the Engineer.

The CPS shall respond to incidents within the diverted expressway lanes in less than 5 minutes of occurrence during Phases 2A and 2B, and within 10 minutes at other locations within the project area.

(e) Courtesy Patrol Coverage Area.

The Contractor shall determine the number of tow trucks required and shall submit a method statement to the Engineer for approval and incorporation into the TMP. The method statement shall include the number of tow trucks required and the location and spacing of these trucks. If the response times are not met, the Engineer may require additional testing or monitoring of CPS operations, such that adjustments may be made. All adjustments shall be implemented within three calendar days and shall be at the Contractors expense.

(D) Measurement and Payment

Courtesy Patrol Service will be measured and paid by the actual number of hours that the service is utilized in the project, regardless of the number of trucks or operators that are utilized to provide the service at any given time.

Tow trucks, equipment, maintenance, and CPS related items will not be measured and paid for separately, but shall be included in the work. Re-stocking of CPS related items will not be measured and paid for separately, but shall be included in the work.

CPS certification and training will not be measured and paid for separately, but shall be included in the work.

Maintenance of drop sites (if allowed by law enforcement agencies) will not be measured and paid for separately, but shall be included in the work. Alternate arrangements for motorists when drop sites are deemed unsafe will not be measured and paid for separately, but shall be included in the work.

The following items shall be considered incidental to the work:

(1) Vehicles provided in excess of those stipulated in the TMP.
(2) Overtime, shift differential, or any other rate adjustments.

39. TRAFFIC CONTROL SPECIAL ITEM – VISUAL SCREEN MOUNTED ON TOP OF TEMPORARY PCC BARRIER, Item 616 805

(A) GENERAL - Visual screens shall be attached to the top of portable concrete barrier

where noted on the plans. Visual screens shall be opaque to prevent drivers from seeing into the adjacent lane and shall obscure the view of pedestrians into the work area and into the diverted expressway lanes.

(B) MATERIAL – The visual screen shall be constructed of double reverse corrugated metal screen. The screen fabric shall be fabricated from 25 gauge steel sheet AISI 1010 or 1008 which has been hot dip galvanized to ASTM A-653, coating designation G90.

Finish shall be medium gloss powder coat epoxy paint with zinc conforming to ASTM D 523 for gloss and B 117 for salt spray resistance, reference test for Bonderite. Film thickness shall be a minimum of 1.8 mils.

(C) METHODS – The visual screen shall be installed in accordance with the recommended practices and details provided by the manufacturer.

(D) MEASUREMENT AND PAYMENT – The visual screen shall be measured and paid for at a unit cost per linear foot of screen provided. All labor, hardware, maintenance, and other incidentals shall be included in the work.

40. TRAFFIC CONTROL SPECIAL ITEM -5" DASHED WHITE PERMANENT PERFORMED PATTERNED REFLECTIVE CONTRAST PAVEMENT MARKINGS (PPPRCP) (10' LINE, 30' GAP), Item 616 811

(A) DESCRIPTION. This work shall consist of furnishing and applying permanent preformed patterned reflective contrast pavement (PPPRCP) markings as specified in the Contract Documents or as directed by the Engineer. PPPRCP markings shall be utilized to replace existing white lane lines and edge lines (5" white skip lines) on existing concrete bridge decks.

(B) MATERIALS.

The material shall be capable of adhering to hot mix asphalt and Portland cement concrete surfaces, and to any existing pavement markings in conformance with manufacturer's recommendations by a precoated pressure sensitive adhesive. A primer shall be used to precondition the surface if recommended by the manufacturer.

The material shall be highly durable and retroreflective and shall be fabricated of a polymeric material designed for longitudinal markings subjected to high traffic volumes and severe wear conditions, such as shear action from crossover or encroachment on typical longitudinal configurations, and where high levels of reflectivity are required to ensure the safety of the motoring public.

The material shall be of good appearance and free from cracks. Edges shall be true, straight, and unbroken. Line marking material shall be in rolls having no more than three splices per 150 ft of length. No splices should occur for lengths less than 150 ft.

All marking materials shall be packaged in conformance with accepted commercial standards and shall have a maximum shelf life of one year from date of manufacture.

The material shall remain in place on the pavement surface without being displaced by traffic, and shall not be affected by weather conditions.

Permanent Preformed Patterned Reflective Contrast Pavement Marking Material Components.

(a) Composition. The material shall consist of a mixture of polymeric materials, pigments and reflective spheres distributed throughout the base cross-sectional area and reflective spheres bonded to the topcoat surface to provide immediate and continuing retroreflection. The PPPRCP material shall consist of white and black tapes bonded together at the manufacturer's facility to form a one piece roll. The PPPRCP material may consist of two separate tapes; white and black tapes that are placed together in the field. The single roll or the two separate tapes shall have a total with three inches wider that the normal width of the tape. The black portion shall be evenly divided with one and one half in. on each side of the white or yellow markings.

(b) Restrictions. The combined total of lead, cadmium, mercury, and hexavalent chromium shall not exceed 100 ppm. Diarylide based pigments and nonleachable lead pigmentation are prohibited. The presence of these compounds shall be tested for compliance to the specification by X-ray diffraction, ICP, or another comparable method capable of this level of detection.

Permanent Preformed Patterned Reflective Contract Pavement Marking Material Physical Requirements.

(a) Reflectance. The manufacturer shall certify that the white materials shall have the minimum initial retroreflectance values of 350 mcd/L/m2 for white in any 528 ft section. Reflectance shall be measured using a reflectometer with CEN 30 meter geometry (88.76 degree entrance angle and 1.05 degree observation angle). The black material shall have no reflectance when measured with a reflectometer.

(b) Color. The color of preformed markings shall essentially match the 37886 or 37038 color chips for white or black respectively as shown in Federal Standard 595A.

(c) Frictional Resistance. The surface of the retroreflective pliant polymer shall provide a minimum initial average skid resistance value of 45 BPN when tested in conformance with E 303.

Field Testing. Materials conforming to this Specification shall be field evaluated at the National Transportation Product Evaluation Program (NTPEP) North test deck for performance. Materials performing satisfactorily throughout the test period will be placed on the Maryland State Highway Administration's Prequalified Materials List.

All marking materials supplied during the Contract shall be identical in composition to the materials submitted for initial testing. Conformity with these requirements will be determined by the Maryland State Highway Administration's Office of Materials and Technology.

Prequalification. Samples will be taken by the Administration for testing. The manufacturer shall submit any data from AASHTO NTPEP North Test Deck that support material performance. Materials conforming to this Specification will be placed on the Maryland State Highway Administration's Prequalified List of Patterned Tapes.

Certification. The Contractor shall furnish notarized certification as specified in TC-1.02. The manufacturer shall certify that any reflective thermoplastic materials supplied during the Contract conforms to the identical formulation as the samples submitted for evaluation on the NTPEP North test deck, and identify the formulas by referring to the code used on the deck. Reflective thermoplastic materials that fail to conform will be rejected.

The manufacturer shall also provide the following:

(a) Material Safety Data Sheets for all materials submitted for testing and use.

(b) A facility, presently in operation, capable of producing the reflective thermoplastic materials in the quantity and quality required by the Administration.

(c) A laboratory subject to the Administration's approval that is capable of performing the required tests.

(C) CONSTRUCTION.

General. PPPRCP markings shall be applied in conformance with the manufacturer's recommendations or as directed by the Engineer.

When the Contract Documents specifies the use of PPPRCP markings on concrete pavements or existing asphalt pavements, the Contractor shall use heat, solvent, or other type of adhesive primer in conformance with the manufacturer's recommendations.

PPPRCP markings shall conform to pavement contours and be resistant to deformation by traffic and damage from snow removal equipment. Surface preparation, use of solvents and primers, and equipment used in the application of PPPRCP markings shall conform with the manufacturer's recommendations and be approved by the Engineer. After PPPRCP markings are applied, they shall be immediately ready for traffic.

The PPPRCP markings shall consist of durable retroreflective white pliant polymer markings with durable matte black nonreflective pliant polymer borders. The total width of the PPPRCP markings shall be an additional 3 in. wider than the nominal

width specified. This additional 3 in. shall be a black nonreflective film with 1-1/2 in. on both sides of the white film.

Quality Assurance/Quality Control. Refer to 549.03.01.

Cleaning Pavement Surfaces. Refer to 549.03.02.

Application. Refer to 549.03.03 and the following:

(a) Manufacturer's Recommendations. The Contractor shall provide a copy of the manufacturer's recommendations to the Engineer, and shall follow them for the installation of the line markings.

(b) Adherence. Adherence of PPPRCP markings shall be randomly checked by using a paint scraper or another approved tool, which shall be held nearly parallel with the highway surface, so there is no dislodging of the tape.

(c) Thickness. The finished thickness of the PPPRCP markings shall have a minimum caliper of 0.060 in. at the thickest portion of the patterned cross section, and a minimum caliper of 0.020 in. at the thinnest portion of the cross section. Thicker material shall maintain the same ratio. Measurements shall be made from the top of finished pavement surface.

(d) Color. The color of the markings shall match Federal Standard 595 (37886 – white, or 37038 - black). The Contractor shall supply the specified color chips for the Engineer's use to visually determine that the PPPRCP markings match the specified color.

(e) Retroreflectance. Refer to 549.03.03 and the following:

MINIMUM RETROREFLECTANCE

COLOR	RETROREFLECTIVITY	CORRECTIVE ACTION
White	350 or higher	None
White	less than 350	Necessary corrective actions, removal, replacement
Black	greater than 15	remove and replace

(f) Width. Refer to 549.03.01.

(g) Alignment. Refer to 549.03.01.

(h) Layout Markings. Refer to 549.03.01.

(i) Quality Control Test Strip. Refer to 549.03.03.

(j) Protection During Application. Refer to 549.03.05.

(k) Observation Period. The Contractor shall be responsible for any defects in materials and workmanship of the PPPRCP markings for a period of 180 days from the date the markings are applied and under traffic.

The Engineer will not assess time charges during the observation period provided all other work on the Contract is complete. At the end of the observation period, the Engineer will inspect the pavement marking for durability, color, and reflectivity; and inform the Contractor of all pavement markings that have failed and require replacement. The pavement marking will be considered failed for any of the following conditions:

(a) More than five percent of the substrate is exposed in any 2000 ft section of longitudinal pavement marking line.

(b) Retroreflectance values have dropped below 300 mcd/L/m2 for white

(c) Marking is discolored on a visual comparison with the color chips.

The Contractor shall remove and replace all failed PPPRCP markings within 30 days of receiving written notification from the Engineer at no additional cost to the Department. Work shall be in conformance with the manufacturer's recommendation and as approved by the Engineer before the project is accepted. The replacement markings shall conform to the same requirements as the original markings. If the work is not completed in this period, the Engineer will resume time charges until this work is completed.

At the end of the observation period, the Engineer will accept the work and terminate the Contractor's responsibilities upon satisfactory inspection of the PPPRCP markings.

(D) MEASUREMENT AND PAYMENT. Permanent Preformed Patterned Reflective Contrast Pavement Markings will be measured and paid for at the Contract unit price per linear foot for the color and width specified. The payment will be full compensation for removal of existing pavement markings, all pavement preparation, furnishing and placing new markings, testing, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Removal, Replacement, or Corrective Actions. Any additional cost (including Maintenance of Traffic) for the removal of markings that are incorrectly or inaccurately installed or failed the observation period, shall be at no additional cost to the Department.

41. TRAFFIC CONTROL SPECIAL ITEM - COVER EXISTING SIGN, Item 616 818

(A) GENERAL - Existing Regulatory Signs, Warning Signs, Guide Signs, and Pavement Markings. Relocate, turn, completely cover with opaque material, or remove with the approval of the Engineer, signs that are not applicable due to temporary traffic conditions. Properly redisplay signs to traffic as soon as conditions warrant. Replace any signs misplaced or damaged by the Contractor's operations.

Prior to construction and in the company of the Engineer, inventory and note the location, type, size, and color of all existing pavement markings, legends, and symbols. Submit the results on a marked up set of the Contract Plans or on Contractor prepared sketches or drawings.

(B) MEASUREMENT AND PAVEMENT – Covering existing signs shall be measured and paid for at a unit cost per square foot. All labor, hardware, maintenance, and other incidentals shall be included in the work.

42. REMOVE EXISTING OVERHEAD SIGN, Item 620 030

This Special Provision supplements 620.07 of the Standard Specifications.

(B) CONSTRUCTION REQUIREMENTS – The existing overhead sign (Pkwy-Baltimore/No Trucks) attached to the existing Eastern Avenue bridge shall be removed and become the property of the contractor. All other overhead signs designated for removal shall be stored by the contractor and then re-installed at the same location during the phase of construction indicated on the traffic control plans.

43. D.C. WATER AND SEWER AUTHORITY SPECIFICATIONS, Items 207 002, 207 004, 207 006, 207 008, and as listed herein

The Water and Sewer Authority Specifications shall be used only for the items listed below. Specifications are included in the Appendix of these Special Provisions. These Specifications supersede the District of Columbia Standard Specifications for Highways and Structures, 2005, revised 2007 and amendments thereto:

DESCRIPTION / ITEM NO.	SECTION
Trench Excavation and Backfill, Item 207 002	02220
Trench Undercut Excavation, Item 207 004	02220
Gravel for Trench Undercut, Item 207 006	02220
Borrow Trench Backfill, Item 207 008	02220
Sewer Manhole on Sewer 48 Inch and Less Dia., Item 309 002	02705
Double Water Quality Control Basin, Item 310 005	02720

Basin Connect PCC Pipe, Class III, Item 15 Inch 310 008	02720
PCC Pipe, Class III, Gasket, 18", Item 314 006	02730
For Pump Station:	
Demolition, Item 205 009	02050, 02076, 02085, 13283
Mechanical Work - Dry Pit Submersible Pump, Item 619 002	Division 15 Specifications
Mechanical Work Special Item – Pumping Station Rehabilitation, Item 619 800	Division 15 Specifications
Miscellaneous Electrical Work Special Item - Pumping Station Rehabilitation, Item 621 800	Division 16 Specifications
Miscellaneous Electrical Work Special Item - Communication Web Based, Item 621 801	Division 16 Specifications
Miscellaneous Electrical Work Special Item - Upgraded Electrical Service, Item 621 802	Division 16 Specifications
Non-shrink Grout < 1", Item 700100	03600
Structural Steel, Item 706800	05120
Heavy duty exterior steel door, Item 706801	08110
Grating, Heavy-Duty Steel Bar Grating, Item 706802	05530
Concrete Repair Type 1- 2.5 inches and over, Item 716011	03301
Concrete Repair Type 2 - Less than 2 Inches, Item 716013	03301
Concrete Repair Type 3 - Crack Repair, Item 716015	03301
Concrete Repair Type 4- Pump and Sump Room, Item 716017	03301
Concrete Repair Type 4- First Floor Room, Item 716019	03301

44. CLEAN SEWER STRUCTURES, Item 311 063

(A) GENERAL - Work consists of cleaning selected sewer structure (storm sewer) within the limits of the project, when directed by the Engineer.

The sewer structures shall be cleaned of all silt and deposits (leaves, trash, etc.) by either manual or mechanical means. Work shall also include removing debris to a distance of 2 ft. into the attached connecting pipe. Debris extracted from the inlet must be removed from the work site by the end of the workday.

(B) MEASURE - The unit of measure for **Clean Sewer Structure** will be each and this measure shall include the elongated section, catchment chamber and the connecting pipe as specified.

(C) PAYMENT - Payment for Clean Sewer Structure will be made at the contract unit price

per each, which payment will include all labor, equipment, tools, materials, and incidentals necessary to complete the work as specified herein.

45. CLEAN PCC PIPE, Item 311 065

(A) GENERAL - Work consists of cleaning PCC Pipe (inlet connection pipe) within the project limits, when directed by the Engineer.

If, during the sewer structure cleaning process, the Engineer determines that a connecting pipe is clogged or requires cleaning, he shall direct the Contractor to clean the connecting pipe.

The connecting pipe shall be cleaned of all debris and thoroughly flushed by use of high-pressure hose. All work to be performed must meet the requirements of Water and Sewer Authority. Any material extracted from the pipe during cleaning operations must be removed from the site by the end of the working day.

(B) MEASURE - The unit of measure for **Clean PCC Pipe** will be **Linear Foot** and this measure shall be the horizontal distance, along the surface from the attached wall of the inlet to the center of the connecting sewer structure minus 2 feet.

(C) PAYMENT - Payment for **Clean PCC Pipe** will be made at the contract unit price per **Linear Foot**, which payment will include all labor, equipment, tools, materials and incidentals necessary to complete the work as specified herein.

46. CAP INLET AND RESTORE BACK TO ORIGINAL CONDITION, Item 309 800

(A) GENERAL - Work consists of capping existing curb inlet during construction for proper maintenance of traffic. Once the construction is finish restore the inlet and manhole back to original state. The existing frame / cover and inlet tops shall be protected and shall be reused. The contractor shall provide complete detail and work sequence for Engineer's approval prior to start of work.

(B) MEASURE - The unit of measure for **Cap inlet and restore back to original condition** will be **Each** and comprises of all the work described above including all labor, equipment, tools, materials and incidentals necessary to complete the work as specified herein.

(C) PAYMENT - The unit of pavement for **Cap inlet and restore back to original condition** will be **Each** and includes all labor, equipment, tools, materials and incidentals necessary to complete the work as specified herein.

47. SPECIAL SEWER MANHOLES, Item 309 801

This Special Provision modifies and supplements 309 of the Standard Specifications.

(A) **GENERAL** - Work consists of excavation, backfill and compaction beyond trench pay limits, disposal of excess excavated material, furnishing and placing all materials and constructing special sewer manholes, including concrete base and manhole frames and covers as per details shown in the contract documents or as directed by the engineer.

(B) **SUBMITTALS** - The requirements of 309.02 apply.

(C) **MATERIALS** - The requirements of 309.03 apply.

(D) **CONSTRUCTION REQUIREMENTS** – The requirements of 309.04 apply.

(E) **MEASURE** - The unit of measure for **Special Sewer Manhole** will be **Vertical Linear Foot** and this measurement will be based on WASA standard section 02705.

(C) **PAYMENT** - Payment for **Special Sewer Manhole** will be made at the contract unit price per **Vertical Linear Foot**, which payment will include all labor, equipment, tools, materials and incidentals necessary to complete the work as per WASA section-02705.

48. CONVERT CURB INLET INTO GRATE INLET AND CONVERT BACK, Item 310 800

(A) **GENERAL** - Work consists of capping existing curb inlet and manhole during construction for proper maintenance of traffic. Once the construction is finish restore the inlet and manhole back to original state. The existing frame / cover and inlet/manhole tops shall be protected and shall be reused. The contractor shall provide complete detail and work sequence for Engineer's approval prior to start of work.

(B) **MEASURE** - The unit of measure for **Cap inlet/ manhole and restore back to original condition** will be **Each** and comprises of all the work described above including all labor, equipment, tools, materials and incidentals necessary to complete the work as specified herein.

(C) **PAYMENT** - The unit of payment for **Cap inlet/ manhole and restore back to original condition** will be **Each** and includes all labor, equipment, tools, materials and incidentals necessary to complete the work as specified herein.

49. DOUBLE WATER QUALITY CONTROL BASINS, Item 310 005

This Special Provision modifies and supplements 310 of the Standard Specifications.

(A) GENERAL - Work consists of excavation and backfill, disposal of excess excavated material, furnishing all materials and constructing double water quality control basins according to the Water and Sewer Authority details attached in these specifications.

(B) SUBMITTALS - The requirements of 310.02 apply.

(C) MATERIALS - The requirements of 310.03 apply.

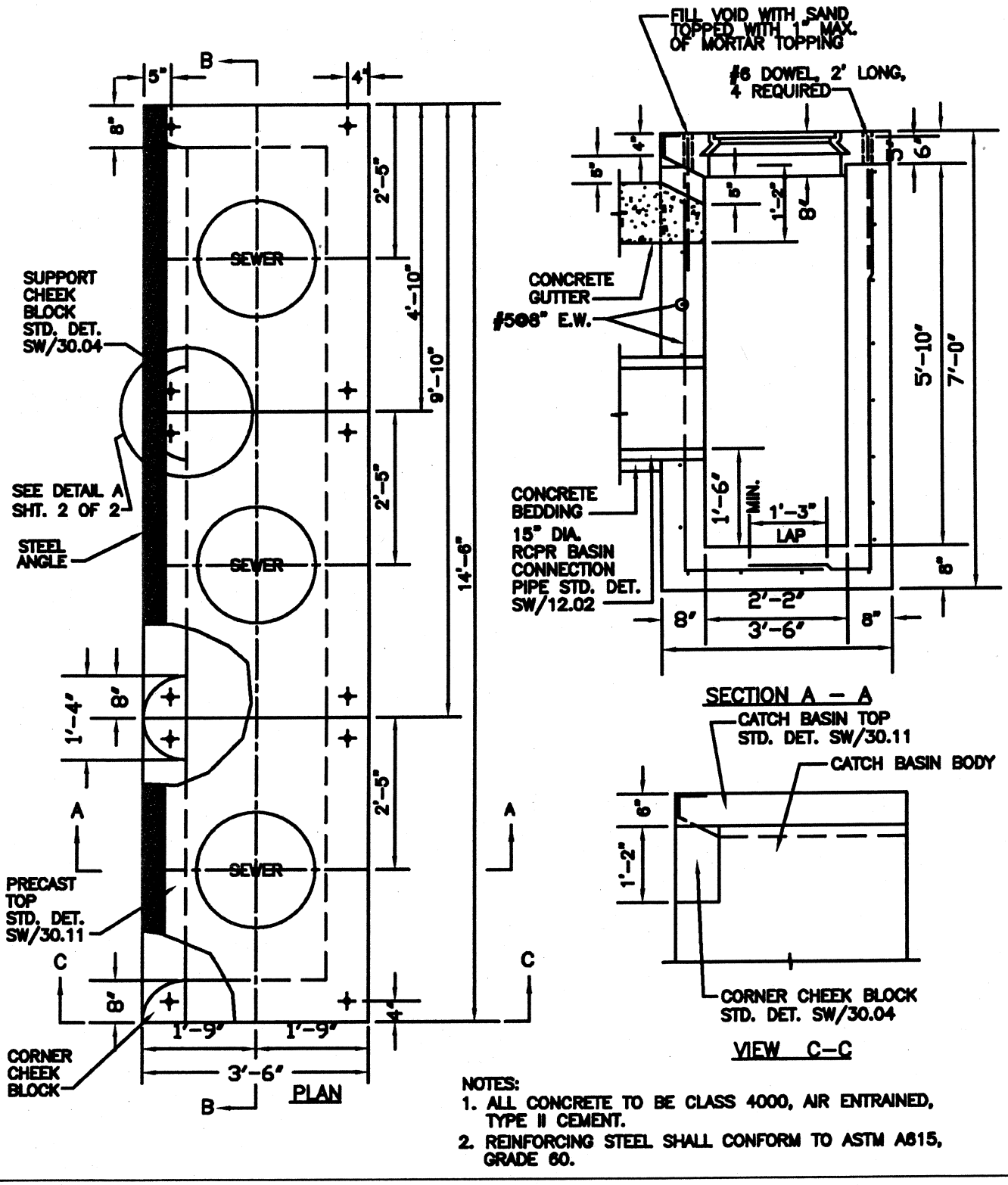
(D) CONSTRUCTION REQUIREMENTS – The requirements of 310.04 apply.

(E) MEASURE AND PAYMENT – The unit of measure for **Double Water Quality Control Basin** will be each.

Payment for **Double Water Quality Control Basin** will be made at the Contract unit price per each, which payment will include all labor, materials, tools, equipment and incidentals needed to complete the work specified.

DISTRICT OF COLUMBIA
WATER AND SEWER AUTHORITY

1 OF 3

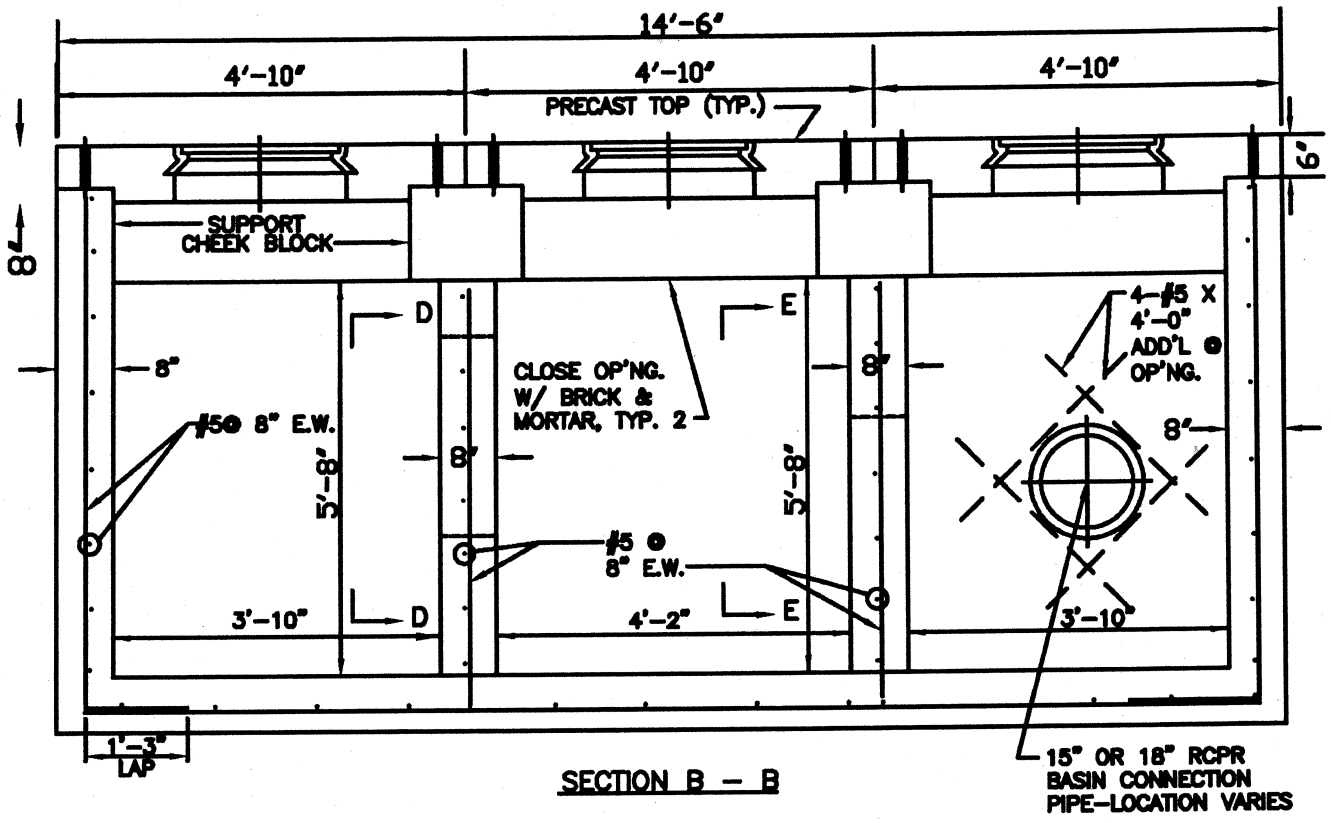


NOTES:
1. ALL CONCRETE TO BE CLASS 4000, AIR ENTRAINED, TYPE II CEMENT.
2. REINFORCING STEEL SHALL CONFORM TO ASTM A615, GRADE 60.

DETAIL
DOUBLE WATER
QUALITY CONTROL BASIN

DISTRICT OF COLUMBIA
WATER AND SEWER AUTHORITY

2 OF 3



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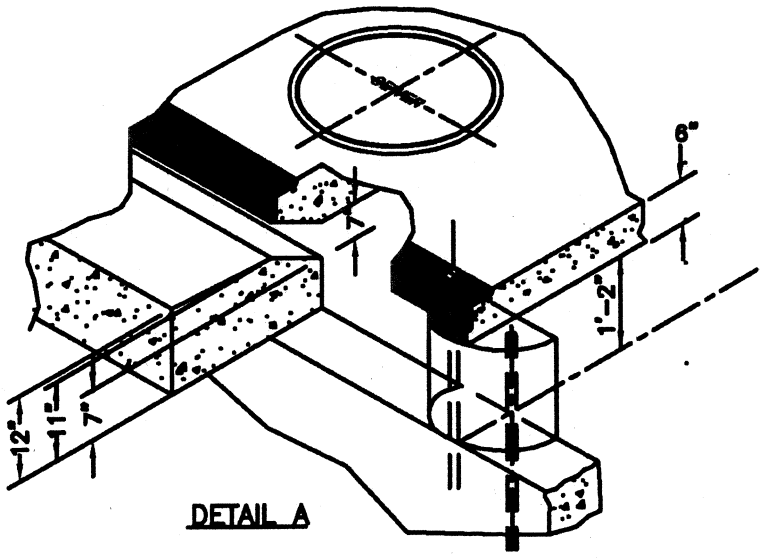
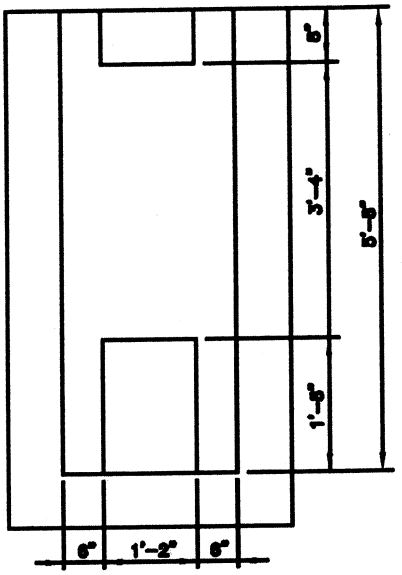
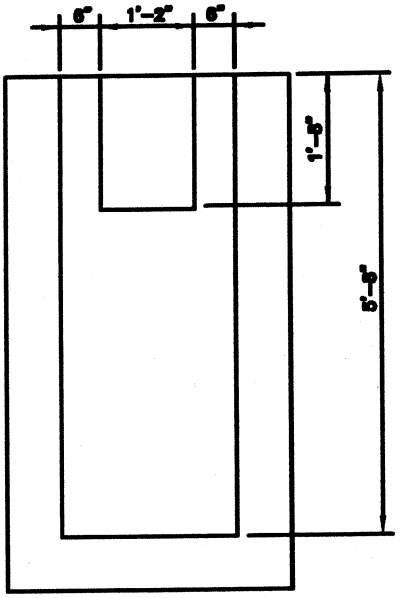


DETAIL A

DETAIL
DOUBLE WATER
QUALITY CONTROL BASIN

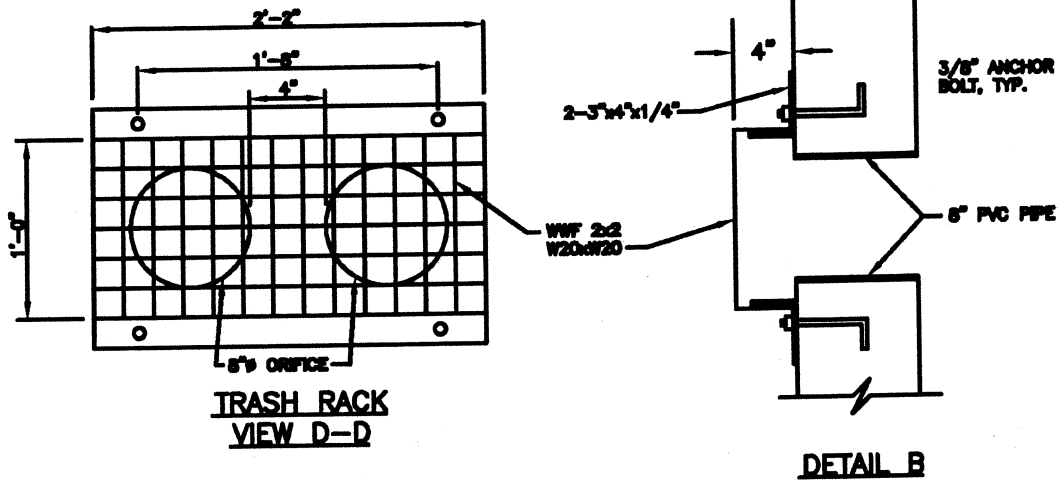


VIEW D–D



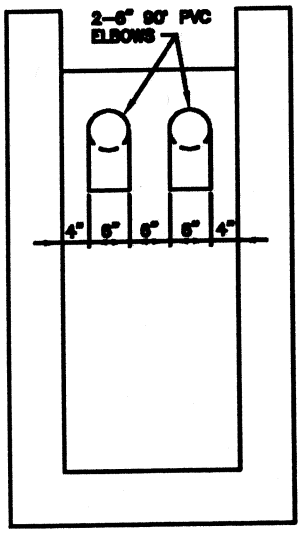
VIEW E–E

DETAIL
DOUBLE WATER
QUALITY CONTROL BASINS



TRASH RACK
VIEW D-D

DETAIL B



VIEW E-E

DETAIL
DOUBLE WATER
QUALITY CONTROL BASINS

50. UNDERDRAIN CONNECT PIPE, 8 INCH, Item 603 014

This Special Provision modifies and supplements 603 of the Standard Specifications as follows:

(A) **GENERAL** – Work under this item also includes connecting existing 8 inch retaining wall underdrain pipe system with an 8 inch PVC pipe. This new 8 inch PVC underdrain pipe then connects to 18 inch RCP at the mid-point or above and have a positive slope at all times. This 8 inch PVC shall have a suitable water-tight connection at both ends. The work includes Labor, fittings and necessary materials to complete the work.

(B) **MEASURE and PAYMENT** - The unit of measure and Payment for **Underdrain Connect pipe** will be **Linear Foot** and will also include labor, fittings and necessary material to complete the work.

51. STREETLIGHTING

This Special Provision revises and supplements 617 and 618 of the Standard Specifications.

SCOPE: STREET LIGHTING

1. Furnish and install conduits, manholes, streetlight, traffic signal pole, and traffic signal controller foundations, pendant post, twin 20 steel/cast iron post, #16 Cast Iron poles, wood pole arms, PVC u-guard, luminaires, conversion kits, globes, photo controls, feeder cables, cables in poles, and all necessary electrical splices

2. Furnish and Install Junction boxes, Rigid Metal Conduit, cables with splices, wall mounted fixtures, lamps and photo controls for lighting under the bridges structure and the north approaches.

3. Removal of the existing street lighting system including luminaires, photo controls, pendant post streetlight poles, transformer bases, wood pole arms, cables, foundations, manholes and abandonment of conduit, as directed by the Engineer. **The Contractor shall maintain the level of streetlight illumination within the project limits by the use of the existing and proposed lighting poles.** There will be no direct payment to the Contractor for maintaining the lighting during construction.

4. Removal of all signs on the existing street light poles, storage and permanent reinstallation of the signs on the new street light poles or new u-post.

5. During this contract all the streetlight service conduits will be replaced with new conduits. The existing street light feeder cables will be removed from the conduits.

6. The Streetlight Contractor shall construct, abandon and or remove all below ground traffic signal conduits, foundations manholes and hand boxes.

7. Other essentials necessary for the satisfactory installation of the roadway lighting system shown on the plans, whether specifically mentioned or not.

The Potomac Electric Power Company currently supplied power to the existing streetlight system from its manholes. PEPCO will supply the power at 120/240 volt to the permanent roadway lighting system. The Contractor shall install the new feeder cables into PEPCO's facilities, under PEPCO's supervision and inspection.

The contractor shall cut when required the existing D.C. cables for new connections in PEPCO owned manholes. PEPCO owns the service tap onto their electrical system. D.C. owns the cable after the service tap to the street light(s).

All new service taps onto PEPCO's electrical distribution system will be performed by PEPCO Forces.

REQUIREMENTS:

(A) GENERAL

All work performed under this contract shall conform to the National Electrical Code (NEC), District of Columbia Electrical Code, District of Columbia Standard Specifications 2005 (revised 2007), Streetlight Electrical Specifications and District of Columbia Streetlight Policy and Design Guideline (March 2005).

Before any electrical work is performed, the electrical Contractor must be licensed and bonded in the District of Columbia and must apply for an electrical permit to perform electrical work in public space. An electrical permit may be obtained by contacting the Public Space Permit Office located on the 1st floor, 941 North Capitol Street, N.E. Washington, D.C. 20000 Mr. Thomas Fulton (202) 478-9193. This application must be signed by a Master Electrician or Electrical Engineer who is required to be licensed in the District of Columbia.

The Contractor's employees installing the electrical work must be licensed in the District of Columbia as a Master Electrician, Electrician or Apprentice Electrician. When Apprentice Electricians are working, a Master Electrician or an Electrician must be on the project site for personal supervision.

The Contractor shall have a copy of the drawings, Electrical Permit and all approved Catalog Cuts on the job at all times when electrical work is being performed.

All electrical work must be inspected by the electrical inspectors of the District Department of Transportation. Forty-Eight (48) hour advance notice is required for inspection. The phone number for the electrical inspector's office is (202) 741-5368 Mr. Bird.

Violation of any electrical code, the Special Provision, Standard Specifications for Highways and Structures (2007) or any other requirements will cause the work to be **STOPPED IMMEDIATELY.**

There will be not direct payment for all testing of ground rods and insulation testing of cables. The cost will be paid for these items shall be paid as part of the Pay Items for Furnish and Install foundations, manholes and stranded cable.

The Contractor is also put on notice that due to the long lead times required to obtain the streetlight posts from the manufacturers, that the Contractor shall not be given additional time for completion of the project.

The Potomac Electric Power Company (PEPCO) will furnish power for the street lighting systems. All work involved with PEPCO facilities shall be performed in conformance with the PEPCO requirements attached in the Appendices. The Contractor shall install the new feeder cables into PEPCO's facilities, under PEPCO's supervision and inspection.

It shall be the Contractor's responsibility to notify and coordinate with PEPCO throughout the construction of the project in connection with all PEPCO services and facilities in the construction area, such that removal and restoration of services can be done in a timely and orderly manner at all times. Construction delays as a result of inadequate coordination shall be the Contractor's responsibility.

It should be noted that the D.C. electrical system is unfused, unprotected with no disconnecting means other than cutting the cable from the feed source.

The Contractor shall be expected to perform electrical work on D.C. cables with the knowledge that the circuits are energized.

The Contractor is here by notify that there could be remote relays located within the project limits, if one is found the Contractor shall notify the Electrical Engineer IPMA team 4 (202) 671-5340.

The Contractor is hereby put on notice that he will be responsible for maintaining the streetlights within the limits of the project from the Notice to Proceed until final acceptance by the District. This shall include all streetlight outages and pole knockdowns. all streetlight outages shall be repaired within 24 hours of being notified by the Project Engineer.

Material removed from service, as part of this project shall be returned to the District of Columbia, Department of Transportation Warehouse, located at 1735 15th Street, N.E., Washington, D.C. as directed by the Project Engineer. All poles and/or parts returned to the District shall be disassembled and stacked/shelved at the warehouse under DC-DOT warehouse personals direction and supervision. All HPS cut-off type luminaires shall be tested, proved functional, in good reusable condition, then they will be wrapped in bubble wrap, boxed, sealed, the boxes marked with the date, size, voltage and shelved at the warehouse under DC-DOT warehouse personals direction and supervision. All other material not returned to the District shall become the Contractor's property and be disposed of at no additional cost to the District.

The Contractor upon completion of the project shall submit a complete set of as-built drawings of the streetlight portion of the project to the DDOT, IPMA, Team 4. The as-built drawings shall meet the requirements of 108.12.

The as-built drawings shall include Maryland Grid indication to show pole and manhole location. Manhole and pole shall be assigned with a Grid Number, which is consistent with the DC Street Lighting Numbering System. The set of drawings shall bear the signature of an officer of the Contractor's organization, certifying compliance with as-built conditions.

The contractor shall coordinate the installation and removal of streetlights with the IPMA, Team 4 (202) 671-5340, and must submit a schedule for the removal and installation of street light poles for approval to the commencement of this project. The approval of this schedule will have a direct bearing on the notice to proceed for the contract. The schedule must include where an existing street light pole is replaced in the same location

The above schedule must reflect the dates for each streetlight replaced under this contract. The following information must be supplied by the Contractor before starting to work:

1. Removal date of each street light pole & fixture (putting it out of service)
2. The date of the complete operational installation of the street light pole & fixture
3. The time between the removal date & complete operational installation must not exceed 8 calendar days for any underground fed light.

(B) PEPCO SERVICE

The Contractor shall coordinate with PEPCO for the following:

1. Payment to PEPCO for manhole entry before any entry into their manholes.
2. Payment to PEPCO for any PEPCO forces work (SLF – Work Orders)
3. To have each "PEPCO MANHOLE" inspected by PEPCO forces and the Electrical Contractor on this contract for safety, clearing of the cables racked on the walls, spotting of the wall for new conduit penetrations and the knowledge of the location of each feed manhole for the street lights.
4. Calling PEPCO when it is necessary for PEPCO Forces to make the taps onto their Electrical System to energize the street lighting and signal systems
5. Calling PEPCO for the final inspection of their manholes after all electrical work is complete in the PEPCO manholes as called for in this contract.

All work performed within PEPCO facilities shall be performed in conformance with all PEPCO requirements. The Contractor shall initiate communication with PEPCO as early as possible after execution of this contract for the purpose of establishing scheduling guidelines and to exchange telephone numbers between the principal points of contract. The power company representative is:

Mr. Joseph D. Schall, Manager
Customer Design-DC
Potomac Electric Power Company

701 9th Street, N.W., Room 6005
Washington, D.C. 20068
Telephone Number: (202) 872-2844
Facsimile: (202) 331-6234
e-mail: jdschall@pepco.com

(C) MATERIAL AND WORK PROCEDURES

Unless otherwise noted in the plans and this special provision, the Contractor shall be responsible for furnishing all proposed materials associated with the electrical work.

The Contractor shall be responsible for submitting to the Infrastructure Project Management Administration (IPMA) catalog cuts and/or samples of all materials to be furnished for street lighting work. Procurement of all such materials by the Contractor may not begin until written approval is obtained from the (IPMA).

1. PAVEMENT RESTORATION

As directed by the Engineer for temporary pavement restoration, the trench shall be backfilled to the bottom of the existing pavement surface. The Contractor shall apply a temporary patch over the backfill until such time as final restoration can be completed.

2. CONCRETE ENCASEMENT

PCC mix design for encased conduits shall conform 817.03 for Class F General Use, minimum 28-day compressive strength of 3,500 psi on field test cylinders made in the field and cured in laboratory. All conduit shall be encased to provide a 4 inch minimum cover all around the conduit.

If existing utilities or conduits are present in the trench, these utilities or conduits shall be surrounded with an encasement of at least 3 inches of sandy fill, free from objects, which might damage the conduit. PCC encasement shall then be placed over the sand encasement to the appropriate level.

3. CONDUITS

PVC
Conduits shall conform to the requirements of this Special Provisions, streetlight electrical specification and DDOT Standard Specifications for Highways and Structures (2005). Two (2) sizes of conduits will be used in this project. Four-inch conduit shall be installed between manholes. Two-inch conduit is for the connection from the manhole to each streetlight pole. All conduits shall be rigid, gray Polyvinyl Chloride (PVC) Schedule 40 conforming to the requirements of NEMA TC-2 and WC-1094. Conduits and fittings shall bear Underwriter's Laboratories, Inc. label. Conduit shall be in factory-supplied lengths, and shall be marked with the manufacturer's name, trade name, or trademark, nominal trade

size, and type of material. All joints shall be water-tight. Solvent cement used for joining PVC conduit shall conform to the requirements of ASTM D2564.

All bends shall be of long sweep, free kinks and of such easy curvature as to permit cable pulling without undue tension on conductors or damage to insulation.

Conduit runs as shown on the plans may be changed to avoid underground obstructions only with written approval by the Engineer.

Unless otherwise shown, conduits shall be placed a minimum depth of 36 inches below final grade, or at greater depths if required to obtain the necessary utility clearance of 6 inches between existing utility and the top of the proposed concrete encasement, and shall slope at a minimum rate of 3 inches per 100 feet of length to a foundation, or manhole.

All conduit fittings shall be free from burrs and rough places and all conduit runs shall be cleaned and swabbed before cables are installed. Cut conduits shall be reamed before fittings and cables are installed.

Standard manufactured elbows, bushings, reducers, bends couplings, etc. of the same materials as the straight conduit pipe shall be used, as required throughout the conduit system. Bends shall meet all the requirements of NEC Article 352-24.

All duct banks will be encased in concrete with 3-inch encasement on all sides. The ducts will be separated from each other by a 1.5-inch space.

There will be instances throughout this project where the Contractor will be required to build conduit to intercept existing PEPCO manholes. In such instances, the Contractor shall be required to coordinate penetration of existing manholes with the Potomac Electric Power Company so as to avoid disruption to PEPCO facilities.

4. RIGID METAL CONDUIT

Shall the requirements of Article 344, National Electrical Code. All conduit and fitting shall by UL Listed. The straps for holding the conduit shall be galvanized. The strap shall match Caddy-Erico Catalog # CD9, or similar product from B-Line or Allied Tube and Conduit, or approved equal.

5. MANHOLES

Manholes shall conform to the requirements the Contract Drawings and these Special Provisions.

Manholes at locations shown in contract plans shall be constructed as detailed in the Contract Drawings. Manholes can be pre-cast or cast-in-place and shall comply with the following requirements:

(1) PCC Mix Design - Shall conform to 817.03 for Class B, structural, minimum 28-day compressive strength of 4,500 psi on field test cylinders made in the field and cured in the laboratory.
(2) Curing Material - Shall conform to 814.03 for Membrane Cure.
(3) Reinforcing Steel - Shall conform to 812.02 of the Standard Specifications, for Grade 60.
(4) Frame and Covers - Shall be gray iron casting conforming to the requirements of 815.04 of the Standard Specifications. The word **"DCSL- TS"** in 1-inch letters shall be cast in the center depression of the top of cover and shall be flush with the surface of cover.
(5) Pre-cast Reinforced Concrete - Shall meet the requirements of 822.06 of the Standard Specifications.
(6) Cable racks shall be PVC with cable insulators.

Manholes shall be installed flush with ground, pavement or sidewalk. The drain hole shall be filled with aggregate conforming to the requirements of 805, Grading No. 67.

Conduit entering manholes shall be terminated flush with the inside wall. Conduits shall be aligned in as nearly a straight line as possible to allow for each of pulling cable. The space remaining between the conduit and the structure wall shall be filled or patched with concrete or acceptable equal so there will be no leakage. Manholes shall be seated on trench fill meeting the requirements of 804.05 in order to prevent settlement.

Cover for manholes shall be clearly marked **"DCSL-TS"** using 1 inch raised letters.

6. PCC FOUNDATIONS FOR STREETLIGHT AND 20' TRAFFIC SIGNAL POLES

The item of work shall consist of constructing concrete foundations complete with necessary electrical conduit, anchor bolts, ground rod, and other work as required in the plans. All foundations to be constructed under this contract shall be fifteen-inch (15") bolt circle.

The materials for reinforced Portland cement foundations shall meet the following requirements:

(1) PCC Mix Design - Shall conform 817.03 for Class B, Structural, minimum 28-day compressive strength of 4,500 PSI on field test cylinders made in the field and cured in the laboratory.
(2) Curing Materials - Shall conform 814.03 for Membrane Cure.
(3) Reinforcing Steel - Shall conform 812.02 of the Standard Specifications, for Grade 60.
(4) Anchor Bolts - Shall conform 822.06 of the Standard Specifications for High-Strength Bolts.
(5) Conduit - Sleeves shall conform to the Conduit Section of this S.P.

(6) Galvanizing - Shall conform to 811.07 of the Standard Specifications.
(7) Ground Rods - Shall be copper-clad rods conforming to the requirements of UL-467. Ground rods shall have a diameter of at least 3/4 inch and a length of at least 15 feet with minimum 8 feet of soil contact.
(8) Ground Wires - Shall be No. 8 AWG for streetlight conforming to the requirements of ASTM B2.
(9) Ground Clamps - Shall be heavy-duty bronze or brass or galvanized malleable iron conforming to the requirements of ASTM A220, any grade.

The exposed portions shall be formed to present a neat appearance. The bottom of concrete foundation shall rest on firm undisturbed ground.

Forms shall be true to line and grade. Conduit ends and anchor bolts shall be placed in proper position and to proper height, and shall be held in place by means of a template until the concrete sets.

Conduit ends shall extend a minimum of 2 inches and a maximum of 4 inches above the top of the finished foundation.

It shall be the responsibility of the Contractor to ensure that all anchor bolts, ground rods, conduits, and other appurtenances are properly located before concrete is poured.

7. CABLES

All underground current carrying conductors used for street lighting, shall be copper, stranded type, RHW-2, 90 C, conforming to IPCA Pub. No. S-68-516/NEMA WC8 for ethylene-propylene-rubber insulated cable. The outside jacket shall conform to IPCA Pub. No. S-19-81.

8. SPLICES

Splices in wires and cables shall be accomplished by means of compression pressure connections. The connectors shall be suitable for the size wire used and shall be of one-piece tubular tinned copper or bolted type copper construction. The indenture shall be such as to assure maximum electrical connection and sufficient physical strength. The connection shall be covered with cross-linked polyoltin shrinkable tubing. The tubing shall be heavy wall rated 600 V 90C and conform to UL 486D, CSA C22.2 No. 198.2 and ANSI C119.1 and Western Underground Guides 2.4, 2.5. If shrinkable tubing is not feasible for a particular connection, the connection shall be covered with Super 88 Scotch plastic electric tape manufactured by Minnesota Mining and Manufacturing Company, or type CW as manufactured by Plymouth Manufacturing Company, or other approved equal half-lapped into a thickness not less than 50 percent greater than the conductor insulation. An approved waterproof coating shall be applied on the outer cover. Wires shall be tagged as specified in 621.13

9. GROUNDING AND BONDING

One copper-clad ground rod shall be installed in each manhole, streetlight and traffic signal foundation. The grounding electrode conductor shall be sized accordance with the National Electric Code. The ground wire shall be installed with other conductors when they were pulled. Grounding shall be accomplished as soon as materials are in place to which the grounding wires are to be attached.

Material used for installation of grounding systems shall meet the following requirements:

(1) Ground Rods - Shall be copper-clad rods conforming to the requirements of UL - 467. Ground rods shall have a diameter of at least 3/4 inches and a length of at least 15 feet, (10' for use in grounding manholes) (or minimum soil contact of 8').
(2) Ground Wires - Shall be at least No. 8 AWG for streetlight grounding and #6 solid bare copper wire for traffic signals. All wires used to ground between DC manholes and the wall mounted fixtures to be #8 RHW-2 insulated cable, not bare copper wire.
(3) Ground Clamps - Shall be heavy-duty bronze compression type
(4) All manhole grounding connections including frame and cover and ground rod connections shall be made using exothermic welding.

The Contractor shall in each District owned manhole bond the neutral conductor and the system ground wire to the manhole grounding electrode. Each metal streetlight pole shall be grounded to the adjacent manhole with a #8 stranded copper wire, which shall be connected to the post shaft and the manhole grounding buss with a solder less bolted post or lug, with non-corrosive components.

10. HPS TEAR DROP LUMINAIRE SPECIFICATIONS

Roadway luminaire shall be a either a 250 or 400 watt HPS Tear Drop shaped made of heavy cast aluminum with cast aluminum top to support the electrical components and provide a solid mounting assembly for the arm fitter. Top and middle sections are hinged together for easy installation and maintenance with 5/16-18 stainless steel toggle eyebolts with cast-iron wing-nut fasteners.

Globe doorframe shall be one-piece aluminum casting, is hinged and retains the globe. All latches and fasteners shall be stainless steel. The glove shall be Acrylic frosted stippled globe. Secured to the doorframe with three stainless steel screws and chips. Gasketing shall be silicone sponge gasket providing a bug-tight-seal.

OPTICS: Reflector is polished, etched and anodized clear semi-specular hydroformed aluminum, mounted to housing cast frame with key slots and stainless steel screws.

The ballast assembly shall be mounted to a cast aluminum plate, which mounts to the housing with self-contained stainless steel screws for easy removal galvanized steel handle allows for easy removal of entire lamp and ballast from housing. All electrical components shall have quick disconnects.

Mounting Systems – Shall consist of a heavy duty cast neck integral to the fixture casting, installation is completed by affixing the removable half collar clamp around the cast neck with stainless steel allen socket head screws. Allows for a full 360° fixture rotation and can be locked in one orientation. Rigid mounting consists of an integral 1-1/2 11.5 NPSM stainless steel pipe permanently attached to the fixture casting for insertion into matching 8 threads on arms of the pole.

The interior components in the luminaire shall be arranged to provide ample space for cables and access to wiring. Cables shall not be close to the ballast and shall be color-coded. The starter shall be placed in an open location for easy access and removal without the use of tools.

The lamp socket shall be heavy-duty, adjustable, with nickel-plated tempered brass split-shell lamp grips and free-floating, spring-loaded center contact.

11. CONVERSION KITS, SODIUM VAPOR

Shall meet the requirements of 820.03j.

12. LAMPS

Shall be high pressure sodium vapor and meet the requirements of 820.03 1streetlights (c).

13. ELECTRONIC PHOTOCONTROL AND CYCLE DETECTION DEVICE

Shall meet the requirements of 820.03 1 streetlights (g).

14. ELECTRONIC BUTTON TYPE PHOTO CONTROL

Shall meet the requirements of 820.03 1 streetlights (h).

15. SPECIFICATION FOR GALVANIZED STEEL TRANSFORMER BASE

The transformer base will have dimensions as detailed on DC-DOT Standard Drawing No. 618.29. The base will be fabricated from hot rolled carbon steel meeting ASTM-A36. The base shall be 20 inches high, 16 inches square at the base and 13 inches square at the top. The top and bottom plates will be made of ¾" minimum thick steel plate. The body of the base will be made of 7 gauge steel. The base will be provided with 4 (four) loose steel plate anchor clips to fasten the

base to the anchor bolts. Each base will be provided with 1" x 3" bolts with nuts and washers to connect the post shaft to the base. The door opening in the base shall be 8½" x 9" x 13¼" and the door shall be secured in place by an approved locking device. The base will be cleaned of all rolled-in mill scale, impurities and nonmetallic foreign materials. The welds will be cleaned of all weld flux. The base is to be degreased by immersion in a heated caustic solution, then pickled in a heated sulfuric acid solution. The base will then be rinsed in a fresh water bath to remove any residual effects of the caustic or acid baths. The base will then be immersed in a concentrated zinc ammonium chloride solution and allowed to air dry before being galvanized. The base, door and anchor clips are to be hot-dip galvanized to the requirements of either ASTM A123 or ASTM A153.

16. SPECIFICATION FOR STEEL PENDANT LIGHT POLE, ARM AND DECORATIVE SHROUD

The post will be octaflute monotube 11 gauge steel, 8" x 4" x 28' 6" with a continuous 0.14 inches per foot taper. The post will be according to D.C. Streetlight Drawing No. 2 dated June 6, 1965.

The post will include a single welded simplex to accommodate 3 to 8 foot single member arm. The arm shall match the one shown in the Contract Drawings

The shaft will be fabricated from 11 gauge steel meeting ASTM-A595 GR A with a yield point of a no less than 55,000 psi. A cast steel anchor base will be welded to the bottom of the shaft in an escalloped pattern. The base will have four (4) bolt holes per the drawing. The base will be complete with ornamental bolt covers and the attaching screws. All posts will have a strain cable grip installed to support the post cables.

The arms will be fabricated from steel. The post and arm will be cleaned of all rolled-in mill scale, impurities and nonmetallic foreign materials. The welds will be cleaned of all weld flux. The post and arm to be degreased by immersion in a heated caustic solution, then pickled in a heated sulfuric acid solution. The base will then be rinsed in a fresh water bath to remove any residual effects of the caustic or acid baths. The post and arm will then be immersed in a concentrated zinc ammonium chloride solution and allowed to air dry before being galvanized. The post and arm are to be hot-dip galvanized to the requirements of either ASTM A123 or ASTM A153. The galvanized coating will be free of any debris or flux ash.

All galvanized exterior surfaces visually exposed are to be coated with a Urethane or Triglycidyl Iscocyanurate (TGIC) polyester powder to a minimum dry film thickness of 2.0 mils. Prior to application, the surfaces to be powder coated are to be mechanically etched by brush blasting (ref. SSPC-SP7) and the zinc coated substrates preheated to 232°C (450° F) for a minimum of one (1) hour in a gas-fired convection oven. The coating will electrostatically applied and cured by elevating

the zinc coated substrate temperature to a minimum of 177°C (350°F) in a gas-fired convection oven. The color will match Federal Color Chip # 16099.

The pole will be wrapped in either a 3/16" U.V. inhibited plastic backed packing foam or cradled in a 1" rubberized foam base. The arms will be wrapped in a 3/16" U.V. inhibited plastic packed packing foam.

As part of the catalog cuts, the contractor shall submit copies of the following certifications:

1. That the welds meet the requirements of AWS D1.1.
2. Material will be provided for all ASTM number referred to in this specification.
3. Copy of factory certification that it meets the requirement of American Institute of Steel Construction (AISC) category.

The decorative shroud assembly shall be a combination of two rotomolded halves , steel mounting bracket, foam inserts, stainless steel and black oxide hardware. The shroud shall have a height of 3' 81/2" and be available for use with both single and twin cross arms.

The two molded parts are to be produced from LLDPE resin and have long term UV8 stabilization. The parts shall include raised shiplap to prevent a visual gap and misalignment between the two parts when the unit is assembled and to ensure a proper fit. Recessed and bossed locations are necessary where the mating hardware is to be installed. Threaded inserts shall be molded into to one side of the shroud to allow stainless steel hardware to secure the two halves together. Banding the two halves together will not be permitted.

Closed cell foam inserts shall be supplied on the shroud where the post enters the shroud and where the cross arm exit the shroud. This foam will prevent creatures and debris from entering the molded shroud.

All molded parts shall be free from abnormal physical qualities, porosity, cracks, shrinkage defects or flaws which may affect the strength, of suitability of the parts for their intended use.

The steel mounting bracket shall be supplied as one unit to fix the mounting locations on the cross arm for ease of installation. The ¼-20 stainless steel hardware shall be used to secure the galvanized bracket together, secure the bracket to the post, and set the height of the shroud to allow the cross arm to be centered in the decorative shroud. The decorative shroud shall be attached to the mounting bracket with the ½" threaded rod and secured with a black oxide furnished acorn nut.

The Contract drawing of the decorative shroud are to be used as a standard of quality and dimensional requirements. Deviating from these dimensions will not be permitted.

17. SPECIFICATION FOR #16 CAST IRON POST

The post shall be made up of three cast components as shown on the Contract drawings. All cast iron components, regardless of the method by which they are produced and assembled, shall be uniform quality and appearance; true to pattern; fine surface texture; free from blow holes, porous spots, hard spots, shrinkage faults, wrap, buckle, cracks, die marks, and all other defects peculiar to the method of production used, which may adversely affect the use, appearance or strength of the component or post.

Each component shall be carefully and thoroughly cleaned of all sand, scale, fins, core anchors, welds, machine markings, projections, imperfections, etc., injurious to insulated electrical conductors or detrimental to its use or appearance.

Each separable component shall bear as pertinent a lot number, casting number, pattern number, or other identifying number for record purposes so that the production history may be traced and contractor shall make such history available to the District of Columbia on demand. The components shall not bear any other mark, lettering, numbering or identifying device not specifically authorized in writhing by the District of Columbia.

All ornamentation and markings shall be sharp and clearly defined. The desired finish for these components shall be the finest surface of hi-grade fabrication with a minimum of grinding, machining, dressing, etc., in accordance with normal foundry practices. Excess dressing shall be cause for rejection. Bolt holes must be clean and true with good alignment in the companion pieces to permit the interchangeability of castings. The shafts shall be straight and true with not more than 3/8" deflection along the length when rotated on the end centers. The base shall be drilled so that it can be installed on a fifteen-inch (15") bolt circle foundation. With each pole supplied the manufacturer shall supply an extra base door.

The castings shall be Heavy Wall Cast Iron per A.S.T.M. A48-83 Class 30. All castings shall be true to pattern and of fine surface texture with a minimum of machining and/or grinding, and shall have a uniform wall thickness +- 1/8'. All components shall receive a cost of red iron oxide primer both inside and out. The components shall be given two coats of a two- part epoxy paint system. The color shall match Federal Color Chip # 16099. The coats shall be allowed to cure according the paint manufacturers specification before recoating and/or shipping. The components shall be wrapped and crated to protect them during shipping and unloading. Any damage to the finish shall be repaired according to the paint manufacturer specifications at no additional cost to the District.

18. WOOD POLE ARM

The arm shall match the arm shown in the Contract Drawings.

19. GLOBE

Shall meet the requirements of 820.03 1 streetlights (k).

20. PVC U-GUARD

The u guard assembly shall be made up of three components. A backing plate that is to be mounted directly on the wood pole with nails provided with the backing plate to protect the cables from the rough surface of the pole, an adapter to make the transition from the PVC sweep bend to the u guard and the 10 foot u guard sections. The 10 foot u guard section shall be heavy duty schedule 40 PVC plastic and meet or exceed the requirements of the National Electric Safety Code (NESC) and designed in accordance with NEMA TC-19 specifications. The schedule 40 walls shall meet the schedule 80 PVC conduit impact requirements. The u guard sections shall have bell end that fit over the end of the adjacent sections. All mounting hardware used to install the u guard shall be hot dipped galvanized steel or stainless steel.

21. GALVANIZED JUNCTION BOXES

Shall be NEMA 4 rated, Galvanized, size to be as shown on the plan sheets. The junction box shall have external brackets for mounting on the wall.

22. 250 WATT WALL MOUNTED LUMINAIRE

The unit shall be totally enclosed and weather-resistant unit consisting of the enclosure, pre-wired ballast, including the starter, optical assembly that shall provide an IES Type IV Distribution. The unit shall be UL Listed. The luminaire shall include a die-cast housing with ballast, pre-wired terminal board, sealed and filtered optical assembly and a die-cast aluminum side-hinged door with glass refractor sealed to it. Mounting shall be by three bolts through the back of the housing. There shall be ¾ inch NPT conduit entrances and provisions for an pre-wired photoelectric receptacle.

The luminaire shall have a magnetic regulator ballast. The plug-in type ignitor and ballast shall be pre-wired to the lamp socket requiring only connection of power supply leads only. The ballast shall start and operate the lamp down to –40 Degrees F.

The optical assembly shall consist of a reflector, lamp socket and prismatic glass refractor.

23. MANHOLE CABLE RACKS

Shall be made of 50% glass-reinforced nylon or a NON-METALIC material having equal mechanical strength, thermal resistance, chemical resistance, dielectric strength and physical properties. The stanchion shall be 36 inches long, shall incorporate multiple arm mounting holes that are 4 inches apart and recessed bolt mounting holes. The arms shall be provided holes or slots the cable ties to hold the cables.

24. ELECTRICAL TESTS

Applicable test shall be performed in accordance with 621.16. Defects in materials or workmanship in the installation as disclosed by the test shall be corrected or replaced by the Contractor without additional compensation. A written report shall be submitted for approval. ALL GROUND RODS WILL BE TESTED AND APPROVED.

(D) PAY ITEMS

1. FURNISH AND INSTALL SCHEDULE 40 PVC RIGID CONDUIT

ITEMS: 617 030, 617 032, 617 034, 618 993 (618 071), 618 072, 618 148, 618 150, 618 152, 618 154 and 618 160

This Special Provision replaces 618.12 of the Standard Specifications.

GENERAL- The Contractor shall furnish all labor, tools, material and equipment necessary to excavate, shoring, de-watering, steel plating (necessary steel plating of the roadway for moving traffic as directed by the Engineer), installation of conduit(s), concrete encasement P.C.C. Wet Mix 3,500 PSI), back filling, compaction of fill, temporary patch and maintenance of the cuts until the permanent repairs are made as directed by the Engineer. The Contractor shall excavate the trench as called for on the project plans. The trenches shall be braced according to the local and federal regulations. All conduit(s) shall be Schedule 40 PVC and shall be installed to proper line and grade. The trench shall be opened completely between manholes or between the end of the existing conduit to be added to the new location or between manholes and the proposed light before installing any conduit. Conduit(s) shall be installed with a minimum of 36" of cover below final grade and shall be installed in dry trenches. The conduit shall be installed in full lengths using manufactures supplied bends and couplings. When the Contractor must make field cuts the conduits ends shall be reamed to removed any rough edges before joining together. The joints shall be cleaned, cemented and the lengths of the conduits coupled together tightly. Where two or more conduits are being installed in the same trench the Contractor shall use spacers between the conduit runs. All conduit runs shall be complete and points of penetration of the wall of manholes be sealed before any concrete encasement is installed.

The wall penetration of PEPCO manholes will be done under the supervision and direction of PEPCO field personal. The penetration of D.C. manholes will be done

under the supervision and direction of District personal. At the end of each workday the Contractor shall seal the ends of the all conduits to prevent the entrance of dirt and water into the conduit system. After the concrete encasement has been installed and allowed to set a minimum of four (4) hours or as directed by the Project Engineer, all wood forms and trench shoring shall be removed completely during the back filling operations, back fill will be done in layers of six (6) inches and compacted before the next layer is added.

If the Contractor is to add on to (splice on to) existing conduit, the splice will be done with an approved coupling. The Contractor shall in part of this Pay Item clean, proof, install a Poly String and seal all conduits prior to installing cables. The Contractor shall run a mandrel, not smaller than ¼" smaller than the diameter of the conduit thru each conduit in the presents of the Engineer. All conduits that a mandrel cannot be pulled thru shall be cleaned and or replaced and shall be reproofed at no additional cost to the District. Each conduit shall be sealed after the copper drag wire has been installed, using approved conduit plugs. Included within this pay item is the temporary patching of the trench and maintenance of the patch until final repairs have been made.

MEASURE AND PAYMENT – The unit of measure of **FURNISH AND INSTALL SCHEDULE 40 PVC RIGID CONDUIT** will be per **LINEAR FOOT.** Payment will include all labor, tools, materials, equipment, excavate, shoring, de-watering, steel plating of roadway, concrete encasement, penetration of manholes (both D.C.'S & PEPCO'S), back filling, compaction of fill, temporary patching, maintenance of the cut until the permanent repairs are made, an all incidentals necessary to complete the work specified herein.

2. **FURNISH AND INSTALL 36"X36"X36" MANHOLE AND FURNISH AND INSTALL 48'x48"x48"MANHOLE**

ITEMS: 618 016 and 618 022

Work under these Pay Items shall meet the requirements of 618.05.

3. **FURNISH AND INSTALL 15" B. C. FOUNDATION FOR STREETLIGHT AND TRAFFIC SIGNAL POST**

ITEM: 618 394

This Special Provision modifies and replaces 618.25 of the Standard Specifications.

GENERAL- The Contractor shall supply all labor, equipment and materials necessary to install streetlight post foundations as shown on the plans. The foundations shall be installed 36 inches from the face of curb to centerline of foundation or as noted on the plans. A 1 ½" conduit shall be installed through the foundation for the installation of the ground rod. The ground rod, ground wire, ground clamps, power feeder cables within the foundation shall be included in the

cost for this pay item. The anchor bolts shall be set to the correct both circle and project 3" above the foundation. The conduit for the electrical conductors shall be set as close to the center of the foundation as possible. All foundation caps shall set 1" above grade. The foundation shall be allowed to set for a minimum of 3 days before installing the post. All dirt excavated and other debris shall become the property of the Contractor and shall disposed of by him at no additional cost to the District.

MEASURE AND PAYMENT – The unit of measure of **FURNISH AND INSTALL 15" B. C. FOUNDATION FOR STREETLIGHT AND TRAFFIC SIGNAL POST** will be per **EACH**. Payment will be made at the contract unit price per each foundation and payment will include all labor, equipment, tools, materials, and all incidentals necessary to complete.

4. **FURNISH AND INSTALL SPECIAL SPREAD FOUNDATION FOR STREETLIGHT AND TRAFFIC SIGNAL POLE**

ITEM: 618 992 (618 395)

GENERAL- The Contractor shall supply all labor, equipment and materials necessary to install special spread foundation for streetlight and traffic signal post as shown on the plans. The foundations shall be installed 36 inches from the face of curb to centerline of foundation or as shown in the electrical detail sheets. The ground wire necessary to ground the pole to the nearest District owned manhole off the structure shall be included in the cost for this pay item. The anchor bolts shall be set to the correct both circle and project 3" above the foundation. The conduit for the electrical conductors shall be set as close to the center of the foundation as possible. All foundation caps shall set 1" above grade The foundation shall be allowed to set for a minimum of 3 days before installing the post. All dirt excavated and other debris shall become the property of the Contractor and shall disposed of by him at no additional cost to the District.

MEASURE AND PAYMENT – The unit of measure of **FURNISH AND INSTALL SPECIAL SPREAD FOUNDATION FOR STREETLIGHT AND TRAFFIC SIGNAL POLE** will be per **EACH**. Payment will be made at the contract unit price per each foundation and payment will include all labor, equipment, tools, materials, and all incidentals necessary to complete.

5. **FURNISH AND INSTALL RIGID METAL CONDUIT**

ITEM 618 993(618 073), 618 993(618 075), 618 993 (618 149) and 618 993 (618 151)

GENERAL- The Contractor shall supply all labor, equipment and materials necessary to install rigid metal conduit as shown on the plans or as directed by the Project Engineer. The conduit shall be installed in factory supplied lengths where possible, filed cutting and bending will be allowed. All fitting, clamps and clamp

mounting shall be approved for use with this type of conduit. Where conduits cross expansion joints the Contractor shall install expansion fittings. All conduit install in the planter box shall receive two coats of a asphalt based paint which shall be allowed to dry between coats prior to installed the Geofoam and planting soil.

MEASURE AND PAYMENT – The unit of measure of **FURNISH AND INSTALL RIGID METAL CONDUIT** will be per **LINEAR FOOT**. Payment will be made at the contract unit price per foot installed and payment will include all labor, equipment, tools, materials, and all incidentals necessary to complete.

6. **FURNISH AND INSTALL JUNCTION BOX**

ITEM 618 930

GENERAL- The Contractor shall supply all labor, equipment and materials necessary to install junction boxes as shown on the plans or as directed by the Project Engineer. The junction boxes shall be mounted to the bridge abutment or walls using approved mounting hardware, also included as part of the Pay Item the cutting of holes in the boxes in order to install the rigid metal conduit. All holes cut in the boxes will be sealed using approved fitting so that the boxes retain the NEMA 4 rating. The cost of bonding the junction boxes to the metal conduit

MEASURE AND PAYMENT – The unit of measure of **FURNISH AND INSTALL JUNCTION BOX** will be per **EACH**. Payment will be made at the contract unit price per each junction box installed and payment will include all labor, equipment, tools, materials, and all incidentals necessary to complete.

7. **FURNISH AND INSTALL WALL MOUNTED HPS LUMINAIRE**

ITEM 618 992(618 757)

GENERAL- The Contractor shall supply all labor, equipment and materials necessary to install wall mounted HPS luminaries as shown on the Contract Plans. Work includes mount the luminaire to the wall, making all electrical connect inside of the unit, installing the lamp, installing the shorting cap on all unit that will burn 24 hours a day or a photo cell on unit that burn at night. Also included is the removal on the existing wall fixtures and the plating over on the hole that the removal creates. All closure material will be submitted and approved by the Project Engineer before installation.

MEASURE AND PAYMENT – The unit of measure of **FURNISH AND INSTALL WALL MOUNTED HPS LUMINAIRE** will be per **EACH**. Payment will be made at the contract unit price per each luminaire installed and payment will include all labor, equipment, tools, materials, and all incidentals necessary to complete.

8. **FURNISH AND INSTALL PCC FOUNDATION FOR CONTROLLER CABINET**

ITEM: 617 038

Work under this pay item shall meet the Requirements of 617.05

9. **FURNISH AND INSTALL STRANDED WIRE**

ITEMS: 618 190, 618 200, 618 202 and 618 250

Work under these Pay Items shall meet the requirements of 618.20

10. **FURNISH AND INSTALL STRANDED GROUND WIRE**

ITEMS: 618 292 and 618 310

Work under these pay Items shall meet the requirements of 618.22

11. **FURNISH AND INSTALL 250 WATT HPS TEAR DROP FIXTURE AND FURNISH AND INSTALL 400 WATT HPS TEAR DROP FIXTURE**

ITEMS: 618 760 and 618 778

Work under these Pay Items shall meet the requirement of 618.35.

12. **FURNISH AND INSTALL 15" B.C. STEEL TRANSFORMER BASE**

ITEM 618 436

Work under this Pay Item shall meet the requirements of 618.27

13. **FURNISH AND INSTALL #16 CAST IRON POLE, AND FURNISH AND INSTALL 28'-6" STEEL PENDANT POLE WITH UP TO 8FT ARM**

ITEMS 618 486 and 618 544

Work under these Pay Items shall meet the requirements of 618.28.

14. **REMOVE PENDANT POLE 30 FT HEIGHT OR LESS**

ITEMS: 618 566

Work under this Pay Item shall meet the requirements of 618.29.

15. **REMOVE STREETLIGHT, TRAFFIC SIGNAL POLE FOUNDATION AND TRAFFIC SIGNAL CONTROLLER CABINET FOUNDATION:**

ITEMS: 617 126 and 618 400

Work under these Pay Items shall meet the requirements of 617.17 and 618.26.

16. **REMOVE MANHOLE OVER 24" X24":**

ITEM: 618 020

Work under this Pay item shall meet the requirements of 618.06.

17. **REMOVE ARM FROM WOOD POLE UP TO 8 FT IN LENGTH**
ITEM: 618 668
The following is added to 618.37
When the Contractor removes a overhead arm from a wood pole the Contractor shall remove the existing u-guard and District owned conductors to within 6 inches of the PEPCO connection. If the arm is to be replaced, then the Contractor shall connect the new conductors to the 6 inch pigtail. If the arm is not to be replaced then the Contractor shall tape the ends of the 6 inch pigtail and leave it for PEPCO to remove.

REMOVE LUMINAIRE FORM WOOD POLE
ITEM: 618 720
REMOVE LUMINAIRE FROM METAL POLE:
ITEM: 618 722

Work under this Pay Item shall meet the requirements of 618.37.

18. **FURNISH AND INSTALL 118 PLASTIC GLOBE:**

ITEM 618 860
Work under this Pay Item shall meet the requirements of 618.34.

19. **FURNISH AND INSTALL 250 WATT HPS CONVERSION KIT:**

ITEM 618 802

Work under this Pay Items shall meet the requirements of 618.36.

20. **FURNISH AND INSTALL 4" PVC RIGID U-GUARD ON WOOD POLE**

ITEM 618 888

Work under this Pay Item shall meet the requirements of 618.38.

21. **FURNISH AND INSTALL 8 FT ARM ON WOOD POLE AND FURNISH AND INSTALL 1 INCH U-GUARD ON WOOD POLE**

ITEMS 618 676 and 618 898

Work under these Pay Items shall meet the requirements of 618.32.

22. **PAYMENT TO PEPCO FOR CONNECTION, DISCONNECT AND INSPECTION FOR STREETLIGHTS AND TRAFFIC SIGNALS**

ITEM 618 999

Work under this Pay Item shall meet the requirements of 618.41.

52. TRAFFIC SIGNAL WORK

This Special Provision supplements and modifies 617 of the standard specifications.

SCOPE:

The Traffic Signal Work consists of the construction or modification the traffic signals at Two intersections: Eastern Avenue and Kenilworth Avenue, N.E. and Eastern Avenue and Minnesota Avenue, N.E.

The work shall be performed as specified herein, as shown on the DC-DOT Standard Drawing (Division 617) or as directed by the Engineer. The work, as indicated on the Plans or as directed, includes:

1. Furnishing and installing all above ground signal equipment, including transformer bases, 20 foot traffic poles, LED traffic and pedestrian signal heads, mast arms, vehicle model 170 traffic signal controllers and cabinets. Furnishing and installing of all conduit, manholes, foundations, both pole and controller and streetlight poles that carry traffic signal equipment will be paid under the Streetlight Pay Items.

2. Installation of local conductors for traffic signal operation.

3. Installation of underground traffic signal communication cables as shown on the plans.

4 Furnish and install conduit and special foundation for CCTV camera pole located on the barrier and removal of the pole and foundation at the end of the project.

5. Removal of existing above-ground traffic signal equipment, traffic signal cabinets and controllers, metal traffic signal poles, temporary signal pole foundations and electrical cables.

6. Furnishing and installing 20-foot traffic signal poles and transformer bases on temporary concrete portable foundations, traffic and pedestrian signal equipment for temporary installations and traffic controller installations on temporary concrete portable foundations for construction operations.

Removed traffic signal equipment, metal poles and transformer bases shall be returned to the D.C. Department of Transportation storage yard as directed by the Engineer. Finally, the work includes disposal of all parts, cables and all other work necessary to obtain a complete and final product as shown on the contract plans and as specified herein and/or as directed.

REQUIREMENTS:

(A) GENERAL

All traffic signal work shall conform to these Special Provisions and the DC-DOT Standard Drawing (Division 617). It is the intent that all items furnished and installed by the Contractor shall provide a traffic signal system, which includes traffic signal poles, traffic and pedestrian signal heads, all wire and cable and other essentials necessary for the satisfactory installation, as shown on the plans, disposal of discarded materials.

Before any traffic signal work is performed, the Electrical Contractor must be licensed and bonded in the District of Columbia and apply for an electrical permit to perform work in public space. This application must be signed by a Master Electrician or an Electrical Engineer who is required to be licensed in the District of Columbia.

The Contractor's employees installing the electrical work must be licensed in the District of Columbia as Master Electricians, Electricians or Apprentice Electricians. When Apprentice Electricians are working, a Master Electrician or an Electrician must be on the project for personal supervision.

A minimum of one of the contractor's employees must have demonstrated experience in the installation of traffic signal heads. This employee must be at least Level II IMSA Certified, and have experience working in and around the Type 170 microprocessor based solid state traffic signal controller. Proof of certification shall be a requirement for consideration as a responsive bidder. A copy of the employee's Level II IMSA certification shall be submitted with the contractor's bid. The contractor will be required to retain an employee with these minimum credentials during the entire contract. This is the only contractor employee who will be permitted access to the controller cabinet.

All traffic signal work must be inspected by the Transportation Operations Division Inspector of the D.C. Department of Transportation. Twenty-four (24) hours advance notice is required for inspection. The Office of the Transportation Operations Division

at 2000 14th Street, NW, Washington, D.C. 20009, Telephone Number: (202) 671-1478 Mr. Harvey Alexander.

The Potomac Electric Power Company will furnish power for the traffic signal system. All work involved with PEPCO facilities shall be performed in conformance with the PEPCO requirements attached in the Appendices.

It shall be the Contractor's responsibility to notify and coordinate with PEPCO throughout the construction of the project in connection with all PEPCO services and facilities in the construction area, such that removal and restoration of services can be done in a timely and orderly manner at all times. Construction delays as a result of inadequate coordination shall be the Contractor's responsibility.

(B) CONSTRUCTION METHODS

1. FURNISH AND INSTALL ELECTRICAL CABLE FOR TRAFFIC SIGNALS

Pay Item No. 617 050, 617 052

Work under these Pay Items shall meet the requirements of 617.07

2. FURNISH AND INSTALL 20 FOOT TALL STEEL TRAFFIC SIGNAL POLE

Pay Item No. 617 046

Work under this Pay Item shall meet the requirements of 617.08

3. FURNISH AND INSTALL 8 FOOT LONG MAST ARM WITH CLAMP AND REMOVABLE END CAP

Pay Item.: 617 048

Works under this Pay Item shall meet the requirements of 617.09

4. FURNISH LED MODULE

Pay Items: 617 068, 617 070, 617 072, 617 076, 617 078, 617 084 and 617 086

Work under these Pay Items shall meet the requirements of 617.10

5. FURNISH AND INSTALL VEHICULAR OR PEDESTRIAN TRAFFIC SIGNAL HEAD ON ANY POLE

Pay Items: 617 090, 617 092 and 617 094

Work under these Pay Items shall meet the requirements of 617 11

6. **FURNISH AND INSTALL CONVENTIONAL VEHICULAR TRAFFIC SIGNAL HEAD ON A MAST ARM (ALL 12")**

Pay Item.: 617 096, 617 098 and 617 100

Work under these Pay Items shall meet the requirements of 617.12

7. **FURNISH AND INSTALL TRAFFIC SIGNAL CONTROLLER AND CABINET**

Pay Item No.: 617 124

Work under this Pay item shall meet the requirements of 617.16

8. **REMOVE TRAFFIC SIGNAL POLES AND TRAFFIC SIGNAL EQUIPMENT**

Pay Item No.: 617 130

Work under this Pay item shall meet the requirements of 617.18

9. **REMOVE TRAFFIC SIGNAL CONTROLLER AND CABINET**

Pay Item No.: 617 132

Work under this pay item shall meet the requirements of 617.19

10. **RELOCATE TRAFFIC SIGNAL CONTROLLER TO TEMPORARY PORTABLE CONCRETE BASE**

Pay item: 617 047

GENERAL- The Contractor shall furnish all labor, materials and equipment necessary to relocate traffic signal controller to temporary portable concrete base as called for in the Contract Plans or as directed by the project Engineer. The temporary base of the traffic signal shall be supplied by the Contractor and meet the standard of the Traffic Signal Branch. The temporary base shall be set so as not to block pedestrian traffic. The Contractor shall relocate the traffic signal controller to the temporary base after the District Traffic Signal Technicians have disconnected all of the traffic and communications cables from the controller. The Contractor shall use care when relocating the controller and cabinet so as not to damage the existing equipment, all damage due to Contractor negligence will be repaired and or replaced by the Contractor as no cost to the District. The Contractor shall supply a

50 foot length of 3" liquid-tight flexible orange non-metallic conduit, and a 50 foot length of 3" liquid-tight flexible orange non-metallic conduit, and 50 foot coils of cable for each traffic signal and communications cable that leaves the controller. The cost of all splice kits and materials required to splice the new cables to the ends of the existing cables shall be included in this pay item.

MEASURE AND PAYMENT – The unit of measure for **RELOCATE TRAFFIC SIGNAL CONTROLLER TO TEMPORARY PORTABLE CONCRETE BASE** will be per **EACH**. Payment will be made at the contract unit price per each traffic signal controller relocated to temporary base portable concrete base, and payment will include all labor, equipment, tools, materials, and all incidentals necessary to complete.

11. FURNISH AND INSTALL TEMPORARY, PORTABLE, CONCRETE BASE FOR MODEL336-S TRAFFIC SIGNAL CABINET, FURNISH AND INSTALL TEMPORARY, PORTABLE, CONCRETE BASE FOR 20 FOOT TRAFFIC SIGNAL POLE MOUNTED ON A TRANSFORMER BASE AND FURNISH AND INSTALL TEMPORARY, PORTABLE, CONCRETE BASE FOR 28 FOOT PENDANT POLE MOUNTED ON A TRANSFORMER BASE

ITEMS 617 040, 617 042 and 617 043

This Special Provision modifies 617.22 of the Standard Specifications.

617.22 (A) are modified by the following:

DESCRIPTION. Work consists of furnishing, maintaining and moving and removal at the end of the project portable concrete traffic signal and traffic signal controller bases, where required, for traffic signal operations within the project limits. A 4 foot by 4 foot by 1 foot deep concrete type base shall be provided, unless otherwise approved by the Chief Engineer. The work also includes providing a length of 3" liquid-tight flexible orange non-metallic conduit for each portable concrete base. The Contractor shall also furnish and install including all necessary splices the necessary 7 conductor 14 AWG cable required to operated the traffic signals as shown on the operational TS drawings. Work also includes all required relocations and removal from the site at the end of the project.

MEASURE AND PAYMENT – The unit of measure for **FURNISH AND INSTALL TEMPORARY, PORTABLE, CONCRETE BASE FOR MODEL336-S TRAFFIC SIGNAL CABINET, FURNISH AND INSTALL TEMPORARY, PORTABLE, CONCRETE BASE FOR 20 FOOT TRAFFIC SIGNAL POLE MOUNTED ON A TRANSFORMER BASE AND FURNISH AND INSTALL TEMPORARY, PORTABLE, CONCRETE BASE FOR 28 FOOT PENDANT POLE MOUNTED ON A TRANSFORMER BASE** will be per **EACH**. Payment will be made at the contract unit price per each temporary

base portable concrete base, and payment will include all labor, equipment, tools, materials, and all incidentals necessary to complete.

12. FURNISH AND INSTALL FOUNDATION FOR CCTV CAMERA IN BARRIER AND REMOVAL AT THE END OF PROJECT

ITEM 617 151

GENERAL- The Contractor shall supply all labor, equipment and materials necessary to install the foundation for the temporary CCTV camera pole as shown on the plans. The foundations shall be installed next to the existing bridge retaining wall the part of the foundation that is out of the ground shall be built to match the profile on the adjoining barrier. A 1 ½" conduit shall be installed through the foundation for the installation of the ground rod. The ground rod, ground wire, ground clamps, with in the foundation shall be included in the cost for this pay item. The anchor bolts shall be set to the correct both circle and project 3" above the foundation. The conduit for the electrical conductors shall be set as close to the center of the foundation as possible. The foundation shall be allowed to set for a minimum of 3 days before installing the post. At the end of the project the foundation shall be removed completely and the ends of the conduit sealed with concrete and the excavation backfilled in 6 inch layers and compacted. All dirt excavated and other debris shall become the property of the Contractor and shall disposed of by him at no additional cost to the District.

MEASURE AND PAYMENT – The unit of measure of **FURNISH AND INSTALL FOUNDATION FOR CCTV CAMERA IN BARRIER AND REMOVAL AT THE END OF PROJECT** will be per **EACH**. Payment will be made at the contract unit price per each foundation and payment will include all labor, equipment, tools, materials, and all incidentals necessary to complete.

13. FURNISH AND INSTALL CCTV CAMERA COMPLETE

Pay Item No. 617 131

GENERAL- The Contractor shall furnish all labor, materials and equipment necessary to furnish and install CCTV camera as shown on the plans or as directed by the Project Engineer. The installation shall include the camera, power supply, cables and all equipment that is installed inside of the traffic controller cabinet. The camera and power supply shall be mounted on the pole using ¾ inch stainless steel bands. The Contractor shall install rubber grommets in the holes drilled in the pole to protect the cables from damage. The 7 conductor IMSA 19-1 cable, the 3 pair 20 gauge twisted pair cable and the RG-6 coax cable shall be pulled from the controller cabinet thru the conduit and manholes in to the pole along with the other traffic signal conductors. The composite cable shall be installed from the power supply box to the camera. The cables from the controller shall be terminated in the power supply enclosure. All connections shall be made in a workmanship manner, all

unused conductor shall be taped and install in the enclosure so as not to block access to the connections with in the enclosure. The video encoder, DSL encoder and the surge protector shall be mounted in the controller cabinet using the cabinet mounting racks. All connections shall be checked and voltage reading taken for the power supply conductor to ensure proper voltage in the power supply enclosure.

The test shall be performed in the presence of the Project Engineer. The Contractor shall furnish all labor, materials and test equipment. The test equipment shall be tested and certified yearly by a certified testing lab or the equipment manufacturer. Copies of the certification shall be supplied to the Project Engineer.

Each conductor shall indicate a value of not less than fifteen (15) megaohms. If a fault is found to exist the Contractor shall locate the faulty cable section, and furnish and install a new cable.

MEASURE AND PAYMENT – The unit of measure for **FURNISH AND INSTALL CCTV CAMERA COMPLETE** will be per **EACH**. Payment will be made at the contract unit price per each complete camera installed, and payment will include all labor, equipment, tools, materials, and all incidentals necessary to complete.

14. RELOCATE AND INSTALL CCTV CAMERA COMPLETE

Pay Item No. 617 133

GENERAL- The Contractor shall furnish all labor, materials and equipment necessary to relocate the existing CCTV camera as shown on the plans or as directed by the Project Engineer. The installation shall include the camera, power supply, cables and all equipment that is installed inside of the traffic controller cabinet. The camera and power supply shall be mounted on the pole using ¾ inch stainless steel bands. The Contractor shall install rubber grommets in the holes drilled in the pole to protect the cables from damage. The 7 conductor IMSA 19-1 cable, the 3 pair 20 gauge twisted pair cable and the RG-6 coax cable shall be pulled from the controller cabinet thru the conduit and manholes in to the pole along with the other traffic signal conductors. The composite cable shall be installed from the power supply box to the camera. The cables from the controller shall be terminated in the power supply enclosure. All connections shall be made in a workmanship manner, all unused conductor shall be taped and install in the enclosure so as not to block access to the connections with in the enclosure. All connections shall be checked and voltage reading taken for the power supply conductor to ensure proper voltage in the power supply enclosure.

The test shall be performed in the presence of the Project Engineer. The Contractor shall furnish all labor, materials and test equipment. The test equipment shall be tested and certified yearly by a certified testing lab or the equipment manufacturer. Copies of the certification shall be supplied to the Project Engineer.

Each conductor shall indicate a value of not less than fifteen (15) megaohms. If a fault is found to exist the Contractor shall locate the faulty cable section, and furnish and install a new cable.

MEASURE AND PAYMENT – The unit of measure for **RELOCATE AND INSTALL CCTV CAMERA COMPLETE** will be per **EACH**. Payment will be made at the contract unit price per each complete camera relocated, and payment will include all labor, equipment, tools, materials, and all incidentals necessary to complete.

(C) INITIAL ACCEPTANCE, GUARANTEE, AND FINAL ACCEPTANCE

1. Initial acceptance of the contractors work will be given by the Engineer after inspection and verification that the work as defined in the contract documents, special provisions, technical specifications and project plans has been satisfactorily completed. Initial acceptance can be granted as individual intersections are completed. Initial acceptance shall neither be sought by the contractor nor approved by the engineer at least until all proposed signs and pavement markings are in place, the new controller is communicating with Central Control, all proposed signal hardware is erected, and the signal is properly operating the proposed traffic signal sequence of operation.

2. After the Engineer has granted initial acceptance, each signalized intersection shall operate for thirty consecutive calendar days without any type of failure of contractor supplied equipment or software. A failure shall be defined as one that results in the operational loss of one or more components of the traffic signal and communication system including cabling, controller software, cabinet components and all equipment furnished and installed by the contractor.

   The purpose of this requirement is to demonstrate that each signalized intersection in properly installed, is free from identified malfunctions, exhibits stable and reliable performance, and complies with all contract specifications and requirements. This thirty day period shall apply to each and all intersections covered under this contract, and shall include emergency on-site maintenance or repair completed within 24 hours of notification by the Engineer. The contractor shall perform on-site diagnosis and trouble-shooting and repair or replacement of failed materials or equipment, as requested by the Engineer.

   Manufacturer's standard warranties that extend beyond the contractor's warranty period shall automatically transfer to the District of Columbia government. The contractor shall inform the manufacturer of this requirement prior to the purchase of the equipment, and provide to the Engineer a written agreement of compliance from the manufacturer.

3. Final acceptance of the work will be given at the end of each intersection's thirty day break-in period. All work including completion of all required permanent street cut repairs must be completed to the satisfaction of the Engineer before final acceptance is given and the contractor is relieved from maintenance responsibility.

MEASURE AND PAYMENT: Warranties will not be measured, but the cost warranties and incidentals shall be included in the contract unit price to furnish and install materials and equipment specified in the contract documents. The payment shall be full compensation for all testing, labor, tools, materials, equipment and incidentals.

(D) BONDING AND GROUNDING

This item of work consists of furnishing and installing complete bonding and grounding systems to traffic signal poles transformer bases and to traffic signal controllers as shown in the Department of Transportation Standard Drawings. The grounding system shall conform to latest edition of the National Electric Code, District of Columbia Code and the serving utility.

Controller cabinets, termination cabinets and traffic signal pole transformer bases shall be made mechanically and electrically secure to form a continuous system, and shall be effectively grounded.

Material used for installation of traffic signal grounding systems shall meet the following requirements:

1. Ground Rods - Shall be copper-clad rods conforming to the requirements of UL - 467. Ground rods shall have a diameter of at least 3/4 inches and a length of at least 15 feet, (10' for use in grounding manholes) (or minimum soil contact of 8').

2. Ground Wires - Shall be at least No. 6 AWG bare solid copper with no splices conforming to the requirements of ASTM B2.

3. Ground Clamps - Shall be heavy duty bronze or brass or galvanized malleable iron conforming to the requirements of ASTM A220, any grade.

4. All manhole and alley post ground rod connections shall be made using exothermic welding.

The Contractor shall, in each District owned manhole, bond the neutral conductor and the system ground wire to the manhole grounding electrode.

Any DC Manhole that is worked in under this contract will be checked to affirm the existence of a existing ground rod, if no ground rod is found, a ground rod must be installed through the floor of the manhole in such a way as to have a minimum soil contact of 8 foot, the diameter of the ground rod must be ¾" in diameter. The Contractor must make the electrical connections between the GROUND ROD-

NEUTRAL CONDUCTOR AND ANY GROUND WIRES using exothermic welds in the existing DC manholes.

(E) ELECTRICAL SERVICE

This item consists of the provision of a complete electrical service installation for the purpose of supplying power from the utility power source to traffic signal controllers as indicated on the plans and in conformance with these Special Provisions. This item includes proper grounding of all equipment as specified.

The District will send a written request to the utility company for the provision of the power. Electrical power is to be provided by the Potomac Electric Company (PEPCO). The power company representative is:

Mr. Joseph D. Schall, Manager
Customer Design-DC
Potomac Electric Power Company
701 9th Street, N.W., Room 6005
Washington, D.C. 20068
Telephone Number: (202) 872-2844
Facsimile: (202) 331-6234
E-mail: jdschall@pepco.com

Service connection at PEPCO facility by PEPCO will be paid for by DCDOT as described in the Special Provision for streetlighting work, Pay Item 618 999.

(F) TRAFFIC SIGNAL HARDWARE PROCUREMENT AND INSTALLATION

Unless otherwise noted in the plans, in the traffic signal installation detail drawings, or in these Specials Provisions, the Contractor shall be responsible for furnishing all proposed materials associated with the traffic signal work. The Contractor shall be responsible for submitting to the Bureau of Traffic Services, Traffic Signal System Division catalog cuts and/or samples of all materials to be furnished for traffic signal work. Procurement of all such materials by the Contractor may not begin until written approval is obtained from the Traffic Signal System Division.

These Special Provisions contains technical specifications for items to be furnished by the Contractor.

1. Mast Arm Signal Head Brackets

The Contractor shall furnish and install Astro-Bracs or approved equivalent for all mast arm pole mounted vehicle signal heads (all lenses 12 inch at locations shown in the plans.

Brackets shall be furnished by the Contractor for 3 section, conventional vehicle signal heads. Back plate shall be affixed to all mast arm mounted vehicle signal heads.

2. Light Emitting Diode (LED) Traffic Signal Modules

All Light Emitting Diodes (LED) traffic signal modules shall meet the requirements of 825.02

3. Conventional Polycarbonate Vehicle Signal Head

All conventional polycarbonate vehicle signal heads shall meet the requirements of 825.06

4. Light Emitting Diode (LED) Pedestrian Count Down Signal Modules

All Light Emitting Diodes (LED) pedestrian countdown signal modules shall meet the requirements of 825.04.

5. Conventional Polycarbonate Pedestrian Traffic Signal Head

All conventional polycarbonate pedestrian signal heads shall meet the requirements of 825.07

6. Vehicle and Pedestrian Signal Mounting Hardware

The Contractor shall furnish all hardware required to mount vehicle and pedestrian signal heads to poles.

Vehicular and pedestrian signal heads, upper and lower mounting brackets, and pole plates will be furnished by the Contractor. The Contractor shall also furnish stainless steel banding materials to affix the signal head assemblies to the pole. The stainless steel banding material shall be ¾" wide. "Bandit" brand, or approved equal. This same banding material is also to be used to affix the pedestrian push buttons to the poles.

7. Steel Traffic Signal Poles

Shall be of the kind or type shown on the plans. The assembled pole shall be of such design and construction as to be capable of withstanding, when installed with all attachments, a static wind load of 80 MPH. Shop drawings for all fabricated metal poles, mast arms, and transformer bases shall be submitted to the District for approval before fabrication for each type proposed for use on the project. Drawings shall be submitted in quadruplicate.

Fabrication - Steel Poles shall be designed in accordance with latest AASHTO "Standard Specification for Structural Supports for Highway Signs, Luminaires and Traffic Signals". Poles shall be continuous tapered, approximately .014" per foot, and octaflute shaped shaft. The shafts shall be fabricated from one length of basic oxygen or open hearth sheet steel of the approximate gage or thickness shown on the plans. The sheet shall be formed into a continuous tapered tube with one continuous longitudinal, automatically, electrically welded seam; no intermediate or horizontal joints or welds will be permitted. After manufacture, the entire supporting pole shall have a minimum yield strength of 55,000 PSI.

A one piece cast steel anchor base of grade 65-35 steel (ASTM A 27 or Equiv.) or a welded steel plate anchor base that is of sufficient strength to develop the yield strength of the pole shall be provided. When the anchor base is attached to the shaft it shall develop the full strength of the shaft section to resist bending action. The base shall be provided with four slotted holes for attachment to the foundation or the transformer base with four anchor bolts. The anchor bolts shall be made from carbon steel meeting the requirements of ASTM A 576 modified to provide a minimum yield strength of 55,000PSI. Threads shall be cut. One end of the anchor bolt shall be provided with at least a 4 inch right angle hook.

Nuts shall meet the requirements of ASTM A 307. All pole hardware shall be galvanized in accordance with ASTM A 153. The anchor bolts holes shall be recessed and covered with ornamental covers, which are provided.

Suitable hand holes with covers shall be provided to facilitate installation and wiring. A suitable grounding connection shall be provided adjoining the base.

Finish - Hot dipped galvanized ASTM A-123 and powder coated to D.C. gray color.

8. Steel Transformer Base

Shall comply with these special provisions and dimension as shown in the Contract Plans.

Fabrication - The fabricated steel transformer base shall have dimensions as detailed on DC-DOT Drawing 393.The side of the base shall be fabricated from not less than #7 Manufactures Standard Gauge, best grade, hot rolled basic open hearth steel. The top and bottom plates shall be made of three-quarter inch (3/4") minimum thick steel plate. The door shall be secured in place by an approved locking device. After complete assembly, the base shall be shot blasted to remove all mill scale and weld slag. Each base shall be provided with four (4) loose steel plate anchor clips to fasten the base down to the anchor bolts. The transformer base shall fasten to the shaft anchor base by means of four (4) galvanized hex head machine bolts and nuts.

Finish - Hot dipped galvanized ASTM A-123.

9. 8 Foot Long Mast Arm and Clamp

Arm - Units to be supplied must be identical to those currently in service. The arm shall be made from one (1) length of steel of not less than 12 gauge, and shall conform to the requirements of ASTM A 570 Grade 50. The arm shall be octagonal in cross section with a continuous taper of .17 to .23 inch per foot depending on the length of the arm.

The design of the arm shall fully comply with the latest edition of AASHTO Specifications for loads as specified. The manufacturer shall supply detail shop drawings and calculations for approval prior to fabrication. The arm length shall be as specified, with a removable end cap.

Clamp - Shall be made of material conforming the ASTM A216 (WCB). The clamp shall be fabricated so as to provide full contact around the existing fluted pole. The exterior of the clamp shall be smooth and fluted to provide and aesthetically pleasing connection between pole and arm.

The clamp shall be fabricated to allow for arm elevation adjustments of eighteen inches (18") above or below the set mounting height. A two-inch (2"0 diameter smooth wiring hole shall be provided in the clamp to facilitate the wiring of the signal via the interior of the arm.

Each clamp shall be furnished with high strength galvanized connecting bolts. These bolts are to finished per manufacturer's specification.

Finish - Arm, clamp, and associated hardware shall be coated with fusion bonded polyester, or a epoxy polyamide primer followed by and aliphatic polyester polyurethane finish. Total film thickness to be 4.5 to 6.5 mils. Color to be D.C. gray: Manufacturer to supply color chip for approval prior to finishing. A 6oz can of "Touch up" paint shall be supplied with each arm assembly.

Shop Inspection - All items shall be of domestic manufacture with the manufacturer providing full access to Washington, D.C. inspectors during fabrication and finishing.

10. Traffic Signal Controller

a. Work relating to the traffic signal controller shall be performed during temporary stage and during the final restoration stage.

b. During the temporary stage, the contractor shall relocate the existing traffic signal controller from its existing foundation to a temporary, portable concrete base. The Contractor shall furnish and install the temporary, portable concrete

base that must conform to the drawing found in DC-DOT Standard Drawing 618.24.

c. The Contractor shall furnish and install a new Type 170 traffic Signal Controller for the final intersection restoration stage. The Controller/cabinet assembly shall conform to the technical specifications found in the Appendix. The controller shall be installed on the foundations shown on the plans.

d. The Contractor shall deliver the proposed controller to the office of the Traffic Signal Maintenance Branch where it will be prepared for operating the traffic signal sequence of operation for these intersections. The DC-DOT will notify the Contractor when the controller has been prepared and as ready to be picked up by the Contractor.

e. The equipment to be furnished shall conform to the technical specifications found in Appendix K of these Special Provisions.

11. Controller Cabinets

This specification applies to all electrical cabinets used for Traffic Control Devices, i.e., traffic signal controller cabinets. The specification for traffic signal controller cabinets is contained in Appendix K within the controller specification.

12. Mast arm traffic signal poles

The poles shall be constructed as shown in the Contract plans

(G) TRAFFIC SIGNAL HARDWARE REMOVAL

As required, traffic signal hardware shall be removed as shown on the plans, as specified herein and as directed by the Engineer.

1. After the Engineer deems the proposed traffic signal to be properly in service, power to the existing traffic signal shall be disconnected. At this time, the existing traffic signal shall be removed.

2. The Contractor shall remove all existing traffic and pedestrian signal heads and return them to the District of Columbia. Care shall be taken to avoid damage to the signal heads, as these shall be reused. The Contractor shall also return to the District of Columbia all mounting hardware.

3. The Contractor shall remove all electrical cable between the old controller foundation and each signal device. The Contractor shall also remove all space wire existing between the mast arm poles. This cable is to be discarded by the Contractor.

4. The Contractor shall remove the existing traffic signal poles and return them to the District of Columbia.

5. The Streetlight Contractor shall demolish and remove all pole foundations and the controller cabinet foundation, as specified in Paragraph E of this Special Provision.

6. Materials to be returned to the District of Columbia shall be delivered to 1725 Fenwick Street, N.E. The Contractor shall contact Warehouse Manager at (202) 576-5258 to arrange for delivery of the material to this warehouse.

7. Removal of traffic materials mounted on street light poles shall be coordinated with these Special Provisions and the Standard Specifications.

(H) AS-BUILT DRAWINGS

Upon completion of the project, the Contractor shall submit one (1) reproducible set of as-built drawing showing the traffic signal portion of the project to the Office of the Transportation Operations Division at 2000 14th Street, NW, Washington, D.C. 20009, Telephone Number: (202) 671-1478 Mr. Harvey Alexander. This set of as-built drawing shall bear the signature of an officer of the Contractor's organization certifying compliance with as-built conditions.

53. PRECAST CONCRETE UNITS

This Special Provision supplements Division 700 Structures of the Standard Specifications.

790 PRECAST CONCRETE UNITS

790.01 DESCRIPTION

Fabricate precast nonstressed concrete units (precast concrete units). Nonstressed is defined as concrete member that have not been prestressed or post-tensioned. Refer to 705.01 for definition of Prestressed and Post-tensioned concrete.

790.02 MATERIALS

(A) PCC Concrete Mixtures – 703 and 817, Class A, B or H as applicable

(B) Structural Steel – 706 and 815.01

(C) Reinforcing Steel – 704 and 812

(D) Cast-in Anchors – 706 and 708.09

(E) Coatings – 707 and 811

(F) Grout – 806.05(E)

790.03 QUALITY ASSURANCE

(A) The precast concrete manufacturing plant shall be certified by the Precast/Prestressed Concrete Institute (PCI), Plant Certification Program, prior to the start of production. At the Contractor's option, in lieu of PCI certification, the manufacturer shall, at no cost to the District, meet the following requirements.

(1) Retain an independent testing or consulting firm approved by the Chief Engineer.

(2) The basis of inspection shall be the Precast/Prestressed Concrete Institute's "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products," MNL-116 and "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products," MNL-117.

(3) This firm shall inspect the precast plant at two week intervals during production and issue a report, certified by a registered Professional Engineer, verifying that materials, methods, products and quality control meet all the requirements of the specifications, drawings, and MNL-116 and/or MNL-117. If the report indicates to the contrary, the Chief Engineer will inspect and, at the Chief Engineer's option, may reject any or all products produced during the period of non compliance with the above requirements.

(B) Qualifications of Manufacturer:

(1) Manufacturer shall have a minimum of five (5) years of production experience in precast concrete work of the quality and scope required on this project.

(C) Qualifications of Erector:

(1) Erection of precast concrete units shall be performed by an established firm regularly engaged for at least two (2) years in the erection of precast concrete units of sizes similar to those required on this project.

(2) Perform inspection of panels under the supervision of a foreman employed by the erection firm for this type of work.

(D) Qualifications of Welders and Tackers:

(1) Welder qualifications shall be in accordance with 706.18.

(E) Testing:

(1) All testing shall be performed by the manufacturer's in-house quality control inspectors and in accordance with all provisions in "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products," MNL-117 as published by PCI.

(F) Allowable Casting Tolerances:

(1) For precast concrete pier units, variation from the plumb - 1/2 inch in 15 feet, Variation in cross-sectional dimensions - Minus 1/4 inch to Plus 1/2 inch.

(2) For precast concrete superstructure units, variation in deck slab thickness - Minus 1/4 inch to Plus 1/2 inch.

790.04 EQUIPMENT

(A) The Contractor shall provide all equipment necessary for the construction of the precast concrete units.

(B) Safety measures shall be taken by the Contractor to prevent accidents during placement and transportation of the precast units.

790.05 CONCRETE CONSTRUCTION

Necessary formwork, concrete placing, exposed surface finishing and other construction requirements shall conform to 703 unless otherwise stipulated.

The units shall be constructed on a rigid base which will not deflect or settle unevenly, to prevent any vertical distortion, and shall be braced transversely so as to prevent any buckling sideways. No concrete shall be deposited in the forms until the formwork, reinforcing, anchorages and other appurtenances have been inspected and approved by the Chief Engineer. Approval, however, does not relieve the Contractor of his responsibility to produce a satisfactory unit, and any unit not meeting the requirements as specified herein will be rejected and the Contractor will be required to replace the unit at his expense.

If the Chief Engineer so directs, the Contractor will be required to vibrate the concrete externally as well as internally. Vibrating shall be done with extreme care and in such a manner as to prevent displacement, crushing or damaging of reinforcement or any other appurtenances which are a part of the construction.

Curing of concrete shall be per 703.18 except as follows:

(A) STEAM CURING. Steam curing will be permitted and shall be done under a suitable enclosure to contain the live steam in order to minimize moisture and heat losses. The initial application of the steam shall commence 2 to 4 hours after the final placement of concrete to allow the initial set of the concrete to take place. If the use of retarders is approved, the waiting period before application of the steam shall be from 4 to 6 hours. The steam shall be at least 100 percent relative humidity to prevent loss of moisture and

to provide excess moisture for proper hydration of the cement. Application of the steam shall not be directly on the concrete. During application of the steam, the temperature of the member shall increase at a rate not to exceed 40°F per hour until a maximum temperature of from 140°F to 160°F is reached. The maximum temperature shall be held until the concrete has reached the desired strength. Suitable probes shall be inserted into the members for monitoring the temperature.

(B) RADIANT HEAT CURING. Precast members may be cured by the radiant heat method provided that the members are enclosed in approved rubberized canvass tarpaulins or other approved enclosures. The application of heat shall be as specified for steam curing. The Contractor shall submit a curing plan which includes procedures to be used for approval by the Chief Engineer before curing may begin.

The Contractor shall submit a curing plan which includes procedures to be used for approval by the Chief Engineer before curing may begin.

790.06 SUBMITTALS

(A) All submittals shall conform to the requirements of 105.02.

(B) Samples:

(1) Before starting the manufacture of precast concrete units, submit for review to the Chief Engineer one (1) sample which represents the finished product and which clearly indicates the color and texture of the units.

(2) Samples are to be 12" x 12" face size by 1 1/2" thick.

(3) Label each sample to indicate name of manufacturer and finish code.

(4) After standard samples are accepted for color and texture, submit three (3) mock-up units at least 4'-0" x 5'-0" for review of the Chief Engineer to show the extreme maximum variations which may occur in the color and texture of the production pieces.

(5) The mock-up units are to be the standard of quality for precast concrete units' work, when they are accepted by the Chief Engineer.

(6) The Chief Engineer should visit the precast plant shortly after the start-up of production in order to inspect actual production pieces. The Contractor will be responsible for all costs incurred by the Chief Engineer to inspect the actual production pieces at the precast plant.

(C) Shop Drawings:

(1) The Contractor shall expedite the submittal with the Chief Engineer to conform to the allotted shop drawing approval time, shown on the precast concrete supplier's order acknowledgment.

(2) The content shall be as follows:

(a) Temporary support configuration at the precast plant. For precast superstructure units this shall entail laying out units in same position as final configuration (i.e. proposed beam seat elevations at pier and abutments shall be used to construct similar temporary supports).

Bearing type and design for support of precast superstructure units shall be included in shop drawing submission.

(b) Unit shapes (elevations and sections) and dimensions.

(c) Finishes.

(d) Joint and connection details.

(e) Lifting and erection inserts.

(f) Location, dimensional tolerances and details of anchorage devices that are embedded in or attached to structure or other construction.

(g) Other items cast into precast concrete units.

(h) Handling procedures, plans and/or elevations showing panel location and sequence of erection for special conditions.

(i) Relationship to adjacent material.

(3) Show location of unit by same identification mark placed on unit.

(4) Individual unit details may be submitted at the request of the Chief Engineer. It is recognized that a review of the unit details prior to actual release for production will greatly impact the construction schedule.

(D) Test Reports:

(1) The Contractor shall submit reports on materials, compressive strength tests on concrete, and water absorption test on units to the Chief Engineer for review and approval.

(E) Design Calculations:

(1) The Contractor shall submit structural design calculations to the Chief Engineer for review and approval. The Contractor shall submit their QA/QC procedure for design calculations to the Chief Engineer for review and approval.

(F) Design Modifications:

(1) Submit design modifications necessary to meet performance requirements and field coordination. Submission of modifications does not guarantee their acceptance by the Chief Engineer.

(2) Variations in details or materials shall not adversely affect the appearance, durability or strength of the units.

(3) Maintain general design concept without altering the size of members, profiles and alignment.

790.07 MANUFACTURING

(A) Finishes:

(1) Exposed face surfaces of precast concrete pier units: Finished to match the approved sample unit where there is architectural treatment. Finished to match the requirements of 703.19 where there is no architectural treatment.

(2) Exposed surfaces of precast concrete superstructure unit: Finished to match the requirements of 703.21 and 703.19. The requirement to texture the bridge deck per 703.19(C) shall be verified with the Chief Engineer.

(B) Precast Unit Identification:

(1) Mark each precast concrete unit to correspond to the code markings appearing on the shop drawings for unit location. Do not mark on the finish surfaces.

(2) Maintain a record of casting date.

(C) Precast Superstructure Units Temporary Supports

(1) Precast superstructure units shall be laid out according to the shop drawings in a manner duplicating the final position. The profile and cross slope of precast superstructure units shall be approved by the Chief Engineer. Units not matching profile and cross slope requirements shall be replaced by the Contractor at his expense.

790.08 JOBSITE CONDITIONS

(A) Before starting to erect the precast concrete unit, the Contractor shall verify that the structure and anchorage inserts not within the tolerances required to erect the units have been corrected.

(B) Determine field conditions before commencing erection.

790.08 PRODUCT DELIVERY, HANDLING AND STORAGE

(A) Delivery and Handling:

(1) Deliver all precast concrete units to project site in such quantities and at such times as to assure the continuation of erection.

(2) Handle and transport units in a position consistent with their shape and design in order to avoid stresses which would cause cracking or damage.

(3) Lift or support units only at the points shown on the shop drawings.

(4) Place non-staining resilient spacers of even thickness between each unit.

(5) Support units during shipment on non-staining shock-absorbing material.

(6) Do not place units directly on the ground.

(B) Storage at Jobsite:

(1) Store and protect units to prevent contact with soil, staining and physical damage.

(2) Store units, unless otherwise specified, with non-staining resilient supports located in the same positions as when transported.

(3) Store units on firm, level and smooth surfaces to prevent cracking, distortion, warping or other physical damage.

(4) Place stored units so that identification marks are discernible and so that product can be inspected.

Care shall be taken during storage, hoisting and handling of the precast units to prevent cracking or damage. Units damaged by improper storing or handling or in any other manner, shall be replaced by the Contractor at his expense.

790.09 ERECTION

(A) Clear, well-drained unloading areas and road access around and in the structure shall be provided and maintained by the Contractor, to include providing and maintaining accessible roadways in which cranes and trucks can maneuver under their own power.

(B) The Contractor shall erect adequate barricades, warning lights or signs to safeguard traffic in the immediate area of hoisting and handling operations. Any overhead obstructions interfering with the erection must be removed by others and any underground equipment installed where cranes and trucks must maneuver is installed at the risk of the trade requiring them and be protected by that contractor.

(C) Set precast concrete unit level, plumb, square and true within the allowable tolerances. The Contractor shall provide true, level bearing surfaces on all field placed concrete which are to receive precast concrete units. The Contractor shall be responsible for providing offset lines and elevations in sufficient detail to allow installation.

(D) Provide temporary supports and bracing, as required, to maintain position, stability and alignment as units are being permanently connected.

(E) Set non-load bearing units dry without mortar, attaining specified joint dimension with, steel or plastic cement spacing shims.

(F) Set precast concrete units in place with closure pours and grouted keys as indicated on the contract drawings and approved erection drawings.

(G) Temporary lifting and handling devices cast into the precast concrete units shall be completely removed, or if protectively treated remove only where they interfere with the work of any other trade.

790.10 REPAIR

(A) Concrete repair and replacement shall meet the requirements of 716.

(B) Repair exposed exterior surface to match color and texture of surrounding concrete.

(C) Adhere large patch to hardened concrete with bonding agent.

790.11 CLEANING

(A) Precast concrete units will be clean upon completion of erection and leaving the job site.

(B) After installation and joint treatment the Contractor should protect the precast concrete units against damage and maintain the cleanliness of the units. Any final wash-down of the precast units should be the responsibility of the Contractor.

790.12 PROTECTION

(A) All work and materials of other trades shall be adequately protected by the Erector at all times.

(B) A fire extinguisher, of an approved type and in operating condition, shall be located within reach of all burning and welding operations at all times.

790.13 WARRANTY

(A) The Precast Concrete Manufacturer shall guarantee the precast concrete products against defects in material and workmanship, for a period of two (2) years, after acceptance of the units by the owner.

790.14 MEASURE AND PAYMENT

This work will be paid for through the concrete, reinforcing steel and structural steel items which are used to construct the precast concrete units. For structural concrete measurement and payment details, see 703.25. For reinforcing steel measure and payment details, see 704.10. For structural steel measurement and payment details, see 706.24 and 706.25.

54. WATERPROOFING, Items 795 001 and 795 002

This Special Provision supplements Division 700 Structures of the Standard Specifications.

795 WATERPROOFING

795.01 DESCRIPTION

This work shall consist of furnishing and applying waterproofing material on concrete bridge decks or other surfaces as shown on the plans.

795.02 MATERIALS

Epoxy-resin compounds and aggregates for surface application shall conform to the requirements of **796 EPOXY-RESIN SYSTEMS**. Epoxy resin shall be Type EP-5, low viscosity.

Membrane and primer shall conform to ASTM D6153.

795.03 PROCEDURES

(A) Epoxy-resin

Containers, tools, and mechanical equipment shall be free from solvents, loose material, and deposits of hardened material.

Epoxy resin shall not be applied when the concrete surface or the ambient air temperature is below 50 degrees F unless otherwise permitted by the manufacturer's instructions.

(1) Surface preparation: Surfaces on which epoxy compounds are to be applied shall be free from grease, dirt, dust, paint, mill scale, curing compound, laitance, and other foreign material.

Concrete surfaces on which epoxy compounds are to be used shall be ground or sandblasted sufficiently to expose the sound concrete. Surfaces that are not to receive epoxy compounds shall be protected from sandblasting. Immediately following sandblasting, the surface shall be thoroughly cleaned.

Before epoxy compounds are applied to metal surfaces, surfaces shall be sandblasted to a bright metallic luster.

Wood surfaces shall be sanded to the texture of new wood.

(2) Mixing: Epoxy mortar shall be made by blending sand, epoxy resin, and hardener in accordance with the manufacturer's instructions.

Batch sizes shall be limited to the maximum batch size recommended by the manufacturer. Mixed epoxy compounds shall be used within the manufacturer's specified pot life. Solvents or other materials shall not be added to the mixture.

(3) **Application:** Masking shall be used to form straight edges. Epoxy resin shall not be allowed to flow into or over expansion joints. The first coat of epoxy resin shall be applied at the rate of 1 gallon per 75 square feet. Sand shall be broadcast into the wet epoxy in sufficient quantity, approximately 11 pounds per square yard, to cover the epoxy completely. Sand shall be firmly embedded so that at least 95 percent of the deck area displays a sand surface after brooming.

Brooming shall not be performed until the epoxy resin has cured sufficiently to prevent tearing. After curing, unbounded sand shall be broomed from the surface and may be reused if uncontaminated. The second coat of epoxy resin shall be applied at the rate of 1 gallon of epoxy per 50 square feet. Requirements pertaining to masking, epoxy, flow, sand broadcasting, percentage of embedment, curing, and brooming shall also apply to the second coat of epoxy resin.

At edges of the waterproofing system and at any point where it is punctured by appurtenances such as drains or pipes, suitable provisions shall be made to prevent water from getting between the waterproofing and the waterproofed surface.

The waterproofing system shall be extended as follows: 1 inch up faces of curbs, continuously across abutment back walls and at least 6 inches down the back of back walls; at least 12 inched onto approach slabs, and continuously across joints expect expansion joints.

When applied to prestressed concrete slab and box beam units for new construction, application shall be made at the prestressing plant. Joints and damaged areas shall be waterproofed after erection.

(4) **Curing:** Curing time shall conform to the manufacturer's recommendations. During this time, both pedestrian and vehicular traffic shall be barred from freshly placed surfaces.

(B) Membrane

(1) The waterproofing membrane sealant shall consist of a prefabricated membrane or liquid membrane conforming to one of the following systems:

System A – A primer and prefabricated membrane consisting of a laminate formed with suitable plasticized coal tar and reinforced with nonwoven synthetic fibers or glass fibers.

System B – A primer, mastic, and prefabricated membrane consisting of a laminate formed and rubberized asphalt and reinforced with synthetic fibers or mesh.

System C – A primer and prefabricated membrane consisting of a laminate formed with suitably plasticized asphalt, reinforced with open weave fiber glass mesh, and having a thin polyester top surface film.

System D – A hot poured liquid elastomeric membrane with protective covering.

System E – A surface conditioner and hot applied rubberized asphalt membrane with protective covering.

(2) **Construction:** On new decks, the waterproofing membrane system shall not be placed until at least 28 days after deck concrete placement, unless otherwise directed by the Chief Engineer.

Each phase of the bridge deck construction shall be completed, including the placing of the surface course overlay, before roadway traffic may be placed on that portion of the bridge structure. In order to minimize possible damage to the membrane, placing of the membrane sealant system will not be permitted until the adjacent roadway binder course has been completed and is ready for traffic. Only vehicles necessary for construction will be permitted on the structure during and after the placing of the membrane system, including the paver, and such vehicles shall be rubber tired or have rubber covered treads. The Contractor shall be responsible for maintaining the condition of the membrane system until covered with the bituminous concrete surface course overlay.

All methods employed in performing the work and all equipment, tools and machinery used for handling materials and executing any part of the work shall be subject to approval of the Chief Engineer before the work is started; and, whenever found unsatisfactory, shall be changed and improved as required. All equipment, tools, machinery, and containers used must be kept clean and maintained in satisfactory working condition.

Work shall not be performed during wet weather conditions. Also, work shall not be performed when the deck and ambient air temperatures are below 50 degrees F, except for System E the minimum temperature shall be 20 degrees F. The deck surface shall be thoroughly dry at the time of the application of the primer or liquid membrane.

Concrete parapet surfaces and railing, including armor plates for the elastomeric joint seals, shall be protected to prevent their being defaced by primer or membrane material. Should defacement occur, the Contractor shall clean surfaces on the structure to the satisfaction of the Chief Engineer.

Between the time the bridge deck is cleaned and prepared for primer and the time the membrane system is placed, no vehicles, including mechanical spreaders, shall be operated on the area being treated. Only the necessary men and equipment to perform the required work will be allowed on the treated surface, and only at such time and in such manner as approved by the Chief Engineer. Care shall be taken to prevent sudden starts, stops or turns by equipment. All other traffic shall be maintained on portions of the structure that are not being given the membrane protection.

(3) Preparation of concrete deck: All surfaces which are to be covered shall be thoroughly cleaned by the use of sandblasting, air jets, mechanical sweeper, hand brooms, or other approved methods, or as required by the Chief Engineer, until the surface is free of all sand, clay dust and all loose or foreign matter. Water shall not be used to clean the deck unless authorized by the Chief Engineer.

Any accumulations of oil or grease shall be scraped off the roadway surface and cleaned with a strong caustic solution. The resulting residue shall be thoroughly flushed away with clean water. All cleaned areas shall be primed without delay as soon as they are dry. All dust and dirt shall be blown off with air jets immediately preceding application of primer or liquid membrane.

Any sharp concrete protrusions on the deck surface which would puncture the membrane shall be removed prior to application of the membrane.

(4) Construction Procedures

(a) Application of primer: The primer shall be applied to the cleaned concrete surfaces at the rate and according to the procedure recommended by the membrane manufacturer. All surfaces to be covered by prefabricated membrane shall be uniformly coated with primer. Drying time prior to applying the membrane shall be as recommended by the manufacturer.

(b) Application of membrane: Before applying the membrane, the direction of operation of the paving equipment shall be ascertained. Unless otherwise approved, each phase of performed waterproofing membrane construction shall begin at the low point of the surface to be waterproofed and shingled so that water will run over and not against any laps. At all deck joints, the membrane shall extend to the edge of the joint opening as shown on the plans.

(1) Prefabricated membrane shall be applied to the primed curb and bridge deck surfaces by either hand methods or mechanical applicators. Prefabricated membranes shall be placed in such a manner that a shingling effect will be achieved, and any water

which accumulates will drain toward the curb and the drainpipes. Each strip shall be overlapped a minimum of 4 inches. The membrane sections shall be placed so that end laps will be in the direction of the paving operation.

An adhesive or a wide tipped torch shall be used, if necessary, to assure a good seal of the prefabricated membrane joints. Hand rollers or other satisfactory pressure apparatus shall be used on the applied membrane to assure firm and uniform contact with the primed concrete surfaces. Special care shall be used at the curb face to see that the membrane is uniformly and positively adhering to the concrete.

Prefabricated membranes shall be free of wrinkles, air bubbles, and other placement defects. Any torn or cut areas, or narrow overlaps shall be patched, using a satisfactory adhesive and by placing sections of the membrane over the defective area in such a manner that the patch extends at least 6 inches beyond the defect. The patch shall be rolled or firmly pressed onto the surface.

(2) Liquid elastomeric membrane shall be heated in a manner as recommended by the membrane manufacturer to 375 degrees F, and applied to the cleaned concrete surface by spraying with a special type nozzle as recommended by the membrane manufacturer, or poured onto the concrete surface and worked into the surface with a silicone rubber squeegee to a uniform 90 mil thickness for System D and 125 mil thickness for system E.

(c) **Application of protective covering:** For System A, B, and C, protective covering shall be used when or as recommended by the membrane manufacturer. For System D and E, the protective covering shall be applied immediately following application of the elastomeric membrane and prior to cooling, before loss of adhesion between materials. Protective covering shall be laid parallel to the centerline of the bridge, unless otherwise approved by the Chief Engineer, and with the talc coated side up.

In the event protective covering is recommended by the prefabricated membrane manufacturer, a suitable compatible mastic or adhesive cement, as recommended by the membrane manufacturer, shall be used to securely adhere any protective covering material to membrane surfaces. Protective covering strips shall be butted tightly together at both longitudinal and transverse joints. Protective covering material shall be securely bonded to the membrane material and shall be

essentially free of wrinkles, bubbles, and other placement defects. Wrinkles and "fish mouths" rising over ½ inch above the bridge deck shall be split and either removed or lapped and securely bonded together.

(d) **Application of surface course overlay:** Unless otherwise approved by the Chief Engineer, an asphalt concrete surface course mixture shall be placed within 24 hours after the placement of the waterproofing membrane system in accordance with Standard Specification 401, except as modified herein.

The asphalt concrete surface course shall be of the type and amount specified on the plans, with a minimum compacted depth of 1 ½ inches. The paving operation shall be in the same direction as the end laps of the membrane. When a protective covering is used, a tack coat shall be applied prior to the paving operation.

The mixing discharge temperature of the mixture shall not exceed 310 degrees F. The temperature of the mixture at the time of placement shall not be less than 275 degrees F. The mixture shall be dumped directly into the pave hopper. After filling the hopper, the truck shall pull forward and shall not be in contact with the paver while it is moving. Dumping the mixture onto the deck ahead of the paver will not be permitted. The mixture shall be spread and rolled in such a manner that the protective coating, when used, will not be damaged. The temperature of the mixture at the time of rolling and compacting shall be not less than 235 degrees F. When using vibratory roller equipment, the vibrator shall not be activated.

(e) **Performance:** After completion of the surface course, the waterproofing effectiveness of the membrane pavement system will be determined. The minimum electrical resistance shall be 500,000 ohms when tested in accordance with VTM-39. Areas designated by the Chief Engineer as having a lower resistance reading than 500,000 ohms will be evaluated and those areas determined by the Chief Engineer to be detrimental to the effectiveness of the system shall be repaired at the Contractor's expense by removing the pavement and then replacing or repairing the defective membrane. Asphalt pavement shall then be placed in a manner that will yield a neat appearing, smooth riding pavement. In the event more than 30 percent of the bridge deck area is shown defective by tests and is determined by the Chief Engineer to be detrimental to the effectiveness of the system, the entire asphalt pavement and membrane system shall be removed and the deck cleaned in a satisfactory manner. The entire membrane-pavement system shall then be replaced in accordance with the requirements herein at the Contractor's expense.

795.04 MEASURE AND PAYMENT

Waterproofing will be measured and paid for in square yards of completed deck and approach slab surface covered between the beginning and end stations of the bridge. For applications other than bridge decks, waterproofing will be measured and paid for in square yards of completed surface as shown on the plans.

The cost of waterproofing applied to prestressed concrete members before erection, and the cost of waterproofing joints and damaged areas shall be included in the price bid per member.

55. EPOXY-RESIN SYSTEM

This Special Provision supplements Division 700 Structures of the Standard Specifications.

796 EPOXY-RESIN SYSTEMS

796.01 DESCRIPTION

These specifications cover epoxy-resin systems to be used for all applications requiring bonding of various materials or as patching or overlay of concrete slabs.

796.02 DETAIL REQUIREMENTS

Epoxy-resin materials shall conform to the applicable requirements of Tables II-19, and II-21. The infrared spectrum for each component shall essentially match that of the standard infrared spectrum for the particular component as specified in AASHTO T237, Sections 4 and 5.

TABLE II-19

Requirements: Component A

Type Property	EP-3B Max.	EP-3T Max.	EP-4 Max.	EP-5 Max.	EP-6 Max.
Epoxide equivalent	245	220	225	270	245

(A) Epoxy Systems

(1) **Types EP-3B and EP-3T** shall be 100 percent reactive high build coatings designed as a two coat (minimum) system for protection of concrete exposed to splash zones and tidal water. Type EP-3B shall be the prime or base coat, and Type EP-3T shall be the finish or topcoat.

(2) **Types EP-4, EP-5, and EP-6** shall be moisture insensitive systems designed for structural bonding, sealing, and grouting of dry, damp, or wet structural material free from standing water. Mortar shall be prepared by mixing 3 1/4 parts by volume of loose oven-dried sand to 1 part of premixed Type EP-4 or EP-5 epoxy; however, Type EP-6 shall be mixed on a 1:1 ratio.

Mortars shall be mixed to a uniform consistency.

Type EP-4 shall be a high modulus, rigid, general purpose adhesive with a tensile elongation of 1 to 3 percent. Type EP-4, low viscosity, shall be used to seal rigid cracks.

TABLE II-21
Requirements: Mixed Epoxy Systems

Property	EP-3B Red		EP-3T Gray		EP-4 Straw		EP-5[1] Straw		EP-6 Lt. Straw		CTE Black	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Pot life at 75°F	40	65	40	65	35	55	35	35	20	30	20	40
Tensile strength (psi) at 75°F	—	—	—	—	3,000	—	2,000	—	1,500	—	400	—
Tensile elongation (%) at 75°F	—	—	—	—	1	3	5	15	5	15	30	—
Water absorption (Max. %)	—	0.8	—	0.8	—	0.8	—	0.8	—	0.8	—	0.8
2 in Cubes compressive (psi, 24 hr, dry) (min.)	—		—		6,000		—		—			
Strength (psi, 48 hr, wet) (min.)	—		—		7,000		4,000		4,000		—	
Bond strength: (7 day) Hardened concrete to hardened concrete or fresh concrete (psi min.)	3,000		3,000		3,000		—		3,000		2,500	
Ash content (%)	20	30	10	20	—	0.5	—	0.5	5	15	—	5.0
Viscosity												
Poises	40	100	40	150	20	40	10	25	—	—		
Spindle No.	4		4		3		3		Gel			
Speed	10 or 20		10 or 20		20		20					
Volatile content (max. %)			6.0		3.0		3.0		3.0		20.0	

[1]Epoxy system EP-5LV shall have the same requirements as epoxy system EP-5 except that the viscosity shall be less than 9.0 poises.

Type EP-5 shall be a low modulus patching, sealing, and overlay adhesive with an elongation of at least 10 percent. When used as a penetrating sealer and to repair nonrigid cracks, Type EP-5 shall be of a low viscosity.

Type EP-6 shall be a low modulus, nonsagging, flexible adhesive with an elongation of at least 5 percent. Type EP-6 shall be used for bonding or repairing damp and underwater surfaces where a nonsagging, low modulus material is required.

(B) Classes

Epoxy resin shall be formulated for use at specific temperatures. Three classes of systems are defined according to the range of temperatures for which they are suited. The controlling temperature shall be that of the surface of the hardened concrete to which the bonding system is applied.

Where unusual curing rates are desired and upon the approval of the Chief Engineer, a class of bonding agent may be used at a temperature other than that for which it is normally intended. The class and gel temperature shall be as follows:

(1) **Class A:** for use below 40 degrees F

(2) **Class B:** for use between 40 degrees F and 60 degrees F

(3) **Class C:** for use below 60 degrees F

(C) Mixing Epoxy

Epoxy resin shall be furnished in two components for combining in accordance with the manufacturer's instructions immediately prior to use. Component A shall contain a condensation product of epichlorohydrin with bisphenol A and shall conform to the requirements of Table II-19. Component B shall conform to the requirements of Table II-20 and shall contain one or more hardening agents that will cause the system to polymerize and harden, on mixing with Component A in accordance with Table II-21. Thixiotropic agents used to control viscosity will be permitted in accordance with the manufacturer's recommendations. If the mixture proportion of component A to component B exceeds 2:1, only complete units as packaged by the manufacturer shall be used.

Contents of the separate packages containing Components A and B shall be thoroughly stirred prior to use. The same paddle shall not be used to stir Component A that is used to stir Component B. The Contractor shall dispose of solvents used for cleaning in accordance with applicable Department of Public Works policies and procedures. Components A and B shall be stored between 65 degrees F and 80 degrees F for at least 2 hours before use. Epoxy components may be heated in hot

water or by indirect heat prior to mixing to bring them to the required temperature. Solvents and thinners shall not be used except for cleaning equipment.

Mixing of epoxy components shall be in accordance with the manufacturer's instructions.

When mineral fillers are specified, they shall be inert and nonsettling or readily dispersible. Materials showing a permanent increase in viscosity or the settling of pigments that cannot be readily dispersed with a paddle shall be replaced at the Contractor's expense. At least 95 percent of the filler shall pass the No. 300 sieve.

(D) Mixing Epoxy

Aggregate for surface application work shall be nonfriable, nonpolishing, clean, and free from surface moisture. Silica sand having a well-rounded particle shape shall be used. Aggregates that will be exposed to traffic shall have a Mohs scale hardness of at least 7. In surface applications, the aggregate shall be applied on the epoxy surface in excess of the amount necessary to cover the surface, shall be sprinkled or dropped vertically in such a manner that the level of epoxy mixture is not disturbed, and shall be applied within 5 minutes after application of the epoxy. At temperatures below 70 degrees F, a maximum of 10 minutes will be allowed. The grading analysis of the fine aggregate (silica sand) shall conform to the requirements of Table II-22.

TABLE II-22
Fine Aggregate (Silica Sand)

	Amounts Finer Than Each Laboratory Sieve (Sieve Opening) (% by Weight)					
Grading	**No. 8**	**No.16**	**No. 20**	**No. 30**	**No. 40**	**No. 100**
D	Min 100	50 ± 10		Max 3		Max 1
E	Min 100	99 ± 1	95 ± 5		Max 10	

Grading D aggregate shall be used in Class I waterproofing and other skid-resistant applications. Grading E aggregate shall be used in epoxy patching mortars and loop detector sealants. Aggregates shall be oven dried.

796.03 HANDLING AND STORING MATERIALS

The two components of the epoxy resin system shall be furnished in separate containers that are nonreactive with the materials. The size of the containers shall be such that the recommended proportions of the final mixture can be obtained by combining one container of Component A with one container of Component B. The size of the container shall be not more than 10 gallons. When less than one complete unit is used, each component shall be measured within ±2 percent of the volume required. Batches of less than 6 fluid ounces shall be measured within ±1 percent.

Containers shall be identified as "Component A—Contains Epoxy Resin" and "Component B—Contains Hardener" and shall show the type, class, and mixing directions. Each container shall be marked with the name of the manufacturer; class, batch, or lot number; date of packaging; date of shelf life expiration; pigmentation, if any; and the quantity contained in pounds and gallons.

796.04 ACCEPTANCE

Shipments of less than 15 gallons may be accepted upon certification. The Contractor shall submit a certification from the manufacturer that Components A and B conform to these specifications. The certification shall consist of a statement by the manufacturer that Components A and B have been sampled and tested. The certification shall be signed by an authorized agent of the manufacturer and contain actual results of tests performed in accordance with the methods specified herein.

For shipments of 15 gallons or more, at least one random test sample of each component from each batch or lot number will be taken by the Chief Engineer. The quantity of Component A required to react with 1 quart of Component B will be a sufficient sample for the tests specified. Components shall be furnished in as few different batches or lots as possible.

Tests will be performed in accordance with the following methods:

Characteristics	Test Method	Other
Viscosity	ASTM D2393, Model RVF Brook-field visco-meter	Determination to be made at Class A–32°F Class B–50°F Class C–77°F
Epoxide equivalent	ASTM D1652 and VTM-43	
Volatile content	ASTM D1259, Method B, for mixed system	Sample cured 4 days at room temperature and weighed on previously weighed metal foil
Filler content	VTM-43	
Ash content	ASTM D482	
Pot life	AASHTO T237	Determination to be made at Class A–32°F Class B–50°F Class C–75°F
Tensile strength	ASTM D638	
Bond strength	VTM-41	
Compressive strength	VTM-41	
Water absorption	ASTM D570	
Thermal shear	VTM-42	

56. INSURANCE

This Special Provision supplements 107.13 of the Standard Specifications.

A. GENERAL REQUIREMENTS. The Contractor shall procure and maintain, during the entire period of performance under this contract, the types of insurance specified below. The Contractor shall submit a Certificate of Insurance giving evidence of the required coverage either before or after contract award but before work commences. All insurance shall be written with financially responsible companies authorized to do business in the District of Columbia or in the jurisdiction where the work is to be performed; have either an A.M. Best Company rating of A-VIII or higher, a Standard & Poor's rating of AA or higher, or a Moody's rating of Aa2 or higher. The Contractor shall require all subcontractors to carry the insurance required herein, or the Contractor may, at its option, provide the coverage for any or all subcontractors, and if so, the evidence of insurance submitted shall so stipulate. All policies (excluding Workers' Compensation and Professional Liability, if applicable) shall name the District as an additional insured with respect to work or services performed under the Contract. All policies shall provide that the insurance coverage provided hereunder will be primary and noncontributory with any other applicable insurance. All policies shall contain a waiver of subrogation in favor of the District of Columbia. In no event shall work be performed until the required Certificates of Insurance signed by an authorized representative of the insurer(s) has been furnished. All policies shall provide that the

Contracting Officer shall be given thirty (30) days prior written notice via certified mail in the event coverage is substantially changed, canceled or not renewed.

1. Certificate of Insurance Requirement. The policy description on the Certificate of Insurance form shall include the District as an additional insured and a waiver of subrogation in favor of the District.

2. Commercial General Liability Insurance. The Contractor shall provide evidence satisfactory to the Contracting Officer with respect to the operations performed, that it carries $2,000,000 limits per occurrence; includes coverage for products and completed operations and personal and advertising injury. The policy coverage shall be primary and non-contributory, shall contain the CGL 2503 per project endorsement, and shall include the District of Columbia as an additional insured.

   If the Contractor is providing insurance for a subcontractor, the Contractor shall provide evidence satisfactory to the Contracting Officer with respect to the operations performed, that it carries $2,000,000 limits per occurrence; $4,000,000 per aggregate; includes coverage for products and completed operations and personal and advertising injury. The policy coverage shall be primary and non-contributory, shall contain the CGL 2503 per project endorsement, and shall include the District of Columbia as an additional insured.

3. Automobile Liability Insurance. The Contractor shall provide automobile liability insurance to cover all owned, hired or non-owned motor vehicles used in conjunction with the performance of the contract. The policy shall cover the operations performed under the contract with a $2,000,000 per occurrence combined single limit for bodily injury and property damage. The policy coverage shall be primary and non-contributory and shall include the District of Columbia as an additional insured.

4. Workers' Compensation Insurance. The Contractor shall provide Workers' Compensation insurance in accordance with the statutory mandates of the District of Columbia or the jurisdiction in which the contract is performed.

5. Employer's Liability Insurance. The Contractor shall provide employer's liability insurance as follows: $1,000,000 per accident for injury; $1,000,000 per employee for disease; and $1,000,000 for policy disease limit.

6. Umbrella or Excess Liability Insurance. The Contractor shall provide umbrella or excess liability insurance as follows: $5,000,000 per occurrence, with the District added as an additional insured.

7. Builder's Risk Insurance. The Contractor shall provide a Builder's Risk policy equal to the replacement cost value of the completed building or other structure, including the building supplies and materials to cover damage to existing facilities at the site, with the District of Columbia named as loss payee. (This policy is not

required for contracts involving demolition only.)

8. Installation Floater Insurance. The Contractor shall provide an Installation Floater policy equal to the replacement cost value of all property being installed under the Contract.

   The Contractor shall maintain this insurance for five (5) years following the District's final acceptance of the work. The policy shall cover the Contractor and its subcontractors of every tier, and shall identify the District as the Project Owner on the policy.

9. Pollution Liability Insurance. The Contractor shall provide a policy to cover costs associated with pollution incidents including, but not limited to, mold, asbestos or lead removal. The policy shall provide a minimum of $2,000,000 in coverage per occurrence.

B. DURATION. Except as proved in I.5.A.6, the Contractor shall carry all insurance until all contract work is accepted by the District. Each insurance policy shall contain a binding endorsement that: The insurer agrees that the Contracting Officer shall be given thirty (30) days prior written notice via certified mail in the event coverage is substantially changed, canceled or not renewed.

C. CONTRACTOR'S PROPERTY. Contractors and subcontractor are solely responsible for any loss or damage to their personal property, including owned and leased equipment, whether such equipment is located at a project site or "in transit". This includes Contractor tools and equipment, scaffolding and temporary structures, and rented machinery, storage sheds or trailers placed on the project site.

D. MEASURE OF PAYMENT. The District shall not make any separate measure or payment for the cost of insurance and bonds. The Contractor shall include all of the costs of insurance and bonds in the contract price.

57. AMERICAN RECOVERY AND REINVESTMENT ACT CONTRACTOR REPORTING REQUIREMENTS

The American Recovery and Reinvestment Act of 2009 (ARRA) requires any entity that receives recovery funds directly from the Federal Government (including recovery funds received through grant, loan or contract) other than an individual, to provide regular recipient reports. As the recipient of AARA funds, the District Department of Transportation (DDOT) is required to report monthly (FHWA-1587) on the use of the ARRA funds and the jobs supported with those funds. These reports are required to be submitted by DDOT no later that the 20th day of each month for the previous month's reporting data.

In order to accomplish this, each Prime Contractor or Consultant working on any project identified as an ARRA project or Economic Recovery Project is responsible for reporting the data contained on the Monthly Employment Report **(attached as an Appendix) no later than the 10th day of each month** for the previous month's reporting data.

This information shall be submitted to:

Mr. Jerry M. Carter, Contracting Officer
Office of Contracting and Procurement
District Department of Transportation
2000 14th Street NW, 6th Floor
Washington, DC 20009

This information shall also be submitted electronically to: jerry.carter@dc.gov

This is a federal reporting requirement and no additional compensation will be paid for preparation and submission of these monthly reports. For your convenience, an electronic copy of the reporting form can also be obtained on DDOT's Internet site at www.ddot.dc.gov

Failure to report this information by the 10th day of each month will result in a late fee of $100 per occurrence to be assessed as a contract liquidated damage. Failure to report this information for an entire monthly reporting period will result in a late fee of $500 per occurrence to be assessed as a contract liquidated damage.

58. REQUIRED CONTRACT PROVISION TO IMPLEMENT ARRA SECTION 902

Section 902 of the American Recovery and Reinvestment Act (ARRA) of 2009 requires that each contract awarded using ARRA funds must include a provision that provides the U.S. Comptroller General and his representatives with the authority to:

"(1) to examine any records of the contractor or any of its subcontractors, or any State or local agency administering such contract, that directly pertain to, and involve transactions relating to, the contract or subcontract; and

(2) to interview any officer or employee of the contractor or any of its subcontractors, or of any State or local government agency administering the contract, regarding such transactions."

Accordingly, the Comptroller General and his representatives shall have the authority and rights as provided under Section 902 of the ARRA with respect to this contract, which is funded with funds made available under the ARRA. Section 902 further states that nothing in this section shall be interpreted to limit or restrict in any way any existing authority of the Comptroller General.

Additionally, please be advised that Section 1515(a) of the ARRA provides as follows:

"(a) ACCESS. --With respect to each contract or grant awarded using covered funds, any representative of an appropriate inspector general appointed under section 3 or 8G of the Inspector General Act of 1978 (5 U.S.C. App.), is authorized --

(1) to examine any records of the contractor or grantee, any of its subcontractors or subgrantees, or any State or local agency administering such contract, that pertain to, and involve transactions relating to, the contract, subcontract, grant, or subgrant; and;

(2) to interview any officer or employee of the contactor, grantee, subgrantee, or agency regarding such transactions."

59. AUTHORITY OF THE INSPECTOR GENERAL ARRA SECTION 1515(A)

Section 1515(a) of the ARRA provides authority for any representatives of the Inspector General to examine any records or interview any employee or officers working on this contract. The contractor is advised that representatives of the inspector general have the authority to examine any record and interview any employee or officer of the contractor, its subcontractors or other firms working on this contract. Section 1515(b) further provides that nothing in this section shall be interpreted to limit or restrict in any way any existing authority of an inspector general.

60. SUBCONTRACTING

The subcontractor approval request form included herein should be used to request approval of subcontractors on this project. The form should be completed for each subcontractor requested for approval and submitted to:

Attention:
Contracting Officer
District Department of Transportation
Office of Contracting and Procurement
2000 14th Street, N.W., 6th Floor
Washington, DC 20009

Copies of these forms are available upon request.

Copies of subcontracts shall be made available for review at any time by representatives of the District Department of Transportation and Federal Highway Administration.

61. MOBILIZATION

This work shall consist of preparatory work and operations needed to mobilize for the project. Work includes but is not limited to:

1. Movement to, placement and set-up on project site of personnel, equipment, supplies and accessory items;

2. Establishment of offices, building and other needed project facilities as well as utility work and connections needed for these facilities;

3. Scheduling details, coordination and any other work and expense appropriate that is prior to the start of work under other contract pay items.

This work, however does not include establishing Chief Engineer's field facilities, construction fence around work and storage areas, nor preparation for maintaining highway traffic.

Mobilization includes demobilization at completion of the project.

612.02 Measure and Payment

The unit of measure will be the job with no actual measure taken.

Payment for Mobilization will be made at the contract lump sum price, subject to allowable limits under this section, which payment will include all operations and expense needed to mobilize, remobilize and demobilize. Lump Sum price for Mobilization shall not exceed applicable amounts determined as follows:

Original Contract Total Including Mobilization More Than To and Incl.	Maximum Lump Sum For Mobilization
$0 $200,000	10% of Contract Total
200,000 1,000,000	$20,000 plus 7.5% (of Contract Total Minus $200,000)
1,000,000	$80,000 plus 5% (of Contract Total Minus $1,000,000)

If the lump sum shown in the Pay Item Schedule for any bid for Mobilization exceeds the allowable amount show in the table above, the District reserves the right to adjust the amount and total bid accordingly when checking bids. Said adjustment will in no way invalidate bids.

Payment for Mobilization will be made in two (2) installments. First payment of 50% of lump sum will be made following mobilization and initiation of construction work. The second and final payment will be made after 20% of contract work is complete.

No additional payment will be made for demobilization and re-mobilization due to shutdowns, suspension, partial suspensions or other interruptions in project progression.

When no pay item is listed for Mobilization, no payment will be made; costs shall be reflected and distributed in other contract items.

INSERT the following S.P.'s:

62. SIGN LIGHTING AND COMPLETE SYSTEM, Item 618 825

Sign Lighting System- Sign lighting system shall also conform to the Requirements of the drawings.

SIGN LIGHTING LUMINAIRE- The totally enclosed and weatherproof luminaire shall operate one 100 Watt HPS Lamp at 120 Volt, 60 Hertz power source. The luminaire shall include a completely prewired integral ballast and optical assembly the shall provide and IES distribution of Type IV. The luminaire shall be UL Listed SUITABLE FOR WET LOCATIONS.

The luminaire shall include a die-cast aluminum housing, ballast, prewired terminal board, sealed and filtered optical assembly and removable die-cast top-hinged door glass with sealed-in refractor. Die-cast aluminum surfaces shall have an electrocoat gray paint finish. There shall be ¾ inch threaded conduit entrances (with screw-in plugs) for feed wiring on the top and sides of the housing. All hardware shall be corrosion-resistant.

All electrical components shall be mounted on the housing. The ballast shall be prewired to the lamp socket and terminal board. There shall be a plug-in ignitor for use with HPS lamps. The luminaire shall contain a Magnetic Regulator ballast. The ballast shall be in full compliance with lamp-ballast specifications available from the lamp manufacturer at the time of manufacture. The ballast shall reliably start and operate the lamp in ambient temperatures down the –40 F.

The optical assembly shall be sealed, filtered, a formed aluminum reflector and a flat, clear flat glass closure with gasketing around the perimeter of the housing. The optical assembly shall contain a mogul base lamp socket.

LAMPS- Shall be 100 Watt High Pressure Sodium Vapor

Disconnect switches shall be non-fused and shall be NEMA-4 type HD. Switch mechanism shall be quick made, quick break type with visible blades. The switch shall have a NEMA-4 sheet metal enclosure with heavy duty operating handle, cover interlock and provision for padlocking the cover in the closed position and the operating handle in the open or closed position. Switch shall be rated at 30 Amps.

Photoelectric control units shall be installed at the top of the sign as directed/approved by the Engineer. The photo control shall be a single pole, twist lock and rated for 3000 Watts. The receptacle shall be suitable for use of the twist lock photo control and also be rated at 3000 Watts. Units shall be installed in strict accordance with the manufacturer's guide for materials used; location shall be approved by the Engineer.

Conduit work and conductors to the sign structure and terminating at sign bases shall be installed and connected to feeder lines at the manhole as indicated in the plans.

MEASURE AND PAYMENT- The unit of measure for SIGN LIGHTING AND COMPLETE SYSTEM shall be LUMP SUM. Payment shall include installation of the complete lighting system shall shown on the plans including luminaries, photocell, grounding, conduits, hangers and straps, other mount arrangements, conductors, junction boxes, cables splice kits testing and adjustments. The lump sum price shall by full compensation for all materials, labor, equipment, tools and incidentals needed to complete the work

63. CAP INLET, Item 300 004

(A) **GENERAL** - Work consists of capping existing curb inlet during construction for proper maintenance of traffic. The existing frame / cover and inlet tops shall be protected (as directed by the engineer). The contractor shall provide complete detail and work sequence for Engineer's approval prior to start of work.

(B) **MEASURE** - The unit of measure for **Cap inlet** will be **Each** and comprises of all the work described above including all labor, equipment, tools, materials and incidentals necessary to complete the work as specified herein.

(C) **PAYMENT** - The unit of pavement for **Cap inlet** will be **Each** and includes all labor, equipment, tools, materials and incidentals necessary to complete the work as specified herein.

64. PLANTER SOIL (GROWING MEDIA), Item 610 100

This special provision supplements and modifies 823.01, TOPSOIL, of the standard specifications.

ENGINEERED GROWING MEDIUM

1. **DESCRIPTION.** This growing medium shall be an engineered mix of well draining sandy loam, 1/4 topsoil, 1/4 decomposed compost or organic matter and 1/2 inorganic material. Natural soils should not be used. The soil shall be a uniform mix, free of stones, stumps, roots, or other similar objects larger than one-half inches. No other materials or substances shall be mixed or dumped within the growing medium that may be harmful to plant growth, or prove a hindrance to the plating or maintenance operations. The growing medium shall be free of Bermuda Grass, Quackgrass, Jonson Grass, Mugwort, Nutsedge, Poison Ivy, Canadian Thistle, or other noxious weeds as set forth in the Federal Seed Act. The growing media shall have a pH range of 5.5 – 6.5.

2. **TOPSOIL.** Topsoil as specified in 823.01.

3. **COMPOST.** Compost shall be organic material of peat humus meeting the requirements of 823.06 (B) and/or leaf mulch.

4. **INORGANIC MATERIAL.** Inorganic material shall be equal parts of a highly porosity natural mineral element such as expanded slate, shale, extruded clay, etc., and coarse sand. The highly porosity natural mineral element shall provide aeration and prevents total compaction of organic matter over time and acts as a good draining medium. Sand shall be clean and free of deleterious materials. Sand shall meet AASHTO M-t or ASTM C-33 at a size ranging from 1.0 – 0.5 mm.

5. **Air.** Air content at maximum water capacity shall be 10% at 35%.

6. **CONSTRUCTION.** The Contractor shall submit a growing media sample to the CO at least 30 days prior to the proposed installation:

   - The growing medium must be blended off-site.
   - Stockpiles shall be certified to demonstrate that the medium meets this specification prior to delivery on site.
   - All growing media must be approved by the CO before delivery to the job site. Material not meeting requirements of this specification may be rejected on or after delivery.
   - Do not deliver or place the growing medium in frozen, wet or muddy conditions.
   - Do not place materials that are excessively moist.
   - The Growing medium must be blended uniformly.
   - After placement, preset the medium by thoroughly watering the entire planting area. Fill settled low areas with the medium and repeat the compaction and filling process until settlement ceases.
   - Plant as soon as possible to avoid soil erosion form wind and unnecessary exposure to elements.

7. **MEASUREMENT AND PAYMENT.** The unit of measure for the growing media will be the job. Placing growing media will be measured and paid for at the contract lump sum price. The payment will be full compensation for the preparation of surfaces, loading, hauling, placing, supplying and spreading growing media and media amendments, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

65. ABANDON HANDBOX, Item 617 029

This special provision supplements and modifies 617 of the standard specifications.

GENERAL-The Contractor shall furnish all labor, materials and equipment necessary to abandon a District-owned handbox as shown on the contract plans or as directed by the Engineer. The contractor shall completely remove the handbox including the cover. All electrical cables shall be cut and removed and the electrical conduits shall be sealed with

cement. The excavation shall be backfilled in 6 inch layers and compacted. All material removed shall become the properly of the Contractor and be disposed of off site at no addition cost to the District. Included within this pay item is the temporary patching of the area where the manhole was removed maintenance of the patch until final repairs have been made.

MEASURE AND PAYMENT-The unit of measure for **ABANDON HANDBOX** will be for **EACH** handbox removed. Payment will be made at the contract unit price per each handbox removed, and payment will include all labor, equipment, tools, materials, temporary patching, maintenance of the cut until the permanent repairs are made and all incidentals necessary to complete the work as specified herein.

66. FURNISH AND INSTALL INDUCTIVE LOOP DETECTOR, Item 617 002

This special provision supplements and modifies 617 of the standard specifications.

Work under this pay item shall meet the requirements of 617.14.

67. RELOCATE TEMPORARY PORTABLE CONCRETE BASE NOT FURNISHED BY THE CONTRACTOR, Item 618 045

This special provision supplements and modifies 618 of the standard specifications.

GENERAL- The Contractor shall furnish all labor, materials and equipment necessary to relocate the temporary portable concrete base not supplied by the Contractor as called for in the project plans or as directed by the Project Engineer. The Contractor shall use care when relocating the temporary base, so as not to damage the pole, transformer base, traffic and pedestrian signal heads and cables. All damage due to Contractor negligence will be repaired and or replaced by the Contractor at not additional cost to the District. When moving the bases care must be taken so as not to endanger pedestrian and vehicular traffic. The Contractor after relocating the temporary base shall check to make sure the traffic and pedestrian signal heads are facing in the correct direction for the new traffic operation. The traffic signal cables from the temporary base to the old foundation shall be protected from damage by pedestrian and vehicular traffic. All methods use for protection of the cables shall be approved by the Project Engineer.

MEASURE AND PAYMENT – The unit of measure for **RELOCATE TEMPORARY PORTABLE CONCRETE BASE NOT FURNISHED BY THE CONTRACTOR will** be per **EACH**. Payment will be made at the contract unit price per each temporary portable base relocated, and will include all labor, equipment, tools, materials, and all incidentals necessary to complete.

SUBCONTRACTOR APPROVAL REQUEST FORM

Reconstruction of Eastern Avenue
Bridge over Kenilworth Avenue, N.E.

SUBCONTRACTOR APPROVAL REQUEST

(1) Project Name	(2) Invitation No.
(3) Prime Contractor's Name	(4) Address
(5) Estimated Starting Date	(6) Estimated Completion Date / (7) F.A.P. #
(8) Subcontractor's Name, Address & Phone No.	(9) Number of Subcontractor Employees in Workforce / (10) Number of DC Residents employed

(11) Pay Item	Item Description	Dollars	Cents

Check Items listed below (13-16) that are included in subcontract agreement

(12) See Attached For Additional Descriptions or Remarks

	Yes	No
(13) (All Projects)		
Contract Wage Schedule	☐	☐
DBE/MBE Policy Statement	☐	☐
(14) (Federal-Aid Projects) Form FHWA-1273 (Required Contract Provisions)	☐	☐
(Non-Federal Aid Projects) (Required Contract Provisions)	☐	☐
(15) (Federal-Aid Projects When Subcontractor Will Receive Over $10,000) On-Site Work Force Affirmative Action Requirements for Women and Minorities-Special Conditions	☐	☐
(16) Subcontractor's Certification of Nondiscrimination in Employment (Form Included in Bid Proposal)	☐	☐
(17) FHWA On-The-Job Training (To Be Provided by Subcontractor)	☐	☐

(18) I Request the Contracting Officer's Approval of this Subcontract and Certify that the Organization which will Perform this Work is Capable, has not been Debarred and that the Work will be Performed in Accordance with the Contract Specifications. I Further Certify that all Required Contract Provisions are Physically Included as Part of the Subcontract Agreement.

PRIME CONTRACTOR'S REPRESENTATIVE _____ TITLE _____ DATE _____

THE INFORMATION BELOW IS COMPLETED BY THE DEPARTMENT

REVIEW AND DISTRIBUTION AFTER APPROVAL

CONTRACT COMPLIANCE _____ DATE _____

PROJECT ENGINEER/MANAGER _____ DATE _____

APPROVAL OF SUBCONTRACT IS HEREBY GIVEN

CONTRACTING OFFICER _____ DATE _____
DC DEPARTMENT OF TRANSPORTATION

CONSTRUCTION ZONE TRAFFIC CONTROL DEVICE INSPECTION FORMS

Reconstruction of Eastern Avenue
Bridge over Kenilworth Avenue, N.E.

CONSTRUCTION ZONE TRAFFIC CONTROL DEVICE INSPECTION LOG

PROJECT: _____ DATE: _____

_____ TIME: _____

FAP NO.: _____

TCP INSPECTION

TCP PHASE DRAWING NO. _____

I. SIGNS:

ALL CORRECT _____ (Y/N) MISSING _____ (NO.) INCORRECT/IMPROPER _____ (NO.)

LOCATIONS OF MISSING LIGHTS: _____ Sta(s).

LOCATIONS OF IMPROPER SIGNS: _____ Sta(s).

II. LIGHTS:

ALL CORRECT _____ (Y/N) MISSING _____ (NO.) INCORRECT/IMPROPER _____ (NO.)

LOCATIONS OF MISSING LIGHTS: _____ Sta(s).

LOCATIONS OF IMPROPER SIGNS: _____ Sta(s).

III. BARRICADES:

ALL CORRECT _____ (Y/N) MISSING _____ (NO.) INCORRECT/IMPROPER _____ (NO.)

LOCATIONS OF MISSING LIGHTS: _____ Sta(s).

LOCATIONS OF IMPROPER SIGNS: _____ Sta(s).

IV. MARKINGS:

ALL CORRECT _____ MISSING _____ INCORRECT/IMPROPER _____
Y/N NO. NO.

LOCATIONS OF MISSING LIGHTS: _____
Sta(s).

LOCATIONS OF IMPROPER SIGNS: _____
Sta(s).

V. REMARKS/CORRECTIVE ACTION DATE: _____

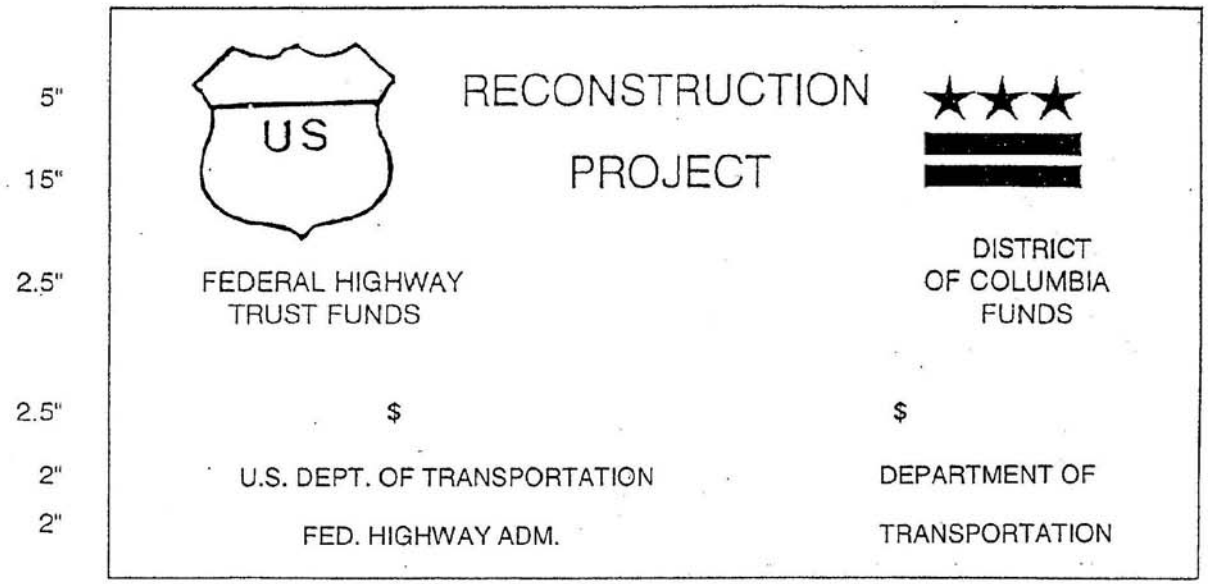
_____

_____

_____

FEDERAL-AID PROJECT SIGN

Reconstruction of Eastern Avenue
Bridge over Kenilworth Avenue, N.E.



NOTE: BOARD SIZE APPROX.
4' x 6'

FEDERAL AID PROJECT SIGN

D.C. DEPARTMENT OF TRANSPORTATION

REQUIRED CONTRACT PROVISIONS
FEDERAL-AID CONSTRUCTION CONTRACTS

Reconstruction of Eastern Avenue
Bridge over Kenilworth Avenue, N.E.

REQUIRED CONTRACT PROVISIONS
FEDERAL-AID CONSTRUCTION CONTRACTS

I. GENERAL

1. These contract provisions shall apply to all work performed on the contract by the contractor's own organization and with the assistance of workers under the contractor's immediate superintendence and to all work performed on the contract by piecework, station work, or by subcontract.

2. Except as otherwise provided for in each section, the contractor shall insert in each subcontract all of the stipulations contained in these Required Contract Provisions, and further require their inclusion in any lower tier subcontract or purchase order that may in turn be made. The Required Contract Provisions shall not be incorporated by reference in any case. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with these Required Contract Provisions.

3. A breach of any of the stipulations contained in these Required Contract Provisions shall be sufficient grounds for termination of the contract.

4. A breach of the following clauses of the Required Contract Provisions may also be grounds for debarment as provided in 29 CFR 5.12:

   Section I, paragraph 2;
   Section IV, paragraphs 1, 2, 3, 4, and 7;
   Section V, paragraphs 1 and 2a through 2g.

5. Disputes arising out of the labor standards provisions of Section IV (except paragraph 5) and Section V of these Required Contract Provisions shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the U.S. Department of Labor (DOL) as set forth in 29 CFR 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the DOL, or the contractor's employees or their representatives.

6. **Selection of Labor:** During the performance of this contract, the contractor shall not:

   a. discriminate against labor from any other State, possession, or territory of the United States, or

   b. employ convict labor for any purpose within the limits of the project unless it is labor performed by convicts who are on parole, supervised release, or probation.

II. NONDISCRIMINATION

(Applicable to all Federal-aid construction contracts and to all related subcontracts of $10,000 or more.)

1. **Equal Employment Opportunity:** Equal employment opportunity (EEO) requirements not to discriminate and to take affirmative action to assure equal opportunity as set forth under laws, executive orders, rules, regulations (28 CFR 35, 29 CFR 1630 and 41 CFR 60) and orders of the Secretary of Labor as modified by the provisions prescribed herein, and imposed pursuant to 23 U.S.C. 140 shall constitute the EEO and specific affirmative action standards for the contractor's project activities under this contract. The Equal Opportunity Construction Contract Specifications set forth under 41 CFR 60-4.3 and the provisions of the American Disabilities Act of 1990 (42 U.S.C. 12101 et seq.) set forth under 28 CFR 35 and 29 CFR 1630 are incorporated by reference in this contract. In the execution of this contract, the contractor agrees to comply with the following minimum specific requirement activities of EEO:

   a. The contractor will work with the State highway agency (SHA) and the Federal Government in carrying out EEO obligations and in their review of his/her activities under the contract.

   b. The contractor will accept as his operating policy the following statement:

"It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, sex, color, national origin, age or disability. Such action shall include: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship, preapprenticeship, and/or on-the-job training."

2. **EEO Officer:** The contractor will designate and make known to the SHA contracting officers an EEO Officer who will have the responsibility for and must be capable of effectively administering and promoting an active contractor program of EEO and who must be assigned adequate authority and responsibility to do so.

3. **Dissemination of Policy:** All members of the contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, will be made fully cognizant of, and will implement, the contractor's EEO policy and contractual responsibilities to provide EEO in each grade and classification of employment. To ensure that the above agreement will be met, the following actions will be taken as a minimum:

a. Periodic meetings of supervisory and personnel office employees will be conducted before the start of work and then not less often than once every six months, at which time the contractor's EEO policy and its implementation will be reviewed and explained. The meetings will be conducted by the EEO Officer.

b. All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer, covering all major aspects of the contractor's EEO obligations within thirty days following their reporting for duty with the contractor.

c. All personnel who are engaged in direct recruitment for the project will be instructed by the EEO Officer in the contractor's procedures for locating and hiring minority group employees.

d. Notices and posters setting forth the contractor's EEO policy will be placed in areas readily accessible to employees, applicants for employment and potential employees.

e. The contractor's EEO policy and the procedures to implement such policy will be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.

4. **Recruitment:** When advertising for employees, the contractor will include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements will be placed in publications having a large circulation among minority groups in the area from which the project work force would normally be derived.

   a. The contractor will, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minority group applicants. To meet this requirement, the contractor will identify sources of potential minority group employees, and establish with such identified sources procedures whereby minority group applicants may be referred to the contractor for employment consideration.

   b. In the event the contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, he is expected to observe the provisions of that agreement to the extent that the system permits the contractor's compliance with EEO contract provisions. (The DOL has held that where implementation of such agreements have the effect of discriminating against minorities or women, or obligates the contractor to do the same, such implementation violates Executive Order 11246, as amended.)

   c. The contractor will encourage his present employees to refer minority group applicants for employment. Information and procedures with regard to referring minority group applicants will be discussed with employees.

5. **Personnel Actions:** Wages, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to race, color, religion, sex, national origin, age or disability. The following procedures shall be followed:

   a. The contractor will conduct periodic inspections of project sites to insure that working conditions

and employee facilities do not indicate discriminatory treatment of project site personnel.

b. The contractor will periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.

c. The contractor will periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the contractor will promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.

d. The contractor will promptly investigate all complaints of alleged discrimination made to the contractor in connection with his obligations under this contract, will attempt to resolve such complaints, and will take appropriate corrective action within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the contractor will inform every complainant of all of his avenues of appeal.

6. **Training and Promotion:**

a. The contractor will assist in locating, qualifying, and increasing the skills of minority group and women employees, and applicants for employment.

b. Consistent with the contractor's work force requirements and as permissible under Federal and State regulations, the contractor shall make full use of training programs, i.e., apprenticeship, and on-the-job training programs for the geographical area of contract performance. Where feasible, 25 percent of apprentices or trainees in each occupation shall be in their first year of apprenticeship or training. In the event a special provision for training is provided under this contract, this subparagraph will be superseded as indicated in the special provision.

c. The contractor will advise employees and applicants for employment of available training programs and entrance requirements for each.

d. The contractor will periodically review the training and promotion potential of minority group and women employees and will encourage eligible employees to apply for such training and promotion.

7. **Unions:** If the contractor relies in whole or in part upon unions as a source of employees, the contractor will use his/her best efforts to obtain the cooperation of such unions to increase opportunities for minority groups and women within the unions, and to effect referrals by such unions of minority and female employees. Actions by the contractor either directly or through a contractor's association acting as agent will include the procedures set forth below:

a. The contractor will use best efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minority group members and women for membership in the unions and increasing the skills of minority group employees and women so that they may

qualify for higher paying employment.

b. The contractor will use best efforts to incorporate an EEO clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to their race, color, religion, sex, national origin, age or disability.

c. The contractor is to obtain information as to the referral practices and policies of the labor union except that to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the contractor, the contractor shall so certify to the SHA and shall set forth what efforts have been made to obtain such information.

d. In the event the union is unable to provide the contractor with a reasonable flow of minority and women referrals within the time limit set forth in the collective bargaining agreement, the contractor will, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, sex, national origin, age or disability; making full efforts to obtain qualified and/or qualifyable minority group persons and women. (The DOL has held that it shall be no excuse that the union with which the contractor has a collective bargaining agreement providing for exclusive referral failed to refer minority employees.) In the event the union referral practice prevents the contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such contractor shall immediately notify the SHA.

8. **Selection of Subcontractors, Procurement of Materials and Leasing of Equipment:** The contractor shall not discriminate on the grounds of race, color, religion, sex, national origin, age or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment.

   a. The contractor shall notify all potential subcontractors and suppliers of his/her EEO obligations under this contract.

   b. Disadvantaged business enterprises (DBE), as defined in 49 CFR 23, shall have equal opportunity to compete for and perform subcontracts which the contractor enters into pursuant to this contract. The contractor will use his best efforts to solicit bids from and to utilize DBE subcontractors or subcontractors with meaningful minority group and female representation among their employees. Contractors shall obtain lists of DBE construction firms from SHA personnel.

   c. The contractor will use his best efforts to ensure subcontractor compliance with their EEO obligations.

9. **Records and Reports:** The contractor shall keep such records as necessary to document compliance with the EEO requirements. Such records shall be retained for a period of three years following completion of the contract work and shall be available at reasonable times and places for inspection by authorized representatives of the SHA and the FHWA.

   a. The records kept by the contractor shall document the following:

(1) The number of minority and non-minority group members and women employed in each work classification on the project;

(2) The progress and efforts being made in cooperation with unions, when applicable, to increase employment opportunities for minorities and women;

(3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minority and female employees; and

(4) The progress and efforts being made in securing the services of DBE subcontractors or subcontractors with meaningful minority and female representation among their employees.

b. The contractors will submit an annual report to the SHA each July for the duration of the project, indicating the number of minority, women, and non-minority group employees currently engaged in each work classification required by the contract work. This information is to be reported on Form FHWA-1391. If on-the-job training is being required by special provision, the contractor will be required to collect and report training data.

III. NONSEGREGATED FACILITIES

(Applicable to all Federal-aid construction contracts and to all related subcontracts of $10,000 or more.)

a. By submission of this bid, the execution of this contract or subcontract, or the consummation of this material supply agreement or purchase order, as appropriate, the bidder, Federal-aid construction contractor, subcontractor, material supplier, or vendor, as appropriate, certifies that the firm does not maintain or provide for its employees any segregated facilities at any of its establishments, and that the firm does not permit its employees to perform their services at any location, under its control, where segregated facilities are maintained. The firm agrees that a breach of this certification is a violation of the EEO provisions of this contract. The firm further certifies that no employee will be denied access to adequate facilities on the basis of sex or disability.

b. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and washrooms, restaurants and other eating areas, timeclocks, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive, or are, in fact, segregated on the basis of race, color, religion, national origin, age or disability, because of habit, local custom, or otherwise. The only exception will be for the disabled when the demands for accessibility override (e.g. disabled parking).

c. The contractor agrees that it has obtained or will obtain identical certification from proposed subcontractors or material suppliers prior to award of subcontracts or consummation of material supply agreements of $10,000 or more and that it will retain such certifications in its files.

IV. PAYMENT OF PREDETERMINED MINIMUM WAGE

(Applicable to all Federal-aid construction contracts exceeding $2,000 and to all related subcontracts, except for projects located on roadways classified as local roads or rural minor collectors, which are exempt.)

1. **General:**

   a. All mechanics and laborers employed or working upon the site of the work will be paid unconditionally and not less often than once a week and without subsequent deduction or rebate on any account [except such payroll deductions as are permitted by regulations (29 CFR 3) issued by the Secretary of Labor under the Copeland Act (40 U.S.C. 276c)] the full amounts of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment. The payment shall be computed at wage rates not less than those contained in the wage determination of the Secretary of Labor (hereinafter "the wage determination") which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor or its subcontractors and such laborers and mechanics. The wage determination (including any additional classifications and wage rates conformed under paragraph 2 of this Section IV and the DOL poster (WH-1321) or Form FHWA-1495) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers. For the purpose of this Section, contributions made or costs reasonably anticipated for bona fide fringe benefits under Section 1(b)(2) of the Davis-Bacon Act (40 U.S.C. 276a) on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of Section IV, paragraph 3b, hereof. Also, for the purpose of this Section, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs, which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in paragraphs 4 and 5 of this Section IV.

   b. Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein, provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed.

   c. All rulings and interpretations of the Davis-Bacon Act and related acts contained in 29 CFR 1, 3, and 5 are herein incorporated by reference in this contract.

2. **Classification:**

   a. The SHA contracting officer shall require that any class of laborers or mechanics employed under the contract, which is not listed in the wage determination, shall be classified in conformance with the wage determination.

   b. The contracting officer shall approve an additional classification, wage rate and fringe benefits only when the following criteria have been met:

(1) the work to be performed by the additional classification requested is not performed by a classification in the wage determination;

(2) the additional classification is utilized in the area by the construction industry;

(3) the proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination; and

(4) with respect to helpers as defined in Section IV.4(c), when such a classification prevails in the area in which the work is performed.

c. If the contractor or subcontractors, as appropriate, the laborers and mechanics (if known) to be employed in the additional classification or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the DOL, Administrator of the Wage and Hour Division, Employment Standards Administration, Washington, D.C. 20210. The Wage and Hour Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

d. In the event the contractor or subcontractors, as appropriate, the laborers or mechanics to be employed in the additional classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Wage and Hour Administrator for determination. Said Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary

e. The wage rate (including fringe benefits where appropriate) determined pursuant to paragraph 2c or 2d of this Section IV shall be paid to all workers performing work in the additional classification from the first day on which work is performed in the classification.

3. **Payment of Fringe Benefits:**

a. Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor or subcontractors, as appropriate, shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly case equivalent thereof.

b. If the contractor or subcontractor, as appropriate, does not make payments to a trustee or other third person, he/she may consider as a part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program,

provided, that the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

4. **Apprentices and Trainees (Programs of the U.S. DOL) and Helpers:**

   a. Apprentices:

      (1) Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the DOL, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State apprenticeship agency recognized by the Bureau, or if a person is employed in his/her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State apprenticeship agency (where appropriate) to be eligible for probationary employment as an apprentice.

      (2) The allowable ratio of apprentices to journeyman-level employees on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any employee listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate listed in the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor or subcontractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman-level hourly rate) specified in the contractor's or subcontractor's registered program shall be observed.

      (3) Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeyman-level hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator for the Wage and Hour Division determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination.

      (4) In the event the Bureau of Apprenticeship and Training, or a State apprenticeship agency recognized by the Bureau, withdraws approval of an apprenticeship program, the contractor or subcontractor will no longer be permitted to utilize apprentices at less than

the applicable predetermined rate for the comparable work performed by regular employees until an acceptable program is approved.

b. Trainees:

(1) Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the DOL, Employment and Training Administration.

(2) The ratio of trainees to journeyman-level employees on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed.

(3) Every trainee must be paid at not less than the rate specified in the approved program for his/her level of progress, expressed as a percentage of the journeyman-level hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman-level wage rate on the wage determination which provides for less than full fringe benefits for apprentices, in which case such trainees shall receive the same fringe benefits as apprentices.

(4) In the event the Employment and Training Administration withdraws approval of a training program, the contractor or subcontractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

c. Helpers:

(1) Helpers will be permitted to work on a project if the helper classification is specified on an applicable wage determination or is approved pursuant to the conformance procedure set forth in Section IV.2. Any worker listed on a payroll at a helper wage rate, who is not a helper as defined above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed.

5. **Apprentices and Trainees (Programs of the U.S. DOT):**

Apprentices and trainees working under apprenticeship and skill training programs which have been certified by the Secretary of Transportation as promoting EEO in connection with Federal-aid highway construction programs are not subject to the requirements of paragraph 4 of this Section IV. The straight time hourly wage rates for apprentices and trainees under such programs will be established by the particular programs. The ratio of apprentices and trainees to journeymen shall not be greater than permitted by the terms of the particular program.

6. **Withholding:**

The SHA shall upon its own action or upon written request of an authorized representative of the DOL withhold, or cause to be withheld, from the contractor or subcontractor under this contract or any other Federal contract with the same prime contractor, or any other Federally-assisted contract subject to Davis-Bacon prevailing wage requirements which is held by the same prime contractor, as much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the SHA contracting officer may, after written notice to the contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

7. **Overtime Requirements:**

No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers, mechanics, watchmen, or guards (including apprentices, trainees, and helpers described in paragraphs 4 and 5 above) shall require or permit any laborer, mechanic, watchman, or guard in any workweek in which he/she is employed on such work, to work in excess of 40 hours in such workweek unless such laborer, mechanic, watchman, or guard receives compensation at a rate not less than one-and-one-half times his/her basic rate of pay for all hours worked in excess of 40 hours in such workweek.

8. **Violation:**

Liability for Unpaid Wages; Liquidated Damages: In the event of any violation of the clause set forth in paragraph 7 above, the contractor and any subcontractor responsible thereof shall be liable to the affected employee for his/her unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory) for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer, mechanic, watchman, or guard employed in violation of the clause set forth in paragraph 7, in the sum of $10 for each calendar day on which such employee was required or permitted to work in excess of the standard work week of 40 hours without payment of the overtime wages required by the clause set forth in paragraph 7.

9. **Withholding for Unpaid Wages and Liquidated Damages:**

The SHA shall upon its own action or upon written request of any authorized representative of the DOL withhold, or cause to be withheld, from any monies payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other Federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph 8 above.

V. STATEMENTS AND PAYROLLS

(Applicable to all Federal-aid construction contracts exceeding $2,000 and to all related subcontracts, except for projects located on roadways classified as local roads or rural collectors, which are exempt.)

1. **Compliance with Copeland Regulations (29 CFR 3):**

The contractor shall comply with the Copeland Regulations of the Secretary of Labor which are herein incorporated by reference.

2. **Payrolls and Payroll Records:**

   a. Payrolls and basic records relating thereto shall be maintained by the contractor and each subcontractor during the course of the work and preserved for a period of 3 years from the date of completion of the contract for all laborers, mechanics, apprentices, trainees, watchmen, helpers, and guards working at the site of the work.

   b. The payroll records shall contain the name, social security number, and address of each such employee; his or her correct classification; hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalent thereof the types described in Section 1(b)(2)(B) of the Davis Bacon Act); daily and weekly number of hours worked; deductions made; and actual wages paid. In addition, for Appalachian contracts, the payroll records shall contain a notation indicating whether the employee does, or does not, normally reside in the labor area as defined in Attachment A, paragraph 1. Whenever the Secretary of Labor, pursuant to Section IV, paragraph 3b, has found that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in Section 1(b)(2)(B) of the Davis Bacon Act, the contractor and each subcontractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, that the plan or program has been communicated in writing to the laborers or mechanics affected, and show the cost anticipated or the actual cost incurred in providing benefits. Contractors or subcontractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprentices and trainees, and ratios and wage rates prescribed in the applicable programs.

   c. Each contractor and subcontractor shall furnish, each week in which any contract work is

performed, to the SHA resident engineer a payroll of wages paid each of its employees (including apprentices, trainees, and helpers, described in Section IV, paragraphs 4 and 5, and watchmen and guards engaged on work during the preceding weekly payroll period). The payroll submitted shall set out accurately and completely all of the information required to be maintained under paragraph 2b of this Section V. This information may be submitted in any form desired. Optional Form WH-347 is available for this purpose and may be purchased from the Superintendent of Documents (Federal stock number 029-005-0014-1), U.S. Government Printing Office, Washington, D.C. 20402. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors.

d. Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his/her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) that the payroll for the payroll period contains the information required to be maintained under paragraph 2b of this Section V and that such information is correct and complete;

(2) that such laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in the Regulations, 29 CFR 3;

(3) that each laborer or mechanic has been paid not less that the applicable wage rate and fringe benefits or cash equivalent for the classification of worked performed, as specified in the applicable wage determination incorporated into the contract.

e. The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph 2d of this Section V.

f. The falsification of any of the above certifications may subject the contractor to civil or criminal prosecution under 18 U.S.C. 1001 and 31 U.S.C. 231.

g. The contractor or subcontractor shall make the records required under paragraph 2b of this Section V available for inspection, copying, or transcription by authorized representatives of the SHA, the FHWA, or the DOL, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the SHA, the FHWA, the DOL, or all may, after written notice to the contractor, sponsor, applicant, or owner, take such actions as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

VI. RECORD OF MATERIALS, SUPPLIES, AND LABOR

1. On all Federal-aid contracts on the National Highway System, except those which provide solely for the installation of protective devices at railroad grade crossings, those which are constructed on a force account or direct labor basis, highway beautification contracts, and contracts for which the total final construction cost for roadway and bridge is less than $1,000,000 (23 CFR 635) the contractor shall:

   a. Become familiar with the list of specific materials and supplies contained in Form FHWA-47, "Statement of Materials and Labor Used by Contractor of Highway Construction Involving Federal Funds," prior to the commencement of work under this contract.

   b. Maintain a record of the total cost of all materials and supplies purchased for and incorporated in the work, and also of the quantities of those specific materials and supplies listed on Form FHWA-47, and in the units shown on Form FHWA-47.

   c. Furnish, upon the completion of the contract, to the SHA resident engineer on Form FHWA-47 together with the data required in paragraph 1b relative to materials and supplies, a final labor summary of all contract work indicating the total hours worked and the total amount earned.

2. At the prime contractor's option, either a single report covering all contract work or separate reports for the contractor and for each subcontract shall be submitted.

VII. SUBLETTING OR ASSIGNING THE CONTRACT

1. The contractor shall perform with its own organization contract work amounting to not less than 30 percent (or a greater percentage if specified elsewhere in the contract) of the total original contract price, excluding any specialty items designated by the State. Specialty items may be performed by subcontract and the amount of any such specialty items performed may be deducted from the total original contract price before computing the amount of work required to be performed by the contractor's own organization (23 CFR 635).

   a. "Its own organization" shall be construed to include only workers employed and paid directly by the prime contractor and equipment owned or rented by the prime contractor, with or without operators. Such term does not include employees or equipment of a subcontractor, assignee, or agent of the prime contractor.

   b. "Specialty Items" shall be construed to be limited to work that requires highly specialized knowledge, abilities, or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid on the contract as a whole and in general are to be limited to minor components of the overall contract.

2. The contract amount upon which the requirements set forth in paragraph 1 of Section VII is computed includes the cost of material and manufactured products which are to be purchased or produced by the contractor under the contract provisions.

3. The contractor shall furnish (a) a competent superintendent or supervisor ~~who is employed by~~ the firm, has full authority to direct performance of the work in accordance with the contract requirements, and is in charge of all construction operations (regardless of who performs the work)

and (b) such other of its own organizational resources (supervision, management, and engineering services) as the SHA contracting officer determines is necessary to assure the performance of the contract.

4. No portion of the contract shall be sublet, assigned or otherwise disposed of except with the written consent of the SHA contracting officer, or authorized representative, and such consent when given shall not be construed to relieve the contractor of any responsibility for the fulfillment of the contract. Written consent will be given only after the SHA has assured that each subcontract is evidenced in writing and that it contains all pertinent provisions and requirements of the prime contract.

VIII. SAFETY: ACCIDENT PREVENTION

1. In the performance of this contract the contractor shall comply with all applicable Federal, State, and local laws governing safety, health, and sanitation (23 CFR 635). The contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions as it determines, or as the SHA contracting officer may determine, to be reasonably necessary to protect the life and health of employees on the job and the safety of the public and to protect property in connection with the performance of the work covered by the contract.

2. It is a condition of this contract, and shall be made a condition of each subcontract, which the contractor enters into pursuant to this contract, that the contractor and any subcontractor shall not permit any employee, in performance of the contract, to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his/her health or safety, as determined under construction safety and health standards (29 CFR 1926) promulgated by the Secretary of Labor, in accordance with Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 333).

3. Pursuant to 29 CFR 1926.3, it is a condition of this contract that the Secretary of Labor or authorized representative thereof, shall have right of entry to any site of contract performance to inspect or investigate the matter of compliance with the construction safety and health standards and to carry out the duties of the Secretary under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 333).

IX. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS

In order to assure high quality and durable construction in conformity with approved plans and specifications and a high degree of reliability on statements and representations made by engineers, contractors, suppliers, and workers on Federal-aid highway projects, it is essential that all persons concerned with the project perform their functions as carefully, thoroughly, and honestly as possible. Willful falsification, distortion, or misrepresentation with respect to any facts related to the project is a violation of Federal law. To prevent any misunderstanding regarding the seriousness of these and similar acts, the following notice shall be posted on each Federal-aid highway project (23 CFR 635) in one or more places where it is readily available to all persons concerned with the project:

NOTICE TO ALL PERSONNEL ENGAGED ON FEDERAL-AID HIGHWAY PROJECTS

18 U.S.C. 1020 reads as follows:

"Whoever, being an officer, agent, or employee of the United States, or of any State or Territory, or whoever, whether a person, association, firm, or corporation, knowingly makes any false statement, false representation, or false report as to the character, quality, quantity, or cost of the material used or to be used, or the quantity or quality of the work performed or to be performed, or the cost thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction on any highway or related project submitted for approval to the Secretary of Transportation; or
Whoever knowingly makes any false statement, false representation, false report or false claim with respect to the character, quality, quantity, or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to material fact in any statement, certificate, or report submitted pursuant to provisions of the Federal-aid Roads Act approved July 1, 1916, (39 Stat. 355), as amended and supplemented;
Shall be fined not more that $10,000 or imprisoned not more than 5 years or both."

X. IMPLEMENTATION OF CLEAN AIR ACT AND FEDERAL WATER POLLUTION CONTROL ACT

(Applicable to all Federal-aid construction contracts and to all related subcontracts of $100,000 or more.)

By submission of this bid or the execution of this contract, or subcontract, as appropriate, the bidder, Federal-aid construction contractor, or subcontractor, as appropriate, will be deemed to have stipulated as follows:

1. That any facility that is or will be utilized in the performance of this contract, unless such contract is exempt under the Clean Air Act, as amended (42 U.S.C. 1857 et seq., as amended by Pub.L. 91-604), and under the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et seq., as amended by Pub.L. 92-500), Executive Order 11738, and regulations in implementation thereof (40 CFR 15) is not listed, on the date of contract award, on the U.S. Environmental Protection Agency (EPA) List of Violating Facilities pursuant to 40 CFR 15.20.

2. That the firm agrees to comply and remain in compliance with all the requirements of Section 114 of the Clean Air Act and Section 308 of the Federal Water Pollution Control Act and all regulations and guidelines listed thereunder.

3. That the firm shall promptly notify the SHA of the receipt of any communication from the Director, Office of Federal Activities, EPA, indicating that a facility that is or will be utilized for the contract is under consideration to be listed on the EPA List of Violating Facilities.

4. That the firm agrees to include or cause to be included the requirements of paragraph 1 through 4 of this Section X in every nonexempt subcontract, and further agrees to take such action as the government may direct as a means of enforcing such requirements.

XI. CERTIFICATION REGARDING DEBARMENT, SUSPENSION,INELIGIBILITY AND VOLUNTARY EXCLUSION

1. **Instructions for Certification - Primary Covered Transactions:**
(Applicable to all Federal-aid contracts - 49 CFR 29)

a. By signing and submitting this proposal, the prospective primary participant is providing the certification set out below.

b. The inability of a person to provide the certification set out below will not necessarily result in denial of participation in this covered transaction. The prospective participant shall submit an explanation of why it cannot provide the certification set out below. The certification or explanation will be considered in connection with the department or agency's determination whether to enter into this transaction. However, failure of the prospective primary participant to furnish a certification or an explanation shall disqualify such a person from participation in this transaction.

c. The certification in this clause is a material representation of fact upon which reliance was placed when the department or agency determined to enter into this transaction. If it is later determined that the prospective primary participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause of default.

d. The prospective primary participant shall provide immediate written notice to the department or agency to whom this proposal is submitted if any time the prospective primary participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

e. The terms "covered transaction," "debarred," "suspended," "ineligible," "lower tier covered transaction," "participant," "person," "primary covered transaction," "principal," "proposal," and "voluntarily excluded," as used in this clause, have the meanings set out in the Definitions and Coverage sections of rules implementing Executive Order 12549. You may contact the department or agency to which this proposal is submitted for assistance in obtaining a copy of those regulations.

f. The prospective primary participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency entering into this transaction.

g. The prospective primary participant further agrees by submitting this proposal that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," provided by the department or agency entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.

h. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to, check the nonprocurement portion of the "Lists of Parties Excluded From Federal Procurement or Nonprocurement Programs" (Nonprocurement List) which is compiled by the

General Services Administration.

i. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

j. Except for transactions authorized under paragraph f of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause or default.

* * * * *

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Primary Covered Transactions

1. The prospective primary participant certifies to the best of its knowledge and belief, that it and its principals:

   a. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

   b. Have not within a 3-year period preceding this proposal been convicted of or had a civil judgement rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

   c. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph 1b of this certification; and

   d. Have not within a 3-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

2. Where the prospective primary participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

* * * * *

2. **Instructions for Certification - Lower Tier Covered Transactions:**
(Applicable to all subcontracts, purchase orders and other lower tier transactions of $25,000 or more - 49 CFR 29)

   a. By signing and submitting this proposal, the prospective lower tier is providing the certification set out below.

b. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department, or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

c. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous by reason of changed circumstances.

d. The terms "covered transaction," "debarred," "suspended," "ineligible," "primary covered transaction," "participant," "person," "principal," "proposal," and "voluntarily excluded," as used in this clause, have the meanings set out in the Definitions and Coverage sections of rules implementing Executive Order 12549. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations.

e. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.

f. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.

g. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to, check the Nonprocurement List.

h. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

i. Except for transactions authorized under paragraph e of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

* * * * *

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Lower Tier

Covered Transactions:

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.

2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

* * * * *

XII. CERTIFICATION REGARDING USE OF CONTRACT FUNDS FOR LOBBYING

(Applicable to all Federal-aid construction contracts and to all related subcontracts which exceed $100,000 - 49 CFR 20)

1. The prospective participant certifies, by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

   a. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

   b. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

2. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

3. The prospective participant also agrees by submitting his or her bid or proposal that he or she shall require that the language of this certification be included in all lower tier subcontracts, which exceed $100,000 and that all such recipients shall certify and disclose accordingly.

SPECIFIC EQUAL EMPLOYMENT OPPORTUNITY RESPONSIBILITIES

Reconstruction of Eastern Avenue
Bridge over Kenilworth Avenue, N.E.

APPENDIX A--SPECIAL PROVISIONS

SPECIFIC EQUAL EMPLOYMENT OPPORTUNITY RESPONSIBILITIES

1. **General**

   a. Equal employment opportunity requirements not to discriminate and to take affirmative action to assure equal employment opportunity as required by Executive Order 11246 and Executive Order 11375 are set forth in Required Contract Provisions (Form FHWA -1273 or 1316, as appropriate) and these Special Provisions which are imposed pursuant to Section 140 of Title 23, U.S.C., as established by Section 22 of the Federal-Aid Highway Act of 1968. The requirements set forth in these Special Provisions shall constitute the specific affirmative action requirements for project activities under this contract and supplement the equal employment opportunity requirements set forth in the Required Contract Provisions.

   b. The contractor will work with the State highway agencies and the Federal Government in carrying out equal employment opportunity obligations and in the review of his/her activities under the contract.

   c. The contractor and all his/her subcontractors holding subcontracts not including material suppliers, of $10,000 or more, will comply with the following minimum specific requirement activities of equal employment opportunity: (The equal employment opportunity requirements of Executive Order 11246, as set forth in Volume 6, Chapter 4, Section 1, Subsection 1 of the Federal-Aid Highway Program Manual, are applicable to material suppliers as well as contractors and subcontractors.) The contractor will include these requirements in every subcontract of $10,000 or more with such modification of language as is necessary to make them binding on the subcontractor.

2. **Equal Employment Opportunity Policy.** The contractor will accept as his/her operating policy the following statement which is designed to further the provision of equal employment opportunity to all persons without regard to their race, color, religion, sex or national origin, and to promote the full realization of equal employment opportunity through a positive continuing program:

   It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, sex, color, or national origin. Such action shall include: employment, upgrading, demotion or transfer, recruitment or recruitment advertising; layoff or termination; rates of pay or

other forms of compensation; and selection for training, including apprenticeship, preapprenticeship, and/or on-the-job training.

3. **Equal Employment Opportunity Officer.** The contractor will designate and make known to the State highway agency contracting officers and equal employment opportunity officer (hereinafter referred to as the EEO Officer) who will have the responsibility for and must be capable of effectively administering and promoting an active contractor program of equal employment opportunity and who must be assigned adequate authority and responsibility to do so.

4. **Dissemination of Policy**

a. All members of the contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, will be made fully cognizant of, and will implement, the contractor's equal employment opportunity policy and contractual responsibilities to provide equal employment in each grade and classification of employment. To ensure that the above agreement will be met, the following actions will be taken as a minimum:

(1) Periodic meetings of supervisory and personnel office employees will be conducted before the start of work and then not less often than once every six months, at which time the contractor's equal employment opportunity policy and its implementation will be reviewed and explained. The meetings will be conducted by the EEO Officer or other knowledgeable company official.

(2) All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer or other knowledgable company official, covering all major aspects of the contractor's equal employment opportunity obligations within thirty days following their reporting for duty with the contractor.

(3) All personnel who are engaged in direct recruitment for the project will be instructed by the EEO Officer or appropriate company official in the contractor's procedures for locating and hiring minority group employees.

b. In order to make the contractor's equal employment opportunity policy known to all employees, prospective employees and potential sources of employees, i.e., schools, employment agencies, labor unions (where appropriate), college placement officers, etc., the contractor will take the following actions:

(1) Notices and posters setting forth the contractor's equal employment opportunity policy will be placed in areas readily accessible to employees, applicants for employment and potential employees.

(2) The contractor's equal employment opportunity policy and the procedures to implement such policy will be brought to the attention of employees by means of meetings, employee handbooks, other appropriate means.

5. **Recruitment**

a. When advertising for employees, the contractor will include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements will be published in newspapers or other publications having a large circulation among minority groups in the area from which the project work force would normally be derived.

b. The contractor will, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minority group applicants, including, but not limited to, State employment agencies, schools, colleges and minority group organizations. To meet this requirement, the contractor will, through his EEO Officer, identify sources of potential minority group employees, and establish with such identified sources procedures whereby minority group applicants may be referred to the contractor for employment consideration.

In the event the contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, he is expected to observe the provisions of that agreement to the extent that the system permits the contractor's compliance with equal employment opportunity contract provisions. (The U.S. Department of Labor has held that where implementation of such agreements have the effect of discriminating against minorities or women, or obligates the contractors to do the same, such implementation violates Executive Order 11246, as amended.)

c. The contractor will encourage his present employees to refer minority group applicants for employment by posting appropriate notices or bulletins in areas accessible to all such employees. In addition, information and procedures with regard to referring minority group applicants will be discussed with employees.

6. **Personnel Actions.** Wages, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to race, color, religion, sex, or national origin. The following procedures shall be followed:

a. The contractor will conduct periodic inspections of project sites to ensure that working conditions and employee facilities do not indicate discriminatory treatment of project site personnel.

b. The contractor will periodically evaluate the spread of wages paid within each

classification to determine any evidence of discriminatory wage practices.

c. The contractor will periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the contractor will promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.

d. The contractor will promptly investigate all complaints of alleged discrimination made to the contractor in connection with his obligations under this contract, will attempt to resolve such complaints, and will take appropriate corrective action within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the contractor will inform every complainant of all of his avenues of appeal.

7. **Training and Promotion.**

a. The contractor will assist in locating, qualifying, and increasing the skills of minority group and women employees, and applicants for employment.

b. Consistent with the contractor's work force requirements and as permissible under Federal and State regulations, the contractor shall make full use of training programs, i.e., apprenticeship, and on-the-job training programs for the geographical area of contract performance. Where feasible, 25 percent of apprentices or trainees in each occupation shall be in their first year of apprenticeship or training. In the event the Training Special Provision is provided under this contract, this subparagraph will be superseded as indicated in Attachment 2.

c. The contractor will advise employees and applicants for employment of available training programs and entrance requirements for each.

d. The contractor will periodically review the training and promotion potential of minority group and women employees and will encourage eligible employees to apply for such training and promotion.

8. **Unions.** If the contractor relies in whole or in part upon unions as a source of employees, the contractor will use his/her best efforts to obtain the cooperation of such unions to increase opportunities for minority groups and women within the unions, and to effect referrals by such unions of minority and female employees. Actions by the contractor either directly or through a contractor's association acting as agent will include the procedures set forth below:

a. The contractor will use best efforts to develop, in cooperation with the unions,

joint training programs aimed toward qualifying more minority group members and women for membership in the unions and increasing the skills of minority group employees and women so that they may qualify for higher paying employment.

b. The contractor will use best efforts to incorporate an equal employment opportunity clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to their race, color, religion, sex, or national origin.

c. The contractor is to obtain information as to the referral practices and policies of the labor union except that to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the contractor, the contractor shall so certify to the State highway department and shall set forth what efforts have been made to obtain such information.

d. In the event the union is unable to provide the contractor with a reasonable flow of minority and women referrals within the time limit set forth in the collective bargaining agreement, the contractor will, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, sex, or national origin; making full efforts to obtain qualified and/or qualifiable minority group persons and women. (The U.S. Department of Labor has held that it shall be no excuse that the union with which the contractor has a collective bargaining agreement providing for exclusive referral failed to refer minority employees.) In the event the union referral practice prevents the contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such contractor shall immediately notify the State highway agency.

9. **Subcontracting**

a. The contractor will use his best efforts to solicit bids from and to utilize minority group subcontractors or subcontractors with meaningful minority group and female representation among their employees. Contractors shall obtain lists of minority-owned construction firms from State highway agency personnel.

b. The contractor will use his best efforts to ensure subcontractor compliance with their equal employment opportunity obligations.

10. **Records and receipts**

a. The contractor will keep such records as are necessary to determine compliance with the contractor's equal employment opportunity obligations. The records kept by the contractor will be designed to indicate:

(1) The number of minority and non-minority group members and women employed in each work classification on the project.

(2) The progress and efforts being made in cooperation with unions to increase employment opportunities for minorities and women (applicable only to contractors who rely in whole or in part on unions as a source of their work force).

(3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minority and female employees, and

(4) The progress and efforts being made in securing the services of minority group subcontractors or subcontractors with meaningful minority and female representation among their employees.

b. All such records must be retained for a period of three years following completion of the contract work and shall be available at reasonable times and places for inspection by authorized representatives of the State highway agency and the Federal Highway Administration.

c. The contractors will submit an annual report to the State highway agency each July for the duration of the project, indicating the number of minority, women, and non-minority group employees currently engaged in each work classification required by the contract work. This information is to be reported on Form PR 1391. If on-the-job training is being required by "Training Special Provision", the contractor will be required to furnish Form FHWA 1409.

(40 FR 28053, July 3, 1975, as amended at 43 FR 19386, May 5, 1978. Correctly redesignated at 46 FR 21156, April 9, 1981.)

Revised 8/88

TRAINING SPECIAL PROVISIONS

Reconstruction of Eastern Avenue
Bridge over Kenilworth Avenue, N.E.

APPENDIX B--TRAINING SPECIAL PROVISIONS

This Training Special Provision supersedes subparagraph 7b of the Special Provision entitled Specific Equal Employment Opportunity Responsibilities, (Appendix A), and is in implementation of 23 U.S.C. 140(a).

As part of the contractors equal employment opportunity affirmative action program training shall be provided as follows:

The contractor shall provide on-the-job training aimed at developing full journeyworkers in the type of trade or job classification involved.

The number of trainees to be trained under the special provision will be **four (4)**.

In the event that a contractor subcontracts a portion of the contract work, he/she shall determine how many, if any, of the trainees are to be trained by the subcontractor, provided, however, that the contractor shall retain the primary responsibility for meeting the training requirements imposed by this special provision. The contractor shall also ensure that this training special provision is made applicable to such subcontract. Where feasible, 25 percent of apprentices or trainees in each occupation shall be in their first year of apprenticeship or training.

The number of trainees shall be distributed among the work classifications on the basis of the contractors needs and the availability of journeyworkers in the various classifications with a reasonable area of recruitment. Prior to commencing construction, the contractor shall submit to the State highway agency for approval the number of trainees to be trained in each selected classification and training program to be used. Furthermore, the contractor shall specify the starting time for training in each of the classifications. The contractor will be credited for each trainee employed by him/her on the contract work who is currently enrolled or becomes enrolled in an approved program and will be reimbursed for such trainees as provided hereinafter.

Training and upgrading of minorities and women toward journeyworker status is a primary objective of this Training Special Provision. Accordingly, the contractor shall make every effort to enroll minority trainees and women (e.g., by conducting systematic and direct recruitment through public and private sources likely to yield minority and women trainees) to the extent that such persons are available within a reasonable area of recruitment. The contractor will be responsible for demonstrating the steps that he/she has taken in pursuance thereof, prior to a determination as to whether the contractor is in compliance with this Training Special Provision. This training commitment is not intended, and shall not be used, to discriminate against any applicant for training, whether a member of a minority group or not.

No employee shall be employed as a trainee in any classification in which he/she has successfully completed a training course leading to journeyworker status or in which he/she has been employed as a journeyworker. The contractors should satisfy this requirement by including appropriate questions in the employee application or by other suitable means. Regardless of the method used, the contractors records should document the findings in each case.

The minimum length and type of training for each classification will be as established in the training program selected by the contractor and approved by the State highway agency and the Federal Highway Administration. The State highway agency and the Federal Highway Administration shall approve a program if it is reasonably calculated to meet the equal employment opportunity obligations of the contractor and to qualify the average trainee for journeyworker status in the classification concerned by the end of the training period. Furthermore, apprenticeship programs registered with the U.S. Department of Labor, Bureau of Apprenticeship and Training, or with a State Apprenticeship Agency recognized by The Bureau and Training programs approved but not necessarily sponsored by the U.S. Department of Labor, Manpower Administration, Bureau of Apprenticeship and Training shall also be considered acceptable provided they are being administered in a manner consistent with the equal employment obligations of Federal-aid highway construction contracts. Approval or acceptance of a training program shall be obtained from the State prior to commencing work on the classification covered by the program. It is the intention of these provisions that training is to be provided in the construction crafts rather than clerk-typists or secretarial-type positions. Training is permissible in lower level management positions such as office engineers, estimators, timekeepers, etc., where the training is oriented toward construction applications. Training in the laborer classification may be permitted provided that significant and meaningful training is provided and approved by the division office. Some off-site training is permissible as long as the training is an integral part of an approved training program and does not comprise a significant part of the overall training.

The Contractor will be reimbursed in the amount indicated in the unit price column of the Pay Item Schedule in the Bid Form and Proposals for each hour of training given an employee on this contract in accordance with an approved training program. As verified by the engineer, reimbursement will be made for training persons in excess of the number specified herein. This reimbursement will be made even though the contractor receives additional training program funds from other sources, provided such other does not specifically prohibit the contractor from receiving other reimbursement. Reimbursement for off-site training indicated above may only be made to the contractor where he/she does one or more of the following and the trainees are concurrently employed on a Federal-aid project; contributes to the cost of the training, provides the instruction to the trainee or pays the trainees wages during the off-site training period.

No payment shall be made to the contractor if either the failure to provide the required training, or the failure to hire the trainee as a journeyworker, is caused by the contractor and evidences a lack of good faith on the part of the contractor in meeting the requirements of this Training Special Provision. It is normally expected that a trainee will begin his/her training on the project as soon as feasible after start of work utilizing the skill involved and remain on the project as long as training

opportunities exist in his/her work classification or until he/she has completed his training program. It is not required that all trainees be on board for the entire length of the contract. A contractor will have fulfilled his/her responsibilities under this Training Special Provision if he/she has provided acceptable training to the number of trainees specified. The number trained shall be determined on the basis of the total number enrolled on the contract for a significant period.

Trainees will be paid at least 60 percent of the appropriate minimum journeyworkers rate specified in the contract for the first half of the training period, 75 percent for the third quarter of the training period, and 90 percent for the last quarter of the training period,unless apprentices or trainees in an approved existing program are enrolled as trainees on this project. In that case, the appropriate rates approved by the Departments of Labor or Transportation in connection with the existing program shall apply to all trainees being trained for the same classification who are covered by this Training Special Provision.

The contractor shall furnish the trainee a copy of the program he/she will follow in providing the training. The contractor shall provide each trainee with a certification showing the type and length of training satisfactorily completed.

The contractor will provide for the maintenance of records and furnish periodic reports documenting his/her performance under this Training Special Provision.

(40 FR 28053, July 3, 1975. Correctly redesignated at 46 FR 21156, April 9, 1981)

Revised 8/88

DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION

Reconstruction of Eastern Avenue
Bridge over Kenilworth Avenue, N.E.

PARTICIPATION BY DISADVANTAGED BUSINESS ENTERPRISE AND NON-DISADVANTAGED BUSINESS ENTERPRISE FIRMS

Policy: It is the policy of the Department of Transportation (DOT) that Disadvantaged Business Enterprises (DBE's) as defined in 49 CFR Part 26 shall have the maximum opportunity to participate in the performance of contracts financed in whole or in part with Federal funds under this agreement. Consequently, the DBE requirements of 49 CFR Part 26 applies to this agreement.

DBE Obligation: The contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and Administration of DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in result in the termination of this contract or such other remedy, as the recipient deems appropriate.

Definitions - The following definitions apply to this contract:

A. "Disadvantaged business" means a small business concern, (a) which is at least fifty-one percent (51%) owned by one or more socially and economically disadvantaged individuals or in the case of any publicly owned business, at least fifty-one percent (51%) of the stock of which is owned by one or more socially and economically disadvantaged individuals; and (b) whose management and daily business operations are controlled by one or more of the socially and economically disadvantaged individuals who own it.

B. "Small business concern" means a small business as defined pursuant to Section (3) of the Small Business Act, as amended, including all applicable and relevant rules and regulations promulgated pursuant thereto.

C. "Socially and economically disadvantaged individuals" means those individuals who are citizens of the United States (or lawfully admitted permanent residents) and who are:

(1) "Black Americans", which includes persons having origins in any of the Black racial groups of Africa;

(2) "Hispanic Americans", which includes persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish or Portuguese culture or origin, regardless of race;

(3) "Native Americans", which includes persons who are American Indian, Eskimos, Aleuts, or Native Hawaiians;

(4) "Asian-Pacific Americans", which includes persons whose origins are from Japan, China, Taiwan, Korea, Vietnam, Laos, Cambodia, Burma, Thailand, the Philippines, Samoa, Guam, the U.S. Trust Territories of the Pacific, and the Northern Marianas;

(5) "Asian-Indian Americans", which includes persons, whose origins are from India, Pakistan, and Bangladesh;

(6) Women (of all races); and

(7) "Any other minorities or individuals found to be economically and socially disadvantaged by the Small Business Administration under Section 8(a) and 8(d) of the Small Business Act, as amended, (15 U.S.C. 637(a)).

The Contracting Officer shall make a rebuttable prerogative that individuals in the above groups are socially and economically disadvantaged. This prerogative shall be based on criteria set forth in 49 CFR Part 26. The Contracting Officer also may determine, on a case-by-case basis, that individuals who are not members of one of the above groups are socially and economically disadvantaged.

Prompt Payment: The prime contractor agrees to pay each subcontractor under this prime contract for satisfactory performance of its contract within 7 days from the receipt of each payment the prime contractor receives from DDOT. Any delay or postponement of payment from the above referenced time frame may occur only for good cause following written approval of the recipient. This clause applies to both DBE and non-DBE subcontractor.

Contract Goals:

The bidder shall subcontract **Eleven (11)%** of the dollar value of the total amount of this DOT-assisted contract to qualified DBE subcontractors. A complete DBE plan containing a list of DBE firms to be utilized on this project must be submitted within five (5) working days subsequent to bid opening to DDOT, Construction Contract Branch; 2000 14th Street, N.W., 6th floor Washington, D.C. 20009.

The DBE plan shall include, but it is not limited to:

1. The names, addresses of DBE firms that will participate in the contract;
2. A description of work that each DBE will perform;
3. The dollar amount of the participation of each DBE firm;
4. Written and signed document of commitment to use the DBE subcontractor whose participation it submits to meet a contract goal;
5. Written and signed confirmation from the DBE that it is participating in the contract as provided in the prime contractor's commitment.
6. If the bidder fails to meet the contract goal, evidence of good faith efforts, as described below shall be submitted.

A bidder who fails to meet these requirements and who cannot show good faith effort will be considered non-responsive.

Good Faith Effort:

The following actions, by the bidder, are generally considered a sign of good faith effort. This list is not exclusive or exhaustive, but should be used as a guide in determining good faith effort.

1. Attendance at pre-bid meetings scheduled to inform DBE's of the project.

2. Advertisement in general circulation, trade association and minority focus media concerning subcontracting opportunities.

3. Written notice to DBE's allowing sufficient time for reply.

4. Follow up of initial solicitation.

5. Selection of portions of the work likely to be performed by DBE's.

6. Provide interested DBE's adequate information for bidding.

7. Negotiation with interested DBE's.

8. Assist interested DBE's with bonding, insurance or credit.

9. Use of minority contractors' groups and minority business assistance offices.

DBE Directory:

Information pertaining to lists of certified DBEs may be obtained by contacting:

Mrs. Glenda Payne, EO Specialist
DC Department of Transportation
Civil Rights Division
2000 14th Street, N.W., 6th Floor
Washington, DC 20009
Office: (202) 671-0479
Email: glenda.payne@dc.gov

Ms. Tammy Paige-Sterling, DBE Program Assistant
Washington Metropolitan Area Transit Authority (WMATA)
600 Fifth Street, NW
Washington, DC 20001
Office: (202) 962-2409
Email: tpsterling@wmata.com

EQUAL EMPLOYMENT OPPORTUNITY/AFFIRMATIVE ACTION REQUIREMENTS

Reconstruction of Eastern Avenue
Bridge over Kenilworth Avenue, N.E.

EQUAL EMPLOYMENT OPPORTUNITY/AFFIRMATIVE ACTION REQUIREMENTS

AFFIRMATIVE ACTION PROGRAM:

Submission by the contractor and all subcontractors of an Affirmative Action Plan, is a requirement of this contract. These Affirmative Action Plans must be received by the Contracting Officer, Construction Contract Branch, 2000 14th Street, N.W., 6th Floor, Washington, DC 20009 within five (5) working days subsequent to the bid opening. Failure to comply in a timely manner may render the bid non-responsible.

APPLICABILITY OF LAW REGARDING EQUAL EMPLOYMENT OPPORTUNITY

The Equal Employment Opportunity Provision of Section 230, Title 23, United States Code applies to this federally aided contract. Sections 102.04,103.02(E) and (H) of the Standard Specifications for Highways and Structures dated 2005, Revised 2007 do not apply. All references to Mayor's Order 85-85 should be disregarded.

APPRENTICESHIP PROGRAM

All prime Contractors and subcontractors who contract with the District of Columbia Government to perform construction or renovation work with a single contract or cumulative contracts of a least $500,000.00 let within a twelve (12) month period, shall be required to register an apprenticeship program with the District of Columbia Apprenticeship Council. (D.C. Code 36-404 (1988)).

APPRENTICES AND TRAINEES

This S.P. supplements APPRENTICES AND TRAINEES, Article 3 of STANDARD CONTRACT PROVISIONS FOR USE WITH SPECIFICATIONS FOR DISTRICT GOVERNMENT CONSTRUCTION PROJECTS, DATED 1973; as amended by the Transmittal Sheet No. 5.

(1) In Items A, B and C, except for subparagraph C5, wherever the words "Apprenticeship Council, DC Department of Labor" appear, add immediately after: "and/or U.S. Department of Labor."

The Contractor and all subcontractors shall furnish to the Contracting Officer written evidence of the registration of his/her program and apprentices as well as the appropriate ratios and wage rates for the areas of construction, prior to using any apprentice on the contract.

EMPLOYMENT OF THE HANDICAPPED:

The contractor and all subcontractors agree not to discriminate against any handicapped person who is qualified to perform the job and also agrees to take Affirmative Action to hire, recruit, train and upgrade qualified handicapped persons without discrimination.

UTILIZATION OF MINORITY BANKING INSTITUTIONS:

All prime and subcontractors are encouraged to use the services of banks and other financial institutions owned and controlled by minorities and females.

MONTHLY EQUAL EMPLOYMENT OPPORTUNITY UTILIZATION REPORTS:

Submission of Monthly Equal Employment Reports (Form AARU-102) to the Contracting Officer is a requirement of this contract. These reports are due on the last working day of each month at the following address:

District of Columbia Government
Department of Transportation
Office of Contracting and Procurement
2000 14th Street, N.W., 6th Floor
Washington, DC 20009

Prime contractors are responsible for timely submission of these reports from all their subcontractors. Failure to comply with this requirement may delay partial payment voucher processing.

MONTHLY EQUAL EMPLOYMENT OPPORTUNITY REPORT

Reconstruction of Eastern Avenue
Bridge over Kenilworth Avenue, N.E.

CONTRACT NO.

DISTRICT DEPARTMENT OF TRANSPORTATION
MONTHLY EQUAL EMPLOYMENT OPPORTUNITY REPORT

1. REPORTING PERIOD

FROM / / TO: / /

This report is required by the District Department of Transportation pursuant to Equal Employment Opportunity requirements of the referenced contract. Failure to report may result in suspension of payments under this contract.

2. PROJECT NAME, LOCATION AND % COMPLETED
WARD________________%__________

3. CONTRACTOR'S NAME:

MINORITY [ ] NON-MIN [ ]
SUB [ ] PRIME [ ]

4. **CONTRACT AMOUNT**

$______________________________

5. CONSTRUCTION TRADE	Classifications	6. WORK-HOUR OF EMPLOYMENT												9.		10.	
		6a. TOTAL ALL EMPLOYEE BY TRADE		6b. BLACK (Not of Hispanic Origin)		6c. HISPANIC		6d. ASIAN OR PACIFIC ISLANDERS		6e. AMERICAN INDIAN OR ALASKAN NATIVE		7. MINORITY PERCENTAGE	8. FEMALE PERCENTAGE	TOTAL NUMBER OF EMPLOYEES		TOTAL NUMBER OF MINORITY EMPLOYEES	
		M	F	M	F	M	F	M	F	M	F			M	F	M	F
	Journey Worker																
	APPRENTICE																
	Helper/Laborer																
	SUB-TOTAL																
	Journey Worker																
	APPRENTICE																
	Helper/Laborer																
	SUB-TOTAL																
	Journey Worker																
	APPRENTICE																
	Helper/Laborer																
	SUB-TOTAL																
	Journey Worker																
	APPRENTICE																
	Helper/Laborer																
	SUB-TOTAL																
	Journey Worker																
	APPRENTICE																
	Helper/Laborer																
	SUB-TOTAL																
TOTAL JOURNEY WORKERS																	
TOTAL APPRENTICES																	
TOTAL HELPERS/LABORERS																	
GRAND TOTAL																	

11. COMPANY OFFICIAL'S SIGNATURE AND TITLE	12. TELEPHONE NUMBER (Include area code)	13. DATE SIGNED	14. PAGE 1 OF 2

FORM AARU-102 (040484) R (Revised 07/02)

PLEASE TYPE OR LEGIBLY PRINT ALL INFORMATION

INSTRUCTIONS FOR FILING MONTHLY EQUAL EMPLOYMENT OPPORTUNITY REPORT (AARU-102)

The Monthly Equal Employment Opportunity Report is to be completed by each subject contractor (both prime and sub) and signed by a responsible official of the company. The reports are filed by the 5th day of each month during the term of the contract, and they shall include the total work-hours for each employee classification in each trade in the covered area for the monthly reporting period. The prime contractor shall submit this report for each project work force and collect and submit reports for each subcontractor's project work force to the Contracting Officer, Department of Transportation. Additional copies of this form may be obtained from the Department of Transportation, Telephone No. 202/671-2270.

Compliance Agency	D. C. Government agency assigned responsibility for equal opportunity. (Secure this information from the contracting agency responsible for the construction project.)
Contracting Agency	D. C. Government agency funding project (in whole or in part). If more than one agency, list all.
Contractor	Any contractor who has a construction contract with D. C. Government or a contract funded in whole or in part with D. C. Government funds.
Minority	Includes Blacks, Hispanics, American Indians, Alaskan Natives, and Asian and Pacific Islanders--both men and women.
1. Reporting	Monthly, or as directed by the compliance agency, beginning with the effective date of the contract.
2. Project	Project name, location(s), contract number and percent completed. List ward in which project is located.
3. Contractor	Contractor's name and address. Check appropriate boxes--minority or non-minority, prime or sub.
4. Contracting Agency	Name(s) of contracting agency(s) funding or supervising project. List contract amount for each contract.
5. Construction Trade	Only those construction trades which contractor employs on this project.
6. Work-Hours of Employment(a-e)	a: The total number of male hours and the total number of female hours worked by employees in each classification. b-e: The total number of male hours and the total number of female hours worked by each specified group of minority employees in each classification.
Classification	The level of accomplishment or status of the worker in the trade (Journey Worker, Apprentice, Helper/Laborer).
7. Minority Percentage	The percentage of total minority work-hours of all work-hours (the sum of columns 6b, 6c, 6d, and 6e divided by column 6a; just one figure for each construction trade).
8. Female Percentage	For each trade the number reported in 6a, (F divided by the sum of the number of reported in 6a M and F).
9. Total Number of Employees	Total number of male and total number of female employees working in each classification of each trade in the contractor's project work force during reporting period.
10. Total Number of Minority Employees	Total number of male minority employees and total number of female minority employees working in each classification in each trade in contractor's project work force during reporting period.

GENERAL WAGE RATE DETERMINATION

Reconstruction of Eastern Avenue
Bridge over Kenilworth Avenue, N.E.

General Decision Number: DC080001 07/10/2009 DC1

Superseded General Decision Number: DC20070001

State: District of Columbia

Construction Types: Heavy (Heavy and Sewer and Water Line)
and Highway

County: District of Columbia Statewide.

HEAVY CONSTRUCTION PROJECTS (Including Sewer and Water Lines);
HIGHWAY CONSTRUCTION PROJECTS

Modification Number	Publication Date
0	02/08/2008
1	04/18/2008
2	05/02/2008
3	05/09/2008
4	05/30/2008
5	06/06/2008
6	07/04/2008
7	07/18/2008
8	07/25/2008
9	08/15/2008
10	09/05/2008
11	09/12/2008
12	09/19/2008
13	11/07/2008
14	12/19/2008
15	02/20/2009
16	03/20/2009
17	05/01/2009
18	05/29/2009
19	06/05/2009
20	06/12/2009
21	06/19/2009
22	06/26/2009
23	07/03/2009
24	07/10/2009

ASBE0024-001 10/01/2008

	Rates	Fringes
Asbestos Worker/Heat and Frost Insulator Includes the application of all insulating materials, protective coverings, coatings and finishes to all types of mechanical systems	$ 29.18	14.18

ASBE0024-002 10/01/2008

	Rates	Fringes

HAZARDOUS MATERIAL HANDLER
Includes preparation, wetting, stripping, removal, scrapping, vacuuming, bagging and disposing of all insulation materials, whether they contain asbestos or not, from mechanical systems.....$ 17.85 6.60

ASBE0024-005 10/01/2008

	Rates	Fringes
Fire Stop Technician.....	$ 22.85	6.59

Includes the application of materials or devices within or around penetrations and openings in all rated wall or floor assemblies, in order to prevent the pasage of fire, smoke of other gases. The application includes all components involved in creating the rated barrier at perimeter slab edges and exterior cavities, the head of gypsum board or concrete walls, joints between rated wall or floor components, sealing of penetrating items and blank openings.

BOIL0193-001 10/01/2008

	Rates	Fringes
Boilermakers:.....	$ 36.61	15.46

BRDC0001-001 05/04/2009

	Rates	Fringes
Bricklayer.....	$ 26.31	7.11

CARP0132-001 05/01/2009

	Rates	Fringes
Carpenter/Lather.....	$ 26.38	7.00
Piledriver.....	$ 24.48	7.70

CARP1831-001 04/01/2009

	Rates	Fringes
Carpenters:		
Millwrights.....	$ 29.39	6.55

CARP2311-002 05/01/2009

	Rates	Fringes
DIVER TENDER.....	$ 24.48	7.80
DIVER.....	$ 36.13	7.80

ELEC0026-001 11/03/2008

	Rates	Fringes
Electricians	$ 36.65	11.45+a

a. PAID HOLIDAYS: New Year's Day, Martin Luther King Jr.'s Birthday, Inauguration Day, Memorial Day, Fourth of July, Labor Day, Veterans Day, Thanksgiving Day, the day after Thanksgiving and Christmas Day or days designated as legal holidays by the Federal Government.

ELEC0026-008 07/01/2003

	Rates	Fringes
Motor Repairmen		
Removal and reinstallation of electrical motors	$ 23.69	7.73+3%+a

a. PAID HOLIDAYS:
New Year's Day, Martin Luther King Jr.'s Birthday, Inauguration Day, Memorial Day, Fourth of July,Labor Day, Veterans Day,Thanksgiving Day, the day after Thanksgiving and Christmas Day or days designated as legal holidays by the Federal Government.

ELEC0070-001 09/02/2007

	Rates	Fringes
Line Construction:		
Cable Splicers	$ 30.29	19.75%+4.81
Equipment Mechanic	$ 21.82	19.75%+4.81
Equipment Operators	$ 25.78	19.75%+4.81
Groundman/Truck Driver	$ 15.34	19.75%+4.81
Line Truck with Auger	$ 20.09	19.75%+4.81
Linemen	$ 28.86	19.75%+4.81

ENGI0077-001 05/01/2009

	Rates	Fringes
Power equipment operators: (HEAVY AND HIGHWAY CONSTRUCTION)		
GROUP 1	$ 30.89	7.52+a+b
GROUP 2	$ 29.89	7.52+a+b
GROUP 3	$ 29.43	7.52+a
GROUP 4	$ 28.72	7.52+a
GROUP 5	$ 26.69	7.52+a
GROUP 6	$ 22.15	7.52+a
GROUP 7	$ 31.26	7.52+a

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Tower Cranes and Cranes 100 ton and over.

GROUP 2: 35 ton cranes & above, tower & climbing cranes, derricks, concrete boom pump, drill rigs (equivalent to L & Double L), mole.

GROUP 3: Backhoes, cableways, cranes, cherry pickers, elevating graders, hoists, paving mixers, power shovels,tunnel shovels. batch plants, shields, tunnel mining machines, gradalls, front end loaders, 3 1/2 cu. yds. and above, power driven wheel scoops and scrapers (50 cu. yds. struck capacity or above), rail tamper, draglines, boomcat, mucking machines, graders in tunnels, pile driving engines.

GROUP 4: Front end loaders below 3 1/2 cu. yds, boom trucks, hydraulic backhoes 1/2 yds. capacity or below rubber or track mounted, tug boats, power driven wheel scoops & scrapers, blade graders, motor graders, bulldozers, trenching machines, concrete mixer, speed swing pettibone, ballast regulator, concrete pump, mechanic, welder, mechanic welder, shotcrete machines, Hoeram, locomotive (standard, narrow gauge), tuggers.

GROUP 5: High lifts above 10 feet, boilers (skelton), asphalt spreaders, bullfloat finishing machines, concrete finishing machines, concrete spreaders, fine graders, air compressors, welding machines, pumps, generators, well points, deep wells, hydraulic pumps, elevators, freeze uniits, tunnel motorman or dinky operator, roller, conveyors, well drilling machines, grout pump, fireman.

GROUP 6: Fork lifts, ditch witch, bobcat 1/3 cu. yd. and below, space heaters, sweepers, assistant engineers, oilers.

GROUP 7: Master mechanic.

a. PAID HOLIDAYS: New Years Day, Inaugural Day, Decoration Day, Independence Day, Labor Day, Martin Luther King's Birthday, Veterans' Day, Thanksgiving Day, Friday after Thanksgiving and Christmas Day.

b. PREMIUM PAY:
Tower crane and cranes 100-ton and over to receive $1.00 per hour premium over Group One.

ENGI0077-002 06/01/2009

	Rates	Fringes
Power equipment operators: (PAVING AND INCIDENTAL GRADING)		
GROUP 1	$ 24.53	6.00
GROUP 2	$ 21.60	6.00
GROUP 3	$ 18.54	6.00
GROUP 4	$ 16.85	6.00
GROUP 5	$ 25.05	5.80

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Gradall operator, Crane.
GROUP 2: Boom Truck, Milling Machine, Excavator, Rubber Tire Backhoe, Asphalt Paver, Asphalt Plant Engineer, Motor Grader, Track Loader, Rubber Tire Loader, Track Dozer, Concrete Paver.

GROUP 3: Broom Truck, Asphalt Roller.
GROUP 4: Air Compressor, Grade Rollers.
GROUP 5: Mechanic.

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* ENGI0077-003 07/01/2009

	Rates	Fringes
Power equipment operators: (SEWER, GAS AND WATER LINE CONSTRUCTION)		
GROUP 1	$ 22.48	6.12+a
GROUP 2	$ 22.08	6.12+a
GROUP 3	$ 21.57	6.12+a
GROUP 4	$ 21.25	6.12+a
GROUP 5	$ 20.43	6.12+a

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Excavators, Cranes, Gradalls.

GROUP 2: Backhoes, Front-end Loaders, Fork alift/Lull, Bulldozers, Motor Graders. Qualified Mechanics, Hydraulic Tamper and Hoe Pack, Paving Mixers, Pile Driving Engines, Batch Plant, Concrete Pumps, Low-Boy Driver, Lube Truck.

GROUP 3: Trenching Machine, Well Drilling Machines, Concrete Mixers, Motor Graders, Truck Driver.

GROUP 4. Roller, Air Compressors, Pumps, Welding Machines, Well Points, Firemen.

GROUP 5: Oiler

a.PAID HOLIDAYS: New Year's Day, Inaugural Day, Washington's Birthday, Decoration Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day, Christmas Day and Martin Luther King's Birthday.

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* IRON0005-001 06/01/2009

	Rates	Fringes
Ironworkers:		
Structural, Ornamental and Chain Link Fence	$ 28.83	13.295

IRON0201-001 05/01/2009

	Rates	Fringes
Ironworkers:		
Reinforcing	$ 25.20	14.33

LABO0657-003 06/01/2009

	Rates	Fringes
Laborers: (HEAVY AND HIGHWAY AND SEWER & WATER LINES		

CONSTRUCTION)

GROUP 1	$ 21.11	5.25
GROUP 2	$ 21.43	5.25
GROUP 3	$ 21.60	5.25
GROUP 4	$ 21.77	5.25
GROUP 5	$ 22.22	5.25
GROUP 6	$ 22.78	5.25
GROUP 7	$ 23.33	5.25
GROUP 8	$ 24.06	5.25

LABORERS CLASSIFICATIONS:

GROUP 1: Carloaders, choker setter, concrete crewman, crushed feeder, demolition laborers, including salvaging all material, loading, cleaning up, wrecking, dumpmen, flagmen, fence erector and installer (other than chain link), including installation and erection of fence, guard rails, medial rails, reference posts, guide posts and right-of-way markers, form strippers, general laborers, railroad track laborers, riprap man, scale man, stake jumper, structure mover, includes foundation, separation, preparation, cribbing, shoring, jacking and unloading of structures, water nozzleman, timber bucker and faller, truck loader, water boys, tool room men.

GROUP 2: Combined air and water nozzleman, cement handler, dope pot fireman (nonmechanical), form cleaning machine, mechanical railroad equipment (includes spiker, puller, tile cleaner, tamper, pipe wrapper, power driven wheelbarrows, operators of hand derricks, towmasters, scootcretes, buggymobiles and similar equipment), tamper or rammer operator, trestle scaffold builders over one tier high, power tool operator (gas, electric or pneumatic), sandblast or gunnite tailhose man, scaffold erector, (steel or wood), vibrator operator (up to 4 feet), asphalt cutter, mortar men, shorer and lagger, creosote material handler, corrosive enamel or equl, paver breaker and jackhammer operators.

GROUP 3: Multi-section pipe layer, non-metallic clay and concrete pipe layer (including caulker, collarman, jointer, rigger and jacker, thermal welder and corrugated metal culvert pipe layer.

GROUP 4: Asphalt block pneumatic cutter, asphalt roller, walker, chainsaw operator with attachment, concrete saw (walking), high scalers, jackhammer operator (using over 6 feet of steel), vibrator operator (4 feet and over), well point installer, air trac operator.

GROUP 5: Asphalt screeder, big drills, cut of the hole drills (1 1/2 " piston or larger), down the hole drills (3 1/2" piston or larger) gunnite or sandblaster nozzleman, asphalt raker, asphalt tamper, form setter, demolition torch operator, shotcrete nozzlemen and potman.

GROUP 6: Powderman, master form setters.

GROUP 7: Brick paver (asphalt block paver, asphalt block sawman, asphalt block grinder, hastings block or similar type)

GROUP 8: Licensed powdermen.

LABO0657-004 06/01/2009

	Rates	Fringes
Laborers: (HAZARDOUS WASTE REMOVAL, EXCEPT ON MECHANICAL SYSTEMS: Preparation for, removing and encapsulation of hazardous materials from non-mechanical systems)		
Skilled Asbestos Abatement Laborers	$ 17.45	5.25
Skilled Toxic and Hazardous Waste Removal Laborers	$ 20.46	5.25

LABO0657-005 06/01/2009

	Rates	Fringes
Laborers: (TUNNEL, RAISE & SHAFT (FREE AIR) FOR HEAVY AND SEWER & WATER LINES CONSTRUCTION)		
GROUP 1	$ 21.84	5.25
GROUP 2	$ 22.50	5.25
GROUP 3	$ 24.18	5.25
GROUP 4	$ 24.89	5.25

LABORERS CLASSIFICATIONS:

GROUP 1: Brakeman, Bull Gang, Dumper, Trackmen, Concrete Man.

GROUP 2: Chuck Tender, Powdermen in Prime House, Form Setters and Movers, Nippers, Cableman, Houseman, Groutman, Bell or Signalman, Top or Bottom Vibrator Operator.

GROUP 3: Miners, Re-Bar Underground, Concrete or Gunnite Nozzlemen, Powdermen, Timbermen and Re-Timbermen, Wood Steel Including Liner plate or Other Support, Material Motorman, Caulkers, Diamond Drill Operators, Riggers, Cement Finishers-Underground, Welders and Burners, Shield Driver, Air Trac Operator, Shotcrete Nozzlemen and Potman.

GROUP 4: Mucking Machine Operator (Air).

LABO0657-006 06/01/2009

	Rates	Fringes
Laborers: (TUNNEL, RAISE AND SHAFT (COMPRESSED AIR) FOR HEAVY CONSTRUCTION ONLY		
Gauge Pressure Work Period (Pounds) (Hours)		
1-14 7	$ 27.66	5.25
14-18 6	$ 32.55	5.25

FOOTNOTE: On any requirement for air pressure in excess of 18

PSI, work periods and rates should be negotiated at a pre-bid conference.

LABO0657-007 06/01/2007

	Rates	Fringes
Laborers: (PAVING AND INCIDENTAL GRADING)		
Asphalt Raker & Concrete Saw Operator	$ 17.14	4.30
Asphalt Shoveler	$ 16.59	4.30
Asphalt Tammer & Concrete Shoveler	$ 16.84	4.30
Jack Hammer	$ 17.03	4.30
Laborer	$ 16.48	4.30
Sand Setter & Form Setter	$ 17.76	4.30

LABO0657-008 06/01/2009

	Rates	Fringes
LABORERS (BRICK MASONRY WORK)		
Mason Tenders	$ 15.06	5.25
Scaffold Builders, Mortarmen	$ 15.90	5.25

MARB0002-003 05/01/2009

	Rates	Fringes
Marble & Stone Mason Includes Pointing, Caulking and Cleaning of All Types of Masonry, Brick, Stone and Cement Structures	$ 32.63	12.99

MARB0003-001 05/01/2008

	Rates	Fringes
Mosaic & Terrazzo Worker, Tile Layer		
Marble Mason and Tile Layer	$ 25.01	8.82
Terrazzo Worker	$ 25.76	8.82

MARB0003-004 05/01/2008

	Rates	Fringes
Marble, Tile & Terrazzo Finisher	$ 20.15	7.97

PAIN0051-001 06/01/2009

	Rates	Fringes
Painters:		
All Industrial Work	$ 26.68	7.86

Bridges, Heavy Highway, Lead Abatement and Flame/Thermal Spray.....$ 30.32 7.86
Commercial and Mold Remediation, Painters, Wallcovers and Drywall Finishers.....$ 24.64 7.86
Metal Polishing and Refinishing.....$ 25.64 7.86

PLAS0891-001 05/01/2008

	Rates	Fringes
Cement Masons:		
HEAVY CONSTRUCTION ONLY	$ 27.15	6.47

PLAS0891-002 06/01/2007

	Rates	Fringes
Cement Masons: (PAVING & INCIDENTAL GRADING)		
Cement Masons	$ 17.35	4.35
Concrete Saw Operators	$ 17.35	4.35
Form Setters	$ 17.35	4.35

PLUM0005-001 08/01/2008

	Rates	Fringes
Plumbers	$ 36.24	13.37+a

a. PAID HOLIDAYS: Labor Day, Veterans' Day, Thanksgiving Day and the day after Thanksgiving, Christmas Day, New Year's Day, Martin Luther King's Birthday, Memorial Day and the Fourth of July.

PLUM0602-005 08/01/2008

	Rates	Fringes
Steamfitter, Refrigeration & Air Conditioning Mechanic	$ 35.12	14.47+a

a. PAID HOLIDAYS: New Year's Day, Martin Luther King's Birthday, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day and the day after Thanksgiving and Christmas Day.

SHEE0100-001 01/01/2009

	Rates	Fringes
Sheet Metal Worker	$ 33.04	12.12

TEAM0639-001 06/01/2009

	Rates	Fringes

Truck drivers: (HEAVY &
HIGHWAY CONSTRUCTION)
Tractor trailer, Low Boy....$ 20.00 2.10+a
Truck Drivers.....$ 18.00 2.00+a

a. VACATION: Employees will receive one (1) week's paid vacation after one (1) year of service.

TEAM0639-005 09/01/2006

	Rates	Fringes
Truck drivers: (PAVING & INCIDENTAL GRADING)		
All paving projects where the grading is incidental to the paving	$ 14.05	3.69

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

In the listing above, the "SU" designation means that rates listed under the identifier do not reflect collectively bargained wage and fringe benefit rates. Other designations indicate unions whose rates have been determined to be prevailing.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

EMPLOYEE TRAINING REQUIREMENTS

Reconstruction of Eastern Avenue
Bridge over Kenilworth Avenue, N.E.

EMPLOYEE TRAINING REQUIREMENTS

23 CFR, Part 230, Subpart A, Appendix B applies to this contract, except as modified below. Prior to commencing, the contractor shall submit to the DC Department of Transportation Contracting Officer for approval, the number of trainees to be trained in each selected and classification and providing the prospective trainee's home address(es) and social security number(s). The number of trainees to be trained under this contract is **four (4)** and shall be in the following classifications

CRAFT	NUMBER
Laborer	3
Reinforcing Ironworker-Bridge and Highway	1

The minimum length and type of training for each classification will be as established in the training program selected by the contractor and approved by the Contracting Officer, DC Department of Transportation and the Division Engineer, Federal Highway Administration.

For purposes of this requirement, a trainee is defined as a person who is registered and receiving on-the-job training in a construction or construction management occupation under a program which has been approved and certified in advance by the U.S. Department of Labor, Employment and Training Administration or by the Division Engineer, Federal Highway Administration.

A trainee differs from an apprentice in that an apprentice means (1) a person employed and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State Apprenticeship Agency recognized by the Bureau, or (2) a person in the first 90 days of probationary employment in an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State Apprenticeship Agency (where applicable) to be eligible for probationary employment as an apprentice.

Contractors are encouraged to utilize the resources of the District of Columbia, Department of Employment Services, Employer Services Center and the District of Columbia, Department of Transportation to recruit and hire prospective trainees. Prospective trainees who are not enrolled in any approved program may be selected from among the contractor's construction workforce, subject to the approval of the Contracting Officer.

The District Department of Transportation- will monitor your training program closely during the life of the project to ensure that the training program is being administered in compliance with the applicable Federal regulations and that the assigned number of trainees are enrolled and receiving training. Contractors are reimbursed only for training actually given and carefully documented by the Project Engineer and verified by the District Department of Transportation.

APPRENTICESHIP PROGRAM:

All prime Contractors and subcontractors who contract with the District of Columbia Government to perform construction or renovation work with a single contract or cumulative contracts of at least $500,000.00, let within a twelve (12) month period, shall be required to register and apprenticeship program with the District of Columbia Apprenticeship Council. (D.C. Code 36-409((1981)).

APPRENTICES AND TRAINEES:

This S.P. supplements APPRENTICES AND TRAINEES, ARTICLE 3 of STANDARD CONTRACT PROVISIONS FOR USE WITH SPECIFICATIONS FOR DISTRICT GOVERNMENT CONSTRUCTION PROJECTS, DATED 1973; as amended by the Transmittal Sheet No. 5.

(1) In Items A, B and C, except for subparagraph C5, wherever the words "Apprenticeship Council, D.C. Department of Labor" appear, add immediately after: "and/or U.S. Department of Labor."

(2) In Item B. Trainees, add the following: "Training programs approved under the requirements of Article IV; Section 4 and 5 of Required Contract Provisions, Federal Aid Construction Contracts (Form FHWA-1273) will satisfy the requirements of this item.

The contractor and all subcontractors shall furnish to the Contracting Officer written evidence of the registration of his/her program and apprentices as well as the appropriate ratios and wage rates for the areas of construction, prior to using any apprentice on the contract.

AMERICAN RECOVERY AND REINVESTMENT ACT MONTHLY REPORT

Reconstruction of Eastern Avenue
Bridge over Kenilworth Avenue, N.E.

MONTHLY EMPLOYMENT REPORT
AMERICAN RECOVERY AND REINVESTMENT ACT

1. First day of reporting period: (mm/dd/yyyy)	2. Report Month: (mm/yyyy)	3. Contracting Agency
		State
4. Federal-Aid Project Number	5. State Contract Number	6. Project Location:State, County or Federal Region

7. CONTRACTOR NAME AND ADDRESS

Name:

Address:

City: State:

Zip:

8. Contractor/Subcontractor DUNS Number:

9. Employment Data

	EMPLOYEES	HOURS	PAYROLL
Prime Contractor Direct, On-Project Jobs (see guidance for definitions)			
Subcontractor Direct, On-Project Jobs			
Subcontractor Name			
Prime and Subcontractor Totals:			

10. PREPARED BY CEO OR Payroll Official:	DATE:
Name:	
Title:	

Please use additional pages as needed

Coding Instructions

BOX 1. **First day of reporting period:** The first day of reporting period is the first day f the first payroll period of the month. If the beginning of the month splits the payroll period then the report will include dates from the prior month as necessary to complete the payroll period.

BOX 2. **Report Month:** The month and year covered by the report, as *mm/yyyy* (e.g. "May 2009" would be coded as "05/2009").

BOX 3. **Contracting agency:** The name of the contracting agency. Enter "State" for State DOT projects. For non-State projects, enter the name of the contracting agency (other State agency, Federal agency, tribe, MPO, city, county, or other funding recipient).

BOX 4. **Federal-aid project number:** The State assigned federal-aid project number, consistent with the format reported in FMIS.

BOX 5. **State project number or identification number:** The project number or ID, as assigned by the State of its funding recipient, consistent with the format reported in FMIS.

BOX 6. **Project location:** State where project occurs. If the project performed for Federal Lands, provide the FLH Division or Federal Land Managing Agency (FLMA) region.

BOX 7. **Contractor name and address:** The name and address of the contracting or consulting firm shall include the name, street address, city, state, and zip code.

BOX 8. **Contractor DUNS number:** The unique nine-digit number issued by Dun & Bradstreet. Followed by the optional 4 digit DUNS Plus number. Reported as "*999999999.9999*"

BOX 9. **Employment data:** The prime contractor or consultant will report the direct, on-the-project jobs for their workforce and the workforce of their subcontractors active during the reporting month. These jobs data include employees actively engaged in projects who work on the jobsite, in the project office, in the home office or telework from a home or other alternative office location. This also includes any engineering personnel, inspectors, sampling and testing technicians, and lab technicians performing work directly in support of the ARRA funded project. This does not include material suppliers such as steel, culverts, guardrail, and tool suppliers. States should include in their reports all direct labor associated with the ARRA project such as design, construction, and inspection. The States reports should include their own project labor, including permanent, temporary, and contract project staff. States are asked not to include estimated indirect labor, such as material testing, material production or estimated macro-economic impacts. FHWA will be estimating all indirect labor based on the information provided in this form along with other FHWA data. The form requests specifically:

a. **Subcontractor name:** The name of each subcontractor or sub-consultant that was active on the project for the reporting month.
b. **Employees:** The number of project employees on the contractor's or consultant's workforce that month, and the number of project employees for each of the active subcontractors for the reporting month. Do not include material suppliers. Total field at bottom will be automatically calculated and reported as a whole number.
c. **Hours:** The total hours on the specified project for all employees reported on the contractor's or consultant's project workforce that month, and the total hours for all project employees reported for each of the active subcontractors that month. Total field at bottom will be automatically calculated and reported as a whole number.
d. **Payroll:** The total dollar amount of wages paid by the contractor or consultant that month for employees on the specified project, and the total dollar amount of wages paid by each of the active subcontractors that month. Payroll only includes wages and does not included overhead or indirect costs. Total field at bottom will be automatically calculated and will be rounded to the nearest whole dollar and reported as a whole number.

BOX 10. **Prepared by:**

a. **Name:** Indicate the person responsible for preparation of the form. By completing the form the person certifies that they are knowledgeable of the hours worked and employment status for all the employees. Contractors, consultants, and their subs are responsible to maintain data to support the employment form and make it available to the State should they request supporting materials.
b. **Date:** The date that the contractor completed the employment form. Reported as "*mm/dd/yyyy*." (e.g. "May 1, 2009" would be coded as "05/01/2009").

D.C. WATER AND SEWER AUTHORITY
SPECIFICATIONS

Reconstruction of Eastern Avenue
Bridge over Kenilworth Avenue, N.E.

DC WATER AND SEWER AUTHORITY OFFICE OF ENGINEERING SERVICES

SPECIFICATION INDEX

RECONSTRUCTION OF EASTERN AVENUE BRIDGE OVER KENILWORTH AVENUE, N.E.
&
REHABILITATION OF EASTERN AVENUE PUMPING STATION

1

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01026 - MEASUREMENT AND PAYMENT

PART 1 MEASUREMENT OF QUANTITIES

1.1 SCOPE:

A. All Contract work will be measured by the Engineer according to United States standard measure.
   1. Measure will be taken only within designated limits as indicated or intended by the Drawings or as directed or computed to provide correct limits per intent of work and the project.
   2. Pay items with units of measure on a linear or area basis will be computed from actual surface measure and/or Drawing dimensions, as altered to meet field conditions.
   3. Measuring quantities where computation of area by geometric methods would be comparatively laborious, the planimeter shall be considered an instrument of precision adapted to area measurement.
   4. Computation of the volume of prismoids shall be by the method of average end areas.
   5. No deduction will be made in area measure for any individual fixture with an exposed area of nine square feet or less.
   6. Materials measured or proportioned by weight shall be weighed on accurate approved scales by qualified personnel at approved locations unless theoretical weights are per-mitted. Ton measure shall mean 2,000 pounds avoirdupois unless otherwise specified.
   7. Net certified scale weights, or rail shipment weights based on certified volumes, shall be basis of weight measure subject to correction for loss as determined.
   8. When volume measure is specified, material shall be weighed when approved and converted to volume measure. Factors for conversion from weight measure to volume measure, unless provided in specifications, will be determined by the Engineer.
   9. Pay items with a "job" unit measure shall include all labor, materials, tools, equipment and incidentals, including all necessary fittings and accessory work needed to complete intent of, and make fully operable, the work.
   10. Unless more rigid tolerances are required by specifications, established industry-manufacturing tolerances will be accepted.

B. Contingent Items:
   1. Quantities for items identified as "Contingent Item" in the Schedule of Prices have been estimated as only approximate and are largely contingent upon conditions not readily determined prior to actual construction operations.
   2. The DC WASA reserves the right to increase or decrease Contingent Item quantities at the Contract price by such amounts as may be necessary to complete the work or to order no work if same is not required.
   3. Quantities under Contingent Items shall be as approved by the Engineer.

PART 2 PRODUCTS
Not used.

PART 3 EXECUTION
Not used.

PART 4 SCOPE OF PAYMENT

4.1 SCOPE:

A. Compensation provided for Contract pay items shall constitute full payment for furnishing all materials and for performing all Contract work in a complete and acceptable manner including all labor, plant and incidentals needed, and for all risk, loss, damage or expense of whatever nature arising from the work and its prosecution, subject to Contract provisions.
   1. Inclusive costs:
      a. Labor.
      b. Equipment.
      c. Materials.
      d. Transportation.
      e. Plant.
      f. Tools.
      g. Insurance.
      h. Workmen's compensation.
      i. Licenses.
      j. Taxes.
      k. Permits.
      l. General overhead.
      m. Profit.
      n. All other expenses necessary for prosecution of work.
   2. Inclusive tests required by applicable pay items:
      a. Laboratory analyses and tests.
      b. Materials and equipment tests.
      c. Concrete trial mix design tests and field tests.
      d. Soil tests.
      e. Paving tests.
      f. Operational tests for valves.

   3. Payment will be made only for required, actual quantities of materials accepted and for work performed and accepted. Allowance will be made for materials actually purchased and work performed prior to notification of any change in items affected.
   4. If payment clauses for specific pay items require that payment include compensation for certain work or material accessory to the pay item, the amount of this included work or material will not be measured nor will payment be made under any other Contract pay item.

5. Where two or more pay item areas overlap, either by discrepancy in definition or by the intricate nature of work, payment will be made at the lowest Contract unit price of overlapping pay items involved.
6. The phrases "work includes" and "as part of work" are used to clarify that referenced requirements shall be included as part of the pay item involved; no separate or additional payment will be made.
7. The phrase "at Contractor expense" means the Contractor shall meet requirements at his sole expense with neither liability nor expense to the DC WASA. "At Contractor expense" normally refers to repair of unacceptable work due either to Contractor operations or to the Contractor's failure to take reasonable or specified precautions.

B. Contingent Items:
1. Contingent Item prices shall include only actual costs for the Contingent Item work complete, and shall exclude overhead or other costs for such items as Contractor's facilities, maintenance of traffic, progress photographs, etc., or other work or requirements for which there is no direct payment.

C. Progress Payments:
1. No progress payment will be made when the total amount due the Contractor since the previous progress payment amounts to less than $500.00, unless it represents a final payment.
2. The value of monthly progress payments for the first, thirty (30) calendar days after Notice to Proceed will be determined based on the cost of activities expected to be completed before approval of the Contractor's Construction Schedule.
3. The value of monthly progress payments will be determined based on the approved cost loaded Contractor's Construction Schedule and in accordance with the requirements of Specification Section 01310 Cash Flow or Schedule Updates.
4. The Contractor's monthly invoice for progress payments must reflect the agreements on the completion status of activities reached at the monthly schedule status review meetings.
5. In computing the value of progress payments, no value will be allowed for partially complete work activities. Payment will be made on completed work activities only. No payment will be allowed for partially complete work activities.
6. Progress payments may be made to the extent of delivered cost of materials to be incorporated in the work provided these materials meet Contract requirements when delivered and are placed in acceptable storage and the Contractor furnishes a paid invoice. Request for progress payment for material on hand shall not exceed Contract price for applicable pay items.
7. At the Contracting Officer's discretion, no progress payment will be made until project construction schedule, safety program, equal employment program, insurance and maintenance of highway traffic provisions have been approved.
8. No progress payment will be made for living and perishable plant materials until properly planted.

END OF SECTION 01026

DIVISION 01 – GENERAL

SECTION 01546 - SAFETY AND HEALTH

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

A. General: This section is general in nature and identifies some of the precautions necessary to protect the safety and health of employees, visitors, occupants and contract employees, and to prevent the loss of or damage to property and the environment. Note the Construction Contractor submittal requirements at paragraph 1.6.

B. Related Work Specification Sections: The following sections, located elsewhere in this spec. package, indicate the scope of work and specific measures to control hazardous materials/conditions:

Section 02085 – “Asbestos Abatement Procedures”
Section 02076 – “Small PCB Items and Lamps”
Section 13283 – “Removal/Control and Disposal of Materials Coated with Lead-Containing Paint”

1.2 REFERENCES:

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

A. Code of Federal Regulations (CFRs):

29 CFR 1910 - OSHA General Industry Safety and Health Standards
29 CFR 1926 - OSHA Construction Industry Standards
EPA, Subchapter R – Toxic Substances Control Act (TSCA)
40 CFR Part 61 – EPA National Emission Standard for Hazardous Air Pollutants (NESHAPs)
40 CFR Part 761 – Polychlorinated Biphenyl Manufacturing, Processing, Distribution and Use
40 CFR Parts 260 through 271 – EPA Resource Conservation and Recovery Act (RCRA)

B. Other Recognized Standards:

American National Standards Institute (ANSI)
American Society for Testing and Materials (ASTM)
National Fire Code (NFC)
National Electrical Code (NEC)
Underwriters Laboratories (UL)

C. Federal Standard 313A - Material Safety Data Sheets, Preparation and Submission

D. Applicable state and local regulations shall apply.

1.3 WORK COVERED BY THIS SECTION: This section is applicable to all work performed under this contract.

1.4 DEFINITION OF HAZARDOUS MATERIALS: Refer to hazardous and toxic materials/ substances, Subparts H and Z of 29 CFR 1910; and to others as defined in Federal Standard 313.

A. Those hazardous materials most commonly encountered can include pesticides, cleaning agents, paints, adhesives, strippers, solvents, asbestos, polychlorinated biphenyls (PCB's), mercury vapor lamps, explosives, and radioactive materials, but may include others. Any unlabelled substance should be handled as hazardous material until properly identified.

B. All thermal systems insulation (i.e., boiler insulation, duct insulation, pipe insulation), surfacing materials (i.e., plaster and sprayed-on fireproofing) and miscellaneous materials (i.e., asphalt flooring, ceiling tiles, adhesives and mastics, drywall, roofing, gaskets and cement board), installed no later than 1980, must be considered asbestos containing unless proven otherwise in accordance with 29 CFR 1926.1101.

C. All finished/painted surfaces of buildings constructed prior to 1978 shall be considered finished with lead based paint unless proven otherwise.

D. Products likely to contain PCB's are electrical transformers, capacitors, voltage regulators, fluorescent light ballasts and oil switches. Transformer vaults with PCB contaminated floors are identified by signage at the entry door (see paragraph 3.1).

1.5 QUALITY ASSURANCE:

A. Pre-Construction Safety Meeting: Representatives of the Contractor must meet with the Contracting Officer and his/her representative(s) prior to the start of work under this contract. The purpose of the pre-construction meeting is to review the Contractor's safety and health programs and policies, and to discuss the implementation of all safety and health provisions pertinent to the work to be performed under the contract. The Contractor shall be prepared to discuss, in detail, the measures he/she intends to take in controlling any unsafe or unhealthy conditions associated with the work to be performed under the contract. If directed by the Contracting Officer, this meeting may be held in conjunction with other pre-construction meetings such as the General Pre-Construction meeting. The level of detail of the safety meeting is dependent upon the nature of the work and the potential inherent hazards. The Contractor's principal on-site representative(s), the general superintendent and his/her safety representative(s) shall be in attendance.

B. Compliance With Regulations: All work, including contact with and handling of hazardous materials, the disturbance or dismantling of structures containing hazardous materials, and/or the transport and disposal of hazardous materials shall comply with the applicable requirements of 29 CFR 1910/1926, and 40 CFR 761/260-271.

1. Work involving the disturbance, dismantling or demolition of asbestos containing materials or structures containing asbestos; and/or the removal and disposal of asbestos, shall also comply with the requirements of 40 CFR Part 61, Subparts A and M, and 29 CFR 1915.1001 (where applicable), as well as Specification 02085 (Asbestos Abatement Procedures).

2. Work involving the disturbance, dismantling or demolition of lead based paint shall comply with 29 CFR 1926.62, as well as Specification 02090 (Lead Based Paint Abatement Procedures). It shall be the responsibility of the Contractor to adequately test and characterize the waste by the toxicity characteristics leaching procedures (TCLP) – Lead.

3. Work involving the removal and disposal of PCBs shall comply with 40 CFR 761. Work involving the removal of PCB light ballasts, switches and similar small PCB items (less

than 3 pounds (1.36 kg) shall also comply with Specification 02076 (PCB Light Ballasts, Switches and Mercury Lamps).

C. All work shall comply with applicable state and municipal safety and health requirements. Where there is a conflict between applicable regulations, the most stringent shall apply.

D. Contractor Responsibility:

1. All Contractors shall assume full responsibility and liability for compliance with applicable regulations pertaining to the health and safety of personnel during the execution of work, and shall hold the Government harmless for any action on his/her part, or that of his/her employees or subcontractors, which results in illness, injury or death.

2. Construction Contractors shall comply with the following additional requirements in accordance with 29 CFR 1926.16 (Prime/Subs):

a. Compliance with the accepted accident prevention plan written by the prime Contractor for the specific work, submitted to the government, and reviewed by the Contracting Officer. The Contractor's plan will be job specific and will include work to be performed by the subcontractors, and measures to be taken by the Contractor to control hazards associated with materials, services, or equipment provided by suppliers.

b. Regularly scheduled safety meetings shall be held at least once a week for all supervisors on the project to review past activities, to plan ahead for new or changed operations, and to establish safe working procedures for the anticipated hazards. An outline of each meeting shall be submitted through the Construction Engineer to the Contracting Officer.

c. At least one “toolbox” safety meeting shall be conducted weekly by field supervisors or foreman for all workers. An outline report of the meeting, including date, time, duration, attendance, subjects discussed and the name of the director shall be maintained and copies furnished to the designated authority on request.

1.6 SUBMITTALS: A submittal punch list for projects involving “other” hazardous materials as identified in 1.6-E, and/or flammable/toxic products is provided as Appendix A.

A. Accident Reporting: Serious accidents such as those resulting in: treatment of an injury at a medical facility; response by emergency medical personnel; or damage to property other than that of the Contractor will be reported to the contracting officer's representative by telephone within twenty-four hours of the occurrence. A copy of each accident report, which the Contractor or subcontractors submit to their insurance carriers, shall be forwarded through the Contracting Officer's Representative (Construction Engineer), to the Contracting Officer as soon as possible (in no event later than seven (7) calendar days after the occurrence). All accidents/losses shall be reported immediately

B. Permits: When hazardous materials (as defined in Paragraph 1.4, and 40 CFR 261) are disposed of, the Contractor must submit copies of permits and manifests from applicable, Federal, state, or municipal authorities, and necessary certifications that the material has been disposed of as per regulations within 30 days of removal from the site.

C. Hot Work Permits: Submit Permit for Welding, Cutting or Brazing as required. (See Paragraph 3.5-B)

D. Scaffolding: All scaffolding that is erected on this job will be erected in accordance with the requirements of 29 CFR 1926.451. For scaffolding over two sections high, a scaffold erection plan will be developed by the Contractor, certified by an engineer and provided to

the Contracting Officer (CO) prior to set up. Once in place, the Contractor's assigned safety officer shall inspect and document the conditions of the scaffold and scaffold anchor points prior to use, and once per shift thereafter. Weekly reports shall be provided to the designated Contracting Officer's Representative (COR) for inclusion in the contract records.

E. Construction Contractor's Plan of Action: Submit a plan of action for handling hazardous materials *(except for asbestos, lead based paint, PCBs and mercury lamps as they are covered by specific sections)* and/or flammable or toxic products as follows. The Construction Contractor's plan of action shall contain:

1. Activity Hazard Analysis - identification of anticipated hazards, problems, and proposed control measures/mechanisms
2. Description of how applicable safety and health regulations and standards are to be met
4. Protection of the public or others not related to the operation
5. Means of protection for adjacent non-construction areas and occupants and for controlling dust/fumes/debris generated by the work
5. Specialized training and experience of employees to be used for the work
6. Type of protective equipment and work procedures to be used
7. Material Safety Data Sheets (MSDSs) for, and proposed procedures for using, disposing of, or storing toxic/hazardous materials (also see 29 CFR 1910.1200)
8. Phasing requirements to minimize impact to non-construction work activities
9. Emergency procedures for handling accidental spills, releases or potential exposures
10. Interfacing of trades and control of subcontractors, if applicable
11. Identification of any required analyses, test demonstrations, and validation requirements; *and*
12. Methods of certification for compliance

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT: Special facilities, devices, equipment, clothing, and similar items used by the Contractor in the execution of work shall comply with the applicable regulations. Such materials and equipment shall be identified in the Plan of Action called for herein.

2.2 MATERIAL SAFETY DATA SHEETS (MSDSs): MSDSs shall be available on-site for all products used under this contract. The prime contractor is responsible for meeting the hazard communication requirements, in accordance with 29 CFR 1910.1200. To the extent feasible, substitute non-flammable and non-toxic products.

PART 3 - EXECUTION

3.1 CAUTIONARY PROCEDURES AT EXISTING VAULTS: Transformer vaults may have floors which are PCB contaminated. These vaults are generally marked by blue signs, which identify the vault as PCB contaminated. Consult the Building Manager to ascertain whether precautionary procedures must be taken.

On rare occasions, vault doors in existing buildings may be equipped with protective alarms and devices. Consult the Building Manager to ascertain whether vault doors in areas under this contract are so equipped.

3.2 HAZARDOUS MATERIALS: The Contractor shall bring to the Contracting Officer's attention, any material suspected of being hazardous which he/she encounters during execution of the work. The Contracting Officer shall then determine whether the Contractor shall perform tests to determine the nature or toxicity of the material. If the Contracting Officer directs the Contractor to perform tests, and/or if the material is found to be hazardous and additional protective measures

are needed, a change of contract may be required (subject to applicable provisions of the contract).

3.3 CONFINED SPACES: The Contractor shall bring to the attention of the Contracting Officer any work he/she encounters which may involve entry into a suspected confined space. The Contracting Officer will make a determination if the area is deemed a permit-required confined space, in which case additional protective measures will be required. The Contractor is responsible for prior notification of the Contracting Officer on the type of work to be conducted in all confined spaces, regardless of permit status.

3.4 CONSTRUCTION STOP WORK ORDERS: Should the Contractor or his/her subcontractors be notified by the Contracting Officer's representatives of any non-compliance with the provisions of the contract, and/or that corrective action(s) are required, the Contractor shall immediately (if so directed) or within 48-hours after receipt of a notice of violation, correct the unsafe or unhealthy condition. If the Contractor fails to comply promptly, the Contracting Officer or his/her representatives may issue a "Stop Work Order" for all or any part of the work being performed. In instances of imminent danger conditions, the Contractor must stop all work immediately. When, in the opinion of the Contracting Officer or his/her representatives, satisfactory corrective action has been taken to correct the unsafe or unhealthy condition, a written order reinstating the work will be issued. The Contractor shall not be allowed any extension of time or compensation for damages by reason of, or in connection with, such work stoppage.

3.5 PROTECTION:

A. Contractor Responsibility: The Contractor shall take all necessary precautions to prevent injury to the public, building occupants and visitors, and damage to or contamination of property or the environment. For the purposes of this contract, the public or building occupants shall include all persons not employed by the Contractor or subcontractor thereof.

B. Welding, Cutting, and Brazing: A Hot Work permit for welding, cutting, and brazing is required.

Work areas shall be kept clear of combustibles within a 25-foot (7.62-meter) radius of any open flame work. Combustibles which cannot be removed shall be covered with flame-resistant blankets.

Compressed gas cylinders shall be secured in a vertical position at all times. Valve protection caps shall be in place whenever cylinders are not in use, moved or stored.

Appropriate fire extinguishers shall be maintained at welding and cutting operations.

A designated fire watch shall sign and return the permit. The fire watch shall be on duty during operations and for a sufficient time afterwards to ensure no possibility of fire exists.

C. Storage: It is prohibited to store, position, or use equipment, tools, materials, scraps, and trash in a manner likely to present a hazard to the public or building occupants by its accidental shifting, ignition, or other hazardous qualities. Storing of combustible or flammable liquids shall be in accordance with the current edition of the National Fire Code for Flammable and Combustible Materials (NFPA 30).

D. Obstructions: No corridor, aisle, stairway, door, or exit shall be obstructed or used in such a manner as to encroach upon routes of ingress or egress utilized by the public or building occupants, or to present an unsafe or unhealthy condition to the public or building occupants.

E. Housekeeping: Housekeeping practices shall be in conformance with OSHA 29 CFR 1910.141 and 29 CFR 1926.25, for non-construction and construction contracts respectively.

F. Protection of the Public and Federal Employees: Work shall not be performed in any area occupied by the public or Federal employees unless specifically permitted by the contract and the Contracting Officer and unless adequate steps are taken for the protection of the public and Federal employees.

G. Fences & Barricades: The work area shall be fenced, barricaded, or otherwise segregated from the public or building occupants to prevent unauthorized entry into the work area.

H. Alternate Precautions: When the nature of the work prevents isolation of the work area and the public or building occupants may be in or pass through, under or over the work area, alternate precautions such as the posting of signs, the use of signal persons, the erection of barricades or similar protection around particularly hazardous operations shall be approved and used as appropriate.

I. Public Thoroughfare: When work is to be performed over a public thoroughfare such as a sidewalk, lobby, or corridor, the thoroughfare shall be closed, if possible, or other precautions taken such as the installation of screens or barricades. When exposure to sizeable falling objects exists, as during the erection of building walls or during demolition, special protection of the type detailed in 29 CFR 1910/1926 shall be provided.

J. Temporary Construction Barriers: Paragraphs 3.5-F through 3.5-I above specify the erection of construction barriers in specific situations. Temporary construction barriers, partitions which cover a hole in a rated fire wall, or separate the construction from public access and exit corridors shall be erected floor-to-ceiling, wall-to-wall, and shall remain in place for the duration of the contract. The minimum construction standards for these temporary barriers shall be metal studs, anchored top and bottom at a maximum spacing of 16 inches (406 mm) on-center, and covered with a minimum of one layer of 1/2 inch gypsum wallboard.

K. Dust and Fume Control Measures: Work performed adjacent to occupied areas shall be done within dust control barriers (generally constructed of polyethylene sheeting). To the extent feasible, maintain the work environment at a negative pressure differential with the adjoining occupied areas. The use of fume and odor producing products and materials shall be done in such a manner, or at such a time as to minimize impact on building occupants. Provide measures to minimize tracking of dust through non-construction areas.

L. Roof Work: During the performance of roofing work on low-pitched roofs, employees will be protected as required by the OSHA standards contained in 29 CFR 1926.500, except that a safety monitoring system, as defined in 29 CFR 1926.502(p)(7) is not an allowable option when working within six feet (1.83 m) of the roofs edge or any opening. When working within six feet (1.83 m) of the roof edge or an opening, motion-stopping safety systems, as defined in 29 CFR 1926.502(p)(5), will be used.

M. Removal of Fences and Barricades: Fences and barricades shall be removed upon completion of the project, in accordance with local ordinance and to the satisfaction of the Contracting Officer or his/her representative(s).

APPENDIX A
01546 – SAFETY SUBMITTAL PUNCH LIST

PROJECT_____ DATE REVIEWED_____

PROJECT NUMBER_____ REVIEWER_____

	REVIEWED	APPROVED	IN FILE
CONSTRUCTION SUBMITTALS: **Post-award** but prior to the start of construction:			
1. HOT WORK – Permit for Welding, Cutting or Brazing			
2. SCAFFOLDING: All scaffolding that is erected on this job will be erected in accordance with the requirements of 29 CFR 1926.451. For scaffolding over two sections high, a scaffold erection plan must be developed by the Contractor:			
A. Scaffold erection plan:			
B. Certified by an engineer:			
3. PLAN OF ACTION: A plan of action for handling hazardous materials (except asbestos, lead based paint, PCBs and mercury vapor lamps) must be submitted. The hazardous materials plan of action shall contain the following:			
A. Activity Hazard Analysis – identification of anticipated hazards, problems, and proposed control mechanisms			
B. Description of how applicable safety and health regulations and standards are to be met			
C. Protection of the public or others not related to the operation			
D. Means of controlling dusts/fumes/debris generated			
E. Specialized training and experience of employees			
F. Protective equipment and work procedures to be used			
G. Material Safety Data Sheets (MSDSs)			
H. Proposed procedures for using, disposing of, or storing toxic/hazardous material (also see 29 CFR 1910.1200)			
I. Phasing requirements to minimize disruption of operations			
J. Emergency procedures for handling accidental spills, releases or exposures			
K. Interfacing of trades and control of subcontractors			
L. Identification of any required analyses, test demonstrations, and validation requirements			
M. Methods of certification for compliance			

	REVIEWED	APPROVED	IN FILE
CONSTRUCTION SUBMITTALS: **During construction** but prior to project closeout			
4. SCAFFOLDING: DAILY DOCUMENTATION (ONCE PER SHIFT):			
A. Inspect and document the conditions of the scaffold (weekly)	_____	_____	_____
B. Scaffold anchor points (weekly)	_____	_____	_____
C. Weekly reports have been provided to the designated Contracting Officer's Representative (COR) – contract record	_____	_____	_____
5. PERMITS: When hazardous materials (as defined in paragraph 1.4, and 40 CFR 261) are disposed of, the Contractor must submit copies of permits and manifests from applicable Federal, state, or municipal authorities	_____	_____	_____
And			
CERTIFICATES that the material has been disposed of as per regulations.	_____	_____	_____
6. "Toolbox" safety meeting documentation	_____	_____	_____
7. Accident Reporting: must be reported to the contracting officer's representative by telephone within twenty-four hours of the occurrence			
A. Serious accidents such as those resulting in: treatment of an injury at a medical facility; response by emergency medical personnel; or damage to property other than that of the Contractor	_____	_____	_____
B. A copy of each accident report, which the Contractor or subcontractors submit to their insurance carriers shall be forwarded as soon as possible, but not later than seven (7) calendar days after the occurrence.	_____	_____	_____

PERMIT FOR WELDING, CUTTING, OR BRAZING		1A. NAME OF EMERGENCY CONTACT	1B. TELEPHONE NUMBER
		2. OFFICE ISSUING PERMIT	
3. LOCATION FOR PERMIT	A. BUILDING NAME	B. SPECIFIC LOCATIONS OF WORK COVERED	
4A. DATE OF WORK	5. NATURE OF WORK		
4B. START TIME AM PM			
4C. STOP TIME AM PM			

6. ANTICIPATED HAZARDS DUE TO WORK (*SAFETY, HEALTH, FIRE*)

7. LIST PROTECTIVE CLOTHING, EQUIPMENT AND CONTROLS REQUIRED FOR THE WORK (*INCLUDES PPE AND PUBLIC PROTECTION*)

8. NAME OF PERSONS AUTHORIZED TO PERFORM WORK	9. NAME OF PERSONS SERVING AS FIRE WATCH

10. EMERGENCY PRECAUTIONS (*INCLUDE TYPE, NUMBER AND LOCATIONS OF FIRE EXTINGUISHERS*)

11. PERMIT ISSUED BY		
A. NAME AND TITLE	B. SIGNATURE	C. DATE
12. PREWORK SITE INSPECTOR		
A. NAME AND TITLE	B. SIGNATURE	C. DATE
13. POSTWORK SITE INSPECTOR		
A. NAME AND TITLE	B. SIGNATURE	C. DATE

END OF SECTION 01546

DIVISION 2 - SITEWORK

SECTION 02050 – DEMOLITION

PART 1 GENERAL

1.1 SCOPE:

A. Furnish all labor, materials, tools and equipment needed for demolition work.

1.2 QUALITY ASSURANCE

A. None this Section.

1.3 SUBMITTALS

A. None this Section.

PART 2 PRODUCTS

A. None this Section.

PART 3 EXECUTION

3.1 WORK

A. Demolish and remove portions of the buildings and structures including equipment and systems necessary to accommodate new construction.

B. Obtain the approval of the Engineer before temporality shutting down or disconnecting utilities.

C. Remove and dispose of debris at an appropriate facility approved for that purpose.
   1. Provide the Engineer with a copy of permission or agreement regarding the hauling and disposal of materials.

3.2 PROTECTION

A. Perform demolition in such manner as to eliminate hazards to persons and property.

B. Minimize interference with use of adjacent areas

C. Protect structures; avoid interruption to utilities or operational systems to remain.

D. Provide safeguards, including warning signs, barricades, temporary fences, warning lights, and other similar items that are required for protection of all personnel during demolition and removal operations.

E. Prevent spread of flying particles and dust. Sprinkle rubbish and debris with water to keep dust to a minimum.

F. All fire and safety regulations specified elsewhere shall be observed in performance of work and include the following:
   1. No complete wall or large part of wall shall be permitted to fall to the ground during demolition.
   2. Whenever a cutting torch or other equipment that might cause a fire is used, provide and maintain fire extinguishers nearby ready for immediate use. All possible users shall be instructed in use of fire extinguishers.
   3. Hydrants shall be accessible at all times. No debris shall be permitted to accumulate within a radius of 15 feet of fire hydrants.

3.3 CLEAN-UP:

A. On completion of work of this section and after removal of all debris, site shall be left in clean condition satisfactory to Engineer. Clean up shall include disposal off-site of all items and materials not required to remain property of the DC WASA as well as all debris and rubbish resulting from demolition operations.

PART 4 MEASURE AND PAYMENT

4.1 LUMP SUM PRICE

A. The unit of measure will be the job. No actual measure will be made. Payment for Demolition will be made at the contract lump sum price, which payment will include removal and proper disposal of all materials including lead paints, and furnishing all labor, tools, equipment and incidentals needed to complete all the above specified work.

END OF SECTION 02050

DIVISION 2 - SITEWORK

SECTION 02076- REMOVAL AND INCINERATION OF FLUORESCENT LIGHT BALLASTS AND SMALL CAPACITORS CONTAINING POLYCHLORINATED BIPHENYLS (PCB)

PART 1- GENERAL

A. Small capacitors and fluorescent light ballasts manufactured after 1978, have been labeled "NO PCBs" by the manufacturers. Prior to 1978, small capacitors and fluorescent light ballasts were not labeled as to whether they contained PCBs, therefore, all unlabelled capacitors and ballasts are assumed to contain PCBs. Some ballasts have been replaced due to renovation or attrition, it is not possible to determine the percentage of replacement. Therefore, all ballasts not labeled "No PCBs' will be considered to contain PCBs and be removed and properly disposed (incinerated). The following procedures have been developed to assure proper disposal of small capacitors and fluorescent light ballasts.

Note All PCB ballasts and contaminated materials are to be incinerated. Large quantities of; or damaged leaking light ballasts are to be incinerated as PCB waste using the following procedures:

B. Fluorescent Lamps, Thermostats and some switches contain mercury. Mercury is a toxic metal that needs to be captured and properly recycled to prevent its release into the environment.

1.1 DESCRIPTION OF WORK:

A. General: This section includes all work necessary to remove and incinerate small capacitors and fluorescent light ballasts which contain polychlorinated biphenyl (PCB) in accordance with current environmental regulations. Also required is the careful removal and containerization in a manner that prevents breakage during handling and shipping, and the recycling of items that contain mercury.

I. Work Area: The work area is the actual area where ballasts are removed from light fixtures or capacitors from small electrical items.

2. Light Ballasts: All fluorescent light fixtures designated and identified for removal on the contract drawings will be removed in accordance with these procedures.

3. Mercury-containing Items. Fluorescent lamps, Thermostats, mercoid-switches, other mercury-containing HVAC controls shall be carefully removed so as to not cause breakage, placed in plastic bags and then properly packaged for transport to a mercury recycling facility.

B. Related Work Specified in Other Sections: Section 01546, "Safety and Health," applies to work covered by this section.

1.2 QUALITY ASSURANCE:

A. Contractor Qualifications: The Contractor shall be a firm of established reputation (or if newly organized, whose personnel have previously established a reputation in the same field), which is regularly engaged in, and which maintains a regular force of workmen skilled in PCB removal, and shall have performed this work on previous projects.

B. Sampling for PCB: In the event that ballasts are discovered to be damaged, clean-up shall proceed as follows:

1. If contamination is restricted to the light fixture, the entire fixture should be treated as PCB contaminated.

2. If surfaces below the light fixture are suspected to be contaminated, the contractor is responsible for proper clean-up of the area. A clean-up procedure must be submitted to the Contracting Officer and approved prior to beginning clean-up.

3. Wipe samples shall be collected utilizing a hexane solvent wipe of the affected area. Samples are to be analyzed by a qualified laboratory accredited by the American Industrial Hygiene Association (AIHA) for organic materials analysis.

C. Plan for Mercury spill cleanup and follow-up testing.

1. Provide a written plan and equipment necessary for a mercury cleanup should a spill occur.

1.3 REFERENCES:

A. Code of Federal Regulations (CFR):

29 CFR 1910, Occupational Safety and Health Act

29 CFR 1926, Occupational Safety and Health Act, Construction Industry,

40 CFR 761, U.S. Environmental Protection Agency Regulations for PCB.

29 CFR 1910.120: OSHA General Industry Hazardous Waste Operations Requirements.

B. Department of Transportation Regulations (DOT)

DOT 49 CFR Part 178

C. State and Local Regulations:

Applicable state and local regulations shall apply.

1.4 SUBMITTALS:

A. Initial Submittals of PCB Contractor

1 Contractor Qualification Information:

a. Name and location of at least 2 PCB and two Mercury removal projects performed by the Contractor, including name and telephone number of contract representative.

b. Name of and experience record of superintendent and foreman Include evidence of knowledge of applicable regulations.

c. Name and experience record of workmen who will be assigned to this project.

B. Post-Award PCB and Mercury Submittals: Required to be approved by the contracting officer or his designated representative prior to starting work.

1. Plan of Action: Submit a detailed plan of the procedures proposed for use in complying with the regulations included in this specification, the location and configuration of work areas where ballasts and Mercury items will be removed, and the debris storage location which shall either be a designated restricted access area or an area isolated temporarily by use of plastic sheeting or other method so that any accidental contamination will not spread to unrestricted areas of the building. The plan shall also include the number of debris filled drums to be allowed on site, the sequencing of PCB and Mercury removal work, the interface of trades involved in the performance of work, methods to be used to assure the safety of building occupants and visitors to the site, and location of approved incineration site contractor is intending to use. Expand upon the packaging of removed Mercury and PCB items. Include information on worker training and personal protective equipment. The plan must be approved by the Contracting Officer prior to commencement of work.

2. Contingency Plan: A contingency plan for response to suspected release of Mercury or PCBs, such as leaking ballasts, etc. should be prepared. This should include

notification of the COTR, environmental testing, and clean up of any contamination resulting from contractor activities. The contingency plan shall include environmental sampling performed by entities meeting the requirements specified elsewhere in this document.

2. Incineration Plan: A plan including location of EPA approved incineration sites, qualifications of transporter, methods of transport, and a description of the methods to be employed to prevent release to the environment. The contractor shall explain the method for documenting proper PCB disposal (incineration) to the contracting officer or his designated representative.

3. Recycling Plan for Mercury: A plan including location of EPA approved recycling sites, qualifications of transporter, methods of transport, and a description of the methods to be employed to prevent release to the environment.

C. During-Work PCB and Mercury Submittals: Items I.04.C.1-3 below are to be submitted to the contracting officer or his designate4 representative as work progresses at the time specified.

1. If leaking ballasts were accumulated, submit proof of notification of EPA and local jurisdiction if debris is to be stored for a period over 30 days.

2. PCB and/or Mercury Sampling:

In the event of a PCB or Mercury release episode, the contractor shall be requested to submit:

a. Laboratory Qualification Information: Submit proof of qualifications of testing laboratory and personnel. Accreditation by the American Industrial Hygiene Association (AIHA) for organic or metals materials analysis, shall be minimum proof of compliance. This submittal must be approved by the Contracting Officer prior to beginning any testing.

b. Submit results of any sampling conducted during the project.

3. Transporting and Incineration of PCB Containing Materials:

a. Recordkeeping: Recordkeeping of all PCB must be accurate, thorough and complete, since the owner remains ultimately responsible for their generated PCB until its final EPA approved destruction. To insure compliance with EPA regulations (40 CFR Part 761) and to take every precaution against improper/incomplete PCB incineration, tracking records are required as follows:

(1) Provide tracking documentation for each container of PCB and/or PCB-

contaminated substance(s) by forwarding copies of all manifests and continuation sheets (information of contents of each PCB container) to;

(2) Each drum shall be properly labeled prior to its leaving the PCB filling location. A properly labeled PCB drum shall have painted on it, or attached to it (in addition to other requirements) the following required information:

(a) A unique PCB container serial number as follows:

Each PCB drum, filled with PCB contaminated substances, will have a serial number that is a combination of the Building number, and the container number painted on the drum.

(b) The initial date the PCB container was filled.

(c) Contents of the PCB container. Liquids shall not be mixed with solids.

(d) The name of the Company and person filling the container and the contract number.

(e) Description of container. (Example: contaminated rags, light fixtures, etc.). All communication relating to these containers must reference the container serial number(s).

(3) Provide the Contracting Officer with an itemized list of all PCB containers along with copies of all PCB manifest(s) and continuation sheets prior to any PCB container being removed from the job site.

(4) Shipping Manifest Forms: Signed and completed Shipping Manifest Forms shall be used for the transportation of PCB and the Mercury Items (PCBs in accordance with 40 CFR Part 761). Each manifest is to be assigned a unique number.

This form shall be signed by each party who has control over the PCB waste, and a copy retained by each party as responsibility for the waste is transferred to the next party. Provision of legible copies of manifests are to go to the Contracting Officer.

(5) Certificates of Destruction: Provision of Certificates of Destruction to the Contracting Officer, as well as a method to ensure that the incineration facility destroys the PCB material and provides signed copy of the

manifest within 30 days of receipt of material and a CD within one year of receipt of the material.

D. Final Submittals: Items I .04.D. 1. below is to be submitted to the contracting officer or his designated representative at the completion of work for each work area.

1. Summary Report: Copies of any sampling results and all narrative reports performed as part of this contract.
2. Disposal/Recycling Manifests: Provide copies of all shipment and disposal records.

1.5 CONTRACTOR RESPONSIBILITY

A. The Contractor shall assume full responsibility and liability for compliance with all applicable Federal, State, and local regulations pertaining to the protection of his workers, visitors to the site, and persons occupying areas adjacent to the site. The Contractor is responsible for providing medical examinations and maintaining medical records of personnel as required by the applicable Federal, State, and local regulations, and shall hold the government harmless for failure to comply with any applicable safety or health regulation on the part of himself; his employees, or his subcontractors.

1.6 PROJECT/SITE CONDITIONS:

A. Means of Egress: Establish and maintain emergency and fire exits from the work area.

B. Use of Existing Facilities: Use of existing toilets, showers, and/or other similar facilities for decontamination areas is prohibited.

C. Maintenance of Existing Equipment: See contract drawings for requirements, if any.

1.7 SEQUENCING/SCHEDULING: See contract drawings for any specific requirements.

PART 2 - PRODUCTS

2.1 EQUIPMENT: Equipment, including disposable protective clothing, used in the execution of this contract and provided to visitors to the site, shall comply with the applicable Federal, State, and local regulations.Provide adequate packaging materials for all mercury-containing items.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Isolate the PCB and Mercury work area for the duration of the work so as to prevent unauthorized access by designating the area off limits to all but authorized personnel.

Maintain a log of all persons visiting the PCB work site.

B. Post warning signs and labels as required by this contract, 29 CFR 1910, 40 CFR 761, and as directed by the Contracting Officer.

3.2 WORK PROCEDURE:

A. General Procedures: Perform all PCB and Mercury related work and comply with the general safety and health provisions in conformance with 29 CFR 1910, 29 CFR 1926, and 40 CFR, respectively. If a conflict arises, the more stringent application shall apply until a determination is made by the contracting officer or his designated representative.

B. Coordination of Work of all Trades: Coordinate the work of all trades to assure that their work is performed in accordance with the applicable regulations and that the PC13 control area remains separated from the remaining work areas.

K. Make arrangements, *i.e.* obtain EPA Generator Identification Number, make EPA notifications, fill out hazardous waste manifest, and incinerate material in the drums as PCB contaminated solid waste.

L. Transport the drum(s) and any other PCB materials to an EPA approved incinerator or ballast recycling facility.

3.3 PCB ITEM REMOVAL: The following is a basic outline of the minimum steps that will be taken during the removal of PCB containing items from buildings. The procedure, plan of action, submitted for approval by the contractor should address these points:

A. Place a minimum of two layers of 6-mil plastic on the floor beneath the disposal drums, the actual work area, and beneath stored disposal drums.

B. Don protective clothing and gloves.

C. Pour a significant (minimum 8 cm layer) amount of oil absorbent in a DOT 17-H drum labeled as containing PCB.

D. Remove the light ballast from the light fixture. If it says "NO PCBs", throw it in the normal trash, if no label is found place the ballast in the drum. Do not throw PCB ballasts.

E. If an unmarked ballast shows any sign of leaking, PCB resistant gloves shall be worn when handling the fixture.

F. Dispose of any light fixture which held an unlabelled leaking ballast or a labeled PCB ballast as PCB contaminated material.

G. Alternately layer the ballasts and absorbent until the drum is full, carefully checking to assure that the last layer will be absorbent.

H. Place all used disposable protective clothing and plastic in the drum.

I. Label the drum with a DOT-ORME label with the following minimum information:

Date of materials were placed in the drum.

- Materials in the drum, i.e. "75 two-tube light ballasts.'
- Name address and phone number of the generator, or owner of the light ballasts.
- Container identification no. (cx: DCOO93ZZ-OOIBAL)

3.4 Mercury Item Removal The following is a basic outline of the minimum steps that will be taken during the removal of Mercury containing items from buildings. The procedure, plan of action, submitted for approval by the contractor should address these points:

A. Place a minimum of two layers of 6-mil plastic on the floor beneath the actual work area, and beneath stored disposal drums/containers.

B. Don protective clothing and gloves.

C. Remove item using proper tools for the job. Remove screws, bolts, and brackets as necessary to release item and place into individual plastic sealable bags or cardboard packaging. Place multiple items into secure packaging for transport.

D. Do not throw , drop, or mishandle mercury-containing items.

3.5 FIELD QUALITY CONTROL:

A. Site Inspection and Stop Work Orders: While performing this work, the Contractor shall be subject to on site inspection by agency officials or agency contracted inspection services. Work shall also be subject to inspection by OSHA and EPA inspectors and/or local building or health officials, If found to be in violation by one of these officials, the Contractor shall cease all work immediately. Until the violation is resolved, standby time required to resolve the violation shall be at the Contractor's expense. One complete set of equipment (such as respirators and disposable clothing) required for entry to the work area shall be made available within 2 hours of request by the Contracting Officer for inspection of the work area. Such requests will only be made during the contractor's working hours.

3.5 CLEANUP AND DISPOSAL:

A. Permits and Notifications: Secure necessary permits in conjunction with PCB removal,

hauling and disposition and provide timely notification of such actions, as may be required by federal, state, regional, and local authorities. Notify the Regional Office of the United States Environmental Protection Agency and provide copies of the notification to the Contracting Officer 10 days prior to the commencement of the work.

B. Housekeeping: Essential parts of PCB control are housekeeping and cleanup procedures. Maintain all surfaces on the work area free of accumulations of debris to prevent further dispersion. Give meticulous attention to restricting the spread of debris, keep waste from being distributed over the general area or to other areas in the building. The blowing down of the work area with compressed air is forbidden. Post appropriate hazard warning signs. In all possible instances workmen shall cleanup their own areas. Equip personnel engaged in cleaning *up* scrap and waste with *necessary* personal protective clothing.

C. Incineration of PCB Containing Materials: Collect and dispose of all PCB ballasts and contaminated waste, rags, scrap, debris, bags, containers, equipment, and PCB

contaminated clothing in properly labeled PCB disposal drums. Waste PCB containing material shall be transported to an incineration site. The contractor will provide the Contracting Officer with a copy of all manifests and continuation sheets resulting from the incineration of the PCB containing waste. In some instances, a temporary holding area can be established upon approval by the Contracting Officer for properly packaged PCB waste.

D. Approval of Final Cleanup: The Contracting Officer or his designated representative will inspect the work area in concert with the government's industrial hygienist for approval of the PCB and Mercury removal. Visual observation of potential contamination, dust or debris is not permitted on any surface in or around the work area. The Contracting Officer's Representative will approve final cleaning and restoration of the work area.

END OF SECTION 02076

DIVISION 2 – SITEWORK

SECTION 02085 - ASBESTOS ABATEMENT PROCEDURES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

A. General: This section includes all work necessary to reduce air concentrations of asbestos to the specified level and maintain the specified asbestos control limits during the life of the contract. It also includes removal, containment, and disposal of asbestos containing materials.

1. Work Area: The work areas include the following:
Pump Room

2. The following asbestos containing materials are to be removed:
All gaskets, insulation or caulking materials

B. Related Work Specified in Other Sections: Section 01546, "Safety and Health," applies to all work covered by this section.

1.02 QUALITY ASSURANCE:

A. Contractor Qualifications: The Contractor shall be a firm of established reputation (or if newly organized, whose personnel have previously established a reputation in the same field), which is regularly engaged in, and which maintains a regular force of workmen skilled in asbestos abatement, and shall have performed this work on previous projects.

1. Contractors performing asbestos abatement work in the District of Columbia are required to be licensed to do asbestos work in the District of Columbia. The contractor shall comply with the licensing regulations of:

Government of the District of Columbia
Department of Health
Environmental Health Administration
51 N Street, NE
Washington, DC 20002

. 2. Contractor employees assigned to active asbestos work areas in the District of Columbia must be licensed in the District of Columbia as trained asbestos worker.

3. Pursuant to NESHAP requirements the contractor should provide appropriate written notification at least 10 days prior to the start of asbestos abatement work to:

Asbestos Program Coordinator, Code 3AM 22
U. S. Environmental Protection Agency Region III
841 Chestnut Street Building
Philadelphia, PA 19107

and to the appropriate local jurisdiction:

a. Government of the District of Columbia
Department of Health
Environmental Health Administration
51 N Street, NE
Washington, DC 20002

B. Laboratory Qualifications: Laboratory shall be regularly engaged in asbestos testing, and personnel used for monitoring airborne concentrations of asbestos fibers shall be proficient in this field. See "Submittals" paragraph for the specific information which must be submitted for approval of the laboratory.

C. Asbestos Control Limits: The enclosed work areas shall be defined as a regulated area in accordance with 29 CFR 1910.1001 and 29 CFR 1926.1101.

1. Inside Asbestos Work Area: For personnel wearing negative-pressure respirators, air concentrations of asbestos shall not exceed an 8-hour time weighted average of 0.1 fibers (longer than 5 microns), per cubic centimeter of air. Regardless of respiratory protection worn, air concentrations inside the work area will not exceed an 8-hour time weighted average of 0.1 fibers per cubic centimeter. It is the responsibility of the contractor to provide an independent industrial hygiene consultant to provide the required personal air monitoring and to assure that all safety and health procedures are followed.

2. Outside Asbestos Work Area: Air concentrations of asbestos shall be maintained at the lowest attainable level and shall not exceed an 8-hour time weighted average of 0.01 fibers (longer than 5 microns) per cubic centimeter of air. This applies to all areas in the building while work is in progress except for the asbestos work area, and to the entire building , including the former work area, after final cleanup. To assure compliance with these standards, the government will provide the required air monitoring outside the contractor's work area and the government's industrial hygienist will have unrestricted access to the contractor's worksite. The asbestos abatement contractor may perform any air sampling he wishes to assure compliance and for comparison with this standard.

1.03 REFERENCES:

A. American National Standards Institute (ANSI) Publication:

Z9.2-79 Fundamentals Governing the Design and Operation of Local Exhaust Systems

B. American Society for Testing and Materials (ASTM) Publication:

E 849-82 Safety and Health Requirements relating to Occupational Exposure to Asbestos

C. Code of Federal Regulations (CFR):

29 CFR 1910.1001, Occupational Safety and Health Act (OSHA), INCLUDING Appendix A through I.

29 CFR 1910.20, Subpart C, General Safety and Health Provisions.

29 CFR 1910.134, OSHA General Industry Respirator Requirements.

29 CFR 1926.1101. Occupational Exposure to Asbestos, Construction Industry Standard, INCLUDING Appendix A through K.

40 CFR Part 61, Subpart M: U.S. Environmental Protection Agency, National Emission Standards for Hazardous Air Pollutants (NESHAP) Asbestos.

D. State and Local Regulations:

1. Applicable state and local regulations shall apply.

1.04 SUBMITTALS:

A. Initial Submittals of Asbestos Abatement Contractor or Subcontractor Qualification Information: Items 1.04.A.1. through 1.04.A.5 below are to be submitted after the bid receipt, but are required to be approved by the contracting officer prior to award.

1. Five Projects: Name and location of at least 5 asbestos abatement projects performed by the Contractor, including name and telephone number of contract representative.

2. Five Air Tests: Copy of daily log and air monitoring reports including final decontamination levels of last five abatement projects.

3. Experience and Qualifications of Supervision: Name of and experience record of superintendent and foreman. Include evidence of knowledge of applicable regulations; evidence of participation and successful completion of EPA approved training course in asbestos removal and/or supervision of asbestos related work; and experience with asbestos related work in a supervisory position as evidenced through supervision of at least two asbestos abatement contracts.

4. Experience and Qualifications of Workers: Name and experience record, if any, of workmen who will be assigned to this project. Include for each person evidence of successful completion of State of Maryland or Commonwealth of Virginia training given by qualified personnel. Provide certification that employees meet the medical surveillance requirements of the state for which they are licensed.

5. License Information: Provide a copy of a current District of Columbia Asbestos Contractor's License for projects in the District of Columbia.

B. Post-Award Asbestos Abatement Submittals: Items 1.04.B.1. through 1.04.B.8 below are to be submitted after the award, but are required to be approved by the contracting officer or his designated representative prior to starting work.

1. Plan of Action: Submit a detailed plan of the procedures proposed for use in complying with the requirement and regulations included in this specification. The plan shall include the location and layout of decontamination areas, the sequencing of asbestos work, the interface of trades involved in the performance of work, methods to be used to assure the safety of building occupants and visitors to the site. Expand upon the use of portable HEPA ventilation system, closing out of the building's HVAC system during removal, method of removal to prohibit emissions in work area, and packaging of removed asbestos debris.

2. Disposal Plan: A disposal plan including location of approved disposal site and the contractors method for documenting proper asbestos disposal to the contracting officer or his designated representative.

3. Environmental Protection Agency (EPA) Notification: Provide a copy of the NESHAPS Notification of Demolition Renovation Form sent to the Regional EPA Asbestos Regulation Office. (Paragraph 1.02)

4. Local Government Notification: Provide a copy of the notification sent to the appropriate State or Local Governmental Asbestos Regulation Office. (Paragraph 1.02)

5. Certificates of Compliance: Submit certification that vacuums, ventilation equipment, and other equipment required to contain airborne asbestos fibers conform to ANSI Z9.2.

6. Information on Encapsulating Material: Submit written evidence that material meets the latest requirements of the Environmental Protection Agency (EPA) and possesses the specified characteristics.

7. Laboratory Qualification Information: Submit proof of qualifications of testing laboratory and personnel. Accreditation by the American Industrial Hygiene Association (AIHA) for asbestos analysis and two most recent consecutive quarterly reports showing that the laboratory analyzing the samples has been judged proficient by successful participation in the National Institute for Occupational Safety and Health (NIOSH) Proficiency Analytical Testing (PAT) Program, shall be considered sufficient proof of compliance. In addition to microscopists employed by AIHA accredited laboratories, microscopists who provide similar evidence of successful participation in the AIHA Asbestos Analyst's Registry may analyze the fibers-in-air on site, however, any samples which are sent to a laboratory for analysis must be analyzed by an AIHA accredited laboratory. This submittal must be approved by the Contracting Officer prior to beginning any testing.

C. During-Work Asbestos Abatement Submittals: Items 1.04.C.1. through 1.04.C.2. below are to be submitted to the contracting officer or his designated representative as work progresses at the time specified.

1. Air Monitoring and Work Area Information:

a. Air Monitoring Results: Results of all air monitoring conducted by the contractor shall be posted within 72 hours of collection and within 24 hours of analysis for all workers to see. A copy of the results shall be given to the contracting officer.

b. Differential Air Pressure Readings: Starting when a negative pressure containment is erected and approved by the contracting officer, a copy of the strip chart record of the work area relative pressure shall be submitted within 24 hours after the recording was made.

c. Work Area Inspections: The contracting officer's representative will perform visual inspections of the work area for the pre-removal, pre-final, and reoccupancy stages of the work. The contractor shall notify the contracting officer at least 14 hours in advance of each required inspection.

2. Transporting and Disposing of Asbestos Containing Materials (ACM):

a. Disposal Receipts: Receipts from the transporter, which acknowledge the contractor's shipment of ACM from the site (NESHAPS Waste Shipment Records) shall be submitted three days following removal of ACM from the premises. Each receipt shall provide date, quantity of material removed, and signature of an authorized representative of the transporter.

b. Transportation Vehicles: Transportation shall be in vehicles dedicated to asbestos transportation. Vehicles shall be marked in accordance with DOT and NESHAPS regulations.

c. Shipping Manifest Forms: Signed and completed Shipping Manifest Forms (NESHAPS Waste Shipment Records) shall be used for the transportation of ACM. This form shall be signed by each party who has control over the asbestos waste, and a copy retained by each party as responsibility for the waste is transferred to the next party.

D. Final Submittals: Items 1.04.D.1. and 1.04.D.2. below are to be submitted to the contracting officer's designated representative at the completion of work for each containment.

1. Daily Log: Copies of a daily log showing the date(s) and time(s) of entrance to and exit from the work area(s) for all persons.

2. Reestablish Systems: Submit written certification:

a. Describing the type, application, and quantity of asbestos containing materials removed by the contractor.

b. That final inspection items were completed.

c. That mechanical and electrical systems disturbed by the contractor during work under the contract have been reinstalled and are in working order.

1.05 CONTRACTOR RESPONSIBILITY: The Contractor shall assume full responsibility and liability for compliance with all applicable Federal, State, and local regulations pertaining to the protection of workers, visitors to the site, and persons occupying areas adjacent to the site. The Contractor is responsible for providing medical examinations and maintaining medical records of personnel as required by the applicable Federal, State, and local regulations, and shall hold the government harmless for failure to comply with any applicable safety or health regulation on the part of himself, his employees, or his subcontractors.

1.06 PROJECT/SITE CONDITIONS:

A. Means of Egress: Establish and maintain emergency and fire exits from the work area.

B. Use of Existing Facilities: Use of existing toilets, showers, and/or other similar facilities as decontamination areas is prohibited.

C. Maintenance of Existing Equipment: See contract drawings for requirements.

D. Environmental Conditions to be Maintained: Normal environmental conditions (heat, light, air conditioning) must be maintained outside of the work area.

E. Decontamination Facility: Throughout the time that asbestos removal is taking place, the abatement contractor will maintain a working five-stage decontamination facility at the point of access to the containment. As a minimum, the decontamination facility will consist of a clean changing area, an air space, a shower, another air space, and a contaminated changing area. The size and location of this facility shall be approved by the contracting officer.

F. Access to Work Area: Access to work areas shall be through decontamination areas. The following shall have access to work area:

1) Contracting Officer or Designated Representative
2) Safety & Environment Personnel
3) Authorized Inspection Personnel
5) OSHA Inspectors
6) EPA Inspectors
7) Local Building or Health Officials

1.07 SEQUENCING/SCHEDULING: Asbestos abatement work will be performed during normal working hours. Any exceptions will be noted on the contract drawings.

PART 2 - PRODUCTS

2.01 EQUIPMENT: Equipment, including protective clothing and respirators, used in the execution of this contract and provided to visitors to the site, shall comply with ASTM E 849 and with the applicable Federal, State, and local regulations. Respirators shall conform to the OSHA requirements in 29 CFR 1910.134 and 29 CFR 1926.1101, except that single use and disposable respirators shall not be used. Type of respirators required shall be as specified in 29 CFR 1926.1101. If any air sampling indicates levels above 0.1 fibers per cubic centimeter or "too dirty to count," powered air or supplied air (type "C") respirators will be required during actual removal operations.

2.02 ENCAPSULATING MATERIALS:

A. Encapsulating materials (sealants) shall meet the latest requirements of the Environmental Protection Agency (EPA) and shall possess the following characteristics:

1. Adherence. The sealant eliminates fiber dispersal by adhering to the fibrous substrate with sufficient penetration to prevent separation of the sealant from the sprayed asbestos material.

2. Impact Penetration. It withstands impact and penetration, protects the enclosed sprayed asbestos material, and it must not cause separation of sprayed asbestos material from its original substrate.

3. Flexibility. It possesses enough flexibility to accommodate atmospheric changes and settling of the structure over time.

4. Resistance to Smoke and Flame. It shall have high flame retardant characteristics and a low toxic fume and smoke emission rating.

5. Ease of Application. It must be easily applied with relative insensitivity to errors in preparation or application. Ease of repair by routine maintenance personnel is desirable.

6. Toxicity. The sealant must be neither noxious nor toxic to application workers and structure users thereafter.

7. Permeability. It should have some permeability to water vapor to prevent condensation accumulation be resistant to common cleaning agents.

8. Stability. It should have suitable stability to weathering and aging.

B. Guarantee. Guarantee encapsulating materials to perform for a period of 1 year, in accordance with "Guarantee" clause of the General Conditions.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Isolate the work area for the duration of the work by completely sealing off all openings and fixtures in the work area, including but not limited to, heating and ventilation ducts, doorways, corridors, windows, and lighting with plastic sheeting taped securely in place.

B. Build double barriers of plastic sheeting at all entrances and exits to the work area so that the work area is always closed off by one barrier when workers enter or exit.

C. Cover all floor and wall surfaces in the work area with plastic sheeting taped securely in place to protect from damage. Assure that two layers cover all floor areas.

D. Before the work is begun, clean all removable items and equipment. Remove them from the work area and store as directed.

E. Cover all nonremovable items and equipment in the work area with plastic sheeting taped securely in place.

F. Remove all heating, ventilation, and air conditioning system filters, pack them in sealable plastic bags (6-mil minimum) for disposal in the approved waste disposal site and replace them with new filters upon completion of abatement. Openings created by the removal of HVAC filters shall be sealed using 6 mil plastic sheeting taped securely in place, prior to start of work.

G. Post warning signs on the primary containment as required by 29 CFR 1910.1001, 29 CFR 1926.1101, DC rules and as directed by the Contracting Officer.

H. Obtain Written Approval of the Finished Primary Containment from the Safety and Environmental Management representative prior to starting any actual asbestos removal work. (This approval authority may be delegated in writing to the Government's contract independent industrial hygienist.)

3.02 WORK PROCEDURE:

A. General Procedures: The enclosed work areas shall be defined as an asbestos regulated area and all asbestos worker protection and work practices not addressed in this specification shall be performed in conformance with the general safety and health provisions of 29 CFR 1910.1001, 29 CFR 1910.20, and 29 CFR 1926.1101, respectively. For asbestos abatement work, use appropriate work procedures approved by the Environmental Protection Agency (EPA). If a conflict arises, the more stringent application shall apply until a determination is made by the contracting officer or his designated representative.

B. Local Exhaust System: Provide a local exhaust system in the asbestos control area as required to meet the asbestos control limit and ceiling concentration. The local exhaust system shall be vented to the outside of the building. Equip exhaust openings with the necessary filters required to reduce the airborne asbestos concentration to below the asbestos control limit. Local exhaust equipment must be sufficient to maintain a negative air pressure of 0.02 inches of water in the asbestos control area. In no case shall the building ventilation system be used as the local exhaust system for asbestos control. Filtering in vacuums and exhaust equipment shall conform to ANSI Z9.2; HEPA filters shall be used in all vacuums and exhaust equipment. If the local exhaust system does not exhaust directly to the outside, the exhaust equipment shall be tested for integrity with a Dioctylphthalate (DOP) or Dioctylsubacate (DOS) smoke generator and particle counter each time a containment is erected.

C. Coordination of Work of all Trades: Coordinate the work of all trades to assure that their work is performed in accordance with the applicable regulations and that the asbestos control limits are maintained at all times both inside and outside the asbestos work area.

3.03 NEGATIVE PRESSURE GLOVEBAG METHOD OF ASBESTOS REMOVAL:

A. General: If the contract drawings specifically permit the glovebag method for removing pipe insulation, personnel decontamination procedures may not be required. However, respiratory protection and disposable clothing will be required. Discard the clothing in accordance with paragraph "Disposal of friable asbestos."

B. Procedure: Install the glovebag and negative pressure equipment according to manufacturer's recommendations. Cut covering on the insulation along the top seam to allow wetting of the

insulation, and cut cover all around section to be removed. Remove in small sections. Lower the insulation material carefully inside the glovebag. Do not permit it to drop.

C. Removal of Glovebag and Disposal: Following removal of insulation, ensure that all visible material is inside the bag. Spray all tools in glovebag with amended water while it is still attached. Evacuate bag with portable HEPA vacuum and while the bag is collapsed, squeeze bag below tool pouch, and twist bag. Seal bag with tape or locking ties, separating the waste from the removal area. Vacuum the inside of the top of the glovebag and unsealed portion of the glovebag below. Keep HEPA vacuum connected until the glovebag is removed. Replace HEPA filters as recommended by manufacturer. Cut the glovebag along the top and sides, then remove it from the pipe. Wet wipe and wash all tools and removal area thoroughly. Dispose of glovebag, material, and contaminated equipment in accordance with paragraph "Disposal of Friable Asbestos."

3.04 QUALITY CONTROL:

A. Monitoring: Monitoring of airborne concentrations of asbestos shall be in accordance with 29 CFR 1910.1001, 29 CFR 1926.1101, and ASTM E 849. Monitor the airborne concentration of asbestos before starting work to obtain a baseline fiber concentration in the affected areas. Then monitor once every four hours, continuously during the course of the work inside the asbestos work area; one time daily outside the entrance to the asbestos work area and at the exhaust opening of the local exhaust system. If monitoring shows airborne concentrations greater than the asbestos control limits, stop all work, correct the conditions causing the excessive levels, and notify the Contracting Officer immediately. In addition, monitor the airborne concentrations of asbestos after final cleanup and removal of the enclosure of the asbestos control area in accordance with paragraph "Final cleanup and removal of enclosures."

B. Site Inspection and Stop Work Orders: While performing asbestos abatement work, the Contractor shall be subject to on site inspection by agency officials or agency contracted inspection services. Work shall also be subject to inspection by OSHA and EPA inspectors and/or local building or health officials. If found to be in violation by one of these officials, the Contractor shall cease all work immediately. Until the violation is resolved, standby time required to resolve the violation shall be at the Contractor's expense. One complete set of equipment (such as respirators and disposable clothing) required for entry to the asbestos control area shall be made available within 2 hours of request by the Contracting Officer for inspection of the asbestos control area. Such requests will only be made during the contractor's working hours.

3.05 CLEANUP AND DISPOSAL:

A. Permits and Notifications: Secure necessary permits in conjunction with asbestos removal, hauling and disposition and provide timely notification of such actions, as may be required by federal, state, regional, and local authorities. Notify the Regional Office of the United States Environmental Protection Agency and provide copies of the notification to the Contracting Officer 10 days prior to the commencement of the work. Provide notification in accordance with 40 CFR 61.22(d)(1). (See Paragraph 1.01)

B. Housekeeping: Essential parts of asbestos dust control are housekeeping and cleanup procedures. Maintain all surfaces throughout the building free of accumulations of asbestos fibers to prevent further dispersion. Give meticulous attention to restricting the spread of dust and debris, keep waste from being distributed over the general area or to lower floors. Use approved industrial vacuum cleaners with a HEPA filter to collect dust and small scrap. The blowing down of the space with compressed air is forbidden. Post appropriate asbestos hazard warning signs. In all possible instances workmen shall cleanup their own areas. Equip personnel engaged in cleaning up asbestos scrap and waste with necessary respiratory equipment and protective clothing.

C. Disposal of Friable Asbestos: Collect and dispose of friable asbestos waste, scrap, debris, bags, containers, equipment, and asbestos contaminated clothing which may produce airborne concentrations of asbestos fibers in sealed impermeable bags. Prior to placing in bags, or containers, wet down asbestos wastes to reduce airborne concentrations. Waste asbestos material shall be disposed of in accordance with all Federal regulations at a sanitary landfill that meets EPA requirements. The contractor will provide the Contracting Officer or his designated representative with a copy of all hazardous waste manifests, haulers receipts or landfill receiving tickets resulting from the disposal of the asbestos waste. Establishment of any on-site temporary holding area for properly packaged asbestos waste must be approved by the Contracting Officer or his designated representative.

D. Final Cleanup and Removal of Enclosure: The Contractor must notify the Contracting Officer that the work area is ready for final inspection. The Contracting Officer or his designated representative will inspect the work area prior to decontamination and removal of enclosure. Visual observation of asbestos materials, dust or debris is not permitted on any surface in or around the work area. Clean work area in accordance with EPA approved methods. The Contracting Officer's independent industrial hygienist will perform air sampling for clearance purposes. Perform sampling in an aggressive manner, using fans or similar equipment to create exaggerated air movement during the clearance air sampling. Repeat the decontamination and testing process until fiber concentration level reaches 0.01 f/cc or the level recommended by EPA. If fiber concentration does not exceed 0.01 f/cc or the level recommended by EPA, the Contracting Officer or a designated representative may authorize removal of the enclosure. Contracting Officer approval of final cleaning and restoration of the work area is required.

END OF SECTION 02085

DIVISION 2 - SITEWORK

SECTION 02220 - TRENCH EXCAVATION AND BACKFILL

PART 1 GENERAL

1.1 SCOPE:

A. Work consists of excavation, shoring, supporting utilities and backfilling of open trenches for the construction of pipe sewer and water main systems, including disposal of unsuitable and excess materials.

B. When water service and/or building sewer connections are part of Contract, payment for excavation and backfill for water service and/or building sewer connections will be made under Section 02650 and/or 02730, respectively.

C. Related Work Specified Elsewhere May Include But Is Not Limited To:
1. Section 02224: Structural Excavation, Backfill and Grading
2. Section 02605: Valve Casings
3. Section 02610: Pipe Water Main - Ductile Iron
4. Section 02650: Water Service Connections
5. Section 02705: Sewer Manholes
6. Section 02730: Pipe Sewer
7. Section 02735: Building Sewer Connections and Cleanouts

1.2 REFERENCES

A. Reference Codes and Specifications:
1. American Association of State Highway and Transportation
a. AASHTO T2 - 96: "Sampling Aggregates".
b. AASHTO T27: "Sieve Analysis of Fine and Coarse Aggregates".
c. AASHTO T87 - 96: "Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test".
d. AASHTO T88: "Particle Size Analysis of Soils".
e. AASHTO T89 - 96: "Determining the Liquid Limit of Sorts".
f. AASHTO T90 - 96: "Determining the Plastic Limit and Plasticity Index of Soils".
g. AASHTO T96: "Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine".
h. AASHTO T180 - 95: "Moisture-Density Relations of Soils Using a 4.54-kg (10 Lb) Rammer and an 457-mm (18 in) Drop".
i. AASHTO T191: "Density of Soil In-Place by the Sand-Cone Method".
j. AASHTO T193 - 93: "The California Bearing Ratio".

k. AASHTO T238: "Density of Soil and Soil-Aggregate in Place by Nuclear Methods".
l. AASHTO T239: "Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods".

2. American National Standards Institute:
    a. ANSI A10.16: "Safety Requirements for Construction of Tunnels, Shafts, and Caissons".
3. American Society for Testing and Materials:
    a. ASTM C33 - 97: "Concrete Aggregates".
    b. ASTM D2940: "Specification for Graded Aggregate Material for Bases or Sub-bases for Highways or Airports".
    c. ASTM D4318 - 98: " Liquid Limit, Plastic Limit, and Plastic Limit, and Plasticity Index of Soils".

1.3 SUBMITTALS

A. Sampling and Tests:
1. Soil samples shall be submitted for trench backfill, soils base, borrow trench fill, and subgrade gravel.
2. GR-16 "Shop and Working Drawings" applies for utility support systems. When shoring is necessary, working drawings, signed and stamped by a licensed professional engineer, shall be submitted for trench shoring scheme.

PART 2 PRODUCTS

2.1 GENERAL:

A. All backfill shall meet requirements of this subsection.
1. Payment for pipe bedding gravel for pipe sewers will be made under Section 02730.
2. Stone or graded aggregate gravel supplied from a quarry producing aggregates of asbestos bearing content or having asbestos present at the quarry is prohibited.
    a. Should such aggregates be utilized, both the Contractor and stone supplier will be directed to remove all asbestos bearing aggregates and replace them with non-asbestos bearing aggregates. The Contractor and supplier shall further be liable for any and all consequential damages, which may result as a violation of this requirement.

2.2 MATERIALS

A. Trench Backfill:
1. Material used in trench backfill shall be a well-graded soil-aggregate mixture with ten- percent maximum, by weight, passing the No. 200 sieve. The soil shall have a liquid limit not greater than 40 and a maximum plasticity index of 10, both per ASTM D4318.
2. Within one foot of the pipe, no gravel or stone shall be larger than 1-1/2 inches in any dimension.
3. For remainder of trench, no gravel or stone shall be larger than 4 inches in any dimension, and not larger than one inch within one foot of finish grade.
4. Backfill shall be free from snow, ice, frozen materials, trash, brick, clay lumps, broken concrete, tree roots, sod, ashes, cinders, glass, plaster, organic matter and any other foreign matter.

5. Backfill shall have a minimum dry weight density of 100 pounds per cubic foot.
6. Backfill shall have a uniform moisture content suitable for compaction to the specified density. The Contractor shall moisten or dry soils materials to obtain suitable, uniform moisture content.
7. If the materials are of such nature that heaving, pumping, rutting, or shearing occurs in the compacted backfill under the action of construction equipment, even though soil meets density requirements, affected material shall be replaced to limits as directed.

B. Trench Subgrade Gravel:
   1. Gravel to backfill trench undercut areas shall be per ASTM C33, Grading Size No. 57.

C. Soils Base:
   1. Soils base course material shall consist of either Bank Run Gravel Base or Crushed Stone Base and have a minimum CBR of 25 in accordance with AASHTO T193.
      a. Bank Run Gravel Base:
         1) Coarse aggregate retained on the No. 10 (2.00 mm) sieve shall consist of hard, durable particles or fragments of stone, gravel or slag; materials that break up when subjected to freeze-thaw or wetting-drying action are prohibited.
         2) Coarse aggregate shall have a maximum percentage of wear of 50 per the Los Angeles test.
         3) Fine aggregate passing the No. 10 (2.00 mm) sieve shall consist of natural and crushed sand and finer mineral particles. The fraction passing the No. 200 (0.075 mm.) sieve shall not exceed one-third (1/3) of the fraction passing the No. 40 (0.425 mm) sieve. The fraction passing the No. 40 sieve shall have a maximum liquid limit of 25 and a maximum plasticity index of 6. The composite material shall conform to the following gradation requirements:

Sieve Designation	Percent Passing By Weight
2-in.	100
1-in.	70-100
3/4-in.	60-95
No. 4	40-75
No. 10	25-65
No. 40	10-45
No. 200	2-10

      b. Crushed Stone Base:
         1) Crushed aggregate shall consist of crushed stone having hard, strong, durable particles per applicable requirements of ASTM D2940.
         2) Additional fine aggregate shall consist of material of the same type and quality as specified above for coarse aggregate.

3) Use of soil fines or natural sands is prohibited.
4) The coarse aggregate and additional fine aggregate shall be so proportioned as to produce a final mixture meeting the following gradation requirements:

Sieve Designation	Percent Passing by Weight	Job Mix Tolerance Weight Percent Passing
2 inch	100	-2
1-1/2 inch	95-100	±5
3/4 inch	70-92	±8
3/8 inch	50-70	±8
No. 4	35-55	±8
No. 30	12-25	±5
No. 200	0-8	±3

PART 3 EXECUTION

3.1 SAMPLING/TESTS

A. General
1. The Contractor shall take five (5) soil samples from areas directed by the Engineer.
   a. The soil samples shall be representative of the soil encountered during excavation. They shall be free from snow, ice, frozen materials, organic matter and foreign matter.
2. The Contractor shall also submit a sample of trench borrow fill material from any supplier which the Contractor purposes to supply backfill material during the Contract.
3. The Contractor shall at no cost to DC WASA, have a testing laboratory which is approved by the Engineer, prepare each sample per AASHTO T-87, perform sieve analysis per AASHTO T-27 and T-88, determine percentage of wear per ASSHTO T-96, determine the liquid limit per AASHTO T-89, determine the plasticity index per AASHTO T-90, provide a modified Proctor test per AASHTO T-180/D and field density test at the ends of each trench and at two hundred (200) foot intervals.
   a. The Contractor shall have the testing laboratory provide the Engineer with copies of the testing laboratory's reports within seven (7) days of when the samples were taken. The Contractor shall not install permanent fill using material which has not been tested and approved by the Engineer.

3.2 TRENCH EXCAVATION

A. General:
1. Trench excavation shall include removal of all materials and objects of whatever nature encountered in excavation, excluding rock and existing steel sheeting left in place.

2. Sewer and water main trench operations shall be coordinated with other utility work and scheduled to meet maintenance of traffic provisions. Utility service connections and appurtenances to individual premises may not be shown in the Contract documents and the Contractor shall determine the exact location of, and maintain these services
3. When trenching through lawn, park or other tillable areas, sod and topsoil shall be removed with care as directed and salvaged if suitable for reuse in restoring disturbed surfaces.
4. Blasting will not be allowed unless approved in writing by the Engineer and permit is obtained by the Contractor.
5. All excavation within trench limits shall be classified as trench excavation unless otherwise stated in the Contract.
6. Surface materials of whatever nature shall be removed, including pavement, base, curb and gutter, sidewalk, and topsoil within trench limits. The Contractor shall properly separate and store materials the Engineer deems suitable for use in backfilling or restoring original conditions.
7. Operations shall be conducted so as to avoid injury to tree trunks, branches and roots. Excavations within limits of tree limb spread shall proceed with extreme care either by use of hand tools or with equipment that will not cause tree damage.
    a. Exposed roots two inches and larger in diameter shall be wrapped in burlap or other approved material and kept moist at all times.
    b. Roots two inches and larger in diameter outside the actual space occupied by the sewer or structure shall not be cut; excavation shall be tunneled under these roots.
    c. When approved, tree branches that interfere with construction may be trimmed in advance of excavation.
    d. Root cutting and branch trimming shall be performed per accepted horticultural practice.
8. When approaching existing underground construction which may be in proximity to work under this Contract, the trench shall be opened a sufficient distance ahead of the work, test pits made, or other approved exploratory methods employed to allow for authorized changes in line and grade.
    a. Changes in line and grade plus excavation and pipe removal caused by failure to take such precautions shall be made at no additional cost to the DC WASA.
9. The Contractor shall adequately support underground pipes or conduits exposed as a result of excavations; adequate support shall be provided along their entire exposed length by using timber or steel in such manner that backfilling may be performed without dislodging such pipes or conduits. No additional payment will be made for support material left in place nor for installing and maintaining supports.
10. When work requires excavation to an elevation below, and to a width wider than trench width required for, a proposed pipe utility, proper backfill and its compaction shall be first completed to a point at least one foot above outside top of proposed utility; utility trench in the backfill may then be excavated. Pipe utilities shall not be placed in such backfill as the fill is brought to utility subgrade.

11. With prior approval, portions of trench may be excavated as tunnel at the Contract price for Trench Excavation measured from surface as if open cut; tunnel bracing and all repair shall be included as part of work.
    a. Tunnel excavation shall meet requirements of ANSI A10.16.
    b. Tunnel excavation includes backfilling the void between pipe structure and tunnel roof with concrete of approved mix design.
    c. Whenever there is any sign of settlement or loose material in tunnel roof or walls, appropriate remedial measures shall be taken, or the excavation shall be made as in open trench as directed.
    d. Tunneling is prohibited when outside of tunnel roof is within such proximity of the bottom of concrete base or asphaltic concrete base to create danger of collapse, settlement or other damage.
12. Trench bottom shall be excavated approximately flat and square with trench walls.
    a. When material at trench grade elevation is suitable, trench bottom shall be protected and maintained free from standing water.
    b. If not maintained, extra excavation and disposal, furnishing and placing undercut gravel to trench grade elevation shall be at no District expense.
13. If material found at trench grade is unsuitable for a foundation for pipe bedding, it shall be removed by the Contractor to the depth and width directed by the Engineer.
14. Except in downtown and other congested areas, trench excavation shall be completed at least 25 feet in advance of pipe laying; at end of a work day or at the discontinuance of work, the pipe laying may be completed to within five feet of the end of the open trench.
15. All trench excavation material suitable for backfill shall be stockpiled, protected, and maintained either on-site or off-site as available space will permit.
    a. Excavated materials shall be neither deposited nor stockpiled so as to endanger in any manner the project, new or existing structures or utilities, nor interfere with project construction sequence and work by others.
16. The Contractor shall remove and dispose of all excess and unsuitable materials, and shall furnish his own disposal areas.
    a. The Contractor must used sealed trucks or containers when hauling wet materials.
    b. The Contractor must obtain written permission from owner or operator of disposal areas before disposing of waste material or surplus debris.

B. Cuts Through Paving and Sidewalk:
    1. Cuts through asphalt wearing surfaces and flexible pavements (full depth asphalt paving) shall be made using pneumatic tools, with asphalt blade, along the trench limit line to make even, neat edges (see Standard Detail CV/50.01).
    2. Cuts through concrete roadway surfaces and concrete base (after removal of asphalt overlays) and cuts through concrete sidewalks, shall be made by concrete saw of sufficient size to saw cut the full depth of the concrete to make even, neat edges; types of paving materials to be cut are indicated in the Contract documents but not guaranteed.
    3. Use of impact type breakers for concrete and asphaltic concrete removal over trenches shall be restricted to the "Hoe Ram" type or approved equivalent; this

type equipment shall not be used near saw cut edges of existing paving limits to remain; this equipment may be restricted or prohibited when in the public interest.

4. Any pavement, sidewalk, curb and gutter, or other highway structure outside the pay limits prescribed for trenches which may be marred, altered, damaged, or destroyed by the Contractor (due, but not limited, to his methods of construction, mobility of equipment, and handling and storage of materials) will be replaced by the District with Department of Public Works' standard type of new pavement, sidewalk, curb, gutter, or other highway structure.
5. The entire cost of any such replacement will be charged against the Contractor, computed using the prevailing rates for street cut repairs chargeable by the Department of Public Works at the time of actual replacement.

C. Trench Shoring:
   1. The Contractor shall furnish, place, maintain, and remove such bracing, trench shields, sheeting or other supporting material to properly support trench side walls and side walls of cuts, and to prevent movement which might in any way injure persons, the project, or other structures near the project, or reduce trench dimensions below those needed for proper construction.
      a. When excavation depth exceeds five feet, adequate shoring is required. For deep trench cuts, adequate trench shields, braced or unbraced sheeting may be necessary.
      b. Working drawings for the proposed method for trench support, maintenance, and shoring removal shall be prepared under the direction, and bear the seal, of a Registered Professional Engineer with a valid license.
         1) Working drawing submittals will be for information only, and shall be submitted in advance of work.
         2) The Engineer shall be notified in advance of any change in method of trench support and maintenance.
      c. If the Contractor elects to use sheeting, the sheeting shall be removed in conjunction with trench backfilling.
         1) If approved in writing, sheeting may be cut off and left in place below a line one foot above the top of the installed pipe.
      d. Voids that may develop outside the bracing, shield, sheeting and shoring shall be promptly filled with appropriate material such as gravel, sand or other approved material.
      e. If at any point sufficient or proper supports have not been provided, the Engineer may order additional supports installed at no additional District cost.

D. Trench Width Design:
   1. Trench width may be less than, but shall not exceed, trench pay width for the trench section from trench subgrade to a point one-foot above top of pipe.
   2. At the Contractor's option, actual trench width more than one foot above the top of the pipe may exceed trench pay width if conditions will permit and are approved.
      a. No additional payment will be allowed for additional excavation, backfill and temporary paving or for support or additional support of underground pipes or conduits which may be required as a result of the Contractor exceeding trench pay width.

b. Should the Contractor elect this option, the Engineer shall be notified prior to work so that he may estimate the additional cost of permanent paving. Monies due the Contractor shall be retained to cover temporary and permanent paving repair beyond trench pay widths.

3. Sewer trench width shall be as shown on applicable Standard Drawings bound in the specifications or as shown on the Contract drawings.
   a. If the value of W is exceeded below a horizontal plane 1'-0" above top of pipe, the Contractor shall submit to the Engineer pipe design reevaluation computations certified by a professional engineer to assure that the allowable load on the pipe will not be exceeded.
   b. Computations shall reflect any additional work required such as concrete bedding, concrete encasement of pipe, higher class of pipe or any other proposed work to solve the problem.
   c. The Contractor shall perform all necessary work at no extra cost to the DC WASA.

E. Abandoned Utilities:
   1. Work includes removal of utilities to be abandoned within limits of trench excavation or infringing on trench limits.
   2. Open ends of abandoned utilities or those scheduled for abandonment shall be bulkheaded by 9-inch thick brick masonry or concrete of approved mix design, or cast-iron plugs or caps in small diameter abandoned in-place water mains.
   3. All abandoned in-place sewers with a 36-inch or larger diameter shall be filled with fly ash, sand or other suitable material prior to bulkheading.
   4. Water mains and water appurtenances shall be abandoned in place as directed.
      a. Frames and covers of manholes and valve casings to be abandoned shall be salvaged and returned to the WASA's property yard.
      b. Abandoned manholes and water valve casings shall be backfilled to grade with approved trench fill.
      c. Abandoned fire hydrants shall be removed including standpipe and boot and delivered to the Department of Water Services Property Yard.
      d. Hydrant drain lateral shall be plugged, if necessary plug drain lateral inside the sewer manhole.
      e. Water mains to be salvaged shall be severed as directed with a smooth cut at a joint or at an intermediate point if approved.
   5. Whenever manholes or water valve casings to be abandoned are isolated from trench excavation limits, they shall be abandoned in place as indicated above and payment made on a per each basis.
   6. Breakage will not be permitted. Mains 24-inch diameter and larger must normally be cut. Any loss of value resulting from damage to usable and surplus water main materials resulting from Contractor operations will be charged to the Contractor.

F. Dewatering:
   1. Trench dewatering and drainage, including pumping and well points, when needed, shall be included as part of trench excavation.

2. Upon entering the premises, the Contractor shall assume responsibility for site surface and subsurface drainage and shall maintain such drainage in an acceptable manner during the life of the Contract.
3. The Contractor shall provide, maintain and operate pumps and related equipment, including stand by equipment, of sufficient capacity to keep all excavation and trenches free of all water at all times and under any and all contingencies that may arise until all foundations, structures, and pipe installations have been completed and backfilled, and are safe from damage, flotation, settlement, or displacement.
4. The Contractor shall supply all supervision, labor, material and equipment necessary to build and maintain all drains, ditching, sluiceways, pumping, bailing, wicking, sumps, wells, well points, cut off trenches, curtains, sheeting, and other appurtenances and structures required to obtain and maintain a dry excavation and as may be necessary to construct the project.
5. The Contractor shall perform all work necessary to keep excavations and areas to be filled free of all groundwaters, surface waters, all supply water, and all wastewater.

G. Temporary Plating Over Trenches:
1. To maintain traffic and safety, steel plates shall be used as directed to temporarily bridge trench excavations at no cost to the DC WASA.
   a. Plates shall be of size and positioned to provide adequate bearing at plate edges, shall be securely anchored, and shall be fitted in place in a manner to minimize noise when crossed by traffic.
   b. Plates shall be of sufficient thickness to safely carry heavy traffic without detrimental deflection; however, unless otherwise specified, the minimum thickness of plates shall be one inch.
   c. Plate edges exposed to traffic shall be feathered with asphalt mix as part of trench excavation work.
   d. Work includes surveillance and adjustment of plating over trenches which shall be provided by the Contractor during non-work hours, weekends, and holidays.
   e. Plating and asphalt around plates shall be removed when directed.

3.3 TRENCH BACKFILL

A. General:
1. When pipes, connections and bedding are complete and approved, trenches shall be backfilled using excavated materials meeting backfill requirements and as shown on applicable Standard Detail(s).
2. All soil materials removed from trench excavations that fall within the Unified Soil Classification System type ML, CL, OL, MH, CH, OH, PT, as well as material containing organic matter, ashes, cinders, refuse, frozen or other unsuitable materials are prohibited for use as backfill and shall be removed from the site.
3. When the required quantity of trench backfill exceeds quantity of approved on-site material, borrow trench fill shall be used. Borrow soils base shall be used in that portion of the trench projecting through soils base layer.

B. Density Requirements:

1. Standard Density requirements for soils, graded stone and recycled materials are defined as the Maximum Dry (Laboratory) Density obtained by AASHTO T180, Method D. The in-place or required density shall be determined per AASHTO T191, or nuclear methods AASHTO T238 and T239, and is expressed as a percentage of the Standard Density.
2. If the in-place density sample contains material larger than three-fourths (3/4) inch, the field density shall be adjusted for the material retained on the three-fourths (3/4)-inch sieve before direct comparison with the Standard Density.
3. The minimum in-place density for trench fill in road-bed areas shall be as specified in Table 02220-1.

TABLE 02220-1 DENSITY REQUIREMENTS

Description	Min. Density Required; % of Max. Dry Density
Trench Backfill, and Backfill for Pipe Sewers and Undercut Areas	93 percent for each layer up to six inches below roadway subgrade. 95 percent for top six inch layer below road-way subgrade.
Trench Backfill for D.I. Pipe Water Mains - Laying Condition Type 2A (See Standard Detail 34.61-1)	70 percent between trench bottom and 12 inches over top of pipe. 93 percent for each layer above the 12-inch layer over top of pipe, up to six inches below roadway subgrade. 95 percent for top six inch layer below roadway subgrade.
Trench Backfill for D.I. Pipe Water Mains - Laying Condition Type 3A (See Standard Detail W/10.02)	Uncompacted for four inch trench bottom layer. 70 percent between four inch uncompacted layer and 12 inches above top of pipe. 93 percent for each layer above the 12-inch layer over top of pipe, up to six inches below roadwaysubgrade.

	95 percent for top six inch layer below roadway subgrade.
Soils Base Course (New and Existing)	95 percent for Portland cement concrete roadway and sidewalk areas. 100 percent for bituminous concrete roadway areas.

C. Construction Requirements:
   1. Trench fill material shall be dumped outside the trench excavation and not end-dumped directly into trench.
      a. Fill shall be placed in uniform horizontal layers of not more than 12 inches loose depth and for full trench width. Any fill placed on frozen trench soils shall be removed at no DC WASA cost.
   2. Backfilling shall proceed without displacement of the grade and alignment of the pipeline and its appurtenances.
      a. Displacement of the pipeline and settlement of backfill shall be considered evidence of improper workmanship or inclusion of unsuitable backfill materials, or both, and will require regrading and realigning the pipeline and removing and recompacting settled material at no DC WASA cost.
      b. Puddling and jetting are prohibited.
   3. Each lift shall be compacted to density requirements herein before next lift is placed.
      a. In trenches outside of roadbed areas, all layers shall be compacted to at least 93 percent of standard density.
      b. The use of "Hydra-Hammer" for compact-ing backfill in trenches is not permitted.
      c. Compaction by hand will be required where necessary.
   4. All trench shoring and supports shall be so removed that trench cave-in and settlement are minimized and no voids remain.
      a. Voids caused and left by sheeting and shoring removal shall be backfilled with pervious fill or other approved material and compacted at no additional DC WASA cost.
      b. All material displaced by slides, settlement, and trench cave-in shall be removed and replaced with specified soils at no additional cost to the DC WASA.
   5. The Engineer may require trench backfilling over completed pipelines if traffic conditions warrant such action.
      a. Extra compensation will not be allowed for such trench backfilling.
   6. The Engineer reserves the right to limit the amount of pipe laid in advance of backfilling, but in no case shall these amounts exceed 100 feet for sewer work and 50 feet for water main work.

PART 4 MEASURE AND PAYMENT

4.1 TRENCH EXCAVATION AND BACKFILL

A. Unit of measure for Trench Excavation and Backfill will be the cubic yard. Space occupied by abandoned utilities will not be deducted except measure will exclude the external cross section area of any existing water main to be removed multiplied by its length.

B. Volumes will be computed from the following dimensions:
   1. Width:
      a. Width for payment at all sewer trench cross sections will be based on trench pay widths tabulated on Standard Details S/15.01, S/12.01 and S/12.02 as applicable.
      b. Width for payment at all water main trench cross sections will be based on trench pay widths on Standard Details W/10.01, W/10.02, or W/10.03, as applicable.
      c. Actual trench width more than one foot above top of pipe may exceed trench pay width if approved and at no additional cost to the DC WASA.
   2. Depth:
      a. Depth at any cross section will be based on mean depth from surface where trench excavation started to trench subgrade elevation.
   3. Length:
      a. Length will be based on the horizontal projection of the completed sewer or water main without deduction for manholes, valves, and fittings. Other types of sewer or water main structures will be deducted from length measure.

C. Payment for Trench Excavation and Backfill will be made at Contract unit price per cubic yard, which price and payment will include disposal of unsuitable excavated material, backfill and compaction with suitable excavated material as well as placement and compaction of Borrow Trench Fill, shoring, trench plating as needed, barricades, maintaining and supporting utilities and structures, and all labor, materials, tools, equipment and incidentals necessary to complete work specified. Payment also includes removal and disposal of existing water main sections as indicated.

D. Payment will not be made for sheeting and shoring left in place at the Contractor's option.

E. Payment for Abandon Isolated Manhole or Water Valve Casing, or Remove Fire Hydrant, isolated from trench excavation limits, will be made at Contract unit price per each, which price and payment will include excavation as needed, salvaging manhole frame and cover, backfill and compaction to approved grade, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

F. Payment for pipe bedding gravel for pipe sewers will be included in Section 02730. Payment for excavation for valve casings will be included in Section 02605. Payment for excavation for sewer manholes will be included in Section 02705. Payment for excavation for water service connections will be included in Section 02650.

4.2 TRENCH UNDERCUT EXCAVATION

A. When material at trench grade is unsuitable, trench bottom shall be undercut to depth, length and width as directed. Undercut volume shall be backfilled to trench grade with subgrade gravel compacted with a vibratory compactor, protected and maintained. Work includes any required additional shoring and disposal of excavated material.

4.3 MEASURE AND PAYMENT FOR TRENCH UNDERCUT EXCAVATION

A. Unit of measure for Trench Undercut Excavation will be the cubic yard, with volumes computed from volume of trench subgrade gravel to fill undercut.

B. Payment for Trench Undercut Excavation will be made at contract unit price per cubic yard of trench subgrade gravel complete in place, which price and payment will include labor, materials, tools, equipment, and incidentals needed to complete work specified, including excavation and shoring as needed, furnishing, hauling and compaction of gravel, and disposal of unsuitable materials.

4.4 BORROW TRENCH FILL

A. When trench excavation soils fail to meet requirements and when the quantity of approved trench excavation soils is insufficient, approved borrow trench backfill shall be used and payment made under Borrow Trench Fill.

B. Furnishing approved borrow soils to replace approved trench excavation soils that become unsuitable shall be at no DC WASA cost. Delivery tickets for each load of borrow material shipped to the project site shall have an inspection certification affixed at the source by the inspector. Any material delivered which has not been inspected prior to delivery may be rejected. The Contractor shall give prior notification of at least 12 hours as to source and quantity to be shipped, but acceptance of the material from any location shall not be construed as approval of the entire location, but only insofar as the material continues to meet specifications.

C. Material may be rejected on visual examination pending tests of representative samples.

D. Work includes Borrow Soils Base to the same depth as, and to replace, soils base removed during trench excavation.

4.5 MEASURE AND PAYMENT FOR BORROW TRENCH FILL

A. Unit of measure for Borrow Trench Fill will be the cubic yard, with volumes computed by the average end area method; however, the Engineer may substitute other methods to determine the exact quantity. Measurement shall be limited to the trench pay width although trench width beyond these limits may be required to properly backfill the trench as excavated. Maximum depth measure shall be limited to distance between top of pipe bedding material and roadway elevation at bottom of asphalt patching material.

B. Payment for Borrow Trench Fill will be made at the Contract unit price per cubic yard for furnishing material as measured complete in place, which price and payment will include soils base layer and all labor, tools, materials, equipment and incidentals necessary for hauling and furnishing the material to the work site.

C. Placement and compaction of Borrow Trench Fill will be included in the cost of Trench Excavation and Backfill.

4.6 MEASURE AND PAYMENT FOR SAMPLING/TESTING

A. Work associated with the Sampling/Testing will not be measured separately for payment.

B. The cost of the Sampling/Testing, including incidental work and materials, will be included in the remaining lump-sum and Contract unit price item for Excavation and Backfill.

END OF SECTION 02220

DIVISION 2 - SITEWORK

SECTION 02705 - SEWER MANHOLES

PART 1 GENERAL

A. Scope:
   1. Work consists of excavation, backfill and compaction beyond trench pay limits, furnishing and placing manholes complete, either over existing or new sewers, including concrete base and manhole frames and covers. Manhole risers shall, in general, be constructed of precast concrete elements unless otherwise specified. Brick masonry may be used in lieu of precast riser units for conditions as approved by the Engineer.

B. Related Work Specified Elsewhere May Include But Is Not Limited To:
   1. Section 02220: Trench Excavation and Backfill
   2. Section 02730: Pipe Sewer

1.2 QUALITY ASSURANCE

A. Reference Codes and Specifications:
   1. ASTM A48: "Standard Specification for Gray Iron Castings".
   2. ASTM C32: "Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)".
   3. ASTM C443: "Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets".
   4. ASTM C478: "Standard Specification for Precast Reinforced Concrete Manhole Sections".
   5. Section 03100: Concrete Formwork.
   6. Section 03200: Reinforcing Steel.
   7. Section 03300: Cast-In-Place Concrete.
   8. Section 03400: Precast Concrete Products.

1.3 SUBMITTALS

A. GR. titled "Shop and Working Drawings" applies. Shop drawings shall be submitted for precast risers, cast-iron frames and covers.

PART 2 PRODUCTS

2.1 MATERIALS

A. Section 02705: Sewer Manholes - Manhole Bases

B. Section 03200: Reinforcing Steel.

C. Section 03300: Concrete
   1. Unless otherwise specified, manhole bases shall be precast or cast-in-place reinforced concrete, set on a minimum six-inch depth of compacted gravel on

undisturbed material. An acceptable steel ring form shall be used to form a groove for the tongue of the bottom precast riser section.

D. Inverts:
   1. Invert channels shall be formed of brickwork and/or Class 4000 concrete conforming to the adjoining pipe sizes. Invert sides shall be smooth curves with longest possible radius tangent to adjoining pipe centerlines. Depths of smaller pipes shall match 0.8 depth of the main pipe. A one-inch wash shall be provided from the inside edge of the manhole base to the edges of the shaped channels.

E. Precast Concrete Risers:
   1. Precast manhole risers shall be per ASTM C478 modified as follows:
   2. Basis of Acceptance - Development of concrete mix proportions shall be determined per subsection 03300.02 F. prior to production.
   3. Manufacture - Concrete shall contain a minimum of 564-lbs. cement per cubic yard per Table 03300-1.
   4. Risers shall be cast with joint groove to receive "O" ring compression seal.

F. Manhole Brick:
   1. Brick shall meet the physical requirements of ASTM C32, Grade MS for manholes and Grade SS for sewer invert surfaces, and shall be 2-1/4 x 3-3/4 x 8 inches in size.

G. Manhole Steps:
   1. Manhole steps shall be reinforced plastic steps composed of ASTM A615, Grade 60 reinforcing bar (#4) completely encapsulated in copolymer polypropylene per ASTM D2146, Type II, Grade 43758, as made by M. A. Industries, Inc., Peachtree City, Georgia:
   2. Model PS1-PF for new manholes for concrete bases and riser sections and replacement steps on existing manholes, where width of steps equals 12"; and Model PS1-B for brick masonry manholes.

H. Compression Seals:
   1. "0" ring compression seals for precast sewer manhole risers shall be per ASTM C443.

I. Manhole Entry Seals:
   1. Manhole pipe entry seals shall be equivalent to "Press Wedge II" gaskets manufactured by Press-Seal Gaskets Corp., Fort Wayne, Ind.; "A-Lok" gaskets manufactured by A-Lok Products Corp., Trenton, NJ; or "Kor-n-Seal", manufactured by National Pollution Control Systems, Inc., Nashua, N. H.

J. Mortar:
   1. Joint and parging mortar for manhole brickwork shall consist of one part Type II Portland cement and 2-1/4 parts fine aggregate per Section 03300 by volume and sufficient water to make a stiff mix. Lime in mortar is prohibited.

K. Manhole Frames and Covers:
   1. Gray iron castings shall be per ASTM A48, Class 30A. Iron castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blowholes and other defects.
   2. Castings shall be boldly filleted at the angles and the arrises shall be sharp and perfect.
   3. All castings shall be sandblasted or otherwise effectively cleaned of scale and sand so as to present a smooth, clean and uniform surface.
   4. Manhole frame and cover bearing surfaces between cover and frame shall be machine finished to ANSI roughness symbol 250, tolerance -0 + 1/16 inch.
   5. The word SEWER shall be cast in one-inch high letters flush with surface of cover.
   6. Manholes designated in Contract documents to be fitted with "lock type" frame and cover, ventilating or pressure type shall be furnished with heavy-duty cast-iron frames, 36-inch I.D. at bottom flange, and corresponding covers with a minimum of four counter-sunk bronze hexagonal-head cap screws and concealed pickholes.
   7. Ventilating type shall have a rubber gasket seal. Lock type frame and cover, Type R-1916-H as manufactured by Neenah Foundry Company, Neenah, Wisconsin or approved equivalent is acceptable.

PART 3 EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. Maintaining Sewer Service:
   1. Existing sewer service shall be maintained at all times. The Contractor shall conduct his operations so as to maintain flows in existing sewers through the project area. This will require proper coordination between construction replacement and abandonment so as not to block existing sewers that are to remain in service.
   2. When necessary to pump sewage while replacing and installing manholes, the material pumped shall be carried by means of approved hose or other closed, watertight conveyor to the downstream sewer or manhole designated by the Engineer. Sewage shall not be allowed to flow onto or over the street surface. Overtime, weekend, and holiday work may be required at no additional DC WASA cost to promptly complete temporary and/ or permanent sewer service.

B. Excavation/Backfill:
   1. Excavation for manholes over all sewers shall be extended as needed beyond trench limits, and the excavation shall be maintained and shored as necessary for proper construction. After the manhole is complete and concrete and parging have cured, the remaining excavation shall be backfilled per Section 02220; the portion of backfill beyond trench limits shall be included as part of Sewer Manhole work. For manholes over existing sewers, all excavation shall be included as part of Sewer Manhole work.

C. Concrete Manhole Sections:

1. Manhole bases shall be precast or cast-in-place reinforced concrete, set on firm foundation. Flow channels and benches shall be shaped with brick; or concrete may be used as needed, with brick facing.
2. Bases for new manholes shall be precast with base riser cast integral with base slab.
3. anhole steps shall be built into walls of manhole base as indicated on the Drawings, with step legs embedded 3-3/8 inches into the concrete.
4. Before press fitting steps into inserts or drilled holes, concrete must have attained 2,500-psi minimum field strength.
5. When constructing a new manhole over an existing sewer, the manhole base shall be constructed around the existing sewer before cutting the sewer. Precast concrete riser with doghouse openings cast in lower end shall be used as base riser and fitted over existing pipe, except over PVC pipe.
6. Riser and base sections shall have cast or augured cutouts of the required diameter for connections and outlet pipes; maximum size of cutouts shall be equal to the outside pipe diameter plus four-inches. A clearance of at least nine inches of concrete shall remain between adjacent connection and outlet pipe holes and between riser joints and holes in precast risers and bases.
7. Lesser clearance will be considered only if additional reinforcing steel is provided and details are submitted for approval.
8. For manholes on sanitary and combined flow sewer 24-inches and smaller diameter, the Contractor shall install a lubricated, rubber gasket entry seal into the manhole wall to effect a watertight connection between the connecting sewer pipe and the manhole.
9. Entry pipes shall be cut flush with the inside wall of the manhole.
10. Two-inch diameter lifting holes spaced 180 degrees apart are permitted provided PVC or rubber plugs are installed to make manhole watertight after installation.
11. Manhole risers shall be constructed of precast concrete elements where feasible, otherwise of brick masonry. Risers and cone tops shall be furnished with manhole steps 12 inches on center.
12. After the precast concrete riser joints have been joined, the annular joint space remaining on the inside and outside of the precast concrete riser joints shall be filled with mortar and the inside joint trowelled smooth.
13. Manhole steps shall be aligned on vertical section of sidewall having no pipe entry, with step legs embedded 3-3/8 inches into the concrete.
14. Manholes shall have a precast slab or eccentric cone top with proper size access hole to accommodate the required frame and cover. Brick masonry shall be used to adjust the frame and cover to approved grade.
15. Not more than 18 inches of brick shall be used unless approved by the Engineer.

D. Brick Manhole Sections:
1. Manhole brickwork shall be plumb except for eccentric top section, true to line with level and accurately spaced courses, with each course breaking joint with the course below. Joints shall not be less than 3/8-inch nor more than 1/2 inch with a minimum of one header course to every six-stretcher courses. Each brick shall be placed with a full joint in a full bed of mortar, shoved up against adjacent brick so that the mortar rises between and completely fills vertical joint. Exterior surfaces of brick manholes shall be completely coated with a 1/2-inch mortar parging and

made watertight. Brick masonry walls shall be nine inches thick for standard manhole depth; when the manhole depth exceeds 15 feet brick wall thickness shall be increased to 13-inches below 15 feet elevation.

2. Brick masonry shall not be placed when ambient air temperature is below 40 deg. F when it appears probable that temperature below 40 deg. F will be encountered before mortar can set, unless adequate approved means are provided for protecting the work from freezing. Work shall be protected by heating and maintaining the temperature of the masonry materials at not less than 40 deg. F on both sides of the masonry for not less than 72 hours. Work with, or on, frozen materials is prohibited.
3. During hot weather, masonry shall be protected from direct rays of the sun. All finished work shall be covered and kept damp for a period of seven (7) days after placement.
4. Mortar shall be freshly mixed for prompt use; no mortar shall be used after setting or beyond one hour after the addition of water. Retempered mortar and freeze preventive chemical additives are prohibited. The mixing machine, batch size, and mixing time shall be approved by the Engineer. When hand mixing is done, mixing shall be accomplished in a clean, leakproof, nonporous mortar box constructed for the purpose.
5. Proper size manhole steps shall be aligned on section of sidewall that is vertical to frame and cover, with step legs embedded 7-3/8-inches into the brickwork.
6. The Contractor shall furnish manhole frames drilled with two 3/4-inch diameter holes, 180 degrees opposed in frame flange. With frame in proper position at required grade, corresponding holes shall be drilled with a minimum of two inches into the brick masonry upon which the frame sits. Steel dowels shall be inserted through these holes to prevent lateral movement of frames during backfill and paving operations.
7. Dowels shall be No. 5 rebars, three inches minimum length, or approved equivalent. A mortar bed shall be constructed around the frame flange.
8. Excavation shall be backfilled per Section 02220.

E. Combined Concrete/Brick Sections:
   1. Where approved by the Engineer, manholes may be constructed from a combination of precast sections, brick masonry, and cast-in-place reinforced concrete. At the point where the different materials join, a watertight joint shall be provided that leaves interior walls straight and smooth.

F. Field Cut Pipe Entry Openings:
   1. Field cuts in concrete sections of manholes shall be accomplished with proper tools. Unless otherwise approved, the outline of the proposed hole shall be clearly marked and shall be line drilled not more than five inches apart. The hole shall be made smooth to receive the pipe entry seal and the pipe. Pipe entry seals shall be used when connecting a proposed sanitary or combined sewer of 24-inches and smaller diameter to an existing manhole. Nonshrink mortar shall be used to fill void between entry seal and pipe. For storm sewer connections made in the field, the annular space around the connection pipe shall be filled with nonshrink mortar. Field cut entry holes will not be permitted in proposed manholes unless approved.
   2. When precast manhole bases are used for sanitary or combined sewer applications, an approved resilient entry seal shall be cast in the base during manufacture.

3. Pipe entry holes in brick sections of existing manholes shall be made by carefully removing sections of brickwork.

G. Replace Manhole Invert:
   1. Remove and replace invert in existing manhole to redirect sewage flow.

PART 4 MEASURE AND PAYMENT

4.1 MEASURE

A. Unit of measure for manholes on sewers 48-inches diameter or less will be the vertical linear foot, with measure taken from sewer outlet invert to top of frame for manholes over existing or new sewers.

B. Unit of measure for manholes on sewers larger than 48-inches diameter will be the vertical linear foot, with measure taken from sewer outlet invert to the top of frame. The unit of measure for the complete reinforced concrete base for manholes on sewers larger than 48-inches diameter will be each.

C. The unit of measure for replacing manhole invert will be each.

4.2 PAYMENT

A. Payment for Precast Sewer Manhole and Brick Sewer Manhole will be made at Contract unit price per vertical linear foot, which price and payment will include excavation, shoring and backfill beyond trench pay width for manholes over new sewers; excavation, shoring and backfill for manholes over existing sewers; furnishing and placing precast or cast-in-place reinforced concrete manhole base on all sewers 48-inches diameter or less, precast or brick manhole risers, precast reinforced concrete slab or eccentric cone top, brick masonry to adjust manhole frames and covers to correct grades; furnishing and placing manhole frames and covers, furnishing and placing manhole steps, maintaining sewer service, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

B. Payment for Complete Reinforced Concrete Base for sewer manholes on sewers larger than 48-inches diameter will be made at the Contract unit price per each, which price and payment will include excavation, shoring and backfill beyond trench pay width for manholes over new sewers; excavation, shoring and backfill for manholes over existing sewers; furnishing and placing reinforced concrete manhole base; furnishing and placing pipe that protrudes into the manhole base; furnishing and placing manhole steps; maintaining sewer service, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

C. Payment for Replace Manhole Invert will be made at the Contract unit price per each, which price and payment will include removal of existing invert, reshaping new invert, disposal of unusable materials, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

END OF SECTION 02705

DIVISION 2 - SITEWORK

SECTION 02720 - CATCH BASINS AND CONNECTING PIPE

PART 1 GENERAL

1.1 SCOPE:

A. Work consists of excavation and backfill, disposal of excess material, furnishing and constructing various types and sizes of reinforced concrete catch basins and connecting pipe to manholes complete as shown on Drawings or as directed.

B. Related Work Specified Elsewhere May Include But Is Not Limited To:
   1. Section 02705: Sewer Manholes.
   2. Section 02730: Pipe Sewer.

1.2 QUALITY ASSURANCE

A. Reference Codes and Specifications:
   1. ASTM A36: "Specification for Structural Steel".
   2. ASTM A48: "Standard Specification for Gray-Iron Castings".
   3. ASTM A123: "Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strip".
   4. ASTM C33: "Specification for Concrete Aggregates".
   5. ASTM C76: "Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe".
   6. ASTM C443: "Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets".
   7. ASTM C478: "Standard Specification for Precast Reinforced Concrete Manhole Sections".

1.3 SUBMITTALS

A. GR.-16 "Shop and Working Drawings" applies. Shop drawings shall be submitted for reinforcing steel layout, reinforced concrete pipe, water seal castings, catch basin tops and catch basin frames and covers.

PART 2 PRODUCTS

2.1 MATERIALS

A. Section 02730: Sewer Pipe

B. Section 03200: Reinforcing Steel.

C. Section 03300: Cast-In-Place Concrete.

D. Precast Basin Tops: ASTM C478 modified as follows:

1. Basis of Acceptance – Section 03300, Production Facility Test Data Proportioning subsection.
2. Manufacture - Concrete shall contain a minimum of 564-lbs. cement per cubic yard per Table 03300-1.

E. Joint Mortar:
1. Joint mortar for sewer pipe shall consist of one part Portland cement, 2-1/4 parts fine aggregate by volume, and sufficient water to make a stiff mix.

F. Water Seal Castings/Basin Frames and Covers:
1. Gray-iron castings for water seals and basin frames and covers shall be per ASTM A48, Class 30A.
2. Iron castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow-holes and other defects affecting their strength and value for the service intended.
3. Castings shall be boldly filleted at the angles, and the arrises shall be sharp and perfect.
4. All castings must be sandblasted or otherwise effectively cleaned of scale and sand so as to present a smooth, clean and uniform surface.
5. Basin manhole frame and cover bearing surfaces between cover and frame shall be machine finished to ANSI roughness symbol 250, tolerance -0 + 1/16-inch.
6. The word SEWER shall be cast in one-inch high letters flush with surface of cover.

G. Steel angles and channels shall be per ASTM A36 and galvanized per ASTM A123.

H. Foundation gravel shall be per ASTM C33.

PART 3 EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. Excavation for catch basins and connecting pipe shall include removal of all materials and objects of whatever nature encountered in excavation; disposal of excavated materials as specified; construction, maintenance and subsequent removal of any sheeting, shoring and bracing; dewatering and precautions, and work necessary to prevent damage to adjacent properties resulting from this excavation.

B. No excavated material shall be deposited at any time so as to endanger portions of the new or an adjacent structure, either by direct pressure or indirectly by overloading banks contiguous to the operation, or in any other manner. Material, if stockpiled, shall be stored so as not to interfere with the established sequence of construction. If the area within project limits is insufficient for stockpiling, the Contractor shall arrange for his own stockpiling area.

C. When the catch basin is to rest on an excavated surface other than rock, care shall be taken not to disturb the bottom of the excavation; final removal of foundation material to subgrade shall be accomplished after forms are set.

D. If the foundation becomes wet and spongy or otherwise unsatisfactory prior to placing concrete, the Contractor shall, at no additional cost to the DC WASA, remove the unsuitable material and replace it with ASTM C33, size No. 57 gravel to secure an adequate foundation.

E. In case of underground obstruction at planned locations, proposed basins or connecting pipe shall be relocated as directed. Excavations at obstructed locations shall be backfilled per Section 02220; payment for excavation and backfill at obstructed locations will be made per Section 02220.

F. Inlets may be either cast-in-place or precast; precast basins require advance approval. Outlet pipe shall project from the inlet sufficiently to permit junction with connection pipe, and shall be cut flush with inlet wall inside face; void between outlet pipe and wall shall be completely sealed on both sides of wall with non-shrink mortar.

G. If a catch basin is to connect to a combined system sewer, an approved water seal casting shall be installed in the basin wall, aligned on same centerline as outlet pipe, and be connected to the inlet connection pipe.

H. Trench excavation and backfill for basin connecting pipe per Section 02220 shall be included as part of work. If trench subgrade material is unsuitable, trench bottom shall be undercut.

I. All connecting pipe shall be included as part of work and shall be constructed per Standard Detail S/12.02. All connecting pipes shall be furnished with rubber gaskets and the required concrete cradle with saddle blocks and mortar joints. Construction shall be per Section 02730. Field leakage test is not required for storm drainpipe.

J. Concrete cradle shall be Class 3000. Concrete shall cure for at least four days prior to backfilling.

K. Where concrete pipe connects to existing clay pipe or to a water seal, a Class 3000 (minimum) concrete collar shall be constructed around the connection joint such that there is at least three inches collar thickness around the entire circumference of the joint. The collar shall overlap each side of joint by six-inches. Collar shall cure for at least four days prior to backfilling.

L. Connecting pipe trench shall be backfilled per Section 02220.

M. Basin tops shall be precast with cast-iron frames and covers as shown on Standard Details S/30.11 and S/30.12.

N. The basin top shall have four holes drilled or cast therein per Standard Details S/30.11, S/30.12 and S/30.13. Corresponding holes shall be drilled into the basin walls. Steel dowels shall be inserted through and into these holes and grouted to prevent lateral movement of top.

PART 4 MEASURE AND PAYMENT

4.1 MEASURE

A. Unit of measure for Catch Basins will be each.
   1. Unit of measure for Basin Connecting Pipe will be the linear foot measured from the inside face of catch basin or water seal to inside face of manhole, or to connection to existing connecting pipe.

B. PAYMENT
   1. Payment for Catch Basins will be made at Contract unit price per each, which payment will include water seal castings, frames and covers, excavation and backfill, and all labor, materials, tools, equipment and incidentals needed to complete work specified.
   2. Payment for 15-Inch and 18-Inch Basin Connecting Pipe will be made at Contract unit price per linear foot, which payment will include pipe excavation and backfill, saddle blocks and concrete cradle, concrete collars at connection to existing clay pipe, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

END OF SECTION 02720

DIVISION 2 - SITEWORK

SECTION 02730 - PIPE SEWER

PART 1 GENERAL

1.1 SCOPE:

A. Work consists of furnishing and placing reinforced concrete pipe and PVC pipe sewers, and all associated work for a complete operable pipe system.

B. Related Work Specified Elsewhere May Include But Is Not Limited To:
   1. Section 02220: Trench Excavation and Backfill.
   2. Section 02705: Sewer Manholes.
   3. Section 02732: Pipe Sewer TV Inspection.

1.2 QUALITY ASSURANCE

A. Reference Codes and Specifications:
   1. American Society for Testing and Materials:
      a. ASTM C33 - 97: "Concrete Aggregates".
      b. ASTM C76 - 98: "Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe".
      c. ASTM C443 - 98: "Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets".
      d. ASTM D3034 - 98: "Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings".
      e. ASTM D3212 - 96a: "Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals".
      f. ASTM F679 - 95: "Poly(Vinyl Chloride) (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings".
      g. ASTM F789 - : "Specification for Type PS-46 Polyvinylchloride, (PVC) Plastic Gravity Flow Sewer Pipe and Fittings."
      h. ASTM F794 - 97: "Poly(Vinyl Chloride) (PVC) Profiled Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

1.3 SUBMITTALS

A. GR.-16 "Shop and Working Drawings" applies. Shop drawings shall be submitted for pipe laying schedule, fittings, specials and bevel pipe.

PART 2 PRODUCTS

2.1 MATERIALS

A. Concrete Pipe:
   1. Reinforced concrete pipe shall be of Class 4000 concrete, Class III minimum, Wall B minimum for the diameter(s) specified in the Contract and per ASTM C76 modified as follows:

a. Basis of Acceptance - Development of concrete mix proportions shall be determined per subsection 03300,1.2,F. prior to production.
b. Manufacture - Concrete shall contain a minimum of 564-lbs. cement per cubic yard per Table 03300-1.
c. Concrete pipe shall be furnished with rubber gasket joints per ASTM C443. Joints shall pass 13 psi hydrostatic test performed by pipe manufacturer. The bevel or drop on bevel pipe shall not exceed the pipe wall thickness.

2. Except for closure sections and as otherwise specified, concrete pipe shall be furnished in minimum eight foot lengths in sizes 12-inch through 72-inch diameter and minimum six foot lengths in sizes larger than 72-inch diameter.
3. Branches and specials shall have standard reinforcement deflected to facilitate opening for the branch or special and shall be formed at time of pipe manufacture. Additional reinforcement shall be welded to longitudinal and circumferential steel where deflection or opening results in bar spacing in excess of one and one half times the wall thick-ness. Branches and specials design and fabrication shall be submitted for approval prior to manufacture.
4. Pipe 12-inch through 72-inch diameter will be accepted from a manufacturer's existing stock provided crushing strength tests meet ASTM C76 requirements. Crushing tests shall be performed under the supervision of a DC WASA inspector on the manufacturer's testing machine.
5. Pipe 78-inch diameter and larger will be accepted based on tests of quality of the concrete as placed in the pipe and by examination of the quality, amount, and accuracy of placement of the steel reinforcement per ASTM C76.
6. The DC WASA will monitor all pipe-manufacturing operations; the Contractor shall notify the Engineer sufficiently in advance of pipe manufacture to facilitate monitoring.

B. PVC Pipe:
1. Polyvinyl chloride (PVC) pipe and fittings shall be per ASTM D3034 SDR 35 for pipe up to 15-inch diameter, and ASTM F679 and wall thickness T-1 for pipe 18 thru 27-inch diameter. Unless otherwise approved, lengths of pipe sections shall not exceed 13 feet and lengths of Y-branches shall not exceed three feet. Saddle Y-branches shall not be used.
2. Joints for both the pipe and fittings shall be of the integral bell type with integral wall section per ASTM D3212. Solid cross section elastomeric gasket seal shall be per ASTM F477, factory assembled and securely locked or cemented in the socket.
3. All pipe and fittings furnished shall be accompanied by a certification, per ASTM D3034, which will be the basis of acceptance of the material. Pipe and fittings will be inspected upon delivery. Rejected pipe and fittings shall be removed by the Contractor.

C. Joint Mortar:
1. Joint mortar for sewer pipe shall consist of one part Type II Portland cement and 2-1/4 parts fine aggregate by volume thoroughly mixed dry, and sufficient water to make a stiff mix.

D. Pipe Bedding:

1. Pipe bedding for sewer pipe shall be per ASTM C33, Size No. 57.

PART 3 EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. General:
   1. Trench excavation shall be complete per Section 02220. If actual trench width below a horizontal plane 1'-0" above top of pipe exceeds the trench design width the pipe installation shall be contingent upon the Contractor's submission, and approval, of pipe design reevaluation.
   2. The Engineer reserves the right to limit the amount of pipe laid in advance of backfilling, but in no case shall the amount exceed 100 feet for sewer work. Trench excavation shall be completed at least 25 feet in advance of pipe laying, except that at the end of a work day or at the discontinuance of work, the pipe laying may be completed to within five feet of the end of the open trench.

B. Maintaining Sewer Service:
   1. Existing sewer service shall be maintained at all times. The Contractor shall conduct his operations so as to maintain flows in existing sewers draining through the project area. This will require the proper coordination between construction replacement and abandonment so as not to block the flow in existing sewers that are to remain in service.
   2. When necessary to pump sewage while replacing and installing relief sewers, the material pumped shall be carried by means of approved hose or other closed, watertight conveyors to the downstream sewer or manhole designated by the Engineer. Sewage shall not be allowed to flow into or over the street surfaces. Overtime, weekend, and holiday work may be required at no additional DC WASA cost to promptly complete temporary and/or permanent sewer service.

C. Pipe Bedding:
   1. Gravel bedding material shall be placed to full trench width and specified depth for proper pipe installation. For pipe of 48-inches and larger diameter, gravel bedding material shall be compacted with an approved vibratory compactor to the satisfaction of the Engineer.
   2. Pipe shall be accurately placed on bedding to line and grade and to uniform bearing throughout its length. After pipe sections have been jointed as specified, remaining bedding material shall be placed, leaving no voids, and compacted under and around sides of the pipe to specified limits; pipe alignment, grade and jointing shall not be disturbed.

D. Pipe Installation - Concrete Pipe:
   1. Pipe shall be accurately placed to line and grade and supported uniformly throughout its entire length by the pipe bedding material. Bell holes shall be carefully excavated to provide total pipe bearing in bedding material. An approved pipe-laying tee shall be used when placing pipe six feet or longer in laying length. A pipe hoist, crane, or other suitable device shall be used in laying all pipes greater than 18-inches diameter. No lifting holes of any sort will be permitted in pipe.

2. After the pipe is aligned for coupling, the groove or bell of the preceding pipe and the spigot of the pipe ready to be coupled shall be liberally coated with an approved type of lubricant. The spigot end, with the gasket placed in the groove and relubricated after placement, shall be entered into the bell of the pipe already installed, making sure that both pipes are properly aligned. The pipe shall be then forced "home" by the use of a wedge puller or other approved means. A wedge, if used, shall be placed at least three pipe lengths back from the pipe being jointed. Before the joint is fully home, the position of the gasket in the joint shall be determined by means of a suitable feeler gauge. If the gasket is found to be improperly positioned, the pipes shall be separated and the gasket repositioned if undamaged; damaged gaskets shall be replaced. Each section of pipe shall be laid in such a manner as to form a close, concentric joint with the adjoining section and to prevent sudden offsets in the flow line. The maximum allowable joint opening shall be three-fourths inch; any larger opening will be cause for rejection.
3. After the pipes have been joined, the annular joint space remaining on the inside and outside of the pipes shall be filled with mortar and the inside joint troweled smooth.
4. When laying straight sewer pipe to a curved line, opening of a pipe joint shall be limited to not more than three-fourths inch; beveled pipe shall be used in any case where it is necessary to exceed this limit, whether the drawings note this condition or not, at no additional cost to the DC WASA.
5. No sand, mud, mortar, concretes or other materials shall be allowed on the inside of the sewer. Upon completion, the sewer shall be left straight, clean, smooth, and acceptable in every respect. Concrete shall be allowed to set before backfilling or walking is allowed on the sewer, and care shall be taken not to disturb the pipe bedding and joints.
6. During suspension of the work at night or other times, a suitable stopper shall be placed in the last pipe section to prevent earth or other foreign matter from washing in.
7. After pipe units have been joined as specified, pipe bedding material shall be placed and compacted under and around the sides of the pipes to the full specified thickness and height, care being taken so that no voids exist and that the alignment and the grade of the pipes are not disturbed.

E. Pipe Installation - PVC Pipe:
1. PVC pipe shall be handled with care to avoid severe impact blows, abrasion damage, gouging and cutting by metal surfaces or rocks, and never handled with individual chain or single cable, even if padded. Exposure to sources of heat or hot objects such as heaters, boilers, steam lines, and engine exhaust shall be avoided. Gaskets shall be protected from excessive exposure to heat, direct sunlight, ozone, oil and grease. Handling techniques in cold weather require more care than during hot weather. Each pipe unit will be inspected for straightness and damage before being installed in the work.
    a. Defective pipe and fittings shall be removed and replaced with approved materials at no additional cost to the DC WASA.
2. Assembly of the gasket joint shall be performed as recommended by pipe manufacturer. All joint surfaces shall be cleaned immediately before joining; the

bell and beveled spigot shall be lubricated with an approved lubricant, then carefully pushed into place. A suitable device shall be used to force the pipe units together. Good alignment of the pipe is essential for ease of assembly. Align the spigot to the bell and insert the spigot into the bell until it contacts the gasket uniformly; do not swing spigot into bell. Generally, the spigot end of the pipe is marked by the manufacturer to indicate the proper depth of insertion. If undue resistance to insertion of the end is encountered or the reference mark does not position properly, disassemble the joint and check the position of the gasket. If it is twisted or pushed out of its seat, inspect components, repair or replace damaged items, clean components, and repeat the assembly steps. If gasket was not out of position, verify proper location of the reference mark. Relocate the reference mark if it is out of position.

3. To join field-cut pipe, the pipe end shall be prepared first; a square cut is required for proper assembly. The pipe can be easily cut with a hacksaw, handsaw, or a power handsaw with a steel blade or abrasive disc. The pipe shall be marked around its entire circumference prior to cutting to insure a square cut.
    a. Use a factory-finished beveled end as a guide for proper bevel angle, depth of bevel, plus the distance to the insertion reference mark. The end shall be beveled using a pipe beveling tool or a wood rasp to the correct taper. A portable sander or abrasive disc also may be used to bevel the pipe end. Round off any sharp edges on the leading edge of the bevel with a pocketknife or a file, then assemble as stated above.
4. Because concrete does not bond to PVC pipe or fittings, only PVC adapters shall be used to connect to the various other types of pipe. In addition, only PVC caps or plugs shall be used to bulkhead the ends.
5. Pipe bedding material shall be carefully placed in four separate courses per Standard Detail S/15.01.
    a. Material shall not be dropped directly on the pipe. After first course is placed to pipe grade, attention shall be given to carefully placing pipe and excavating for socket joints. Bedding gravel shall then be placed around pipe haunch in second course to provide correct alignment. Then, third course and finally fourth course shall be placed and consolidated to avoid pipe deflection.
    b. Compaction equipment shall not be used directly over pipe until sufficient backfill has been placed to insure that such equipment will not damage or disturb pipes, usually a minimum of 30-inches depth.

F. Leakage Tests:
    1. A leakage test shall be conducted on completed sections of all pipe sewer sections on the sanitary and combined sewer systems. Field leakage tests are not required for storm drainpipe.
    2. Air Test.
        a. Pipe sewer up to 42-inch diameter shall be tested with air under low pressure and will not be accepted by the DC WASA until the sewer retains the air for the specified time. Sewers over 42-inches diameter shall be air tested if approved test equipment is available per DC Water and Sewer Authority requirements. All tests shall be conducted in the presence of DC WASA representatives.

b. The Contractor shall have test equipment supplier furnish the Engineer certification that actual test equipment to be used has been calibrated and is accurate. Tests shall not commence until the certification has been accepted.
c. All equipment and materials required to perform pressure air testing of sewers and all expenses in connection with such tests, except for equipment specifically designated as being furnished by the DC WASA and DC WASA personnel engaged in the supervision of testing, shall be included as part of pipe sewer work.
d. Failure of leakage tests will require investigation and repair by the Contractor at no additional cost to the DC WASA.
e. The DC WASA will participate in one test and one retest, if required, of each specific section of sewer without charge to the Con-tractor. If additional retests are required, all costs of DC WASA personnel and equipment associated with the retesting will be deducted from the Contractor's final payment.
f. Before an air test is scheduled, all backfill shall be completed and trench-dewatering methods discontinued. Sewers to be tested, including manholes, shall be thoroughly cleaned, free from all debris and shall be inspected for any water leakage sufficient to constitute a noticeable trickle or flow. Such leakage shall be corrected and eliminated prior to beginning the air test. Leakage tests shall be scheduled with the Engineer at least 48 hours in advance.

3. Test Procedure:
   a. Test plugs shall be furnished and installed within the pipe at each manhole and shall be securely braced.
   b. If the pipe to be tested is expected to be below ground water table, a small diameter perforated vertical pipe shall be installed from the invert elevation of the sewer to the ground surface prior to backfilling, or a pipe probe inserted by a boring or driving into the backfill material adjacent to the invert elevation of the pipe, to determine the ground water level above the pipe invert immediately prior to air testing the sewer.
      1) All gauge pressures in the test shall be increased by the amount of this backpressure due to ground water submergence over the end of the probe.
      2) Air shall be added slowly to the portion of the pipe under test until the internal air pressure is raised to 4.0 psig. The air temperature shall be allowed to stabilize for at least two minutes with the pipe subjected to an internal pressure of 4.0 psig by adding only the amount of air required to maintain this pressure. After the two-minute period, the hose and compressor shall be disconnected completely from the pipe being tested to assure that no additional air is added.
      3) As a safety precaution, no one shall be allowed in manholes after the air pressure is increased in the sewer line. If the Engineer suspects that the test plug may be leaking, the pressure first shall be relieved before any adjustments are made to eliminate air leakage at the plug. The plug may be precoated with a soap solution to check the plug for leakage.
      4) If the internal pressure decreases, the time required for the pressure to drop from 3.5 to 2.5 psig shall be observed and recorded. This time interval shall be compared with Table 02730-1. Pipe which fails to

maintain the stipulated pressure for a period equal to or greater than the holding time shown in the table shall be deemed to have failed the low pressure air test. A sewer that fails to pass this test shall be repaired by the Contractor at no additional cost to the DC WASA. Following repairs, the sewer shall be retested per designated procedure.

5) The Engineer will prepare a report on the required form for each section of sewer tested. The report form shall be executed by the Contractor and submitted to the Engineer.

TABLE 02730-1

Minimum Air Test Holding Time in Minutes and Seconds
Required For Pressure Drop From 3.50 to 2.50 psig

Pipe Diameter, 10-Inch Thru 36-Inch

Length (Feet)	10"	12"	15"	18"	21"	24"	27"	30"	33"	36"
25	1:00	1:00	1:02	1:29	2:01	2:38	3:20	4:08	4:59	5:56
50	1:00	1:19	2:04	2:58	4:03	5:17	6:41	8:15	9:59	11:53
75	1:23	1:59	3:06	4:27	6:04	7:55	10:01	12:23	14:58	17:00
100	1:50	2:38	4:08	5:56	8:05	10:34	12:45	14:11	15:35	"
125	2:18	3:18	5:09	7:26	9:55	11:20	" "	" "		
150	2:45	3:58	6:11	8:30	" "	" "	" "			
175	3:13	4:37	7:05	" "	" "	" "	"			
200	3:40	5:17	" "	" "	" "	" "				
225	4:08	5:40	" "	" "	" "	" "				
250	4:35	" "	" "	" "	" "	"				
≥ 275	4:43	5:40	7:05	8:30	9:55	11:20	12:45	14:11	15:35	17:00

TABLE 02730-1 (Continued)

Pipe Diameter, 42-Inch Thru 108-Inch

Length (Feet)	42"	48"	54"	60"	66"	72"	78"	84"	90"	96"	108"
25	8:05	10:34	13:22	16:30	19:58	23:45	27:53	32:20	37:08	42:15	50:56
50	16:10	21:08	25:28	28:18	31:08	33:58	36:47	39:32	42:27	45:17	50:56
≥ 275	19:49	22:38	25:28	28:18	31:08	33:58	36:47	39:32	42:27	45:17	50:56

4. Hydrostatic Test.
   a. Sewers over 42-inches diameter and manholes shall be tested by the hydrostatic method if approved air test procedure is not available.

b. Leakage shall not exceed a rate of 100 gallons per inch diameter per 24 hours per mile of sewer.
c. All equipment and materials required to perform tests and all expenses in connection with such tests, except for DC WASA personnel engaged in the supervision of testing, shall be included as part of pipe sewer work.
d. Test Procedure:
    1) Where ground water is encountered in the trench during construction and the water level is expected to be over the top of the sewer pipe, the completed and connected pipe shall be tested for infiltration leakage by the exact measurement of the amount of water entering it after the pumping of ground water has been discontinued for at least three days.
    2) Where the ground water level is expected to be below the top of the pipe and where the slope of the pipe between adjacent manholes will permit, the sewer shall be subjected to an internal pressure by plugging the pipe lower end and then filling the sewer and manholes with clean water to a height of two feet above the top of the pipe. Upper end plugs may be needed as directed. Measurements will be made of the rate of leakage from the pipe by determining amount of water required to maintain the initial level of two feet above the top of pipe. The Contractor shall provide water for this test by making arrangements with the Engineer.
    3) Each manhole and appurtenance to the system shall be watertight within the foregoing leakage limit. Repairs to all defects responsible for leakage shall be by the Contractor at no additional cost to the DC WASA.

PART 4 MEASURE AND PAYMENT

4.1 MEASURE

A. Unit of measure will be the linear foot, with measure taken along the top of the pipe complete in place, measured to inside face of sewer manhole. If profiles are included in the Contract documents, they are approximate and any variation shall not be a basis of any claim for compensation above that provided by direct measure.

4.2 PAYMENT

A. Payment for Pipe Sewer will be made at Contract unit price per linear foot complete in place, which price and payment will include furnishing and placing required pipe, bedding, jointing, maintaining sewer service, leakage tests, and all labor, materials, tools, equipment and incidentals needed to complete work specified.

B. The complete reinforced concrete base for manholes on sewers larger than 48 inches diameter will be payable as pipe sewer; the horizontal centerline of the manhole will be the dividing point in deter-mining the length of each pipe size for payment.

END OF SECTION 02730

DIVISION 3 - CONCRETE

SECTION 03100 - CONCRETE FORMWORK

PART 1 GENERAL

1.1 SCOPE:

A. Furnish all labor, materials, equipment and incidentals required to provide formwork for all concrete structures as shown on the Drawings and as specified herein.

B. Related Work Specified Elsewhere May Include But Is Not Limited To:
   1. Section 03200: Reinforcing Steel.
   2. Section 03250: Concrete Accessories.
   3. Section 03300: Cast-In-Place Concrete.

1.2 QUALITY ASSURANCE

A. Reference Codes and Specifications:
   1. ACI 347R: "Guide to Formwork for Concrete".
   2. ACI Special Publication Number SP-4: "Formwork for Concrete".
   3. ACI 117: "Standard Specification for Tolerances for Concrete Construction and Materials".
   4. U. S. Commercial Standard CS-251.
   5. U. S. Product Standard PS-1.

B. General Design Criteria:
   1. Design formwork for vertical loads and lateral pressures per ACI 347R.
   2. Design formwork system, which is adequately braced and has adequate strength and stability to ensure, finished concrete within specified tolerances.
   3. When necessary to maintain specified tolerances, design camber into formwork to compensate for anticipated deflection and creep due to weight and pressure of fresh concrete.
   4. Chamfer exposed external corners 3/4-inch.
   5. Concrete formwork drawings and calculations shall be prepared by or under the direction of a Registered Professional Engineer (P.E.), and shall bear his/her P.E. Seal. Forms shall be designed in accordance with the criteria specified herein.

1.3 SUBMITTALS

A. GR.-16 entitled "Shop and Working Drawings" applies.

B. Submit the following:
   1. Working drawings showing details of form types including methods of form construction, erection and removal, design computations, and location of form joints and form ties.
   2. Certificates from manufacturers stating that materials meet specified requirements.
   3. Early form removal calculations in advance of any early form removal.

PART 2 PRODUCTS

2.1 MATERIALS

A. Wood Forms:
   1. All framing lumber stress-graded.
   2. Lumber in direct contact with concrete, dressed on at least the contact side, with dressed or tongue-and-groove edges; other lumber may be dressed or rough.

B. Plywood Forms:
   1. Grade marked.
   2. B-B Plyform, Exterior Class 1 and 2 and HDO High Density Concrete Form Plywood, Class 1 and 2 per U.S. Product Standard PS-1. Use at locations as specified.

C. Hardboard:
   1. Tempered, smooth one-side, not less than 3/16 inch thick per U.S. Commercial Standard CS-251.

D. Form Ties:
   1. Factory fabricated snap-off metal type of adequate design to minimize form deflection and preclude concrete spalling upon removal.
   2. Fabricated so that setback in the concrete is such that the portion of the tie remaining after snap-off and removal of the exterior portions is at least 1-1/2 inches back from the concrete surface.

E. Bond Breaker:
   1. Non-staining liquid product which imparts a waterproof film to prevent adhesion of concrete and will not leave a paint impeding coating on face of concrete.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:
   1. The insides of forms shall be thoroughly cleaned prior to concreting so they are free from dirt, debris, and any foreign material.
   2. Construct adequately braced formwork so that resulting concrete surfaces will conform to specified tolerances.
   3. Brace forms, falsework, and centering adequately to retain forms in position as shown on approved working drawings.
   4. Provide mortar-tight forms of approved materials, which conform to required shapes, lines, and dimensions and will produce a smooth surface without fins and projections.
   5. Where shown on Drawings or required by the Engineer because of lagging or form irregularity, line the inner form surfaces with hardboard. Fasten securely to the backing by flush driven galvanized or aluminum nails. Line areas less than four

feet wide with a single width piece of hardboard. Offset lining joints from those in the backing.

B. Field Quality Control:
   1. Construct concrete elements to meet allowable tolerances as specified under ACI 117.

C. Coating Forms:
   1. Coat forms with bond breaker prior to the placement of reinforcing steel.
   2. Do no allow excess coating materials to stand in puddles in the forms nor to come in contact with concrete against which fresh concrete is to be placed.
   3. Coat bolts and rods that are to be completely removed or that are to be free to move with bond breaker.

D. Embedded Items:
   1. For items to be embedded in concrete, clean free from oil or foreign matter that would weaken the bond of the concrete to these items.
   2. Install in the formwork requisite inserts, anchors, sleeves, and other items specified under other sections of these Specifications. Close ends of conduits, piping, and sleeves embedded in concrete with caps or plugs.
   3. Concrete pads, curbs, pedestals and similar means devised by the Contractor to support the forms will be subject to review by the Engineer.
   4. Before depositing concrete, check the location and support of items, which are to be wholly or partially embedded.

E. Openings and Recesses in Concrete:
   1. Provide openings and recesses in the concrete as may be required and furnished by other sections of these Specifications.

F. Joints:
   1. Make contraction, expansion, and construction joints in accordance with Section 03150 and as shown on the Drawings.
   2. Form keyways as shown.

G. Removal of Forms, Falsework and Centering:
   1. Maintain forms, falsework, and centering in place until the concrete has attained sufficient strength for the structural members to carry their own weight and any loads to which they will be subjected without deformation and without exceeding the permissible stresses.
   2. Forms and supports shall not be removed without Engineer approval; however, in all cases, such removal and imposing of loads on the new work shall be at Contractor risk.
   3. Concrete strength attained prior to form removal shall be determined from tests of cylinders, per Section 03300, cured adjacent to and under the same conditions as the placed concrete.
   4. Shores and falsework may be removed when such cylinders have been tested and show strength equal to or greater than 60 percent of the minimum 28 day field cylinder strength of the class of concrete being tested.

5. Except as specifically authorized, forms shall not be removed before the concrete has attained a strength of at least 30 percent of the 28 day field cylinder strength of the class of concrete affected, and not before reaching the following number of day-degrees (whichever is the longer period).

Forms For	Day-Degrees*
Beams and slabs including integrally poured walls	500
Walls, piers, footings, other elements	100

   a. *Day-degree: Total number of days times average daily air temperature at surface of concrete. For example, 5 days at a daily weighted average temperature of 60 deg. F, equal 300 day-degrees. On days when temperature at the surface of the concrete is below or drops below 40 deg. F, the number of day-degrees for that day shall be zero (0).
6. Do not alter the loading conditions on the concrete subsequent to the removal of forms if it results in exceeding the permissible stresses and deformation at the attained concrete strengths.
7. The removal portion of form ties shall be withdrawn from the concrete immediately after taking down the forms. The holes left by such ties shall be filled with grout from a grout gun and the surface shall be finished with a steel spatula or rubbed with sackcloth.
8. Care shall be taken in removing forms, wales, shoring, supports, and form ties to avoid spalling or marring the concrete. The required finish and such patching as may be necessary shall be started immediately after form removal.
9. Backfilling may begin immediately after the necessary patching and finish on the concrete has hardened sufficiently so marring will not result. Heavy equipment used in backfilling shall be used with discretion and at Contractor risk.

PART 4 MEASURE AND PAYMENT

Concrete formwork will not be measured separately for payment; the cost thereof shall be included in the unit price for concrete items of which it is a part.

END OF SECTION 03100

DIVISION 3 - CONCRETE

SECTION 03200 - REINFORCING STEEL

PART 1 GENERAL

1.1 SCOPE:

A. Furnish all labor, materials, equipment and incidentals required and install all reinforcing steel required for the reinforcement of concrete, as shown on the Drawings and as specified herein.

B. Related Work Specified Elsewhere May Include But Is Not Limited To:
   1. Section 03300: Cast-In-Place Concrete.

1.2 QUALITY ASSURANCE

A. Reference Codes and Specifications:
   1. American Concrete Institute: ACI 315, "Manual of Standard Practice for Detailing Reinforced Concrete Structures".
   2. American Concrete Institute: ACI 318, "Building Code Requirements for Reinforced Concrete".
   3. ASTM A82: "Specification for Cold-Drawn Steel Wire for Concrete Reinforcement".
   4. ASTM A185: "Specification for Welded Steel Wire Fabric for Concrete Reinforcement".
   5. ASTM A615: "Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement".
   6. CRSI: "Manual of Standard Practice for Reinforcing Concrete Construction".

1.3 SUBMITTALS

A. The Contractor shall submit to the Engineer for approval, in accordance with GR.-16 titled "Shop and Working Drawings", completely detailed placing drawings, bending details and schedules of all reinforcing steel required.

PART 2 PRODUCTS

2.1 MATERIALS

A. Unless otherwise specified or required, materials, bar supports, detailing, fabrication, workmanship, and erection shall conform to the requirements of the latest CRSI "Manual of Standard Practice".

B. Concrete reinforcement shall be deformed billet-steel bars per ASTM A615, Grade 60.

C. Rail-steel bars are prohibited.

D. Reinforcement shall be newly rolled in an approved mill and accurately fabricated to the dimensions indicated on the Drawings. Bars shall be tested per ASTM Specifications; the Contractor shall submit certified copies of tests with the reports certifying mill test results, physical and chemical requirements meet ASTM Specifications.

E. Wire fabric shall conform to ASTM A185.

F. Metal accessories for setting and fastening of reinforcement shall be furnished and installed per general requirements of the CRSI Manual of Standard Practice.

2.2 HANDLING MATERIALS

A. Reinforcement shall be shipped to the work with bars of the same size and shape fastened in bundles, with metal identification tags giving size and mark securely wired to bundle. The identification tags shall be labeled with the same designation as shown on submitted bar schedules and shop drawings.

B. All bars shall be stored off the ground and shall be protected from moisture and be kept free from dirt, oil, or other injurious contaminants.

2.3 CONSTRUCTION REQUIREMENTS

A. A projected schedule of reinforcement placing and concrete placement shall be prepared at the beginning of the project and updated bi-weekly. This schedule shall be subject to the approval of the Engineer.

B. No reinforcing bars shall be welded either during fabrication or erection without prior written approval from the Engineer.

C. Bar splices shall be used only where indicated on the Drawings, or approved by the Engineer. Requirements of ACI 315: "Manual of Standard Practice for Detailing Reinforced Concrete Structures" shall be followed.

D. Before being placed in position, reinforcement shall be thoroughly cleaned of loose mill and rust scale, dirt and other coatings, including ice, that reduce or destroy bond. Where there is delay in depositing concrete after reinforcement is in place, bars shall be reinspected by the Contractor and cleaned as needed for proper bond.

E. Reinforcement shall be accurately positioned as indicated on the Drawings, and secured against displacement by using zinc-coated annealed iron wire ties of not less than No. 16 gage, or suitable clips at intersections. When spacing is less than 12 inches, tie alternate intersections.

F. All accessories such as chairs, chair bars, and the like shall be furnished and installed in sufficient quantity to satisfactorily position all steel per ACI 315.

G. All slab reinforcing shall be supported on concrete cubes or wafers of the correct height. Wafers shall contain soft steel wires imbedded therein for fastening to

reinforcing. Wafers shall have a minimum compressive strength of 3500 psi and shall have been cured as specified for concrete. Masonry units will not be permitted for supporting steel in bottom mats or elsewhere. For supporting the top steel in slabs, the Contractor shall furnish extra steel supports such as channels if required and shall construct blocks of concrete having the same quality as specified for the structure for use in supporting both top and bottom mat steel. Wood blocks, stones, brick chips, cinder blocks, concrete building blocks, etc., are prohibited.

1. Alternate methods for supporting top steel in slabs, such as vertical reinforcing fastened to bottom and top mats, may be used if approved by the Engineer.
2. Alternate methods of supporting bottom reinforcement for slabs and beams not exposed to the weather (such as plastic chairs, but not plastic-tipped bolsters) may be used only if specifically approved by the Engineer.

H. Reinforcement in walls shall be properly and firmly positioned from the forms at all points by means of stainless steel (tipped) bolsters or approved equivalent, subject to Engineer's approval.

I. The use of construction joints not indicated shall be only as specifically approved by the Engineer.

J. Reinforcement which is to be exposed for a considerable length of time after being placed shall be painted with a heavy coat of neat cement slurry, if directed.

K. In no case shall any reinforcing steel be covered with concrete until the amount and position of the reinforcement has been checked and approved by the Engineer. The Engineer shall be given ample prior notice of the availability of in-place reinforcement for checking.

L. Field bending of reinforcing steel is prohibited.

PART 3 MEASURE AND PAYMENT

Reinforcing Steel will not be measured separately for payment; the cost thereof shall be included in the unit price for concrete items of which it is a part.

END OF SECTION 03200

DIVISION 3 - CONCRETE

SECTION 03250 - CONCRETE ACCESSORIES

PART 1 GENERAL

1.1 SCOPE:

A. Furnish all materials, labor, tools, equipment and incidentals required to make all joints tight in the concrete, as detailed on the Drawings and as specified herein.

B. Related Work Specified Elsewhere May Include But Is Not Limited To:
1. Section 03200: Reinforcing Steel.
2. Section 03300: Cast-In-Place Concrete.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. AASHTO M282: "Joint Sealants, Hot-Poured, Elastomeric-Type, For Portland Cement Concrete Pavements".
2. ASTM Dl752: "Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers For Concrete Paving and Structural Construction".
3. U. S. Army Corps of Engineers Specification CRDC572: "Specification for PVC Water Stop".

1.3 SUBMITTALS

A. Shop Drawings:
1. GR.-16 titled Shop And Working Drawings applies. Submit specification sheets on the products including names, sources and descriptions.

B. Samples:
1. Submit samples of materials being used when requested by the Engineer.

1.4 MATERIALS

A. Water stops shall be of the highest-grade polyvinyl chloride per Corps of Engineers Specification CRD C572. Water stops shall be 9-inch dumbbell type for construction joints and dumbbell type with center bulb for expansion joints. Use of reclaimed PVC is prohibited.

B. Preformed expansion joint filler shall be per ASTM D1752, Type II or III. Premolded joint filler shall be of suitable length to minimize splices and of proper width to eliminate field cutting longitudinally.

C. Joint sealant for joints in slabs and walls shall be per AASHTO M282. Bond breaker shall be a suitable polyethylene tape of correct width to suit joint conditions. The sealant manufacturer shall submit written certification that the sealant is resistant to acid (down to a pH of 3.5) and alkali (up to a pH of 8.5).

PART 2 EXECUTION

2.1 CONSTRUCTION REQUIREMENTS

A. Footings, beams and slabs shall have no horizontal joints.

B. Construction joints shall be placed and secured perpendicular to the face of the concrete section.

C. Defective joints and defective and improperly placed sealers and sealants shall be removed and reconstructed at Contractor expense.

D. Water Stops:
   1. Water stops for all joints, as indicated on the Drawings, shall be placed without bends but shall be continuous around all corners and intersections. Splices shall be made by welding per manufacturer's recommendations, subject to Engineer's approval.
   2. Make provisions to support and protect water-stops during the progress of the work. Fabricate field joints in waterstops per manufacturer's printed instructions. Protect waterstop material from damage where it protrudes from any joints.
   3. A sufficient number of ties shall be placed, as directed, to insure that waterstops will remain in the required position during concrete placement.

E. Preformed Expansion Joint Filler:
   1. Expansion joint filler shall be furnished in the longest practicable lengths, but shall not be furnished or stored in rolls. Laitance shall be removed and joint faces acceptably cleaned before placing preformed joint material.
   2. Joint filler shall be fastened to the inside of the bulkhead form with noncorrodible fasteners to secure a mechanical bond with concrete placed on both sides of the filler. Material shall be so placed that exposed edge is within 1/8 inch for a 1/4 inch joint, in order that filler material edge can be lightly ground to provide uniform sealant depth.
   3. Care shall be taken at all times to prevent any disturbance of or damage to the joint filler.
   4. Field splices shall be made per manufacturer's recommendations for total contact fit.

F. Joint Sealant:
   1. Before sealing joint edges with sealants, all mortar, surface coatings, form coating, moisture, spalls, protrusions, dust, oil, grease, and frost shall be removed as approved by the Engineer by use of grinding, sandblasting, mechanical abrading, acid washing, or a combination of these methods to provide a clean, sound base for sealant adhesion. Heat shall be applied to dry out joints where required. Loose particles present or resulting from grinding, abrading or blast cleaning shall be removed by blowing out joints with oil-free compressed air prior to application of primer or sealant. Where concrete has spalled or broken, an epoxy grout shall be used to repair the concrete to give a uniform width of joint. The epoxy shall be Engineer approved and shall be applied as directed by the manufacturer.

2. No sealant shall be placed until at least 28 days after the concrete is placed. Polyethylene bond breaker tape of correct width and length shall be placed over the joint edge.
3. Sealant shall be applied by experienced applicators in strict accordance with manufacturer's recommendations. Joint sealer shall be applied when the ambient temperature is between 60 degrees and 80 degrees F.
4. All concrete joint faces to be sealed shall be primed with a primer recommended by the sealant manufacturer. The primer shall dry for the length of time recommended by the sealant manufacturer before applying the sealant. The sealant shall be placed before the primer has dried out, so that it will provide the proper bond. If the primer dries out, another prime coat shall be applied before placing the sealant.
5. Sealant shall be installed within the time limit specified. All material not used after this time shall be discarded.
6. The application, tooling and finishing of the sealant shall be as recommended by the manufacturer. Sealant surfaces shall be smooth and even.
7. Adjacent surfaces shall be cleaned free of sealant or soiling as the work progresses. Use solvent or cleaning agent as recommended by the sealant manufacturer. All finish work shall be left in neat, clean condition.

PART 3 MEASURE AND PAYMENT

Concrete accessories will not be measured separately for payment; the cost thereof shall be included in the Contract price for concrete items of which it is a part.

END OF SECTION 03250

DIVISION 3 - CONCRETE

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SCOPE:

A. Furnish all labor, materials, tools, equipment and incidentals required to place concrete, forms, joints including water-stops, and miscellaneous related items including inserts, manhole steps and embedded items, and concrete finishing.

1.2 QUALITY ASSURANCE

A. Concrete:
   1. Portland cement, fine aggregate, coarse aggregate, water and admixtures as specified and shall be ready-mixed (transit-mixed) concrete produced per ASTM C94 and as specified herein. All constituents, including admixtures, shall be batched at a central batch plant, except as further specified herein.

B. Reinforced Concrete:
   1. Per ACI 301 and as specified herein.

C. Laboratory Tests:
   1. Samples of constituents and of concrete as placed shall be subjected to laboratory tests. All materials incorporated in the work shall conform to approved samples.

D. Minor Deviation Allowance:
   1. Under special circumstances, the Engineer may allow minor deviations from the material requirements specified, provided the resulting concrete quality is not adversely affected or provided a suitable adjustment in cement content is made to compensate for such deviations without additional cost to the DC WASA. Any deviation or adjustment shall be made only after tests are made on trial mixes using new materials and approved by the Engineer.

E. Reference Codes and Specifications:
   1. American Association of State Highway and Transportation Officials:
      a. AASHTO M6: "Fine Aggregate for Portland Cement Concrete".
      b. AASHTO M80: "Coarse Aggregate for Portland Cement Concrete".
      c. AASHTO M240: "Blended Hydraulic Cements".
      d. AASHTO M295: "Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete".
      e. AASHTO T11: "Standard Method of Test for Amount of Material Finer than O.O75mm Sieve in Aggregate".
      f. AASHTO T21: "Standard Method of Test for Organic Impurities in Sands for Concrete".
      g. AASHTO T26: "Standard Method of Test for Quality of Water to be Used in Concrete".

h. AASHTO T27: "Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates".
i. AASHTO T104: "Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate".

2. American Concrete Institute:
   a. ACI 211.1: "Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete".
   b. ACI 214: "Recommended Practice for Evaluation of Compression Test Results of Concrete".
   c. ACI 301: "Specifications for Structural Concrete in Buildings".
   d. ACI 304: "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete".
   e. ACI 305: "Recommended Practice for Hot Weather Concreting".
   f. ACI 306: "Recommended Practice for Cold Weather Concreting".
   g. ACI 308: "Recommended Practice for Curing Concrete".
   h. ACI 309R: "Guide to Consolidation of Concrete".
   i. ACI 347R: "Guide to Formwork for Concrete".
   j. ACI Committee 304 Report: "Placing Concrete by Pumping Method".
3. American Society for Testing and Material:
   a. ASTM C31: "Method of Making and Curing Concrete Test Specimens in the Field".
   b. ASTM C33: "Specification for Concrete Aggregates".
   c. ASTM C39: "Test Method for Compressive Strength Cylindrical Concrete Specimens".
   d. ASTM C40: "Test Method for Organic Impurities in Sands in Concrete".
      1) ASTM C42: "Methods of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete".
      2) ASTM C94: "Specification for Ready-Mixed Concrete".
      3) ASTM C138: "Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete."
      4) ASTM C143: "Test Method for Slump of Portland Cement Concrete."
      5) ASTM C150: "Specification for Portland Cement."
      6) ASTM C171: "Specification for Sheet Materials for Curing Concrete."
      7) ASTM C172: "Method of Sampling Freshly Mixed Concrete."
      8) ASTM C173: "Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method."
      9) ASTM C192: "Method of Making and Curing Concrete Test Specimens in the Laboratory."
      10) ASTM C227: "Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)".
      11) ASTM C231: "Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method."
      12) ASTM C260: "Specification for Air-Entraining Admixtures for Concrete."
      13) ASTM C289: "Test Method for Potential Reactivity of Aggregates (Chemical Method)".
      14) ASTM C295: "Recommended Practice for Petrographic Examination of Aggregates for Concrete".

15) ASTM C309: "Specification for Liquid Membrane - Forming Compounds for Curing Concrete".
16) ASTM C311: "Method for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete".
17) ASTM C470: "Specification for Molds for Forming Concrete Test Cylinders Vertically".
18) ASTM C494: "Specification for Chemical Admixtures for Concrete".
19) ASTM C586: "Potential Alkali Reactivity of Carbonate rocks for Concrete Aggregates (Rock Cylinder Method)".
20) ASTM E329: "Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction".
21) ASTM Committee C9: "Manual of Aggregate and Concrete Testing".

F. Pre-Production Selection of Proportions:
1. Prior to production of concrete for the Contract, development of approved mix proportions to produce concrete conforming to these specifications shall be determined either by means of laboratory tested trial mixes or by use of appropriate production facility test records.
   a. Trial Mix Proportioning - When a concrete production facility does not have adequate field strength test records, concrete proportions shall be established based on trial mixtures meeting the following restrictions.
      1) Trial mixes and tests shall be made by an independent testing laboratory, per ANSI/ASTM E329, experienced in design and testing concrete materials and mixes; the laboratory shall be retained by the Contractor as part of Contract concrete requirements.
      2) The Contractor shall submit a report describing proposed concrete testing laboratory, giving qualifications of personnel, laboratory facilities and equipment, evidence of compliance with ANSI/ASTM E329, name and phone number of lab supervisor, and other information as may be requested.
      3) Selection of the testing laboratory is subject to DC WASA approval.
   b. Combination of materials and source shall be those proposed for use in the Contract.
   c. Trial mixtures having proportions and consistencies suitable for proposed work shall be made using at least three different water-cement ratios that will produce a range of strengths for each class of concrete required, encompassing those required for the Contract.
   d. For each Class concrete and each size aggregate required:
      Mix designed with water reducer.
      1) Mix designed with reducer-retarder.
      2) Mix designed per 1) and 2) where required in Contract for use as pumped concrete, per ACI Committee 304 report "Placing Concrete by Pumping Method".
   e. Trial mixtures shall be designed to produce a slump within one inch of maximum permitted, and within 0.5 percent of maximum allowable air content. These tolerances apply to trial mixtures only.

f. For each proposed mixture, at least three compressive test cylinders for each age shall be made and cured per ASTM C192. Each change of water-cement ratio shall be considered a new mixture. The cylinders shall be tested for strength per ASTM C39 at 28 days or at a specified earlier or later age.

g. From the results of these cylinder tests, a curve shall be plotted showing the relationship between 28-day compressive strength and the water-cement ratio.

h. From this curve, the water-cement ratio for the concrete to be used in the proposed work shall be selected to meet requirements of, and produce the average compressive strength, f'_{cr}, required by Table 03300-1. The cement content and mixture proportions to be used shall be such that the selected water-cement ratio is not exceeded when slump is the maximum permitted.

TABLE 03300-1

Class (f'_c) (1)	Min. Cement (lbs./ cu.yd.)	Coarse Aggregate Grading (2)	Max. Water (gal./94 lbs. cement) (3)	Air (% by vol.)	Req. Avg. 28 Day Lab Test Cyl. Str.f'_{cr} (psi) (4)
4000	564	#67 or 57	5	6.0+1.0	5200
	517	#467	5.0+1.0		
3500	564	#67 or 57	5-1/2	6.0+1.0	4700
	517	#467	5.0+1.0		
3000	564	#67 or 57	5-1/2	6.0+1.0	4200
	517	#467	6	5.0+1.0	

i. Notes:

1) Mixes may be designed containing fly ash pozzolan by decreasing the amount of cement and water. Fly ash may be substituted for cement such that not more than 15 percent by weight of cement is removed; the water-cement ratio for Class 4000 shall not exceed 0.44 by weight. Fly ash shall be additive in computing the water-cement ratio. The Contractor shall submit to the Engineer for approval the laboratory design mix including 72 hour, 7 day, and 28 day strength test results along with the same data for the Table 03300-1 concrete which fly ash concrete is intended to replace.

2) The Contractor may use either Grading Size #57, #67, or #467 grading coarse aggregate as available and as space within forms and pumping requirements will permit.

3) Maximum; decrease if possible. This represents total water placed in mix at time of mixing, including free unabsorbed water in aggregates and water in admixture solution.

4) Slump = four inches maximum.

2. Production Facility Test Data Proportioning - Concrete proportions may be established on the basis of a production facility's field strength test records.

a. Where a concrete production facility has adequate test records, based on at least 30 consecutive strength tests or two groups of tests totaling at least 30

within the past 12 months, the standard deviation shall be calculated; the required average compressive strength, f'_{cr}, calculated; and mixture proportions selected that will produce an average 28 day compressive strength at least equal to the calculated f'_{cr}.

b. Documentation shall be submitted to the Engineer. If documentation is considered inadequate, the Trial Mix Proportioning method shall be used.
   1) Test records from which a standard deviation is calculated shall:
      a) Represent materials and materials source, quality control procedures and conditions similar to those expected for the Contract. Changes in materials and proportions within the test records shall not have been more restricted than those for proposed work.
      b) Represent concrete produced to meet a specified strength or strengths f'_c within 1000 psi of that specified for proposed work.
      c) Consist of test cylinder concrete proportions meeting cement, aggregate, water and air content requirements of Table 03300-1.
      d) Consist of tests made by an independent testing laboratory per ANSI/ASTM E329 experienced in design and testing concrete materials and mixes. The laboratory report of tests shall include information per subsection 03300.03 A.
      e) Consist of at least 30 consecutive tests or two groups of consecutive tests totaling at least 30 strength tests.
   2) The standard deviation (psi) shall be determined per ACI 301, subchapter 3.9.1.1(c), using Subsection 2.a. herein test records.
   3) Required average compressive strength, f'_{cr}, used as the basis for selection of concrete proportions shall be the larger of the following two equations using the standard deviation calculated per subsection 2.b. above:

$$f'_{cr} \geq f'_c + 1.34s$$

or

$$f'_{cr} \geq f'_c + 2.33s - 500$$

where:

f'_c = specified compressive strength of concrete, psi

f'_{cr} = required average compressive strength of concrete, psi

s = standard deviation, psi

   4) Documentation that proposed concrete proportions will produce an average strength equal to or greater than the required average strength, f'_{cr}, per formulas above, shall consist of the strength test record, or several strength test records, from existing field tests that also meet Table 03300-1 requirements for cement, aggregate grading, water and air content. Required concrete proportions may be established by interpolation between the strengths and proportions of two or more test records, each of which meets other requirements of this Section.

1.3 SUBMITTALS

A. Each concrete mix design laboratory report submitted for approval shall include the following:

1. Name and Location of the applicable D C WASA's Project and the Contract Invitation Number.
2. Name and Address of Contractor.
3. Name and Address of Concrete Producer.
4. Class (es) of Concrete.
5. Sources of Concrete Materials, Name and Location:
    a. Cement.
    b. Fine aggregate.
    c. Coarse aggregate.
    d. Water.
    e. Admixtures.
6. Concrete Mix Design:
    a. Type of cement and cement content (#/c.y.).
    b. Type/gradation of fine aggregate and S.S.D. weight (#/c.y.).
    c. Type/gradation of coarse aggregate and S.S.D. weight (#/c.y.).
    d. Water content including free moisture in aggregate (#/c.y. or gals./c.y.).
    e. Admixture type and dosage (oz./c.y.).
    f. Water-cement ratio for each mix design.
    g. Slump of plastic concrete (in.).
    h. Air content of plastic concrete (% by vol.).
    i. Concrete temperature when placed in molds.
    j. Unit weight of plastic concrete (#/c.f.).
    k. Compressive strength tests:
        1) Date of test(s).
        2) 3-day strength (psi).
        3) 7-day strength (psi).
        4) 28-day strength (psi).
7. Concrete Materials Tests:
    a. Sieve analysis, fine and coarse aggregate.
    b. Bulk specific gravity (dry and S.S.D.), fine and coarse aggregate.
    c. Absorption, fine and coarse aggregate.
    d. Soundness, fine and coarse aggregate.
    e. Fineness modulus (FM), fines aggregate.
    f. Organic impurities, fine and coarse aggregate.
    g. Dry rodded unit weight (#/c.f.), coarse aggregate.
    h. Abrasion resistance, coarse aggregate.
    i. Alkali reactivity, fine and coarse aggregate.
    j. Deleterious substances, fine and coarse aggregate.
    k. Mill tests, Portland cement.
8. Concrete Materials Certification:
    a. Cement.
    b. Admixtures.
    c. Aggregates.
    d. Pozzolan.
9. Laboratory reports for concrete mix designs:
    a. include all information required in Subsection A;

b. certified by an authorized laboratory member and must be original reports bearing actual signature of authorized lab member; copies are not acceptable; and
c. include certification date, and shall be sent by certified mail directly to the Engineer from the laboratory.
d. Lab reports submitted in any other manner, or with any evidence of lab report tampering, will be rejected.

B. The Contractor and concrete supplier shall each submit certification that materials for the Contract are from the same source as trial mix tested materials.

C. The Contractor shall submit, for the Engineer's approval, proposed methods for controlling concrete temperature.

D. Ready mixed concrete production facilities shall be certified by the National Ready Mixed Concrete Association. A copy of the "Certificate of Conformance for Concrete Production Facilities" shall be submitted to the Engineer prior to batching any concrete materials. Equipment shall conform to the Standards of the Concrete Plant Manufacturer's Bureau and shall have a rating plate attached.

E. Truck mixers shall meet requirements of the Truck Mixer Manufacturers Bureau (TMMB). A standard rating plate shall be attached to each truck mixer stating the maximum capacity as a mixer and that mixer complies with TMMB standards.

PART 2 PRODUCTS

2.1 MATERIALS

A. Portland Cement:
1. Cement for all cast-in-place concrete shall be a domestic Portland cement of uniform high quality and uniform color, ASTM C150, Type II including Table 2A, free from injurious water soluble salts. Alkali content shall not exceed 0.6 percent by weight.
2. Cement brands shall be subject to approval of the Engineer.
3. Cement shall be subject to testing, with certified mill tests on each barge or carload or smaller lot from an approved laboratory at no cost to the DC WASA. Cement shall not be used when retrieved, reclaimed or injured by age or exposure. Cement in bags shall be stored 12 inches from walls and ground or in weather-tight bins or silos if in bulk. Cement shall be protected from dampness and foreign materials.

B. Pozzolan:
1. Pozzolan, except as modified below, shall conform to AASHTO M295, Class F.
2. The Loss on Ignition (L.O.I.) shall not exceed 4.0 percent and the Pozzolanic Index with lime shall govern.
3. For computation purposes, the water-cement ratio will be computed using the total quantity of cement plus fly ash.
4. Written certification is required that all pozzolan meets these specifications for physical and chemical requirements.

5. Pozzolan shall be produced from either mine-mouth plants or plants utilizing 95 percent of coal from a single source. The Contractor shall obtain written certification from the source that all pozzolan is Class F with no pozzolan made from sub-bituminous or lignite coal.
6. Blended portland cement and pozzolan shall conform to AASHTO M240 for Type IP (MS). A manufacturer's certification shall be furnished indicating the source, amount, and composition of the blended cement, and indicate that the material was tested during production or transfer in accordance with this specification, and a report of the test results shall be furnished at the time of shipment.
7. Fly ash shall be stored in the same manner as cement.

C. Fine Aggregate:
1. Fine aggregate for Portland cement concrete (other than lightweight aggregate) shall meet quality and grading requirements of AASHTO M6, as modified herein.
   a. To determine soundness, the weight loss shall not exceed 12 percent by weight when the fine aggregate is subjected to five cycles per the magnesium sulfate soundness test per AASHTO T1O4.
   b. To determine the degree of uniformity of the fine aggregate, fineness modulus (FM) determinations shall be made on representative samples from each source. Thereafter, if the fineness modulus varies by more than 0.20 from the value established on representative samples, the fine aggregate shall be rejected until suitable adjustments are made in the concrete proportions to compensate for the difference in grading. To determine alkali reactivity, fine aggregate shall be tested per ASTM C227 or C289.
2. The amount of deleterious substances also shall not exceed the following limits:

Property	Max. Limits % by Weight
Clay lumps	2.0
Other deleterious substances (such as shale, mica, coated grains, soft and flaky particles)	1.0

   a. Chert, metaquartzite or a combination of both shall not exceed eight percent by weight per ASTM C295. Further examination under other tests not required if content over eight percent.
   b. Alkali-silica reactive constituents shall not exceed 0.05 percent expansion at six months per ASTM C227, and will be acceptable only when classified as innocuous per Figure 2, ASTM C289.
   c. For alkali-carbonate reactive constituents, test specimen cylinders shall not exceed 0.08 percent expansion after 28 days immersion in a 1 N NaOH solution per ASTM C586.
3. Organic impurities shall produce a color not darker than Organic Plate No. 2 per AASHTO T21 or ASTM C40.
4. Fine aggregate shall be well graded from coarse to fine and when tested by means of laboratory sieves shall conform to the following requirements (per AASHTO M6 as modified for percent passing No. 16 sieve):

Sieve	% by Weight

Designation	Size	Passing
3/8-in.	9.50mm	100
No. 4	4.75mm	95-100
No. 16	1.18mm	45-85
No. 50	0.30mm	10-30
No. 100	0.15mm	2-10

In addition to AASHTO M6 sieves specified for grading, the No. 8 and No. 30 sieves may be used in determining the fineness modulus.

D. Coarse Aggregate:

1. Coarse aggregate for Portland cement concrete (other than lightweight aggregate) shall consist of trap rock from an approved quarry source, crushed air-cooled blast furnace slag, or other approved inert materials of similar characteristics, or a combination thereof as specified, and shall meet the quality requirements of AASHTO M80, and shall meet the Size Number requirements for grading specified.
   a. Crushed stone or graded aggregate supplied from a quarry producing aggregates of asbestos bearing content or having asbestos present at the quarry are prohibited. Should such aggregates be utilized, both the Contractor and stone supplier will be directed to remove all asbestos bearing aggregates and replace them with non asbestos bearing aggregates. The Contractor and supplier shall further be liable for any and all consequential damages, which may result as a violation of this requirement.
   b. The percentage of wear per the Los Angeles Abrasion Test shall not exceed 40. To determine soundness, the weight percentage of loss shall not exceed 15 percent by weight when the coarse aggregate is subjected to five cycles of the magnesium sulfate soundness test per AASHTO T104.
2. The amount of deleterious substances shall not exceed the following limits:

Property	Max. Limits % by weight
Soft fragments ……..	2.00
Clay lumps ……	0.25
Total material finer than No. 200 sieve	
Material containing clay or shale……...	1.00
Material free of clay or shale ……	1.50
Thin or elongated pieces (length greater than 5 times the smallest dimension of a circumscribing rectangular prism) …….	15.00
Sum of clay lumps, friable particles and chert (less than 2.40 Sp. Gr. SSD)……..	3.00
Other local deleterious substances ……	2.00

   a. Chert, metaquartzite or a combination of both shall not exceed three percent (3%) by weight per ASTM C295. Further examination under other tests not required if content over three percent (3%).

b. Alkali-silica reactive constituents shall not exceed 0.05 percent expansion at six months per ASTM C227, and will be acceptable only when classified as innocuous per Figure 2, ASTM C289.
c. For alkali-carbonate reactive constituents, test specimen cylinders shall not exceed 0.08 percent expansion after 28 days immersion in a 1 N NaOH solution per ASTM C586.

3. Organic impurities shall produce a color not darker than Organic Plate No. 1 per AASHTO T21 or ASTM C40.
4. After first dry sieving on the No. 200 sieve per AASHTO T27, the adherent coating on coarse aggregate as tested per AASHTO T11 shall not exceed one percent (1%) by weight.

E. Water:
1. Water shall be clean, fresh and free from injurious amounts of oils, acid, alkali, organic matter or other deleterious substances. River and stream water shall not be used.
2. When subjected to the mortar strength test described in AASHTO T26, the 28 day strength of mortar specimens made with the water under examination and normal Portland cement shall be at least 100 percent of the strength of similar specimens made with distilled water.
3. Potable tap water will normally fulfill the above requirements.

F. Admixtures:
1. All concrete, when placed at ambient air temperatures above 75 deg. F, shall have a water reducing and retarding admixture conforming to ASTM C494, Type D. When temperatures are below 75 deg. F, a water-reducing admixture shall be used conforming to ASTM C494, Type A. Proportioning and mixing shall be as recommended by the manufacturer.
2. Air-entrainment admixture shall conform to ASTM C260.
3. Admixtures causing accelerated setting of cement in concrete shall not be used.
4. Admixtures shall not contain sugar, calcium chloride or other chlorides. Admixtures shall be stored in a manner so as to prevent contamination, evaporation, or damage.

2.2 MEASURING/MIXING

A. Materials shall be measured to provide mixes matching the approved design mix (es).

B. Materials shall be measured per ASTM C94, Section 8 except as otherwise specified. The apparatus provided for weighing the aggregates and cement shall be suitably designed and constructed for this purpose. Scales shall have been certified by the local Sealer of Weights and Measures within one year of use. Each size of aggregate and the cement shall be weighed separately. The accuracy of all weighing devices shall be such that successive quantities of cement can be measured to within one percent of the desired amount, and aggregate to within two percent. Cement in standard packages (sacks) need not be weighed, but bulk cement and fractional packages shall be weighed.

C. Water shall be measured by volume or by weight. The water-measuring device shall be capable of control to one- percent accuracy. All measuring devices shall be subject to approval.
   1. All washwater shall be dumped before loading drum with concrete materials.
   2. No truck shall be loaded which contains freewater in drum unless washwater quantity is accurately determined beforehand and is accordingly subtracted from total water calculation for the mix.
   3. The batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregate, and all water shall be in the drum by the end of the first one-fourth of the specified mixing time.

D. Admixtures shall be dispensed either manually with the use of calibrated containers or measuring tanks, or by means of an approved automatic dispenser designed by the manufacturer of the specific admixture. Admixture dispenser shall be capable of control to 3.0 percent accuracy. Each admixture shall be added separately and with a different portion of the batch loading sequence.

E. Concrete shall be ready-mixed (transit-mixed per ASTM C94) as produced by equipment acceptable to the Engineer. Concrete shall be mixed at mixing speed for at least 70 and not more than 100 revolutions immediately after charging the drum, followed by agitation without interruption until discharged per ASTM C94. No hand mixing will be permitted. Adding water in controlled amounts during the mixing cycle shall be done only with the express approval of, and under the direction of, the Engineer, and then only if the maximum water-cement ratio is not exceeded.

F. Ready-mix (transit-mixed) concrete meeting approved design mix (es) shall be transported to the site in watertight agitator or mixer trucks loaded not in excess of rated capacities for the respective conditions as stated on the nameplate. It is important to dispatch trucks from the batching plant so that they arrive at the site of the work just before the concrete is required, thus avoiding excessive agitating of concrete while waiting, or delay in placing successive layers of concrete in the forms. Discharge at the site shall be within 1-1/2 hours after cement was first introduced into the mix; where ambient temperature is above 85 deg. F, concrete shall be discharged within one hour. Concrete not discharged within specified time shall be discarded and not used, and no payment will be made.

G. The retempering of concrete which has partially hardened will not be permitted. All concrete shall be discharged completely before drum is recharged.

H. Concrete delivered without a proper delivery ticket will be rejected. The delivery ticket shall show:
   1. Name and location of batch plant.
   2. Ticket number.
   3. Load number.
   4. Date and truck number.
   5. Destination (name and location of contract).
   6. Type and brand of cement.
   7. Concrete class and whether reducer-retarder in mix.

8. Actual quantities of all dry materials, including admixtures.
9. Water content (including free moisture in the aggregate plus water in the drum, exclusive of absorbed moisture in the aggregate) in gallons or pounds per cubic yard of concrete.
10. Volume of concrete (cubic yards).
11. Time mixer drum charged with cement.
12. For transit mixed concrete, the recording of revolution counter.
13. Space for initials of receiving party.

2.3 PRODUCTION CONCRETE FIELD TESTS

A. Conformity of production concrete and concrete materials of this Specification and the actual proportions of cement, aggregates, and water necessary to produce concrete conforming to requirements of Table 03300-1, will be determined by tests made with representative samples of the materials to be used in the work. Tests will be made by an approved laboratory using the following test procedures:
   1. Check of aggregates per ASTM C33.
   2. Cement and fly ash tests per ASTM C311.
   3. Concrete yield per ASTM C138.
   4. Air content per ASTM C231 when gravel or stone course aggregate are used and ASTM C173 when slag or other highly porous course aggregates are used.
   5. Slump per ASTM C143.
   6. Plastic concrete sampled per ASTM C172.
   7. Compression and flexure specimens made in the field and cured per ASTM C31.
   8. Compressive strength per ASTM C39.
   9. The Contractor shall furnish at his expense one slump cone per ASTM C143, all test cylinder molds per ASTM C470 and one air test set per ASTM C231.

B. Methods of testing shall conform to the appropriate specification; the place, time, frequency and method of sampling will be determined by the Engineer.

C. Samples of fine and coarse aggregates shall be furnished by the Contractor for examination and testing at least three weeks before the Contractor proposes to use them in the work and may be retested during the construction period at any time.

D. Initial sets of tests will be made by an approved laboratory at DC WASA expense.
   1. The cost of any retesting of materials and concrete tests (that are additional to requirements in subsection E. below) due to unacceptable materials or defective concrete shall be borne by the Contractor.

E. The following criteria establish the required minimum sampling/tests frequency for each class of concrete:
   1. Sets of at least three field control cylinder specimens will be taken at random by the Engineer for each strength test.
   2. Samples for strength tests of each class of concrete placed each day will be taken not less than once a day, nor less than once for each 150 cubic yards of concrete nor less than once for each 5,000 square feet of surface area for slabs or walls.
   3. On a given project, if total volume of concrete is such that frequency of testing required by E.2 above would provide less than five strength tests for a given class

of concrete, tests will be made from at least five randomly selected batches or from each batch if fewer than five batches are used.

4. Samples of portland cement and aggregates will be taken at random by the Engineer.
5. When total quantity of a given class of concrete for the project is less than 25 cubic yards, strength tests may be waived by the Engineer, if the Contractor provides written evidence of satisfactory materials, quantities and strength.
6. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days for determination of f'_c.

F. The Contractor shall cooperate during sampling and testing operations by affording free access to the work for selection of samples, providing heated, moist storage facilities for specimens, affording protection to specimens against injury or loss through his operations, and furnishing materials and labor required to assist the DC WASA in taking concrete materials and batch specimens.

G. Slump tests will be made in the field by the Engineer and/or testing laboratory personnel. A slump test will be made for each truck. Slump shall be measured at the point of delivery into forms. If slump exceeds the values shown in Table 03300-2, the required slump may be obtained by reducing the amount of water shown in the approved proportions. If slump is less than the desired value at first discharge from the mixing drum, water may be added one time only, but only up to the maximum water specified in Table 03300-1, with the approval of the Engineer, to increase the slump to within the specified limits; water shall be incorporated into the mix by further mixing equal to at least one-half the number of mix revolutions for normal mixing. Further addition of water is prohibited.

TABLE 03300-2

Portion of Structure	Max. Slump
Footings, caissons, substructure walls	3-in.
Slabs, beams, reinforced walls, columns	4-in.

H. Cylinders for concrete strength tests shall be molded per ASTM C31 and lab cured per ASTM C31, Section entitled "Curing Cylinders for Checking the Adequacy of Laboratory Mixture Proportions for Strength or as the Basis for Acceptance or for Quality Control". The Contractor shall cure specimens strictly per ASTM C31.

1. Strength level of an individual class of concrete shall be considered satisfactory if both of the following requirements are met:
   a. Average of all sets of three consecutive strength tests equal or exceed f'_c.
   b. No individual strength test (average of two cylinders) falls below f'_c by more than 500 psi.
2. If requirements of subsection H.l. are not met, steps shall be taken to increase the average of subsequent strength test results. If requirements of subsection H.l.b) are not met, the Engineer will determine whether the concrete already placed must

be tested further or be removed and replaced, or whether it can remain with the Contractor granting an appropriate credit to the DC WASA.

I. Field cured cylinder strength tests are required to check the adequacy of curing and protection of concrete in the structure(s).
   1. Field-cured cylinders shall be cured under field conditions per ASTM C31 section entitled "Curing Cylinders for Determining Form Removal Time or When a Structure May Be Put into Service". The Contractor shall cure specimens strictly per ASTM C31.
   2. Field-cured test cylinders shall be molded at the same time and from the same samples as lab-cured test cylinders.
   3. Procedures for protecting and curing concrete shall be improved when strength of field-cured cylinders at test age designated for determination of f'_c is less than 85 percent of that of companion lab-cured cylinders. The 85 percent may be waived if field-cured strength exceeds f'_c by more than 500 psi.

J. As sufficient data become available during construction, the amount by which value of f'_{cr} must exceed specified value of f'_c may be reduced, provided 30 or more test results from the Contract are available and the average of test results exceeds that required by Subsection 03300,1.2,F,2,b,3), using a standard deviation calculated per Subsection 03300,1.2,F,2,b,1) and 2).

K. Change of trial mix and additional tests shall be at Contractor's expense:
   1. If materials are unacceptable.
   2. If field test results are not approved.
   3. If Contractor desires to use materials source different from original approved samples source.

L. The Engineer will use the "Manual of Aggregate and Concrete Testing" of ASTM Committee C9 as a guide to concrete testing.

PART 3 EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. Inspection and Control:
   1. The preparation of forms, placing of reinforcing steel, conduits, pipes and sleeves, batching, mixing, transportation, placing and curing of concrete shall be at all times subject to the inspection of the Engineer.
   2. In the event a production mix design is not in full compliance with applicable specifications, further production of that mix shall be suspended until an approved mix design has been obtained per these specification requirements. Revised mix designs and additional tests required because of unacceptable materials or unapproved first test results shall be at Contractor's expense.
      a. If production concrete has a lower average strength or a higher coefficient of variation than required, mix design proportions will be adjusted by the Engineer at no additional cost to the DC WASA.
      b. When sources of materials change from those of the approved mix design or when the fineness modulus of the fine aggregate changes by more than 0.20

from the mix design, the mix design will be reviewed by the Engineer and may require a new design. New mix designs shall meet all requirements of this Section.

c. In the event concrete can not be obtained with the required workability and consistency and within the maximum water-cement ratio with the approved mix designs, necessary adjustments shall be made to secure the desired properties, subject to limiting requirements of this Section.

d. Mix design proportions will be adjusted by the Engineer when the concrete requirements are not achieved when batched within the following tolerances of any or all proportions:

Material	Tolerance, % by Weight of Mix Design
Cement	+ 4
Coarse Aggregate	± 2
Fine Aggregate	± 2
Water	± 1
Admixtures	± 3

3. No concrete shall be ordered or placed until all formwork, reinforcing steel, anchor bolts and other items to be incorporated in the concrete structure have been placed complete, inspected and approved.
4. The Contractor shall advise the Engineer of his readiness to proceed at least 20 hours prior to each concrete placement. The Engineer will inspect the preparations for concreting including the preparation of previously placed concrete, the reinforcing and the alignment and tightness of formwork.
5. The Engineer may have cores taken from any question-able area in the concrete work such as construction joints and other locations as required for determination of concrete and construction quality. The results of tests of such cores shall be the basis for acceptance, rejection or determining the continuation of concrete work.
6. The Contractor shall cooperate in the obtaining of cores by allowing free access to the work and permitting the use of ladders, scaffolding and such incidental equipment as may be required. The Contractor shall repair all core holes to the satisfaction of the Engineer at no additional cost to the DC WASA. Cutting and testing the cores will be at DC WASA expense unless work is found to be defective, then the Contractor shall assume all costs of obtaining the cores and patching core holes.

B. Forms:
1. Formwork shall be as specified in Section 03100 "Concrete Formwork".
2. Forms shall be used for all concrete work, including footings, and comply with ACI 347R. Forms shall be so constructed and placed that the resulting concrete will be of the shape, lines, dimensions, appearance, and to the elevations indicated on the drawings. Forms constructed and erected shall conform to the shapes, lines and dimensions to tolerances per ACI 117. Forms shall be fabricated in sections as large as practicable.

C. Placing and Consolidating:

1. The Engineer shall be notified at least 20 hours prior to proposed placement of any concrete. Unless otherwise permitted, the work begun on any day shall be complete in daylight of the same day.
2. Concrete shall have a minimum temperature of 50 deg. F and a maximum temperature of 90 deg. F when placed; concrete at a discharge temperature over 90 deg. F. will be rejected. In warm weather, cement temperature at delivery to mixer shall not exceed 170 deg. F. When placing concrete at ambient air temperatures over 75 deg. F, a mix designed with reducer-retarder shall be used. When ambient air temperatures are below 45 deg. F, the mix temperature shall not exceed 70 deg. F.
3. Mixing and placing operations shall be discontinued when a descending ambient air temperature in the shade and away from artificial heat approaches 35 deg. F; operations shall not resume until the temperature reaches 35 deg. F unless aggregate and/or mixing water are heated.
4. If concrete mixing and placing is authorized during ambient air temperatures near or below 35 deg. F, the Contractor shall use proper heating equipment maintained in operable condition to heat the aggregates and/or mixing water to at least 70 deg. F, but not over 150 deg. F. Aggregates shall be heated uniformly, prior to placing in mixer, by steam (only if not by direct discharge into aggregate pile), dry heat or other approved closed system. Heating equipment and methods, which overheat, alter or prevent air entrainment, or prevent proper aggregate discharge from bins, are prohibited.
5. Place no concrete until reinforcing steel, pipes, anchors, and other work required to be built into concrete have been inspected and approved by the Engineer. Remove water and foreign matter from forms and excavation. Place no concrete on frozen soil, and provide adequate protection against frost action during freezing weather. All base courses for slabs and footings shall be approved by the Engineer before placing concrete.
6. All concrete walls, slabs and beams shall be built so as to minimize the effects of shrinkage, preferably by skipping alternate sections that are to placed until the earlier placed concrete has cured for 72 hours.
7. At least two hours shall elapse after depositing concrete in walls and columns before depositing concrete in adjacent beams or slabs.
8. For joints see Section 03250. "Cold joints" shall be avoided, but if they occur, shall be treated as bonded construction joints.
9. At construction joints, the surfaces of the concrete already placed, including vertical and inclined surfaces, shall be thoroughly cleaned of foreign materials, laitance and weak concrete, and roughened with suitable tools to expose a fresh face. At least two hours before and again shortly before the new concrete is deposited, the joints shall be saturated with water. After glistening water disappears, the joints shall be given a thorough coating of neat cement slurry mixed to the consistency of very heavy paste. The surfaces shall receive a coating at least 1/8-inch thick on vertical surfaces and 1/2-inch thick on horizontal surfaces. New concrete shall be deposited before the neat cement dries.
10. Construction joints in elevated slabs shall be located near the middle of the spans of slabs, beams or girders, unless a beam intersects a girder at this point, in which case the joint in the girders shall be offset a distance equal to twice the width of the

beam. In this case, provision shall be made for shear by the use of inclined reinforcement.

11. Transport concrete from mixer to place of final deposit as rapidly as practicable by methods which prevent separation of ingredients and displacement of reinforcement, and which avoid rehandling. Deposit no partially hardened concrete. Concrete shall not be conveyed through pipe made of aluminum or aluminum alloy.
12. Chutes for conveying concrete into forms shall be of U-shaped design and sized to insure a continuous flow of concrete. Flat (coal) chutes or aluminum chutes are prohibited. Chutes shall be metal or metal-lined and each section shall have approximately the same slope. Chutes shall be inclined not flatter than 1 on 3 nor greater than 1 on 2 and shall be such as to prevent the segregation of the ingredients. The discharge end of the chute shall be provided with a baffle plate or snout to prevent segregation. If the discharge end of the chute is more than four feet above the surface of the concrete in the forms, a spout shall be used, and the lower end maintained as near the surface of deposit as practicable. When the operation is intermittent, the chute shall discharge into a hopper. Chutes shall be thoroughly cleaned before and after each run, and the debris and any water shall be discharged outside the forms. Concrete shall not be allowed to flow horizontally over a distance exceeding five feet.
13. Concrete shall be deposited continuously in vertical layers of approximately 12 to 18 inches thickness for walls so that concrete will not be deposited on concrete which has hardened sufficiently to cause the formation of seams and planes of weakness within the section. If a section cannot be placed continuously, construction joints may be located at points as indicated on the Drawings or approved by the Engineer.
14. Consistency of the concrete as measured at point of delivery into forms per ASTM C143 shall be as shown in Table 03300-2.
    a. Concrete shall be of such consistency and mix composition that it can be readily worked into the corners and angles of the forms and around the reinforcement, inserts, and wall castings without permitting materials to segregate or free water to collect on the surface, due consideration being given to the methods of placing and compacting.
    b. No excessive slump concrete will be permitted, and if at any time concrete of such consistency beyond the limits of Table 03300-2 is delivered to the job, the Engineer may direct the Contractor to reject same or to add extra cement for which no additional payment will be made. A supply of approved cement shall be kept available at the site, and suitably stored, for this purpose. No additional water shall be added by drivers of truck mixers in excess of that established for the design. Failure to comply with this requirement shall be justification for rejecting the concrete.
15. Promptly after depositing concrete in forms, it shall be properly consolidated per ACI 309 by means of suitable tools and methods. Internal-type mechanical vibrators shall be employed in all areas where space permits. Rodding and tamping will be allowed to consolidate concrete around embedded materials. Spading will be allowed only when approved by the Engineer. Consolidation shall be done by experienced operators under close supervision and shall be carried on long enough to produce homogeneity and optimum consolidation without

permitting segregation of the solid constituents or "pumping" or migration of air. All vibrator consolidation shall be supplemented by proper wooden spade puddling adjacent to forms to remove included bubbles and honeycomb. All vibrators shall conform to ACI 309 and shall provide not less than 7,000 impulses per minute.

a. At least one vibrator shall be used for every ten cubic yards of concrete placed per hour.
b. In addition, one spare vibrator in operating condition shall be available on the site. Vibrators shall be inserted at uniformly spaced points not more than twice the radius over which vibrations are visibly effective, but not more than three feet apart. Vibrators shall be lowered vertically into the concrete, (not thrown in) and allowed to descend by gravity, avoiding forms and reinforcement. Vibrators shall be manipulated so as to thoroughly work concrete into corners, around reinforcing steel and inserts with a five second minimum and 15 second maximum vibration time per each location; they shall not be used to transport concrete laterally. When mortar paste first appears near the top of the vibrator head, the vibrator shall be completely withdrawn vertically at about the same rate it descended.

16. Incomplete consolidation (indicated by honeycomb and voids) and over-vibration (indicated by flushing of mortar and/or water to surface) is prohibited and may require concrete removal and replacement at the Contractor's expense.
17. Manhole steps shall be cast-in-place, fitted into precast inserts or fitted into drilled holes. Before press fitting steps into inserts or drilled holes, concrete must have attained 2500-psi minimum field strength.

D. Removal of Forms:
   1. See Section 03100 "Concrete Formwork".

E. Curing and Protection:
   1. Protect all concrete work against injury from the elements and defacements of any nature during construction operation per ACI 308.
   2. Water shall not be permitted to rise on concrete within 24 hours after placement. Running water over concrete is prohibited within four days of placement.
   3. All concrete, particularly exposed surfaces shall be treated immediately after concreting or cement finishing is completed to provide continuous moist curing above 50 deg. F for at least the first seven days, regardless of the ambient air temperature. Concrete surfaces may be covered with wet burlap thoroughly saturated with water prior to placement and maintained in a constant saturated condition with a sprinkler system for the first 24 hours when ambient air temperatures are above 90 F.
      a. Wet burlap shall not be used when ambient air temperatures are below 35 deg. F or are descending and expected to go below 35 deg. F.
   4. Polyethylene and burlap-polyethylene may be used in lieu of wet burlap. Burlap-polyethylene shall be placed with burlap side down and in such a manner as to obtain intimate contact with concrete surfaces and edges. Polyethylene and burlap-polyethylene shall conform to ASTM C171.
   5. Sprayed liquid membrane-forming compound may be allowed if approved by the Engineer. The liquid membrane-curing compound shall be free of wax and shall contain fugitive dye when used for concrete paving work including sidewalk, curb

and gutter. Curing compound shall be applied to wet concrete surfaces in two applications at a rate of at least one gallon per 300 square feet, per application. Curing compound shall not be used when the ambient air temperature during placement and for 24 hours after placement is, or will fall below 35 deg. F. Curing compound shall not be used on concrete surfaces, which will receive future grout, grout fill or coatings. Liquid membrane curing compound, if used, shall conform to ASTM C309, Type 1-D.

6. In continuous cold weather below 32 deg. F., supplementary continuous warm curing (above 50 deg. F.) shall be provided for an additional 350-day degrees (e.g. 5 days at 70 deg. F, etc.) of curing.
7. No salt, manure or chemicals shall be used for protection.
8. Finished surfaces and slabs shall be protected from the direct rays of the sun to prevent checking and crazing.

F. Failure to Meet Requirements:
   1. Should the strengths shown by the test specimens made and tested per provisions herein fall below the values given in Table 03300-1 and Subsection 3300,2.3, the Contractor shall make changes in source of supply and/or proportions as approved by the Engineer. The Contractor shall replace those portions of the structure, which fail to develop the required strength. The cost of all such core borings and/or load tests and concrete replacement, required because strengths of test specimens are below that specified, shall be entirely at Contractor expense.
      a. In case of failure to meet 28-day strength requirements, the Contractor shall make the concrete and/or structure satisfactory to the Engineer at no additional cost to the DC WASA.
   2. When tests on control specimens of concrete fall below the required strength, the Engineer will permit check tests for strength to be made by means of typical cores drilled from the structure per ASTM C42 and C39. In case of failure of the latter per paragraph 17.3.2 of ACI 301, the Engineer may require load tests at Contractor expense. Load tests shall not be made until concrete has aged 60-days.

G. Patching Repairs:
   1. It is the intent of these Specifications to require forms mixture of concrete and workmanship so that concrete surfaces, when exposed, will require no patching.
   2. As soon as the forms have been stripped and the concrete surface exposed fins and other projections shall be removed, recesses left by the removal of form ties shall be filled, and surface defects which do not impair structural strength shall be repaired. All exposed concrete surfaces and adjoining work stained by leakage of concrete shall be cleaned to provide approved appearance.
   3. Immediately after removal of forms, plugs and break-off metal ties shall be removed and holes moistened with water, followed with a 1/16-inch brush coat of neat cement slurry mixed to the consistency of a heavy paste. Each hole shall then be immediately plugged with a 1:2 mixture of cement and concrete sand mixed slightly damp to the touch (just short of "balling"), hammered into the hole until dense, and an excess of paste appears on the surface in the form of a spiderweb. The area shall then be troweled smooth with heavy pressure and warm-moist cured. Burnishing shall be avoided. Grout over 30 minutes old and retempered grout shall not be used.

4. When patching or repairing exposed surfaces, the same source of cement and sand as used in the parent concrete shall be employed. Color may be adjusted if necessary by addition of proper amounts of white cement. Area shall be rubbed lightly with a fine carbo-rundum stone at an age of one to five days if necessary to bring the surface down with the parent concrete. Care shall be exercised to avoid damaging or staining the virgin skin of the surrounding parent concrete. Area shall be washed thoroughly to remove all accumulations.
5. Defective concrete and honeycomb areas as determined by the Engineer shall be chipped down reasonably square and at least one inch deep to sound concrete by means of hand chisels or pneumatic chipping hammers. Irregular voids or surface stones need not be removed if they are sound, free or laitance, and firmly embedded in the parent concrete, subject to the Engineer's final inspection. The remaining sound concrete in the defective area shall be roughened. If honeycomb exists around reinforcement, the area shall be chipped to provide a clear space at least 3/8 inch wide all around the steel. For areas less than 1-1/2 inch deep, the patch may be made in the same manner as described above for filling form tie holes, care being exercised to use adequately dry (non-trowelable) mixtures and to avoid sagging. Thicker repairs will require build-up in successive 1-1/2 inch layers on successive days, each layer being applied (with slurry, etc.) as described above. To aid strength and bonding of multiple layer repairs, the Engineer may order the use of an approved non-shrink, non-metallic grout as recommended by the manufacturer.
6. For larger defects, the Contractor shall cut back the area to sound concrete and replace the removed area using the materials and methods of this specification, if directed by the Engineer. The Contractor shall partially or totally remove and rebuild the defective area at no additional expense to the DC WASA, using the materials and methods herein specified.

H. Epoxy Bonding of Concrete:
   1. Epoxy bonding of new concrete or new grout to existing concrete is specifically indicated on the Drawings where required.
      a. Existing surfaces of previously placed concrete to be bonded shall be thoroughly cleaned of all foreign materials and laitance.
      b. Existing concrete surfaces shall be roughened with suitable tools and methods such as wire brushes, picks, wet sand blasting, or other approved method. Surfaces shall be roughened so that the aggregate is slightly exposed over 90 percent of the area.
      c. After roughening, surfaces shall be recleaned with either a stream of water or clean compressed air.
      d. The roughened/cleaned concrete surfaces shall be saturated with clean water. Pools shall be subsequently removed by clean air jet.
      e. The prepared concrete surfaces shall be coated with an epoxy-bonding compound per manufacturer's recommendations.
         1) Epoxy bonding compound shall be Concresive 1001-LPL made by Structa-Bond, Inc., Rockville, Md.; Dural-Bond made by Dural International Corp., Deer Park, N.Y.; Meta Bond HM made by American Metaseal Company, Carlstadt, N.J.; or approved equivalent.

2) The compound shall be a two component epoxy resin system, with 100 percent reactive components and 100 percent solids.
3) The compound shall be new and shall be used within the shelf life limitations marked on each container.

f. New concrete shall be deposited per these specifications and bonded to the epoxy compound after the compound has been cured per the manufacturer's recommendations.

I. Concrete Finishes:
1. Concrete for the project shall be finished in the various specified manners either to remain as natural concrete or to receive an additional applied finish or material under another section.
2. Finishes shall be as follows:
   a. Concrete to receive waterproofing - off-form finish.
   b. Concrete for top slab of junction chambers and floor - wood float finish, non-slip.
   c. Concrete over which sanitary or storm water sewage flows - steel troweled finish.
   d. Concrete not exposed to view and not scheduled to receive an additional applied finish or material - off-form finish.
   e. Concrete interior of culvert walls and arches exposed to storm water flow-smooth form finish.
   f. Concrete above grade or exposed and not receiving additional finish on vertical surfaces - rubbed finish.

PART 4 MEASURE AND PAYMENT

Concrete work will not be measured separately for payment. The cost thereof, including incidental work and materials, will be included in the payment for the applicable work.

END OF SECTION 03300

DIVISION 3-CONCRETE

SECTION 03301-CONCRETE REPAIR

PART 1 GENERAL

1.1 SCOPE

A. Section Includes: Furnishing of materials, labor, tools, and equipment necessary to repair deteriorated concrete.

B. Concrete Repairs are classified as follows:
   1. Type 1 –Repair to be used for greater than 2.5 inch deep spalled delaminated and deteriorated concrete. This repair shall consist of cleaning all surface areas that need to be repaired, and placing, finishing, and curing repair mortar. –
   2. Type 2- Repair to be used for up to 2.5 inch deep spalled, delaminated and deteriorated concrete. The surface repair material shall be repair mortar. In large application area the Machine-Applied repair mortar can be used.
   3. Type 3 – Crack Repair: To be used for concrete repair for 0.02" to 0.25" wide cracks. The structural crack repair shall use epoxy crack filler material. Non-structural crack repair utilizes hydrophilic filler material.
   4. Type 4 – Concrete Protective Coating and Waterproofing.

C. The contractor shall remove any deposit/accumulations on the bottom of the sum pump wet well. The concrete sum well shall be power washed before scheduling repair work.

D. Related Work Specified Elsewhere:
   1. Section 03100, Concrete Formwork –
   2. Section 03200, Reinforcing Steel
   3. Section 03300, Cast –in-Place Concrete
   4. Section 03600, Non-Shrink Grout.
   5. Section 02050, Demolition.

1.2 QUALITY ASSURANCE

A. Codes, Regulations, Reference Standards and Specifications:
   1. Codes and regulations of the jurisdictional authorities
   2. ACI: Unless otherwise specified, ACI requirements govern the performance of the work of this section.
   3. ASTM C 109 Test Method for Compressive Strength of Hydraulic Cement Mortars.
   4. ASTM C 882, Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete Specs.

B. The Contractor shall furnish the name of all subcontractors which he proposes to use for this work including necessary evidence and/or experience records to ascertain their

qualifications in the application of epoxy, polyurethane, polymer-modified and cement-based compounds, and hydrophilic resins.

C. Approved applicator qualifications shall include:
   1. A minimum of five years experience in applying epoxy, and polymer-modified and cement-based compounds similar to those specified in this Section.
   2. A minimum of three years experience in applying hydrophilic resins.
   3. The subcontractor/applicator shall submit a list of five previous jobs that successfully utilized the specified repair system.
   4. A letter from the manufacturer of the specified materials, on the manufacturer's letterhead, signed by an officer of the company, stating that the subcontractor/applicator has been trained in the proper techniques for the preparation of the surface, and proper methods for mixing, placing, curing, caring and injection techniques of the manufacturer's products.

D. Bond strength (ACI503.R, Pull Off) - Prior to any repair being applied, a bond pull off test shall be conducted. A minimum bond tensile strength of 200 psi shall be achieved.

1.3 SUBMITTALS

Submit the following for approval in accordance with GR-16, entitled "Shop and Working Drawings", and with the additional requirements as specified for each.

A. Shop Drawings:
   1. The Contractor shall submit manufacturer's product information and recommended placement procedures for all repair materials.

B. Certification:
   1. Ingredients:
      a. Submit laboratory test reports and mill or manufacturer's certificates verifying that ingredients conform to specified requirements and have a minimum of six month's residual shelf life when shipped.

C. Documentation:
   1. Proposed methods of installation and plans for placing concrete patching and filling cracks, taking into account sun, heat, wind, ambient air temperature or other limitations of facilities that will prevent proper finishing or curing.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site appropriately packaged and labeled to indicate manufacturer's name, type, grade and color.

B. Store materials in accordance with manufacturer's precautions.

C. Follow manufacturer's precautions for handling components.

PART 2 PRODUCTS

2.1 MATERIALS

A. Repair Mortars:
1. Repair mortar shall be a prepackaged cement based product specifically formulated for the repair of concrete surface defects. It shall have the following properties:

Physical Property	Value	ASTM Standard
Compressive Strength (minimum)		C-109
at 1 day	2000 psi	
at 28 days	6000 psi	
Bond Strength (minimum)		C-882*
at 28 days	1800 psi	

*Modified for use with repair mortars, as recommended by manufacturer.

2. The repair mortar shall be as follows:
   a. SikaRepair 2234, SikaRepair 222, SikaCrete 211, manufactured by Sika Corporation. The formulation, among those listed, recommended by the manufacturer for the specific application condition shall be used.
   b. Emaco S88-CI or S66-CI, manufactured by BASF The Chemical Company. The formulation, among those listed, recommended by the manufacturer for the specific application conditions shall be used.
   c. Or equal.

3. Where the dimension of the placement, in width or thickness (neat), exceeds manufacturer recommendation, the repair mortar shall be extended by addition of aggregate as recommended by the manufacturer.

B. Crack Injection Material:
1. Epoxy:
   a. Epoxy for injection shall be a low viscosity, high modulus moisture insensitive type.
   b. Epoxies for injection shall be:
      1) Sikadur 35, and Sikadur 31, as manufactured by Sika Corporation.
      2) Eucopoxy Injection Resin, as manufactured by The Euclid Chemical Company.
      3) Or equal.
2. Hydrophilic resin shall be:
   a. Duroseal Inject 215, as manufactured by BBZ USA, Inc.
   b. SikaFix HH LV by Sika Corporation.
   c. Or equal.

C. Epoxy-Bonding Agent (See Section 03300)

D. Concrete Protective Coating and Waterproofing:

1. Sikatop Seal 107, for Sump and pump Chamber, and SikaGard 670W, for Motor Room Walls and Ceiling, as manufactured by Sika Corporation
2. Or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Non-Structural Crack Injection Repair:
   1. All cracks identified by the Engineer as non-structural shall be repaired with a hydrophilic resin as specified herein. Hydrophilic resin shall be pressure injected into all cracks as indicated by the Engineer in those structures included in the scope of work listed herein. Installation instructions and recommendations by the manufacturer shall be followed.
   2. Location of Injection Ports: Injection ports shall be spaced as recommended by the manufacturer and as needed to ensure complete penetration of the joint of crack with the injected material. Spacing of injection ports shall not exceed 2 feet.
   3. Drilling Ports: Holes for injection ports shall be drilled to the depth needed for proper distribution of the injected material. Care shall be taken to not damage any reinforcing steel.
   4. Port Preparation: Holes for injection ports shall be cleaned of all debris and fitted with an injection fitting as provided by the manufacturer of the injected material. The injection fitting shall be installed as per the manufacturer's instructions and will remain in place until injection work has been completed at that area. Caps or valves will be installed at the injection ports to prevent back flow of the uncured injected material after it has been injected.
   5. Injection Procedure:
      a. The Contractor shall follow the instructions of the manufacturer and their representatives for all mixing and injection procedures.
      b. All cracks shall be sealed at the surface where needed to provide for complete penetration of the injected material and to prevent loss of material.
      c. Prior to sealing material injection, water shall be injected into the ports in order to flush the crack clean and to verify continuity between adjacent ports. Water shall be injected into each of the ports until it begins to flow from an adjacent or nearby port.
      d. If the water injection procedure indicates the potential presence of voids within members or behind members resting against soil, the Engineer shall be notified immediately.
      e. Beginning at the lowest injection port, inject the sealing material until it begins to flow from an adjacent or nearby port. Repeat the process until the crack is completely filled. In general, the port to port travel of the injection process will be from low to high in a continuous operation.
      f. If port to port continuity does not occur at locations where continuity was verified through water injection, mark location and notify the Engineer.
      g. Avoid sudden application of high pressures during the injection process.
      h. After completion of the injection operation, all ports and surface sealing materials shall be removed so as to leave an undamaged surface.

B. Structural Crack Repair:
   1. All cracks identified by the Engineer as structural shall be repaired with an epoxy resin as specified herein. Epoxy shall be pressure injected into all cracks in damaged concrete as indicated by the Engineer in those structures included in the scope of work listed herein. Installation instructions and recommendations by the epoxy manufacturer shall be followed.
   2. Cracks shall be injected with sufficient pressure to ensure full penetration of the epoxy buy without causing further damage.
   3. The location, drilling, and preparation of ports for injection shall be as required for chemical grout herein.
   4. Epoxy Injection:
      a. The Contractor shall follow the instructions of the epoxy manufacturer and their representatives for all mixing and injection procedures.
      b. All cracks shall be sealed at the surface where needed to provide for complete penetration of the injected epoxy and to prevent loss of material.
      c. Beginning at the lowest injection port, inject the epoxy until it begins to flow from an adjacent or nearby port. Repeat the process until the crack is completely filled.
      d. If port to port continuity does not occur, mark the location and notify the Engineer.
      e. Avoid sudden application of high pressures during the injection process.
      f. After completion of the injection operation, all ports and surface sealing materials shall be removed so as to leave an undamaged surface.

C. Minimum ambient temperature shall be 45°F or as recommended by manufacturer.

D. Machine Applications Method: As per Manufacturer (material) recommendations.

E. Extend all existing control and expansion joints through any repair work.

F. Apply the concrete protective coating/waterproofing to all walls and ceiling of pump station. A minimum of two (2) coats of concrete protective coating shall be applied, or as per manufacturer's recommendation.

3.2 SURFACE PREPARATION

A. The entire area to be repaired shall have all laitance, foreign material, and all loose, broken, softened, and acid contaminated concrete removed by chipping (only 15 and 30 pound pneumatic chipping hammers to be used with pointed shipping ends, 30 pound hammer limited to large areas and away from reinforcement) and/or a heavy abrasive blasting, shotblasting or hydroblasting. The surface shall be further roughened to 1/4-inch amplitude textured surface (ridge to valley shall be approximately 1/4 inch) as specified herein. Where repair mortar or concrete coatings are used, any additional surface preparations steps recommended by the manufacturer shall be performed.

B. Where existing reinforcing bars are exposed, concrete shall be removed to a minimum of one inch all around the bars. If the existing bars are cut through, cracked, or the

cross sectional area is reduced by more than 20 percent, provide a supplemental bar (See Drawings).

C. The perimeter of the damaged area shall be score cut to a minimum depth of 0.5 inch and a maximum depth so as to not cut any existing reinforcing steel. Existing concrete shall be chipped up to the score line so that the minimum thickness of repair mortar is 0.5 inch. Areas requiring repair should be modified to provide for simple layouts. Excessive or complex edge condition result in shrinkage stress concentration and cracks.

D. The recommendations of both the repair material and bonding agent manufacturers shall be followed.

E. Injection Ports/Packers – Establish port holes using a 1/2 or 5/8 in. (1.27 to 1.59 cm) roto-hammer bit at a 45 degree angle (approximate) to the crack or joint being injected. Alternate holes from side-to-side if possible. Injection ports shall be per manufacturer's recommendations.

F. Concrete Coating – All concrete surfaces to receive concrete coating system shall be clean and sound, free of dirt, grease, dust, mildew, fungus, previous coatings or any other intervening barrier which may cause a future coating failure.

3.3 PLACEMENT OF BONDING AGENT (SEE SECTION 03300)

3.4 PLACEMENT, COMPACTING, FLOATING AND FINISHING

A. The procedures recommended by the manufacturer for the mixing and placement of the repair mortar shall be followed.

B. After the initial mixing of the repair mortar, additional water shall not be added to change the consistency.

C. Repair mortar shall be placed to a minimum thickness as recommended by the manufacturer but not less than 0.50 inch. Where removal of deteriorated concrete results in a repair thickness of less than 0.5 inch to return to original concrete surface location in isolated areas totaling less than 10 percent of the total repair area, additional concrete shall be removed to obtain the 0.5-inch thickness. Where the area with repair thickness of less than 0.5 inch exceeds 10 percent of the total repair area, notify the Engineer. In any case, repair mortar shall be added so that the minimum cover over existing reinforcing steel is 2 inches. The Contractor shall not place repair mortar so as to create locally raised areas. Where there is a transition with wall surfaces which are not in need of repair, the repair mortar shall not be feathered at the transition. A score line shall be saw cut to not less than the minimum repair mortar depth and concrete chipped out to it to form the transition. Care shall be taken to not cut or otherwise damage any reinforcing steel.

D. Concrete shall be screeded and bullfloated to the proper elevation to insure that all surface moisture will drain freely to drains and sides, and that no puddle areas exist.

E. The repair mortar shall be placed to an even, uniform plane to restore the member to its original surface. Tolerance for being out of plane shall be such that the gap between a 12-inch straight edge and the repair mortar surface does not exceed 0.20 inch and the gap between a 48-inch straight edge and the repair mortar surface does not exceed 0.375 inch. This shall apply to straight edges placed in any orientation at any location.

F. Steps shall be taken to prevent exposed plastic concrete surfaces from drying. Windbreaks, foggers and/or evaporation retarders shall be standing by during all finishing operations. Foggers shall maintain the humidity to recommended range of 2 ft. to 3 ft. away from the surface of the concrete. If necessary, evaporation retarder between finishing operations shall be applied.

G. The repair mortar shall receive a smooth, steel troweled finish.

H. Pressure injection material shall comply with all the requirements as per manufacturer's specifications.

3.5 CURING

A. Curing shall follow immediately behind the final finish. Curing shall be performed by a combination of covering the concrete with a layer of wet burlap and the application of a liquid membrane-forming curing compound. The sequence, at the Contractor's option, shall be selected to retain moisture in the slab or wall for a minimum of 7 days.

3.6 DEFECTIVE REPAIR

A. Repair will be considered defective if Schmidt-Hammer test gives results less then 3500 psi for repair mortars at any location in seven days, or if the repair is not properly finished and within specified tolerances.

B. Concrete repair material in place that is deemed structurally defective must be removed.

C. Replace, strengthen or correct defective concrete repair material as directed by Engineer.

3.7 DAMAGED WORK

A. Before final acceptance of the work, neatly repair damaged surfaces, corners of concrete and concrete finish.

B. Where surface repairs are permitted, finish damaged areas to smooth, dense watertight condition.

C. Replace concrete patching material that is not satisfactorily installed.

3.8 CORRECTIVE WORK

A. If correction of defects is approved, remove defective concrete. Key area to be repaired, clean and soak surface with water and patch with approved materials. Patch concrete so as to match existing.

B. Clean surface cavities produced by form ties, other holes, honeycomb spots, broken corners or edges and other defects. Saturate with water and point with a mortar consisting of patching material paste. Follow patching material manufacturer's recommendations concerning placement, pot life, and curing.

C. Prepare pointing material not more than 30 minutes prior to use. Cure mortar patches properly. Carefully tool contraction and articulated joints in completed work and keep them free of concrete. Where necessary, leave joint filler exposed for its full length with clean and true edges.

D. Tolerance deviations and other surface defects may also be corrected, if approved, by grinding high areas of swales.

E. Where corrective work is unsatisfactory, completely remove such work and replace with new work complying with specified requirements.

PART 4 MEASUREMENT AND PAYMENT:

A. Concrete repairs will be measured and paid for in accordance with the unit price items listed here and in the Schedule of Prices which payment will include furnishing all labor, material, tools, equipment, and incidentals needed to complete the job.
   1. Repair Type 1, Concrete Repair - Payment will be made at the contract unit price per square foot.
   2. Repair Type 2, Concrete Repair – Payment will be made at the contract unit price per square foot
   3. Repair Type 3, Crack Repair - Payment will be made at the contract unit price per linear foot.
   4. Repair Type 4, Concrete Protective Coating and waterproofing - Payment will be made at the contract unit price per square foot

C. Repair of damaged concrete resulting from Contractor's demolition activities and corrective works shall be at his own expense.

END OF SECTION 03301

DIVISION 3 - CONCRETE

SECTION 03316 - CONCRETE COLLAR (REINFORCED)

PART 1 GENERAL

1.1 SCOPE:

A. Work consists of excavation, backfill and compaction beyond trench excavation limits, disposal of excess material, furnishing and constructing reinforced concrete collar(s) complete. Concrete collar(s) shall be constructed as shown on Standard Detail S/60.05 or as detailed on Contract Drawings to encompass sewers so as to provide rigid watertight connection.

B. Related Work Specified Elsewhere May Include But Is Not Limited To:
   1. Section 02220: Trench Excavation and Backfill.
   2. Section 02730: Pipe Sewer.

1.2 QUALITY ASSURANCE

A. Reference Codes and Specifications:
   1. None this Section.

1.3 SUBMITTALS

A. Shop Drawings:
   1. GR-16 applies. Drawings shall be submitted for reinforcing steel layout.

PART 2 PRODUCTS

2.1 MATERIALS

A. Section 03200: Reinforcing Steel.

B. Section 03300: Cast-In-Place Concrete.

PART 3 EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. Concrete collar(s) shall be constructed per Standard Detail S/60.05 or as detailed on Contract Drawings. Concrete shall cure for a minimum of four days prior to backfilling. Backfill shall be per Section 02220.

PART 4 MEASURE AND PAYMENT

4.1 MEASURE

A. Unit of measure for Concrete Collar (Reinforced) will be each.

4.2 PAYMENT

A. Payment for Concrete Collar (Reinforced) will be made at Contract unit price per each, which price and payment will include furnishing and forming Class 4000 concrete, furnishing and placing reinforcing steel complete, backfilling and all labor, materials, tools, equipment and incidentals needed to complete work specified.

END OF SECTION 03316

DIVISION 3 - CONCRETE

SECTION 03600 - NON-SHRINK GROUT

PART 1 GENERAL

1.1 SCOPE:

A. Furnish all labor and material required performing the grouting called for on the Drawings or in the Specifications.

B. Related Work Specified Elsewhere May Include But Is Not Limited To:
   1. Section 03100: Concrete Formwork.
   2. Section 03200: Reinforcing Steel.
   3. Section 03250: Concrete Accessories.
   4. Section 03300: Cast-In-Place Concrete.
   5. Section 05100: Structural Steel.

1.2 QUALITY ASSURANCE

A. Acceptable Manufacturers:
   1. U. S. Grout Corporation.
   2. Master Builders.
   3. USM Corporation.
   4. W. R. Meadows.
   5. Sonneborn-Contech.

B. Applicable Codes, Standards and Specifications:
   1. American Society for Testing and Materials (ASTM).
   2. U. S. Corps of Engineers (CRD).

1.3 SUBMITTALS

A. The Contractor shall furnish recent independent laboratory tests showing compliance with requirements specified. Certification or affidavits will not be acceptable.

B. The Contractor shall furnish manufacturer's literature describing product and instructions for use.

C. GR titled "Shop And Working Drawings" applies.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Grout shall be delivered in moisture proof bags with the manufacturer's name, product name and general instructions for placement printed on the bag.

B. Product shall be stored on pallets and protected from damage.

PART 2 PRODUCTS

2.1 MATERIALS

A. All grout shall be non-metallic, non-shrink, non-gas forming, preblended and ready-for-use requiring only the addition of water.
   1. Grout shall contain no metals nor rust or corrosion promoting agents, or gypsums.
   2. The addition of set control agents or water reducers will not be allowed.
   3. Grout shall conform to the following properties:

Property	Test Methods	Requirements
Shrinkage below Placement Volume	ASTM C827	0
Drying Shrinkage	CRD 588	0
Expansion	CRD 588	0.10% max.
Compressive Strength*		
24 hours	ASTM C109	3000 psi min.
7 days		6000 psi min.
Initial Set Time	ASTM C191	Min. 45 minutes
Pull-Out Strength	#5 bar grouted 6" deep in a 7/8" dia. hole in saturated surface dried concrete	10,000 lbs

*Flowable mix

B. Water shall be clean and free from injurious chemicals and deleterious materials.

PART 3 EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

A. Preparation:
   1. All contact surfaces shall be prepared in accordance with manufacturer's recommendations.
   2. Grout contact surfaces shall be cleaned of all oil, grease, scale and other foreign matter.
   3. Unsound concrete shall be removed leaving surface level but rough.
   4. Concrete contact area shall be saturated with water 12-24 hours prior to grouting. Before placing grout, remove all excess or freestanding water.

B. Mixing:
   1. Grout shall be mixed in strict accordance with the manufacturer's written instructions. Amount of water used should be a minimum quantity to provide the desired grout consistency.
   2. Mix only that quantity of grout that can be placed within 30 minutes after mixing.

C. Grouting:
   1. All work shall be done in strict accordance with the manufacturer's recommendations, including special procedures for hot and cold weather grouting.
   2. At the request of the Engineer, the manufacturer's representative shall be called to the job site for consultation regarding detailed use of the grout.
   3. The grout shall be placed using the most practical method, completely filling the space to be grouted and shall be thoroughly compacted and free of air pockets.
   4. Do not remove forms until after the grout has taken an initial set and will not slump. After removal, cut off excess grout and finish to a smooth surface.
   5. Prevent rapid loss of water from the grout during first 48 hours with the use of an approved membrane-curing compound, or with the wetted burlap method.

PART 4 MEASURE AND PAYMENT

Non-shrink grout will not be measured separately for payment; the cost thereof shall be included in the payment for the items of which it is a part.

END OF SECTION 03600

DIVISION 5 – METALS

SECTION 05120 - STRUCTURAL STEEL

PART 1 GENERAL

1.1 DESCRIPTION

A. This section specifies structural steel work. Work under this Section includes fabricating, furnishing, installing or erecting all steel and miscellaneous metal work specified for use in the contract documents and in the Contract Drawings.

B. Related work specified elsewhere may include but is not limited to:

1. Section 707, Painting, DDOT Standard Specification.

1.2 QUALITY ASSURANCE

A. Codes, Regulations, Reference Standards and Specifications:

1. Codes and regulations of the jurisdictional authorities.

2. AWS: D1.1.

3. AISC:

a. Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

b. Code of Standard Practice for Steel Buildings and Bridges.

c. Specifications for Structural Joints using ASTM A325 and A490 Bolts.

4. SSPC: SP-6, SP-7, SP-10.

5. ANSI: B18.2, B27.2.

6. ASTM: A6, A36, A307, A325, A370, A500, A501, A514, A572.

B. Source Quality Control:

1. Testing and inspection:

a. Nondestructive-test requirements for welded members:

1) All welds shall be visually inspected in accordance with AWS D1.1 code.

2) For all welded connections: 10 percent of welds inspected by magnetic particle inspection and radiographic testing.

3) The Engineer may designate additional items to be inspected by radiography.

b. Mill Testing:

1) Cut, machine and test specimens in accordance with ASTM A370.

C. Qualification of Welding Personnel and Procedures:

1. Employ welding personnel whose qualification is certified in accordance with AWS Standard D1.1. Such certification is to remain in force for the duration for the welding operations under this Contract.

D. Stock Materials:

1. For qualification of welding personnel and procedures and for quality-assurance testing, use only stock materials which can be identified as having been rolled from a given heat and for which certified mill tests can be produced.

1.3 SUBMITTALS

Submit the following for approval in accordance with the General Requirements and with the additional requirements as specified for each:

A. Shop Drawings:

1. Structural details: Include the following:

a. Bill of materials giving complete information for fabrication and erection of component parts of structures including material and finish information.

b. Details of location, type, sizes of bolts and welds and for welded structures details of welding as specified.

c. Structural computations for Contractor-designed work certified by a professional engineer registered in the area where the work is to be performed.

2. Erection: Erection of structural steel shall be in accordance with construction sequence as shown on Drawings.

B. Certification:

1. Certified mill test reports of structural steel at least 10 days prior to start of fabrication.

2. Certified quality-assurance testing and inspection reports.

3. Certification verifying that welding personnel have been qualified in accordance with AWS D1.1.

4. Manufacturer's certification that bolts meet approved testing.

1.4 MATERIAL

A. General Requirements for Rolled-Steel Plates, Shapes and Bars: ASTM A6.

B. Carbon-Steel Structural Steel Plates, Shapes and Bars: ASTM A36.

C. Low-Carbon Steel Bolts and Nuts: ASTM A307, Grade A or B.

D. High-Strength Carbon-Steel Bolts, Nuts and Washers for Structural Joints: ASTM A325.

E. High-Strength Alloy-Steel Bolts, Nuts and Washers for Structural Joints: ASTM A490.

F. Bolts and Nuts: ANSI B18.2.1 and B18.2.2.

G. Round Washers other than those in contact with High-Strength Bolt Heads and Nuts: ANSI B27.2, Type B.

H. Structural-Steel Tubing: ASTM A501.

I. Paint for Shop Prime Coating: Inorganic Zinc Rich Primer, Type II.

J. Cleaning solution: Muriatic acid solution, specific gravity 1.18, prepared in a solution of one-part muriatic acid and five parts water.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. General:

1. Load, transport, unload and store structural materials so as to keep them clean and free from damage.

2. Store material on platforms, skids or other supports above the ground and ensure proper drainage and protection from corrosion.

B. Steelwork:

1. When handling and shipping steelwork, prevent bending, scraping or overstressing members.

2. Block projecting parts likely to be bent or damaged during handing with wood or other approved materials.

3. Replace pieces bent or damaged unless repair is approved.

C. Bolts and Nuts:

1. Ship small parts such as bolts, nuts, washers, pins, fillers and small connecting plates or angles in boxes, crates or barrels.

2. Pack separately bolts of each length and diameter and loose nuts or washers of each size.

D. Paint:

1. Have paint materials delivered in manufacturer's original sealed containers, bearing manufacturer's label and name, specification identification number where applicable as well as month and year of manufacture.

1.6 JOB CONDITIONS

A. Environmental Requirements:

1. Welding:

a. When welding during cold weather, avoid chilling weld metal within zone of welding influence and avoid restraining manual functions of welder or welding operator.

b. When temperature where steel is stored is more than 20^{o}F below that of welding shop, move steel to be welded into shop sufficiently in advance of welding to allow it to attain shop temperature prior to welding.

c. Steel to be free of moisture. Dry as necessary by application of heat not exceeding 100°F.

d. Do not weld when shop temperature is below 40°F.

2. Painting:

a. Apply paint when temperature of steel and paint is above 40°F and temperature is forecast to remain above 40°F until paint has dried.

b. Painting steel at a temperature which can cause blistering, porosity or conditions otherwise detrimental to life of paint is prohibited. When paint is applied in hot weather or thinned in cold weather, ensure that specified thickness of paint coating is obtained.

c. Application of paint in rain, wind, snow, fog or mist or when steel surface temperature is below dew point is prohibited, unless otherwise approved. If painting in damp or cold weather is unavoidable, provide protective covering and heat steel and surrounding air to 40F minimum. Maintain this temperature until weather conditions permit discontinuance.

PART 2 EXECUTION

2.1 FABRICATION

A. Workmanship and finish to best commercial practice accomplished in structures.

B. Straightening Material:

1. Use rolled material that, before being laid off or worked, is straight within tolerances specified in ASTM A6.

2. Perform straightening where necessary by approved methods which will not overstress material.

3. Do not heat-shrink low-alloy structural steel.

4. Achieve fabrication tolerances which will result in full bearing.

5. Perform straightening, planing and connecting of portions of members in bearing assemblies and in direct bearing after fabrication as necessary to provide full bearing assemblies and bearing areas.

C. Cutting:

1. Flame-cut edges of members subject to dynamic loading by mechanically guided torch or by hand. Remove nicks by grinding to depth not exceeding 1/4 inch.

2. Shape re-entrant comers notch-free to radius of 1/2-inch minimum.

3. Perform flame cutting so that metal does not carry stress during cutting.

4. Direct flame so that remaining material is not damaged.

5. Gas cutting in the field is prohibited.

D. Planning and Fading:

1. Plane to depth of 1/4 inch sheared edges of plates more than 5/8-inch thick which will carry calculated stress.

2. Fabricate floor beams, stringers and girders having end connection angles to exact length back-to-back of connection angles.

3. For compression joints depending on contact, prepare bearing surfaces to a common plane by milling, sawing or other approved means.

E. Bolt Holes:

1. Punch or drill holes for bolts.

2. Sub punch or sub drill and ream assemblies using steel template for alignment of connections as necessary. Flame cutting is prohibited.

3. Subdrill or subpunch holes 3/16 inch less than nominal diameter of bolt; drill or ream holes 1/16 inch greater than nominal diameter of bolt.

F. Connections:

1. Except where welded or ASTM A307 bolted connections are shown, use ASTM A325 bolts. Unless otherwise specified, use minimum ¾-inch diameter bolts.

2. Unless otherwise shown, bolt field connections using ASTM A325 or bolts in accordance with AISC specifications for structural joints.

G. Plates:

1. Sheared plates: For gusset plates or connection plates, use sheared plates designed to resist applied loads in more than one direction in plane of plate.

2.2 WELDING

A. Perform welding in accordance with AWS D1.1.

B. Perform procedure and sequence of welding so as to avoid needless distortion and to minimize stresses. Straighten transverse warpage of flanges, if necessary, by controlled heating along outside face.

C. Unless otherwise shown, use welded connections with minimum 3/16 inch fillet weld.

2.3 BOLTING

A. Connections using high-strength steel bolts in accordance with AISC Specifications for Structural Joints using ASTM A325 bolts.

B. Assemble high-strength bolted parts so that they fit solidly together when assembled. Do not use gaskets or other compressible materials.

C. Remove scale, dirt, burrs and other defects likely to prevent proper seating when assembling joint surfaces, including those adjacent to washers.

D. Remove oil, paint, lacquer and galvanizing from contact surfaces of friction joints.

2.4 SHOP ASSEMBLY

A. Clean surfaces of metals in contact with each other before assembling.

B. Assemble parts to line and fit; drill or ream bolt holes while assembled. Hand reaming is prohibited unless approved.

2.5 SHOP PAINTING

A. Clean steel surfaces in accordance with SSPC SP-6 or SP-10.

B. Shop Painting:

1. Shop paint structural-steel work which will be exposed in finished structures.

2. Do not shop paint the following:

   a. Surfaces within three inches of joints to be field welded.

   b. Contact surfaces: Apply rust-inhibitive treatment to such surfaces; remove by means of appropriate solvent prior to assembly.

   c. Surfaces to be encased in concrete or in fire-protection material.

3. Use paint-spraying equipment, if approved, with type of spray gun recommended by paint manufacturer for paint being applied.

4. Use brushes of good quality bristle. Nylon brushes and roller coaters are prohibited.

5. Neutralize areas of welding which are to be painted by applying specified cleaning solution. Wash neutralized area thoroughly with clean water and allow to dry before painting.

6. Apply shop prime coat at minimum wet-film thickness of three mils. Give surfaces which will be inaccessible after assembly or erection three coats of paint before assembly.

7. Complete shop painting and ensure paint has completely dried prior to shipment of steel.

2.6 ERECTION

A. Install anchor bolts accurately in positions shown.

B. If anchor bolts are cast in substructure masonry during its construction, ensure that each bolt is firmly held in its correct position and elevation by suitable templates.

C. If approval is given for installing anchor bolts in preformed holes or in drilled holes in concrete or masonry, use approved nonshrink, nonstaining grout to secure them in place.

D. Set bearing assemblies to lines and grades shown and adjust to horizontal position shown.

E. Erect steel structures true and plumb following match marks.

F. Use temporary bracing to support loads to which structures may be subjected including erection equipment and their operations. Leave bracing in place as long as safety requires.

G. Report immediately to the Engineer errors in shop fabrication or deformation resulting from handling or transportation which prevent proper erection and fitting of parts.

H. Ensure that holes are not enlarged and that metal in vicinity of holes is not disturbed by drifting during assembly.

I. Enlargement of holes to accept bolts for connections is prohibited unless approved. Make enlargement by reaming not by hand reaming. Avoid hand reaming.

J. Do not field weld main stress members.

K. Dimensional tolerances are permissible in accordance with AISC Specifications and Codes.

PART 3 MEASURE AND PAYMENT

A. Structural steel will be paid at the contract unit bid price per pound, which payment will include all materials, labor, equipment, tools, painting, and incidentals necessary to complete the specified work.

END OF SECTION 05120

DIVISION 5 - METALS

SECTION 05530 GRATINGS

PART 1 GENERAL

1.1 SCOPE

A. Furnish all labor, materials, equipments and incidentals required to install steel gratings as shown on the drawings and as specified herein.

1.2 SUMMARY

A. Related work specified elsewhere may include but is not limited to:

1. Related Sections include Davison 5 Section “Structural Steel”

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance of Gratings:

Provide gratings capable of withstanding the effects of gravity loads and stresses within limits and under conditions indicated:

1. Floors: Uniform load of 300 lbs/sq. ft.

2. Limit deflection to L/360 or ¼ inch, whichever is less.

1.4 SUBMITTALS

A. Product Data: For the followings:
1. Steel Bar Gratings.
2. Clips and anchorage devices for gratings.

B. Shop Drawings: Include plans, elevations, sections, details and attachments to other work.
1. Provide templates for anchors and bolts specified for installation.
2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Bar Grating Standards: Comply with NAAMM MBG 532, “Heavy-Duty Steel Bar Grating Manual”.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, “Structural Welding Code-Steel.”

2. AWS D1.3, “Structural Welding Code-Sheet Steel.”

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 CO-ORDINATION

A. Co-ordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete. Deliver such items to Project Site in time for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering approved products equivalent to Robertson Grating, P&R Metals or Amico Grating products, shall be accepted.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36

B. Wire Rod for Grating Crossbars: ASTM A 510

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless steel fasteners for corrosive environment.

B. Plain Washers: Round, ASME B18.22.1

C. Lock Washers: Helical, spring type, ASME B18.21.1

D. Anchors: Provide anchors with capability to sustain, without failure, a load equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

1. Material for Anchors for corrosive environment: Alloy Group A4 stainless steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

2.4 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form hairlines joints.

E. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metal.

2. Obtain fusions without undercut or overlap.

3. Remove welding flux immediately.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

2.5 STEEL BAR GRATINGS

A. Provide heavy duty steel Grating Type 19W2 with bar size 1½"x¼" by Robertson Grating Products or approved equal for pump opening.

B. For drainage trough provide Grating Type 19W2 with bar size 1"x ¼" Robertson Grating or approved equal.

C. Steel Finish: Shop primed hot –dip galvanized with a coating weight of not less than 1.8 oz./sq.ft. of coated surface. Apply zinc coating by the hot-dip process complying with ASTM A123.

D. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section, include anchors and fasteners of type as recommended by manufacturer.

2.6 GRATING FRAMES AND SUPPORTS

A. Frames and Supports for Steel Gratings: Fabricates from steel shapes, plates, and bars of welded constructions to sizes, shapes and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames.

B. Galvanize all steel frames and supports.

PART 3 – EXECUTION

3.1 INSTALLATION

A General: Provide anchorage devices and fasteners where necessary for securing grating to in- place construction.

B Cutting, Fitting, and Placement: perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C Adjusting and Cleaning: Clean field welds, bolted connections, abraded areas and repair galvanizing to comply with ASTM A780.

PART 4 -- MEASURE AND PAYMENT

4.1 LUMP SUM PRICE

The unit of measure will be the job. No actual measure will be made. Payment will be made at the contract lump sum price, which payment will include all labor, tools, equipment and incidentals needed to complete all the above specified work.

END OF SECTION 05530

SECTION 08110

STEEL DOORS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes removal of existing door and related hardware and installation of a new steel door in existing opening as manufactured in accordance with SDI "Standard Door Institute", Recommended Standards.
   1. Exterior Doors: Full flush composite construction heavy-duty (Grade II) steel door for exterior location, factory primed for field painting.

B. Related Sections: The following sections contain requirements that relate to this Section:
   1. Section 02050, "Demolition", for removal of existing doors.
   2. Section 08710, "Finish Hardware", for requirements related to preparation of doors and frames for finish hardware.
   3. Section 707, Painting, DDOT Standard Specification, for painting the door and frame.

1.2 SUBMITTALS

A. Manufacturer's product data sheets listing manufacturer specifications for fabrication indicating that products comply with requirements.

B. Shop Drawings: Submit for fabrication and installation of steel door. Include details of the elevation of door design types, conditions at openings, details of construction, details of reinforcing, location and installation requirements of finish hardware and reinforcements, and details of joints and connections.
   1. Show anchorage and accessory items, including type and location of all reinforcing.
   2. Coordinate preparation of door with Hardware specified in Section 08710 and indicate hardware preparation requirements.

1.3 QUALITY ASSURANCE

A. Provide door complying with Steel Door Institute "Recommended Specifications: Standard Steel Doors and Frames" (SDI-100) and as herein specified.

B. Single Source Responsibility: Obtain steel doors and frames from a single manufacturer and fabricator.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver hollow metal work cartoned or crated to provide protection during transit and job storage. Provide additional sealed plastic wrapping for factory finished door.

B. Inspect door upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to the Engineer; otherwise, remove and replace damaged items as directed.

C. Store door at building site under cover. Place units on minimum 4" high wood blocking. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering which may be incorporated in the work include, but are not limited to, the following:
   1. Steel Doors :
      a. Ceco Door Products.
      b. Curries Company.
      c. Republic Builders Products.
      d. Rediframe Products

2.2 MATERIALS

A. Cold-Rolled Steel Sheets: 18 gauge cold-rolled commercial quality carbon steel, complying with ASTM A 366 and ASTM A 568.

B. Exterior Door: Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:

   1. Level 2 and Physical Performance Level B (Heavy Duty) Model 1 (Full Flush)

C. Inserts, Bolts, and Fasteners: Manufacturer's standard units complying with ASTM A 153, Class C or D as applicable.

D. Shop Applied Paint:
   1. Primer: Manufacturer’s standard universal rust-inhibitive alkyd metal primer.

E. Supports and Anchors: Fabricate of not less than 18 gauge galvanized sheet steel.

F. Silencers: Neoprene Rubber; Ives 20 or equal.

2.3 DOORS

A. General: Provide doors of sizes, thickness, and designs indicated

B. Exterior Doors: Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
   1. Level 2 and Physical Performance Level B (Heavy Duty) Model 1 (Full Flush)

2.4 FABRICATION, GENERAL

A. General: Fabricate steel door units to comply with ANSI A250.8 and to be rigid, neat in appearance, and free from defects including warp and buckle.

B. Exterior Door Construction: For exterior location, fabricate door panels from metallic-coated steel sheet. Close top and bottom edges of doors flush as an integral part of door construction or by addition of 0.053-inch (1.3mm) thick, metallic-coated steel channels with channel webs placed even with top and bottom edges.

C. Core Construction: Manufacturer's standard core construction that produces a door complying with SDI standards.

D. Clearance for Non-Fire-Rated Doors: Not more than 1/8 inch (3.2mm) at jambs and heads, except not more than ¼ inch (6.4mm) between pairs of doors. Not more than ¾ inch 19mm) at bottom.

E. Single-Acting, Door-Edge Profile: Square edge.

F. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

G. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold or hot-rolled steel sheet.

H. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

I. Hardware Preparation: Prepare frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware.

J. Locate hardware as indicated on Door Schedule on Drawings or, if not indicated, according to ANSI A250.8.

2.3 FINISHES

A. Finish: Anodized Bronze – All exterior doors.

B. Factory Priming for Field Painted Finish: For cold rolled steel where field painting after installation is indicated, factory apply full coat air dried primer. Paint immediately after surface preparation, cleaning and pretreatment, for all doors.

PART 3 EXECUTION

3.1 INSTALLATION

A. General: Verify existing opening dimensions and steel angles embedded into the concrete wall and header. Install standard steel door, and accessories in accordance with final shop drawings, manufacturer's data, and as herein specified.

1. In existing concrete or masonry construction, provide at least three completed opening anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Set frames and secure to adjacent construction with bolts and masonry anchorage devices.

2. Repair all damaged or defective frames prior to job closeout or final inspection.

A. Door Installation: Comply with ANSI A250.8. Fit hollow-metal doors accurately in frames, within clearances specified in ANSI A250.8. Shim as necessary to comply with DSI 122 and ANSI/DHI A115.1G.

3.2 ADJUST AND CLEAN

A. Prime Coat Touch-Up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

B. Protection Removal: Immediately prior to final inspection, remove protective plastic wrappings from pre-finished doors.

C. Final Adjustments: Check and readjust operating finish hardware items, leaving steel door undamaged and in complete and proper operating condition.

PART 4 MEASURE AND PAYMENT

4.1 LUMP SUM PRICE

A. The unit of measure will be the job. No actual measure will be made. Payment will be made at the contract lump sum price, which payment will include removal and proper disposal of existing door including all hardware, instating of new door and all hardware, painting of new door, and existing door opening’s frame, and furnishing all labor, tools, equipment and incidentals needed to complete all the above specified work.

END OF SECTION 08110

SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes, to the extent not furnished in other sections, the permanent door hardware for the following:
   1. Double Doors open to inside.

B. Related Sections include the following:
   1. Steel Doors and Frames - Section 8110.

C. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.

   1. Final replacement cores and keys to be installed by Owner.

1.2 SUBMITTALS

A. Product Data: Include installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of door hardware indicated.

C. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

   1. Content: Include the following information:

      a. Type, style, function, size, label, hand, and finish of each door hardware item.

      b. Manufacturer of each item.

      c. Fastenings and other pertinent information.

      d. Explanation of abbreviations, symbols, and codes contained in schedule.

      e. Mounting locations for door hardware.

      f. Door and frame sizes and materials.

D. Provide name and telephone number of manufacturer's representative for each submitted product.

E. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, indicating current products comply with requirements.

G. Warranties: Special warranties specified in this Section.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Supplier Qualifications: Door hardware supplier with warehousing facilities in Project's vicinity and who is or employs a qualified Hardware Consultant, available during the course of the Work to consult with Contractor and Owner about door hardware and keying.

1.4 DELIVERY, STORAGE AND HANDLING

A. Inventory door hardware on receipt and provide secure lockup for door hardware delivered to Project site.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Do not deliver hardware until immediately prior to installation. Store hardware in a secure room and guard against theft.

D. Provide temporary locksets on secure doors as required and install permanent locksets until shortly before time of Substantial Completion.

E. Deliver keys to Owner by registered mail or overnight package service.

1.5 WARRANTY

A. Written warranty: Executed by manufacturer agreeing to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.

2. Faulty operation of operators and door hardware.

3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

B. Warranty Period: **Three** years from date of Substantial Completion, unless otherwise indicated.

PART 2 PRODUCT

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware to comply with requirements for quantity, in this Section**,** item, design grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in the following Door Hardware Schedule or as indicated or required by actual conditions at the building. Some minor variation may be required.

Door Hardware Set External Steel Door
11/2 Pr. Hinges Stanley FBB 199
1 Ea. Mortise Lock Schlage L 9466 w/ Lever arm 06
3 Ea. Silencers Hager 307D
1 Ea. Overhead Closer LCN 4110H
1 Set Door Stop Hager 237W
1 Set. Top & Bottom Flush Bolts Hager 282D/283D
1 Set Weather-stripping Pemko 29310DS including at meeting stiles
2 Ea. Bottom Shoe Pemko 222DPK

2.2 HINGES AND PIVOTS, GENERAL

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Hinges:

a. Baldwin Hardware Corporation.

b. Bommer Industries, Inc.

c. Hager Companies.

d. Lawrence Brothers, Inc.

e. McKinney Products Company; Div. of ESSEX Industries, Inc.

f. Stanley Commercial Hardware; Div. of The Stanley Works.

B. Standards: Comply with the following:

1. Butts and Hinges: BHMA A156.1.Template Hinge Dimensions: BHMA A156.7.

2. Pivots: BHMA A156.4.

C. Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

Door Size (inches)	Hinge (inches)	Metal Thickness (inches)
36 by 84 by 1_3/4	4_1/2	0.180

D. Hinge Applications: Unless otherwise indicated, provide the following:

1. Exterior Entrance Door: Heavyweight hinges.

E. Hinge Base Metal: Unless otherwise indicated, provide the following:

1. Exterior Hinges: Stainless steel, with stainless steel pin

F. Fasteners: Comply with the following:

1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.

2. Screws: Phillips flathead screws; machine screws (drilled and tapped holes) for metal doors. Finish screw heads to match surface of hinges.

2.3 LOCKS AND LACHES, GENERAL

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Mechanical Locks and Latches:

a. Best Lock Corporation.

b. Corbin Russwin Architectural Hardware; Div. of Yale Security Inc.

c. Folger Adam Security Inc.

d. Schlage Lock Company; an Ingersoll_Rand Company.

e. Security Door Controls.

f. Simplex; Div. of UNICAN.

B. Standards: Comply with the following:

1. Bored Locks and Latches: BHMA A156.2.

2. Mortise Locks and Latches: BHMA A156.13.

C. Bored Locks: BHMA Grade 1; Series 4000.

D. Mortise Locks: Stamped steel case with steel or brass parts; BHMA Grade 1; Series 1000.

E. Lock Trim: Comply with the following:

1. Lever: Wrought, forged, or cast.

2. Knob: Wrought

3. Escutcheon (Rose): Wrought

4. Lockset Designs: Provide lockset design designated below or, if sets are provided by another manufacturer, provide designs that match those designated:

a. Bored Locks: Schlage D-Series

b. Mortise Locks: Schlage L-Series

2.4 FABRICATION

A. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18 for finishes. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.

B. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended. Provide Phillips flathead screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed.

2.5 FINISHES

A. Standard: Comply with BHMA A156.18.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of

other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. BHMA Designations: Comply with base material and finish requirements complying BHMA.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of door hardware.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPATRATION

A. Steel Doors and Frames: Comply with DHI A115 series.

1. Surface Applied Door Hardware: Drill and tap doors and frames according to SDI 107.

3.3 INSTALATION

A. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way. Do not install surface mounted items until finishes have been completed on substrates involved.

2. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.

3. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

PART 4 MEASURE AND PAYMENT

Door hardware for Steel doors will not be measured separately for payment; the cost thereof shall be included in the lump sum price for doors of which it is a part.

END OF SECTION 08710

DIVISION

SECTION 13283 - REMOVAL/CONTROL AND DISPOSAL
OF MATERIALS COATED WITH LEAD-CONTAINING PAINT

PART 1 GENERAL

Assume all painted surfaces contain lead. Demolition work shall comply with the OSHA Lead-in-Construction Standard.

This specification shall be followed for the demolition of

The work under this contract is not considered lead abatement, it is the demolition of structures and components that may be coated with lead-containing materials.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z88.2 (1992)	Respiratory Protection

U. S. CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1926.21	Safety Training and Education
29 CFR 1926.33 Records	Access to Employee Exposure and Medical
29 CFR 1926.55	Gases, Vapors, Fumes, Dusts, and Mists
29 CFR 1926.59	Hazard Communication
29 CFR 1926.62	Lead Exposure in Construction
29 CFR 1926.65	Hazardous Waste Operations and Emergency Response
29 CFR 1926.103	Respiratory Protection
40 CFR 260 General	Hazardous Waste Management Systems:
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Generators of Hazardous Waste
40 CFR 263	Transporters of Hazardous Waste
40 CFR 264	Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standard for Owners and

	Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 745	Lead; Requirements for Lead-Based Paint Activities
49 CFR 172	Hazardous Materials, Tables, and Hazardous Materials Communications Regulations
49 CFR 178	Shipping Container Specification

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)

HUD 6780	(1995) Guidelines for the Evaluation and Control of Lead Based Paint Hazards in Housing

UNDERWRITERS LABORATORIES INC. (UL)

UL 586	(1996 R 1999) High-Efficiency, Particulate, Air Filter Units

1.2 DEFINITIONS

1.2.1 Abatement

As applied to target housing and child occupied facilities, "abatement" means any set of measures designed to permanently eliminate lead-based paint hazards in accordance with standards established by appropriate Federal agencies. Such term includes:

a. The removal of lead-based paint and lead-contaminated dust, the permanent containment or encapsulation of lead-based paint, the replacement of lead-painted surfaces or fixtures, and the removal or covering of lead contaminated soil; and

b. All preparation, cleanup, disposal, and post-abatement clearance testing activities associated with such measures.

1.2.2 Action Level

Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8 hour period in a work environment.

1.2.3 Area Sampling

Sampling of lead concentrations within the lead control area and inside the physical boundaries, which is representative of the airborne lead concentrations but is not collected in the breathing zone of personnel.

1.2.4 Child Occupied Facility

A building or portion of a building constructed prior to 1978 visited regularly by the same child, 6 years of age or under, on a least two different days within any week, provided each days visit last at least 3 hours and the combined weekly visit last at least 6 hours and the combined annual visit last at least 60

hours. Child occupied facilities may include, but are not limited to day-care centers, preschools and kindergarten classrooms.

1.2.5 Competent Person (CP)

As used in this section, refers to a person employed by the Contractor who is trained in the recognition and control of lead hazards in accordance with current federal, State, and local regulations. A Certified Industrial Hygienist (CIH) certified for comprehensive practice by the American Board of Industrial Hygiene or a Certified Safety Professional (CSP) certified by the Board of Certified Safety Professionals is the best choice.

1.2.6 Contaminated Room

Refers to a room for removal of contaminated personal protective equipment (PPE).

1.2.7 Decontamination Shower Facility

That facility that encompasses a clean clothing storage room, and a contaminated clothing storage and disposal rooms, with a shower facility in between.

1.2.8 Deleading

Activities conducted by a person who offers to eliminate lead-based paint or lead-based paint hazards or to plan such activities in commercial buildings, bridges or other structures.

1.2.9 Eight-Hour Time Weighted Average (TWA)

Airborne concentration of lead to which an employee is exposed, averaged over an 8 hour workday as indicated in 29 CFR 1926.62.

1.2.10 High Efficiency Particulate Air (HEPA) Filter Equipment

HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-contaminated paint dust. A high efficiency particulate filter means 99.97 percent efficient against 0.3 micron or larger size particles.

1.2.11 Lead

Metallic lead, inorganic lead compounds, and organic lead soaps.

1.2.12 Lead-Based Paint (LBP)

Paint or other surface coating that contains lead in excess of 1.0 milligrams per centimeter squared or 0.5 percent by weight.

1.2.13 Lead-Based Paint Activities

In the case of target housing or child occupied facilities, lead-based paint activities include; a lead-based paint inspection, a risk assessment, or abatement of lead-based paint hazards.

1.2.14 Lead-Based Paint Hazard (LBP Hazard)

Any condition that causes exposure to lead from lead-contaminated dust, lead-contaminated soil, lead-based paint that is deteriorated or present in accessible surfaces, friction surfaces, or impact surfaces that would result in adverse human health effects.

1.2.15 Paint with Lead (PWL)

Any paint that contains lead as determined by the testing laboratory using a valid test method. The requirements of this section does not apply if no detectable levels of lead are found using a quantitative method for analyzing paint using laboratory instruments with specified limits of detection (usually 0.01%). An X-Ray Fluorescence (XRF) instrument is not considered a valid test method.

1.2.16 Lead Control Area

A system of control methods to prevent the spread of lead dust, paint chips or debris to adjacent areas that may include temporary containment, floor or ground cover protection, physical boundaries, and warning signs to prevent unauthorized entry of personnel. HEPA filtered local exhaust equipment may be used as engineering controls to further reduce personnel exposures or building/outdoor environmental contamination.

1.2.17 Lead Permissible Exposure Limit (PEL)

Fifty micrograms per cubic meter of air as an 8 hour time weighted average as determined by 29 CFR 1926.62. If an employee is exposed for more than eight hours in a workday, the PEL shall be determined by the following formula:

PEL (micrograms/cubic meter of air) = 400/No. hrs worked per day

1.2.18 Personal Sampling

Sampling of airborne lead concentrations within the breathing zone of an employee to determine the 8 hour time weighted average concentration in accordance with 29 CFR 1926.62. Samples shall be representative of the employees' work tasks. Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of 6 to 9 inches and centered at the nose or mouth of an employee.

1.2.19 Physical Boundary

Area physically roped or partitioned off around an enclosed lead control area to limit unauthorized entry of personnel. As used in this section, "inside boundary" shall mean the same as "outside lead control area but inside the physical boundary."

1.2.20 Target Housing

Housing constructed prior to 1978. It does not include housing for the elderly, or persons with disabilities unless any one or more children age 6 years and younger resides or is expected to reside in such housing.

1.3 DESCRIPTION

1.3.1 Description of Work

Demolish the structures and equipment designated in a manner that minimizes the release of lead to the environment and complies with the OSHA Lead-in-Construction Standard. Use methods that minimize the generation of dust. Use dust suppression methods and engineering controls to protect workers. Conduct OSHA lead exposure monitoring to establish respiratory protection requirements. Institute measures to collect lead chips so as not to contaminate the environment. Use covered dumpsters if components demolished are separated from the waste stream. Collect and analyze representative samples of the resulting demolition debris by TCLP methods. Dispose of waste in a legal manner. Assume for bidding purposes that waste is non-hazardous

1.3.2 Coordination with Other Work

The contractor shall coordinate with work being performed in adjacent areas. Coordination procedures shall be explained in the Removal/Control Plan and shall describe how the Contractor will prevent lead exposure to other contractors and/or Government personnel performing work unrelated to lead activities.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Vacuum Filters; G
Respirators; G

SD-06 Test Reports

sampling results; G

Occupational and Environmental Assessment Data Report; G

SD-07 Certificates

Qualifications of CP; G

Testing Laboratory qualifications; G

Third Party Consultant Qualifications; G

lead-based paint/paint with lead control plan including CP approval (signature, date, and certification number); G

Rental equipment notification; G

Respiratory Protection Program; G

Hazard Communication Program; G

State-approved hazardous waste treatment, storage, or disposal facility for lead disposal; G

Lead Waste Management Plan; G

Vacuum filters; G

Clearance Certification; G

SD-08 Manufacturer's Instructions

Chemicals and equipment; G

Materials; G

Material safety data sheets for all chemicals; G

SD-11 Closeout Submittals

Completed and signed hazardous waste manifest from treatment or disposal facility; G

Certification of Medical Examinations; G

Employee Training Certification; G

Waste turn-in documents or weight tickets for non-hazardous wastes that are disposed of at sanitary or construction and demolition landfills; G

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

1.5.1.1 Qualifications of CP

Submit name, address, and telephone number of the CP selected to perform responsibilities specified in paragraph entitled "Competent Person (CP) Responsibilities." Provide previous experience of the CP. Submit proper documentation that the CP is trained and licensed in accordance with Federal, State, and local laws.

1.5.1.2 Training Certification

Submit a certificate for each employee and supervisor, signed and dated by the authorized training provider meeting 40 CFR 745 (Subpart L) requirements, stating that the employee or supervisor has received the required lead training and is certified to perform or supervise deleading or lead removal. Submit proof the work will be performed by a certified firm.

1.5.1.3 Testing Laboratory

Submit the name, address, and telephone number of the testing laboratory selected to perform the air sampling, testing, and reporting of airborne concentrations of lead. Use a laboratory accredited under the EPA National Lead Laboratory Accreditation Program (NLLAP) by either the American Association for Laboratory Accreditation (A2LA) or the American Industrial Hygiene Association (AIHA) and that is successfully participating in the Environmental Lead Proficiency Analytical Testing (ELPAT) program to perform sample analysis. Laboratories selected to perform blood lead analysis shall be OSHA approved.

1.5.1.4 Third Party Consultant Qualifications

Submit the name, address, and telephone number of the third party consultant selected to perform the wipe sampling for determining concentrations of lead in dust or soil sampling. Submit proper documentation that the consultant is trained and certified as an inspector technician or inspector/risk assessor by the USEPA authorized State (or local) certification and accreditation program.

1.5.2 Requirements

1.5.2.1 Competent Person (CP) Responsibilities

a. Verify training meets all federal, State, and local requirements.

b. Review and approve lead-based paint/paint with lead removal/control plan for conformance to the applicable standards. Ensure work is performed in strict accordance with specifications at all times.

c. Continuously inspect lead-based paint removal/control work for conformance with the approved plan.

d. Perform air, wipe and TCLP sampling.

e. Control work to prevent hazardous exposure to human beings and to the environment at all times.

f. Certify the conditions of the work as called for elsewhere in this specification.

1.5.2.2 Lead-Based Paint/Paint with Lead Removal/Control Plan (LBP/PWL R/CP)

Submit a detailed job-specific plan of the work procedures to be used in the removal/control of LBP/PWL. The plan shall include a sketch showing the location, size, and details of lead control areas, location and details of decontamination facilities, viewing ports, and mechanical ventilation system. Include a description of equipment and materials, controls and job responsibilities for each activity from which lead is emitted. Include in the plan, eating, drinking, smoking and sanitary procedures, interface of trades, sequencing of lead related work, collected waste water and paint debris disposal plan, air sampling plan, respirators, personal protective equipment, and a detailed description of the method of containment of the operation to ensure that lead is not released outside the lead control area. Include site preparation, cleanup and clearance procedures. Include occupational and environmental sampling, training, sampling methodology, frequency, duration of sampling, and qualifications of sampling personnel in the air sampling portion of the plan. Include a description of arrangements made among contractors on multi-contractor worksites to inform affected employees and to clarify responsibilities to control exposures.

1.5.2.3 Occupational and Environmental Assessment Data Report

If initial monitoring is necessary, submit occupational and environmental sampling results to the Contracting Officer within three working days of collection, signed by the testing laboratory employee performing the analysis, the employee that performed the sampling, and the CP.

In order to reduce the full implementation of 29 CFR 1926.62, the Contractor shall provide documentation. Submit a report that supports the determination to reduce full implementation of the requirements of 29 CFR 1926.62 and supporting the Lead Removal/Control Plan.

a. The initial monitoring shall represent each job classification, or if working conditions are similar to previous jobs by the same employer, provide previously collected exposure data that can be used to estimate worker exposures per 29 CFR 1926.62. The data shall represent the worker's regular daily exposure to lead for stated work.

b. Submit worker exposure data gathered during the task based trigger operations of 29 CFR 1926.62 with a complete process description. This includes manual demolition, manual scraping, manual sanding, heat gun, power tool cleaning, rivet busting, cleanup of dry expendable abrasives, abrasive blast enclosure removal, abrasive blasting, welding, cutting and torch burning where lead containing coatings are present.

c. The initial assessment shall determine the requirement for further monitoring and the need to fully implement the control and protective requirements including the lead compliance plan per 29 CFR 1926.62.

1.5.2.4 Medical Examinations

Initial medical surveillance as required by 29 CFR 1926.62 shall be made available to all employees exposed to lead at any time (1 day) above the action level. Full medical surveillance shall be made available to all employees on an annual basis who are or may be exposed to lead in excess of the action level for more than 30 days a year or as required by 29 CFR 1926.62. Adequate records shall show that employees meet the medical surveillance requirements of 29 CFR 1926.33, 29 CFR 1926.62, and 29 CFR 1926.103. Maintain complete and accurate medical records of employees for a period of at least 30 years or for the duration of employment plus 30 years, whichever is longer.

1.5.2.5 Training

Train each employee performing paint removal, disposal, and air sampling operations prior to the time of initial job assignment and annually thereafter, in accordance with 29 CFR 1926.21, 29 CFR 1926.62, and State and local regulations where appropriate.

1.5.2.6 Respiratory Protection Program

a. Provide each employee required to wear a respirator a respirator fit test at the time of initial fitting and at least annually thereafter as required by 29 CFR 1926.62.

b. Establish and implement a respiratory protection program as required by ANSI Z88.2, 29 CFR 1926.103, 29 CFR 1926.62, and 29 CFR 1926.55.

1.5.2.7 Hazard Communication Program

Establish and implement a Hazard Communication Program as required by 29 CFR 1926.59.

1.5.2.8 Lead Waste Management

The Lead Waste Management Plan shall comply with applicable requirements of federal, State, and local hazardous waste regulations and address:

a. Identification and classification of hazardous wastes associated with the work; include TCLP sampling methodology.

b. Estimated quantities of wastes to be generated and disposed of.

c. Names and qualifications of each contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location and operator and a 24-hour point of contact. Furnish two copies of proof of hazardous waste.
d. Names and qualifications (experience and training) of personnel who will be working on-site with hazardous wastes.

e. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.

f. Spill prevention, containment, and cleanup contingency measures including a health and safety plan to be implemented in accordance with 29 CFR 1926.65.

g. Work plan and schedule for waste containment, removal and disposal. Wastes shall be cleaned up and containerized daily. Proper containment of the waste includes using acceptable waste containers (e.g., 55-gallon drums) as well as proper marking/labeling of the containers.

h. Unit cost for waste disposal if found to fail TCLP analysis.

1.5.2.9 Environmental, Safety and Health Compliance

In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of Federal, State, and local authorities regarding removing, handling, storing, transporting, and disposing of lead waste materials. Comply with the applicable requirements of the current issue of 29 CFR 1926.62. Submit matters regarding interpretation of standards to the Contracting Officer for resolution before starting work. Where specification requirements and the referenced documents vary, the most stringent requirement shall apply.

1.5.3 Pre-Construction Conference

Along with the CP, meet with the Contracting Officer to discuss in detail the lead waste management plan and the lead-based paint/paint with lead removal/control plan, including work procedures and precautions for the removal plan.

1.6 EQUIPMENT

1.6.1 Respirators

Furnish appropriate respirators approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services, for use in atmospheres containing lead dust. Respirators shall comply with the requirements of 29 CFR 1926.62.

1.6.2 Special Protective Clothing

Furnish personnel who will be exposed to lead-contaminated dust with proper disposable protective whole body clothing, head covering, gloves, and foot coverings as required by 29 CFR 1926.62. Furnish proper disposable plastic or rubber gloves to protect hands. Reduce the level of protection only after obtaining approval from the CP.

1.6.3 Rental Equipment Notification

If rental equipment is to be used during lead-based paint handling and disposal, notify the rental agency in writing concerning the intended use of the equipment. Furnish a copy of the written notification to the Contracting Officer.

1.6.4 Vacuum Filters

UL 586 labeled HEPA filters.

1.6.5 Equipment for Government Personnel

Furnish the Contracting Officer with two complete sets of personal protective equipment (PPE) daily, as required herein, for entry into and inspection of the paint removal work within the lead controlled area. Personal protective equipment shall include disposable whole body covering, including appropriate foot, head, and hand protection. PPE shall remain the property of the Contractor. The Government will provide respiratory protection for the Contracting Officer.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Protection of Existing Work to Remain

Perform paint removal work without damage or contamination of adjacent areas. Where existing work is damaged or contaminated, restore work to its original condition or better.

PART 2 PRODUCTS

Provide all necessary personal protective equipment.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Protection

3.1.1.1 Notification

a. Notify the Contracting Officer 20 days prior to the start of any paint removal work.

3.1.1.2 Boundary Requirements

a. Provide physical boundaries around the lead control area by roping off the area designated in the work plan or providing curtains, portable partitions or other enclosures to ensure that lead will not escape outside the lead control area.

b. Warning Signs - Provide warning signs at approaches to lead control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62.

3.1.1.3 Furnishings

NA

3.1.1.4 Heating, Ventilating and Air Conditioning (HVAC) Systems

Shut down, lock out, and isolate HVAC systems that supply, exhaust, or pass through the lead control areas. Seal intake and exhaust vents in the lead control area with 6 mil plastic sheet and tape. Seal seams in HVAC components that pass through the lead control area. Provide temporary HVAC system for areas in which HVAC has been shut down outside the lead control area.

3.1.1.5 Decontamination Shower Facility

Provide clean and contaminated change rooms and shower facilities in accordance with this specification and 29 CFR 1926.62.

3.1.1.6 Eye Wash Station

Where eyes may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes shall be provided within the work area.

3.1.1.7 Mechanical Ventilation System

a. Use adequate ventilation to control personnel exposure to lead in accordance with 29 CFR 1926.62.

b. To the extent feasible, use local exhaust ventilation connected to HEPA filters or other collection systems, approved by the CP. Local exhaust ventilation systems shall be evaluated and maintained in accordance with 29 CFR 1926.62.

c. Vent local exhaust outside the building only and away from building ventilation intakes.

d. Use locally exhausted, power actuated, paint removal tools.

3.1.1.8 Personnel Protection

Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking or application of cosmetics is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been appropriately trained and provided with protective equipment.

3.2 ERECTION

3.2.1 Lead Control Area Requirements

Establish a lead control area by situating critical barriers and physical boundaries around the area or structure where LBP/PWL removal/control operations will be performed.

3.3 APPLICATION

3.3.1 Work Procedures

Perform removal of materials coated with lead-containing paint in accordance with approved lead-based paint/paint with lead removal/control plan. Use procedures and equipment required to limit occupational and environmental exposure to lead when lead-based paint is removed in accordance with 29 CFR 1926.62. Dispose of removed paint chips and associated waste in compliance with Environmental Protection Agency (EPA), State, and local requirements.

3.3.2 Personnel Exiting Procedures

Whenever personnel exit the lead-controlled area, they shall perform the following procedures and shall not leave the work place wearing any clothing or equipment worn during the work day:

a. Vacuum themselves off.

b. Remove protective clothing in the contaminated change room, and place them in an approved impermeable disposal bag.

c. Wash hands and face at the site, don appropriate disposable or uncontaminated reusable clothing; move to an appropriate facility; shower.

d. Change to clean clothes prior to leaving the physical boundary designated around the lead control area.

3.4 FIELD QUALITY CONTROL

3.4.1 Tests

3.4.1.1 Air and Wipe Sampling

Air sample for lead in accordance with 29 CFR 1926.62 and as specified herein. Air and wipe sampling shall be directed or performed by the CP.

a. The CP shall be on the job site directing the air and non-clearance wipe sampling and inspecting the lead-based paint removal/control work to ensure that the requirements of the contract have been satisfied during the entire lead-based paint removal operation.

b. Collect personal air samples on employees who are expected to have the greatest risk of exposure as determined by the CP. In addition, collect air samples on at least 25 percent of the work crew or a minimum of two employees, whichever is greater, during each work shift.

c. Submit results of air samples, within 72 hours after the air samples are taken.

d. Before any work begins, a third party consultant shall collect and analyze baseline wipe and soil samples in accordance with methods defined in federal, state, and local standards inside and outside of the physical boundary to assess the degree of dust contamination in the facility prior to lead-based paint removal/control.

3.4.1.2 Air Sampling During Paint Removal Work

Conduct area air sampling on the initial demolition of each unit type, on each shift in which lead-based paint removal operations are performed, in areas immediately adjacent to the lead control area. Sufficient area monitoring shall be conducted to ensure unprotected personnel are not exposed at or above 30 micrograms per cubic meter of air. If 30 micrograms per cubic meter of air is reached or exceeded, stop work, correct the conditions(s) causing the increased levels. Notify the Contracting Officer immediately. Determine if condition(s) require any further change in work methods. Removal work shall resume only after the CP and the Contracting Officer give approval. For outdoor operations, at least one sample on each shift shall be taken on the downwind side of the lead control area.

3.4.1.3 Sampling After Paint Removal/Control

After the visual inspection, collect wipe samples according to the HUD protocol contained in HUD 6780 to determine the lead content of settled dust and dirt in micrograms per square meter foot of surface area. Results must meet current wipe testing criteria or the unit must be recleaned.

3.4.1.4 Testing of Removed Paint and Used Abrasive

Test removed paint and used abrasive in accordance with 40 CFR 261 for hazardous waste.

3.5 CLEANING AND DISPOSAL

3.5.1 Cleanup

Maintain surfaces of the lead control area free of accumulations of paint chips and dust. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use compressed air to clean up the area. At the end of each shift and when the paint removal operation has been completed, clean the area of visible lead paint contamination by vacuuming with a HEPA filtered vacuum cleaner, wet mopping the area and wet wiping the area as indicated by the CP. Reclean areas showing dust or residual paint chips or debris. After visible dust, chips and debris is removed, wet wipe and HEPA vacuum all surfaces in the work area. If adjacent areas become contaminated at any time during the work, clean, visually inspect, and then wipe sample all contaminated areas. The CP shall then certify in writing that the area has been cleaned of lead contamination before restarting work.

3.5.1.1 Clearance Certification

The CP shall certify in writing that air samples collected outside the lead control area during paint removal operations were less than 30 micrograms per cubic meter of air; that the final clearance wipe

samples are acceptable; the respiratory protection used for the employees was adequate; the work procedures were performed in accordance with 29 CFR 1926.62 and 40 CFR 745; and that there were no visible accumulations of material and dust containing lead left in the work site. Do not remove the lead control area or roped off boundary and warning signs prior to the Contracting Officer's acknowledgement of receipt of the CP certification.

For exterior paint removal/control work, soil samples taken at the exterior of the work site shall be used to determine if soil lead levels had increased at a statistically significant level (significant at the 95 percent confidence limit) from the soil lead levels prior to the work. If soil lead levels do show a statistically significant increase or is above any applicable Federal or State standard for lead in soil, the soil shall be remediated back to the pre-work level.

3.5.2 Disposal

a. Collect lead-contaminated waste, scrap, debris, bags, containers, equipment, and lead-contaminated clothing that may produce airborne concentrations of lead particles. Label the containers in accordance with 29 CFR 1926.62 and 40 CFR 262. Dispose of lead-contaminated waste material at a State-approved hazardous waste treatment, storage, or disposal facility off government property.

b. Place waste materials in U.S. Department of Transportation (49 CFR 178) approved 55 gallon drums. Properly label each drum to identify the type of waste (49 CFR 172) and the date the drum was filled. For hazardous waste, the collection drum requires marking/labeling in accordance with 40 CFR 262 during the accumulation/collection timeframe. The Contracting Officer or an authorized representative will assign an area for interim storage of waste-containing drums. Do not store hazardous waste drums in interim storage longer than 90 calendar days from the date affixed to each drum.

c. Handle, transport, and dispose lead or lead-contaminated material classified as hazardous waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, and 40 CFR 265. Comply with land disposal restriction notification requirements as required by 40 CFR 268.

d. All material, whether hazardous or non-hazardous shall be disposed in accordance with laws and provisions and Federal, State, or local regulations. Ensure waste is properly characterized. The result of each waste characterization (TCLP for RCRA materials) will dictate disposal requirements.

3.5.2.1 Disposal Documentation

Submit written evidence to demonstrate the hazardous waste treatment, storage, or disposal facility (TSD) is approved for lead disposal by the EPA, State or local regulatory agencies. Submit one copy of the completed hazardous waste manifest, signed and dated by the initial transporter in accordance with 40 CFR 262. Contractor shall provide a certificate that the waste was accepted by the disposal facility. Provide turn-in documents or weight tickets for non-hazardous waste disposal.

3.5.3 Payment for Hazardous Waste

Payment for disposal of hazardous and non-hazardous waste will not be made until a signed copy of the manifest from the treatment or disposal facility certifying the amount of lead-containing materials or non-hazardous waste delivered is returned and a copy is furnished to the Government.

END OF SECTION 13283

SECTION 15010 – MECHANICAL SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Work covered by the Contract Documents.
2. Type of the Contract.
3. Work phases.
4. Work under other contracts.
5. Products ordered in advance.
6. Owner-furnished products.
7. Use of premises.
8. Owner's occupancy requirements.
9. Work restrictions.
10. Specification formats and conventions.

B. Related Sections include the following:

1. Division 1 Section "Summary of Multiple Contracts" for division of responsibilities for the Work.
2. Division 1 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: Eastern Avenue Pumping Station – BH3107 (001)

1. Project Location: Eastern Avenue & Olive Street, NE

B. Owner: WASA

C. Engineer: Allen & Shariff

D. The Work consists of the following:

1. The Work includes the removal and replacement of storm water pumps, including new controllers, valves and piping tied into existing discharge lines. During the course of the work the pumping station shall remain in service.

2. This would require the removal of one pump, valves, piping, controllers and electrical while maintaining the operation of the remaining existing pump. Prior to the installation of the first new pump the electrical contractor shall install a new service to the building. After the construction and installation of the new pump has been tested to the satisfaction of the Owner, the second pump shall be installed. At no time shall the pumping station by without the operation of a single pump.

3. The contractor shall include the cost of providing a bypass pumping service in their proposal for a scheduled period of time as required to perform their work.

1.4 TYPE OF CONTRACT

A. Project will be constructed under a single prime contract.

1.5 WORK UNDER OTHER CONTRACTS

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.

1.6 USE OF PREMISES

A. General: Each Contractor shall have full use of premises for construction operations, including use of Project site, during construction period. Each Contractor's use of premises is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. Use of Existing Building: Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

1.7 OWNER'S OCCUPANCY REQUIREMENTS

A. Full Owner Occupancy: Owner will occupy site and **existing** building during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits, unless otherwise indicated.

1. Maintain access to existing walkways, and other adjacent occupied or used facilities. Do not close or obstruct walkways, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
2. Provide not less than 72 hours notice to Owner of activities that will affect Owner's operations.

1.8 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 16-division format and CSI/CSC's "MasterFormat" numbering system.

1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
2. Division 1: Sections in Division 1 govern the execution of the Work of all Sections in the Specifications.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

    a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 15010

SECTION 15052 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Plumbing demolition.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 15 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. [**Available**]Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Dresser Industries, Inc.; DMD Div.
c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
d. JCM Industries.
e. Smith-Blair, Inc.
f. Viking Johnson.

2. Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling.
4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: [**CPVC**] [**PVC**] [**CPVC and PVC**] one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. [**Available**]Manufacturers:

a. Eslon Thermoplastics.
b. Plasco Welding & Fabrication, Inc.

c. Harvel Plastics, Inc.
d. Georg Fishcer Piping Systems
e. Thompson Plastics, Inc.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. [**Available**]Manufacturers:

a. Thompson Plastics, Inc.
b. Plasco Welding & Fabrication, Inc.
c. Harvel Plastics, Inc.
d. Georg Fishcer Piping Systems

D. Plastic-to-Metal Transition Unions: MSS SP-107, [**CPVC**] [**PVC**] [**CPVC and PVC**] four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. [**Available**]Manufacturers:

a. NIBCO INC.
b. NIBCO, Inc.; Chemtrol Div.
c. USCO-FW Webb Utilites Supply Co.
d. Spears Manufacturing Company

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. [**Available**]Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Fernco, Inc.
c. Mission Rubber Company.
d. Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

1. [**Available**]Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Eclipse, Inc.
d. Epco Sales, Inc.

e. Hart Industries, International, Inc.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

1. [**Available**]Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. [**Available**]Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

1. [**Available**]Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.
c. Watts Water Twchnologies, Inc.
d. Hart Industries, International Inc.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

1. [**Available**]Manufacturers:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. [**Available**]Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: [**EPDM**] [**NBR**] interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: [**Plastic**] [**Carbon steel**] [**Stainless steel**]. Include two for each sealing element.
4. Connecting Bolts and Nuts: [**Carbon steel with corrosion-resistant coating**] [**Stainless steel**] of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe: ASTM D 1785, Schedule 40.

G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: [**Polished chrome-plated**] [**Rough brass**] [**Polished chrome-plated and rough brass**].

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: [**Polished chrome-plated**] [**Rough brass**] [**Polished chrome-plated and rough brass**].

E. One-Piece, Stamped-Steel Type: With [**set screw**] [**spring clips**] [**set screw or spring clips**] and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With [**concealed**] [**exposed-rivet**] hinge, [**set screw**] [**spring clips**] [**set screw or spring clips**], and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    f. Bare Piping at Ceiling Penetrations in Finished Spaces: [**One-piece**] [**Split-casting**] [**One-piece or split-casting**], cast-brass type with polished chrome-plated finish.

g. Bare Piping at Ceiling Penetrations in Finished Spaces: [**One-piece, stamped-steel type**] [**Split-plate, stamped-steel type with concealed hinge**] [**One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge**] and set screw.
h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with [**polished chrome-plated**] [**rough-brass**] finish.
i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with [**concealed**] [**exposed-rivet**] [**concealed or exposed-rivet**] hinge and [**set screw**] [**spring clips**] [**set screw or spring clips**].
j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with [**set screw**] [**spring clips**] [**set screw or spring clips**].
l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

2. Existing Piping: Use the following:

a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
b. Insulated Piping: Split-plate, stamped-steel type with [**concealed**] [**exposed-rivet**] [**concealed or exposed-rivet**] hinge and spring clips.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
g. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with [**polished chrome-plated**] [**rough-brass**] finish.
h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with [**concealed**] [**exposed-rivet**] [**concealed or exposed-rivet**] hinge and set screw or spring clips.
i. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
k. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. [**PVC**] [**Steel**] Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

A. Painting of plumbing systems, equipment, and components is specified in Division 9 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use [**3000-psi (20.7-MPa)**], 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "[**Cast-in-Place Concrete**] [**Cast-in-Place Concrete (Limited Applications)**]."

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.10 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 15052

SECTION 15057 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: [**Class F**].

J. Code Letter Designation:

1. Motors [**15**] HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than [**15**] HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes [**324T**] and larger; rolled steel for motor frame sizes smaller than [**324T**].

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: [**Ratings, characteristics, and features coordinated with and approved by controller manufacturer.**]

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 15057

SECTION 15061 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following hangers and supports for plumbing system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Pipe positioning systems.
10. Equipment supports.

B. Related Sections include the following:

1. Division 5 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 13 Section "Fire-Suppression Piping" for pipe hangers for fire-suppression piping.
3. Division 15 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
4. Division 15 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment[**and obtain approval from authorities having jurisdiction**].

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Fiberglass pipe hangers.
3. Thermal-hanger shield inserts.
4. Powder-actuated fastener systems.
5. Pipe positioning systems.

B. Shop Drawings:[**Signed and sealed by a qualified professional engineer.**] Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Fiberglass strut systems. Include Product Data for components.
4. Pipe stands. Include Product Data for components.
5. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to [**AWS D1.1, "Structural Welding Code--Steel."**] [**AWS D1.4, "Structural Welding Code--Reinforcing Steel."**] [**ASME Boiler and Pressure Vessel Code: Section IX.**]

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
4. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. [**Available**]Manufacturers:

1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 FIBERGLASS PIPE HANGERS

A. Clevis-Type, Fiberglass Pipe Hangers: Similar to MSS Type 1, steel pipe hanger except hanger is made of fiberglass and continuous-thread rod and nuts are made of [**polyurethane**] [**polyurethane or stainless steel**] [**stainless steel**].

1. [**Available**]Manufacturers:

    a. B-Line Systems, Inc.; a division of Cooper Industries.
    b. Champion Fiberglass, Inc.
    c. Cope, T. J., Inc.; Tyco International, Ltd.
    d. Seasafe, Inc.
    e. Unistrut Corp.; Tyco International, Ltd.
    f. Wesanco, Inc.

B. Strap-Type, Fiberglass Pipe Hangers: Made of fiberglass loop with stainless-steel continuous-thread rod, nuts, and support hook.

1. [**Available**]Manufacturers:

    a. Plasti-Fab, Inc.
    b. All Plastics and Fiberglass, Inc.
    c. Lee Composites, Inc.
    d. Unistrut, Inc.

2.5 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. [**Available**]Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.6 FIBERGLASS STRUT SYSTEMS

A. Description: Shop- or field-fabricated pipe-support assembly, similar to MFMA-3, made of fiberglass channels and other components.

B. [**Available**]Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. Champion Fiberglass, Inc.
3. Cope, T. J., Inc.; Tyco International Ltd.
4. Seasafe, Inc.

2.7 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- (690-kPa-) minimum, compressive-strength insulation insert encased in sheet metal shield.

B. [**Available**]Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: [**Water-repellent treated, ASTM C 533, Type I calcium silicate**] [**Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass**] [**ASTM C 552, Type II cellular glass**] with vapor barrier.

D. Insulation-Insert Material for Hot Piping: [**Water-repellent treated, ASTM C 533, Type I calcium silicate**] [**Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass**] [**ASTM C 552, Type II cellular glass**].

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.8 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. [**Available**]Manufacturers:

a. Hilti, Inc.
b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.

d. MKT Fastening, LLC.
e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type [**zinc-coated**] [**stainless**] steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. [**Available**]Manufacturers:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head.
e. MKT Fastening, LLC.
f. Powers Fasteners.

2.9 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

1. [**Available**]Manufacturers:

a. ERICO/Michigan Hanger Co.
b. MIRO Industries.
c. PHP Systems/Design
d. PHS Industries, Inc

C. Low-Type, Single-Pipe Stand: One-piece [**plastic**] [**stainless-steel**] base unit with plastic roller, for roof installation without membrane penetration.

1. [**Available**]Manufacturers:

a. MIRO Industries.
b. PHP Systems/Design
c. PHS Industries, Inc
d. ERICO/Michigan Hanger Co.

D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

1. [**Available**]Manufacturers:

a. ERICO/Michigan Hanger Co.
b. MIRO Industries.

c. Portable Pipe Hangers.

2. Base: [**Plastic**] [**Stainless steel**].
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

1. [**Available**]Manufacturers:

a. Portable Pipe Hangers.
b. ERICO/Michigan Hanger Co.
c. PHP Systems/Design

2. Bases: One or more plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.10 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

B. [**Available**]Manufacturers:

1. C & S Mfg. Corp.
2. HOLDRITE Corp.; Hubbard Enterprises.
3. Samco Stamping, Inc.

2.11 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.12 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F (49 to 232 deg C) pipes, NPS 4 to NPS 16 (DN 100 to DN 400), requiring up to 4 inches (100 mm) of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24 (DN 20 to DN 600), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24 (DN 15 to DN 600), if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8 (DN 20 to DN 200).
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2 (DN 15 to DN 50).
10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8 (DN 10 to DN 200).
11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3 (DN 10 to DN 80).

12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36 (DN 100 to DN 900), with steel pipe base stanchion support and cast-iron floor flange.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36 (DN 100 to DN 900), with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36 (DN 65 to DN 900), if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30 (DN 25 to DN 750), from 2 rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20 (DN 65 to DN 500), from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42 (DN 50 to DN 1050), if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24 (DN 50 to DN 600), if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30 (DN 50 to DN 750), if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb (340 kg).
    b. Medium (MSS Type 32): 1500 lb (680 kg).
    c. Heavy (MSS Type 33): 3000 lb (1360 kg).

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.

5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use [**powder-actuated fasteners**] [**or**] [**mechanical-expansion anchors**] instead of building attachments where required in concrete construction.

O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Fiberglass Pipe Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled fiberglass struts.

F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

G. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

H. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 7 Section "Roof Accessories" for curbs.

I. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 15 Section "Plumbing Fixtures" for plumbing fixtures.

J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

M. Install lateral bracing with pipe hangers and supports to prevent swaying.

N. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, [**NPS 2-1/2 (DN 65)**] and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

O. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

Q. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
   b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
   c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
   d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
   e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.

5. Pipes NPS 8 (DN 200) and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for [**trapeze pipe hangers**] [**and**] [**equipment supports**].

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to [**1-1/2 inches (40 mm)**].

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9 [**painting Sections.**] [**Section "High-Performance Coatings."**]

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 15061

SECTION 15076 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: [**Brass, 0.032-inch (0.8-mm)**] [**Stainless steel, 0.025-inch (0.64-mm)**] [**Aluminum, 0.032-inch (0.8-mm)**] [**or**] [**anodized aluminum, 0.032-inch (0.8-mm)**] minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel [**rivets**] [**rivets or self-tapping screws**] [**self-tapping screws**].
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, [**1/16 inch (1.6 mm)**] [**1/8 inch (3.2 mm)**] thick, and having predrilled holes for attachment hardware.
2. Letter Color: [**Black**] [**Blue**] [**Red**] [**White**] [**Yellow**].
3. Background Color: [**Black**] [**Blue**] [**Red**] [**White**] [**Yellow**].
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel [**rivets**] [**rivets or self-tapping screws**] [**self-tapping screws**].
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, [**1/16 inch (1.6 mm)**] [**1/8 inch (3.2 mm)**] thick, and having predrilled holes for attachment hardware.

B. Letter Color: [**Black**] [**Blue**] [**Red**] [**White**] [**Yellow**].

C. Background Color: [**Black**] [**Blue**] [**Red**] [**White**] [**Yellow**].

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel [**rivets**] [**rivets or self-tapping screws**] [**self-tapping screws**].

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to [**partially cover**] [**cover full**] circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: [**Aluminum**] [**Brass**] [**Fiberboard**] [**Fiberboard or metal**].

2. Stencil Paint: Exterior, gloss, [**alkyd enamel**] [**acrylic enamel**] black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, [**alkyd enamel**] [**acrylic enamel**] in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: [**Brass, 0.032-inch (0.8-mm)**] [**Stainless steel, 0.025-inch (0.64-mm)**] [**Aluminum, 0.032-inch (0.8-mm)**] [**or**] [**anodized aluminum, 0.032-inch (0.8-mm)**] minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass [**wire-link or beaded chain; or S-hook**] [**wire-link chain**] [**beaded chain**] [**S-hook**].

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: [**3 by 5-1/4 inches (75 by 133 mm) minimum**] [**Approximately 4 by 7 inches (100 by 178 mm)**].
2. Fasteners: [**Brass grommet and wire**] [**Reinforced grommet and wire or string**].
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 9 Section "[**Interior Painting**] [**High-Performance Coatings**]."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels [**with painted, color-coded bands or rectangles**] [**, complying with ASME A13.1,**] on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of [**50 feet (15 m)**] along each run. Reduce intervals to [**25 feet (7.6 m)**] in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

1. Low-Pressure, Compressed-Air Piping:

   a. Background Color: [**Black**] [**Blue**] [**Red**] [**White**] [**Yellow**].
   b. Letter Color: [**Black**] [**Blue**] [**Red**] [**White**] [**Yellow**].

2. Medium-Pressure, Compressed-Air Piping:

   a. Background Color: [**Black**] [**Blue**] [**Red**] [**White**] [**Yellow**].
   b. Letter Color: [**Black**] [**Blue**] [**Red**] [**White**] [**Yellow**].

3. Domestic Water Piping:

   a. Background Color: [**Black**] [**Blue**] [**Red**] [**White**] [**Yellow**].
   b. Letter Color: [**Black**] [**Blue**] [**Red**] [**White**] [**Yellow**].

4. [**Sanitary Waste**] [**and**] [**Storm Drainage**] Piping:

   a. Background Color: [**Black**] [**Blue**] [**Red**] [**White**] [**Yellow**].
   b. Letter Color: [**Black**] [**Blue**] [**Red**] [**White**] [**Yellow**].

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

   a. Cold Water: [**1-1/2 inches (38 mm)**] [**2 inches (50 mm)**], [**round**] [**square**].
   b. Hot Water: [**1-1/2 inches (38 mm)**] [**2 inches (50 mm)**], [**round**] [**square**].
   c. Low-Pressure Compressed Air: [**1-1/2 inches (38 mm)**] [**2 inches (50 mm)**], [**round**] [**square**].
   d. High-Pressure Compressed Air: [**1-1/2 inches (38 mm)**] [**2 inches (50 mm)**], [**round**] [**square**].

2. Valve-Tag Color:

   a. Cold Water: [**Natural**] [**Green**].
   b. Hot Water: [**Natural**] [**Green**].
   c. Low-Pressure Compressed Air: [**Natural**] [**Green**].
   d. High-Pressure Compressed Air: [**Natural**] [**Green**].

3. Letter Color:

   a. Cold Water: [**Black**] [**White**].
   b. Hot Water: [**Black**] [**White**].
   c. Low-Pressure Compressed Air: [**Black**] [**White**].
   d. High-Pressure Compressed Air: [**Black**] [**White**].

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 15076

SECTION 15111 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze angle valves.
2. Brass ball valves.
3. Bronze ball valves.
4. Iron ball valves.
5. Iron, single-flange butterfly valves.
6. Iron, grooved-end butterfly valves.
7. Bronze lift check valves.
8. Bronze swing check valves.
9. Iron swing check valves.
10. Iron swing check valves with closure control.
11. Iron, grooved-end swing check valves.
12. Iron, center-guided check valves.
13. Iron, plate-type check valves.
14. Bronze gate valves.
15. Iron gate valves.
16. Bronze globe valves.
17. Iron globe valves.
18. Lubricated plug valves.
19. Chainwheels.

B. Related Sections:

1. Division 2 water distribution piping Sections for general-duty and specialty valves for site construction piping.
2. Division 15 plumbing piping Sections for specialty valves applicable to those Sections only.
3. Division 15 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 (DN 200) and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller[**except plug valves**].
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every [**5**] [**10**] plug valves, for each size square plug-valve head.
5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

A. Class 125, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Hammond Valve.
b. Milwaukee Valve Company.
c. Nibco Inc.
d. American Valve, Inc

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron[**, bronze, or aluminum**].

B. Class 125, Bronze Angle Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. American Valve, Inc.
b. NIBCO INC.
c. Milwaukee Valve Company.
d. Hammond Valve.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: PTFE or TFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron[**, bronze, or aluminum**].

C. Class 150, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Crane Co.; Crane Valve Group; Stockham Division.
b. Kitz Corporation.
c. American Valve, Inc.
d. NIBCO INC.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.

g. Handwheel: Malleable iron[**, bronze, or aluminum**].

D. Class 150, Bronze Angle Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Powell Valves.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: PTFE or TFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron[**, bronze, or aluminum**].

2.3 BRASS BALL VALVES

A. One-Piece, Reduced-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Kitz Corporation.
b. Watts Water Technologies, Inc.
c. DuraValve, Inc.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Design: One piece.
d. Body Material: Forged brass.
e. Ends: Threaded.
f. Seats: PTFE or TFE.
g. Stem: Brass.
h. Ball: Chrome-plated brass.

i. Port: Reduced.

B. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. DynaQuip Controls.
d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
e. Hammond Valve.
f. Jamesbury; a subsidiary of Metso Automation.
g. Jomar International, LTD.
h. Kitz Corporation.
i. Legend Valve.
j. Marwin Valve; a division of Richards Industries.
k. Milwaukee Valve Company.
l. NIBCO INC.
m. Red-White Valve Corporation.
n. RuB Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Full.

C. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
d. Hammond Valve.
e. Jamesbury; a subsidiary of Metso Automation.
f. Kitz Corporation.
g. Marwin Valve; a division of Richards Industries.
h. Milwaukee Valve Company.

i. RuB Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

D. Two-Piece, Regular-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Hammond Valve.
b. Jamesbury; a subsidiary of Metso Automation.
c. Legend Valve.
d. Marwin Valve; a division of Richards Industries.
e. Milwaukee Valve Company.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Regular.

E. Two-Piece, Regular-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Jamesbury; a subsidiary of Metso Automation.
b. Marwin Valve; a division of Richards Industries.
c. Watts Water Technologies, Inc.
d. M.A. Stewart and Sons, Ltd.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Brass or bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Regular.

F. Three-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Jomar International, LTD.
b. Kitz Corporation.
c. Red-White Valve Corporation.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Three piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Full.

G. Three-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Jomar International, LTD.
b. Kitz Corporation.
c. Marwin Valve; a division of Richards Industries.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Three piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.4 BRONZE BALL VALVES

A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. American Valve, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. NIBCO INC.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Design: One piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE or TFE.
g. Stem: Bronze.
h. Ball: Chrome-plated brass.
i. Port: Reduced.

B. One-Piece, Reduced-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Conbraco Industries, Inc.; Apollo Valves.
b. NIBCO INC.
c. American Valve, Inc

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig (4140 kPa).

c. Body Design: One piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE or TFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Reduced.

C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. American Valve, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Crane Co.; Crane Valve Group; Crane Valves.
d. Hammond Valve.
e. Lance Valves; a division of Advanced Thermal Systems, Inc.
f. Legend Valve.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Red-White Valve Corporation.
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

D. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Hammond Valve.
d. Lance Valves; a division of Advanced Thermal Systems, Inc.
e. Milwaukee Valve Company.
f. NIBCO INC.

g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

E. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. American Valve, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. DynaQuip Controls.
f. Hammond Valve.
g. Lance Valves; a division of Advanced Thermal Systems, Inc.
h. Milwaukee Valve Company.
i. NIBCO INC.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Regular.

F. Two-Piece, Regular-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Regular.

G. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Conbraco Industries, Inc.; Apollo Valves.
b. DynaQuip Controls.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Red-White Valve Corporation.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Three piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

H. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Three piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.5 IRON BALL VALVES

A. Class 125, Iron Ball Valves:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. American Valve, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Kitz Corporation.
d. Sure Flow Equipment Inc.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-72.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Split body.
d. Body Material: ASTM A 126, gray iron.
e. Ends: Flanged.
f. Seats: PTFE or TFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel.
i. Port: Full.

2.6 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
    b. Conbraco Industries, Inc.; Apollo Valves.
    c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
    d. Crane Co.; Crane Valve Group; Jenkins Valves.
    e. Crane Co.; Crane Valve Group; Stockham Division.
    f. DeZurik Water Controls.
    g. Flo Fab Inc.
    h. Hammond Valve.
    i. Kitz Corporation.
    j. Legend Valve.
    k. Milwaukee Valve Company.
    l. NIBCO INC.
    m. Norriseal; a Dover Corporation company.
    n. Red-White Valve Corporation.
    o. Spence Strainers International; a division of CIRCOR International, Inc.
    p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Standard: MSS SP-67, Type I.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
    d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
    e. Seat: EPDM.
    f. Stem: One- or two-piece stainless steel.
    g. Disc: Aluminum bronze.

B. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
    b. Conbraco Industries, Inc.; Apollo Valves.
    c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
    d. Crane Co.; Crane Valve Group; Jenkins Valves.
    e. Crane Co.; Crane Valve Group; Stockham Division.
    f. DeZurik Water Controls.
    g. Flo Fab Inc.
    h. Hammond Valve.
    i. Kitz Corporation.
    j. Legend Valve.
    k. Milwaukee Valve Company.
    l. NIBCO INC.

m. Norriseal; a Dover Corporation company.
n. Red-White Valve Corporation.
o. Spence Strainers International; a division of CIRCOR International, Inc.
p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: NBR.
f. Stem: One- or two-piece stainless steel.
g. Disc: Aluminum bronze.

C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. American Valve, Inc.
c. Conbraco Industries, Inc.; Apollo Valves.
d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
e. Crane Co.; Crane Valve Group; Center Line.
f. Crane Co.; Crane Valve Group; Stockham Division.
g. DeZurik Water Controls.
h. Flo Fab Inc.
i. Hammond Valve.
j. Kitz Corporation.
k. Legend Valve.
l. Milwaukee Valve Company.
m. Mueller Steam Specialty; a division of SPX Corporation.
n. NIBCO INC.
o. Norriseal; a Dover Corporation company.
p. Spence Strainers International; a division of CIRCOR International, Inc.
q. Sure Flow Equipment Inc.
r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.

f. Stem: One- or two-piece stainless steel.
g. Disc: Nickel-plated[**or -coated**] ductile iron.

D. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. American Valve, Inc.
c. Conbraco Industries, Inc.; Apollo Valves.
d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
e. Crane Co.; Crane Valve Group; Center Line.
f. Crane Co.; Crane Valve Group; Stockham Division.
g. DeZurik Water Controls.
h. Flo Fab Inc.
i. Hammond Valve.
j. Kitz Corporation.
k. Legend Valve.
l. Milwaukee Valve Company.
m. Mueller Steam Specialty; a division of SPX Corporation.
n. NIBCO INC.
o. Norriseal; a Dover Corporation company.
p. Spence Strainers International; a division of CIRCOR International, Inc.
q. Sure Flow Equipment Inc.
r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: NBR.
f. Stem: One- or two-piece stainless steel.
g. Disc: Nickel-plated[**or -coated**] ductile iron.

E. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
b. American Valve, Inc.
c. Conbraco Industries, Inc.; Apollo Valves.
d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
e. Crane Co.; Crane Valve Group; Jenkins Valves.

f. Crane Co.; Crane Valve Group; Stockham Division.
g. DeZurik Water Controls.
h. Flo Fab Inc.
i. Hammond Valve.
j. Kitz Corporation.
k. Legend Valve.
l. Milwaukee Valve Company.
m. Mueller Steam Specialty; a division of SPX Corporation.
n. NIBCO INC.
o. Norriseal; a Dover Corporation company.
p. Red-White Valve Corporation.
q. Spence Strainers International; a division of CIRCOR International, Inc.
r. Sure Flow Equipment Inc.
s. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

F. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Stainless-Steel Disc:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. ABZ Valves and Controls; A div. of ABZ Manufacturing, Inc.
b. American Valve, Inc.
c. Conbraco Industries, Inc.; Apollo Valves.
d. Cooper Cameron Valves; A div. of Cooper Cameron Corp.
e. Crane Co.; Crane Valve Group; Jenkins Valves.
f. Crane Co.; Crane Valve Group; Stockham Div.
g. DeZurik Water Controls.
h. Flo Fab Inc.
i. Hammond Valve.
j. Kitz Corporation.
k. Legend Valve.
l. Milwaukee Valve Company.
m. Mueller Steam Specialty; a division of SPX Corporation.
n. NIBCO INC.
o. Norriseal; a Dover Corporation company.
p. Red-White Valve Corporation.
q. Spence Strainers International; a division of CIRCOR International, Inc.
r. Sure Flow Equipment Inc.

s. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: NBR.
f. Stem: One- or two-piece stainless steel.
g. Disc: Stainless steel.

2.7 IRON, GROOVED-END BUTTERFLY VALVES

A. 175 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Kennedy Valve; a division of McWane, Inc.
b. Shurjoint Piping Products.
c. Tyco Fire Products LP; Grinnell Mechanical Products.
d. Victaulic Company.

2. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 175 psig (1200 kPa).
c. Body Material: Coated, ductile iron.
d. Stem: Two-piece stainless steel.
e. Disc: Coated, ductile iron.
f. Seal: EPDM.

B. 300 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Anvil International, Inc.
b. Kennedy Valve; a division of McWane, Inc.
c. Mueller Steam Specialty; a division of SPX Corporation.
d. NIBCO INC.
e. Shurjoint Piping Products.
f. Tyco Fire Products LP; Grinnell Mechanical Products.
g. Victaulic Company.

2. Description:

a. Standard: MSS SP-67, Type I.
b. NPS 8 (DN 200) and Smaller CWP Rating: 300 psig (2070 kPa).
c. NPS 10 (DN 250) and Larger CWP Rating: 200 psig (1380 kPa).
d. Body Material: Coated, ductile iron.
e. Stem: Two-piece stainless steel.
f. Disc: Coated, ductile iron.
g. Seal: EPDM.

2.8 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

B. Class 125, Lift Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Flo Fab Inc.
b. Hammond Valve.
c. Kitz Corporation.
d. Milwaukee Valve Company.
e. Mueller Steam Specialty; a division of SPX Corporation.
f. NIBCO INC.
g. Red-White Valve Corporation.
h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: NBR, PTFE, or TFE.

2.9 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Red-White Valve Corporation.
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
l. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.

e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corporation.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: PTFE or TFE.

C. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corporation.
i. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.

e. NIBCO INC.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 4.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: PTFE or TFE.

2.10 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Kitz Corporation.
f. Legend Valve.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Red-White Valve Corporation.
k. Sure Flow Equipment Inc.
l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
m. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-71, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Gasket: Asbestos free.

B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Stockham Division.
    c. M.A. Stewart and Sons, Ltd.
    d. NIBCO, Inc.
    e. Powell, Wm. Co.

2. Description:

    a. Standard: MSS SP-71, Type I.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Design: Clear or full waterway.
    d. Body Material: ASTM A 126, gray iron with bolted bonnet.
    e. Ends: Flanged.
    f. Trim: Composition.
    g. Seat Ring: Bronze.
    h. Disc Holder: Bronze.
    i. Disc: PTFE or TFE.
    j. Gasket: Asbestos free.

C. Class 250, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. Crane Co.; Crane Valve Group; Crane Valves.
    b. Crane Co.; Crane Valve Group; Jenkins Valves.
    c. Crane Co.; Crane Valve Group; Stockham Division.
    d. Hammond Valve.
    e. Milwaukee Valve Company.
    f. NIBCO INC.
    g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Standard: MSS SP-71, Type I.
    b. CWP Rating: 500 psig (3450 kPa).
    c. Body Design: Clear or full waterway.
    d. Body Material: ASTM A 126, gray iron with bolted bonnet.
    e. Ends: Flanged.
    f. Trim: Bronze.
    g. Gasket: Asbestos free.

2.11 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. NIBCO INC.
b. Metraflex Co.
c. Val-Matic Valve & Mfg. Corp.

2. Description:

a. Standard: MSS SP-71, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Gasket: Asbestos free.
h. Closure Control: Factory-installed, exterior lever and spring.

B. Class 125, Iron Swing Check Valves with Lever- and Weight-Closure Control:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-71, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Gasket: Asbestos free.
h. Closure Control: Factory-installed, exterior lever and weight.

2.12 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP, Iron, Grooved-End Swing Check Valves:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Anvil International, Inc.
b. Shurjoint Piping Products.
c. Tyco Fire Products LP; Grinnell Mechanical Products.
d. Victaulic Company.

2. Description:

a. CWP Rating: 300 psig (2070 kPa).
b. Body Material: ASTM A 536, ductile iron.
c. Seal: EPDM.
d. Disc: Spring-operated, ductile iron or stainless steel.

2.13 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Anvil International, Inc.
b. APCO Willamette Valve and Primer Corporation.
c. Crispin Valve.
d. DFT Inc.
e. Flo Fab Inc.
f. GA Industries, Inc.
g. Hammond Valve.
h. Metraflex, Inc.
i. Milwaukee Valve Company.
j. Mueller Steam Specialty; a division of SPX Corporation.
k. NIBCO INC.
l. Spence Strainers International; a division of CIRCOR International, Inc.
m. Sure Flow Equipment Inc.
n. Val-Matic Valve & Manufacturing Corp.
o. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 126, gray iron.

d. Style: Compact wafer.
e. Seat: Bronze.

B. Class 125, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.
d. Flomatic Corporation.
e. Hammond Valve.
f. Metraflex, Inc.
g. Milwaukee Valve Company.
h. Mueller Steam Specialty; a division of SPX Corporation.
i. NIBCO INC.
j. Spence Strainers International; a division of CIRCOR International, Inc.
k. Sure Flow Equipment Inc.
l. Val-Matic Valve & Manufacturing Corp.
m. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 126, gray iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: Bronze.

C. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
d. Style: Compact wafer.
e. Seat: Bronze.

D. Class 150, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

   a. APCO Willamette Valve and Primer Corporation.
   b. Crispin Valve.
   c. Val-Matic Valve & Manufacturing Corp.

2. Description:

   a. Standard: MSS SP-125.
   b. CWP Rating: 300 psig (2070 kPa).
   c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
   d. Style: Globe, spring loaded.
   e. Ends: Flanged.
   f. Seat: Bronze.

E. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

   a. APCO Willamette Valve and Primer Corporation.
   b. Crispin Valve.
   c. DFT Inc.
   d. Flo Fab Inc.
   e. Hammond Valve.
   f. Metraflex, Inc.
   g. Milwaukee Valve Company.
   h. NIBCO INC.
   i. Sure Flow Equipment Inc.
   j. Val-Matic Valve & Manufacturing Corp.

2. Description:

   a. Standard: MSS SP-125.
   b. CWP Rating: 400 psig (2760 kPa).
   c. Body Material: ASTM A 126, gray iron.
   d. Style: Compact wafer, spring loaded.
   e. Seat: Bronze.

F. Class 250, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.
d. Flomatic Corporation.
e. Hammond Valve.
f. Metraflex, Inc.
g. Milwaukee Valve Company.
h. Mueller Steam Specialty; a division of SPX Corporation.
i. NIBCO INC.
j. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Material: ASTM A 126, gray iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: Bronze.

G. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 500 psig (3450 kPa).
c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
d. Style: Compact wafer, spring loaded.
e. Seat: Bronze.

H. Class 300, Iron, Globe, Center-Guided Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 500 psig (3450 kPa).
c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: Bronze.

I. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.
d. Flo Fab Inc.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Spence Strainers International; a division of CIRCOR International, Inc.
i. Sure Flow Equipment Inc.
j. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 126, gray iron.
d. Style: Compact wafer.
e. Seat: [**EPDM**] [**or**] [**NBR**] .

J. Class 125, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Anvil International, Inc.
b. APCO Willamette Valve and Primer Corporation.
c. Crispin Valve.
d. DFT Inc.
e. GA Industries, Inc.
f. Hammond Valve.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Sure Flow Equipment Inc.
j. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 126, gray iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: [**EPDM**] [**or**] [**NBR**].

K. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
d. Style: Compact wafer.
e. Seat: [**EPDM**] [**or**] [**NBR**].

L. Class 150, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. APCO Willamette Valve and Primer Corporation.
b. Crispin Valve.
c. DFT Inc.
d. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: [**EPDM**] [**or**] [**NBR**].

M. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

   a. APCO Willamette Valve and Primer Corporation.
   b. Crispin Valve.
   c. DFT Inc.
   d. Flo Fab Inc.
   e. Hammond Valve.
   f. Milwaukee Valve Company.
   g. NIBCO INC.
   h. Sure Flow Equipment Inc.
   i. Val-Matic Valve & Manufacturing Corp..

2. Description:

   a. Standard: MSS SP-125.
   b. CWP Rating: 400 psig (2760 kPa).
   c. Body Material: ASTM A 126, gray iron.
   d. Style: Compact wafer, spring loaded.
   e. Seat: [**EPDM**] [**or**] [**NBR**].

N. Class 250, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

   a. APCO Willamette Valve and Primer Corporation.
   b. Crispin Valve.
   c. DFT Inc.
   d. Hammond Valve.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Val-Matic Valve & Manufacturing Corp.

2. Description:

   a. Standard: MSS SP-125.
   b. CWP Rating: 400 psig (2760 kPa).
   c. Body Material: ASTM A 126, gray iron.
   d. Style: Globe, spring loaded.
   e. Ends: Flanged.
   f. Seat: [**EPDM**] [**or**] [**NBR**].

O. Class 300, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

   a. APCO Willamette Valve and Primer Corporation.
   b. Crispin Valve.
   c. Val-Matic Valve & Manufacturing Corp.

2. Description:

   a. Standard: MSS SP-125.
   b. CWP Rating: 500 psig (3450 kPa).
   c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
   d. Style: Compact wafer, spring loaded.
   e. Seat: [**EPDM**] [**or**] [**NBR**].

P. Class 300, Iron, Globe, Center-Guided Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

   a. APCO Willamette Valve and Primer Corporation.
   b. Crispin Valve.
   c. Val-Matic Valve & Manufacturing Corp.

2. Description:

   a. Standard: MSS SP-125.
   b. CWP Rating: 500 psig (3450 kPa).
   c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
   d. Style: Globe, spring loaded.
   e. Ends: Flanged.
   f. Seat: [**EPDM**] [**or**] [**NBR**].

2.14 IRON, PLATE-TYPE CHECK VALVES

A. Class 125, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

   a. APCO Willamette Valve and Primer Corporation.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Flomatic Corporation.

d. Mueller Steam Specialty; a division of SPX Corporation.

2. Description:

a. Standard: API 594.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Wafer, spring-loaded plates.
d. Body Material: ASTM A 126, gray iron.
e. Seat: Bronze.

B. Class 150, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. APCO Willamette Valve and Primer Corporation.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Mueller Steam Specialty; a division of SPX Corporation.
d. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: API 594.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Design: Wafer, spring-loaded plates.
d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
e. Seat: Bronze.

C. Class 250, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. APCO Willamette Valve and Primer Corporation.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Powell, Wm. Co.

2. Description:

a. Standard: API 594.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Design: Wafer, spring-loaded plates.
d. Body Material: ASTM A 126, gray iron.
e. Seat: Bronze.

D. Class 300, Iron, Dual-Plate Check Valves with Metal Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. APCO Willamette Valve and Primer Corporation.
    b. Crane Co.; Crane Valve Group; Crane Valves.
    c. Mueller Steam Specialty; a division of SPX Corporation.
    d. Val-Matic Valve & Manufacturing Corp.

2. Description:

    a. Standard: API 594.
    b. CWP Rating: 500 psig (3450 kPa).
    c. Body Design: Wafer, spring-loaded plates.
    d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
    e. Seat: Bronze.

E. Class 125, Iron, Single-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. Flo Fab Inc.
    b. Sure Flow Equipment Inc.
    c. NIBCO INC.
    d. APCO Willamette Valve and Primer Corporation.

2. Description:

    a. Standard: API 594.
    b. CWP Rating: 200 psig (1380 kPa).
    c. Body Design: Wafer, spring-loaded plate.
    d. Body Material: ASTM A 126, gray iron.
    e. Seat: [**EPDM**] [**or**] [**NBR**].

F. Class 125, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. APCO Willamette Valve and Primer Corporation.
    b. Cooper Cameron Valves TVB Techno.
    c. Crane Co.; Crane Valve Group; Crane Valves.
    d. Crane Co.; Crane Valve Group; Stockham Division.
    e. NIBCO INC.
    f. Spence Strainers International; a division of CIRCOR International, Inc.
    g. Sure Flow Equipment Inc.
    h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: API 594.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Wafer, spring-loaded plates.
d. Body Material: ASTM A 126, gray iron.
e. Seat: [**EPDM**] [**or**] [**NBR**].

G. Class 150, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. APCO Willamette Valve and Primer Corporation.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Val-Matic Valve & Manufacturing Corp.

2. Description:

a. Standard: API 594.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Design: Wafer, spring-loaded plates.
d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
e. Seat: [**EPDM**] [**or**] [**NBR**].

H. Class 250, Iron, Wafer, Single-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Sure Flow Equipment Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. APCO Willamette Valve and Primer Corporation.

2. Description:

a. Standard: API 594.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Design: Wafer, spring-loaded plate.
d. Body Material: ASTM A 126, gray iron.
e. Seat: [**EPDM**] [**or**] [**NBR**].

I. Class 250, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

   a. APCO Willamette Valve and Primer Corporation.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Sure Flow Equipment Inc.

2. Description:

   a. Standard: API 594.
   b. CWP Rating: 400 psig (2760 kPa).
   c. Body Design: Wafer, spring-loaded plates.
   d. Body Material: ASTM A 126, gray iron.
   e. Seat: [**EPDM**] [**or**] [**NBR**].

J. Class 300, Iron, Dual-Plate Check Valves with Resilient Seat:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

   a. APCO Willamette Valve and Primer Corporation.
   b. Val-Matic Valve & Manufacturing Corp.
   c. Crane Co.; Crane Valve Group; Crane Valves.

2. Description:

   a. Standard: API 594.
   b. CWP Rating: 500 psig (3450 kPa).
   c. Body Design: Wafer, spring-loaded plates.
   d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
   e. Seat: [**EPDM**] [**or**] [**NBR**].

2.15 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

   a. American Valve, Inc.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Crane Co.; Crane Valve Group; Jenkins Valves.
   d. Crane Co.; Crane Valve Group; Stockham Division.
   e. Hammond Valve.
   f. Kitz Corporation.
   g. Milwaukee Valve Company.

h. NIBCO INC.
i. Powell Valves.
j. Red-White Valve Corporation.
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
l. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded[**or solder joint**].
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron[**, bronze, or aluminum**].

B. Class 125, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
k. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded[**or solder joint**].
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron[**, bronze, or aluminum**].

C. Class 150, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

   a. Hammond Valve.
   b. Kitz Corporation.
   c. Milwaukee Valve Company.
   d. NIBCO INC.
   e. Powell Valves.
   f. Red-White Valve Corporation.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 300 psig (2070 kPa).
   c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
   d. Ends: Threaded.
   e. Stem: Bronze.
   f. Disc: Solid wedge; bronze.
   g. Packing: Asbestos free.
   h. Handwheel: Malleable iron[**, bronze, or aluminum**].

D. Class 150, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Stockham Division.
   c. Hammond Valve.
   d. Kitz Corporation.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Powell Valves.
   h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   i. Zy-Tech Global Industries, Inc.

2. Description:

   a. Standard: MSS SP-80, Type 2.
   b. CWP Rating: 300 psig (2070 kPa).
   c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
   d. Ends: Threaded.
   e. Stem: Bronze.
   f. Disc: Solid wedge; bronze.
   g. Packing: Asbestos free.
   h. Handwheel: Malleable iron[**, bronze, or aluminum**].

2.16 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Flo Fab Inc.
e. Hammond Valve.
f. Kitz Corporation.
g. Legend Valve.
h. Milwaukee Valve Company.
i. NIBCO INC.
j. Powell Valves.
k. Red-White Valve Corporation.
l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
m. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

B. Class 125, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Flo Fab Inc.
e. Hammond Valve.
f. Kitz Corporation.
g. Legend Valve.
h. Milwaukee Valve Company.
i. NIBCO INC.
j. Powell Valves.
k. Red-White Valve Corporation.
l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

m. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

C. Class 250, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. NIBCO INC.

2. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 500 psig (3450 kPa).
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

D. Class 250, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Powell Valves.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 500 psig (3450 kPa).
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

2.17 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Hammond Valve.
d. Kitz Corporation.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Powell Valves.
h. Red-White Valve Corporation.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
j. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded[**or solder joint**].
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron[**, bronze, or aluminum**].

B. Class 125, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. NIBCO INC.
d. Red-White Valve Corporation.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded[**or solder joint**].
e. Stem: Bronze.
f. Disc: PTFE or TFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron[**, bronze, or aluminum**].

C. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Hammond Valve.
c. Kitz Corporation.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Powell Valves.
g. Red-White Valve Corporation.
h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
i. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig (2070 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: PTFE or TFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron[**, bronze, or aluminum**].

2.18 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.

d. Hammond Valve.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Powell Valves.
i. Red-White Valve Corporation.
j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
k. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-85, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Packing and Gasket: Asbestos free.

B. Class 250, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-85, Type I.
b. CWP Rating: 500 psig (3450 kPa).
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Packing and Gasket: Asbestos free.

2.19 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Nordstrom Valves, Inc.
b. Val-Matic, Inc.
c. Walworth, Inc.

2. Description:

a. Standard: MSS SP-78, Type II.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
d. Pattern: [**Regular or short**] [**Venturi**].
e. Plug: Cast iron or bronze with sealant groove.

B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Nordstrom Valves, Inc.
b. Val-Matic, Inc.
c. Walworth, Inc.

2. Description:

a. Standard: MSS SP-78, Type II.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
d. Pattern: [**Regular or short**] [**Venturi**] .
e. Plug: Cast iron or bronze with sealant groove.

C. Class 125, Cylindrical, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Homestead Valve; a division of Olson Technologies, Inc.
b. Milliken Valve Company.
c. R & M Energy Systems; a unit of Robbins & Myers, Inc.

2. Description:

a. Standard: MSS SP-78, Type IV.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
d. Pattern: [**Regular or short**] [**Venturi**].
e. Plug: Cast iron or bronze with sealant groove.

D. Class 125, Cylindrical, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

   a. Homestead Valve; a division of Olson Technologies, Inc.
   b. Milliken Valve Company.
   c. R & M Energy Systems; a unit of Robbins & Myers, Inc.

2. Description:

   a. Standard: MSS SP-78, Type IV.
   b. CWP Rating: 200 psig (1380 kPa).
   c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
   d. Pattern: [**Regular or short**] [**Venturi**].
   e. Plug: Cast iron or bronze with sealant groove.

E. Class 250, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

   a. Nordstrom Valves, Inc.
   b. Val-Matic, Inc.
   c. Walworth, Inc.

2. Description:

   a. Standard: MSS SP-78, Type II.
   b. CWP Rating: 400 psig (2760 kPa).
   c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
   d. Pattern: [**Regular or short**] [**Venturi**].
   e. Plug: Cast iron or bronze with sealant groove.

F. Class 250, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

   a. Nordstrom Valves, Inc.
   b. Val-Matic, Inc.
   c. Walworth, Inc.

2. Description:

a. Standard: MSS SP-78, Type II.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
d. Pattern: [**Regular or short**] [**Venturi**].
e. Plug: Cast iron or bronze with sealant groove.

G. Class 250, Cylindrical, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Homestead Valve; a division of Olson Technologies, Inc.
b. Milliken Valve Company.
c. R & M Energy Systems; a unit of Robbins & Myers, Inc.

2. Description:

a. Standard: MSS SP-78, Type IV.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
d. Pattern: [**Regular or short**] [**Venturi**].
e. Plug: Cast iron or bronze with sealant groove.

H. Class 250, Cylindrical, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. Homestead Valve; a division of Olson Technologies, Inc.
b. Milliken Valve Company.
c. R & M Energy Systems; a unit of Robbins & Myers, Inc.

2. Description:

a. Standard: MSS SP-78, Type IV.
b. CWP Rating: 400 psig (2760 kPa).
c. Body Material: ASTM A 48/A 48M or ASTM A 126, Grade 40 cast iron with lubrication-sealing system.
d. Pattern: [**Regular or short**] [**Venturi**].
e. Plug: Cast iron or bronze with sealant groove.

2.20 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to [**ball**] [**butterfly**] [**and**] [**plug**] valve stems.
3. Sprocket Rim with Chain Guides: [**Ductile iron**] [**Ductile or cast iron**] [**Cast iron**] [**Aluminum**] [**Bronze**], of type and size required for valve.[**Include zinc coating.**]
4. Chain: [**Hot-dip, galvanized steel**] [**Brass**] [**Stainless steel**], of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for [**ball**] [**butterfly**] [**gate**] [**globe**] [**and**] [**plug**] valves [**NPS 4 (DN 100)**] and larger and more than [**96 inches (2400 mm)**] above floor. Extend chains to [**60 inches (1520 mm)**] above finished floor.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. [**Center-Guided**] [**and**] [**Plate-Type**] Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly[**, or gate**] [**, gate, or plug**] valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service: [**Globe**] [**Globe or angle**] [**or ball**] [**or butterfly**] [**, ball, or butterfly**] valves.
4. Pump-Discharge Check Valves:

    a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with [**bronze**] [**or**] [**nonmetallic**] disc.
    b. NPS 2-1/2 (DN 65) and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, [**metal**] [**or**] [**resilient**]-seat check valves.
    c. NPS 2-1/2 (DN 65) and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
7. For Grooved-End [**Copper Tubing**] [**and**] [**Steel Piping**]: Valve ends may be grooved.

3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG (1035 kPa) OR LESS)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze[**and Brass**] Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: [**One**] [**Two**] [**Three**] piece, [**full**] [**regular**] [**reduced**] port, [**brass**] [**or**] [**bronze**] with [**brass**] [**bronze**] [**stainless-steel**] trim.
3. Bronze Lift Check Valves: Class 125, [**bronze**] [**nonmetallic**] disc.
4. Bronze Swing Check Valves: [**Class 125**] [**Class 150**], [**bronze**] [**nonmetallic**] disc.
5. Bronze Gate Valves: [**Class 125**] [**Class 150**], [**NRS**] [**RS**].

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, [**aluminum-bronze**] [**ductile-iron**] [**stainless-steel**] disc.
3. Iron, Grooved-End Butterfly Valves: [**175**] [**300**] CWP.
4. Iron Swing Check Valves: [**Class 125**] [**Class 250**], [**metal**] [**nonmetallic-to-metal**] seats.
5. Iron, Grooved-End Swing Check Valves: 300 CWP.
6. Iron, Center-Guided Check Valves: [**Class 125**] [**Class 150**] [**Class 250**] [**Class 300**], [**compact-wafer**] [**globe**], [**metal**] [**resilient**] seat.
7. Iron, Plate-Type Check Valves: [**Class 125**] [**Class 150**] [**Class 250**] [**Class 300**]; [**single**] [**dual**] plate; [**metal**] [**resilient**] seat.
8. Iron Gate Valves: [**Class 125**] [**Class 250**], [**NRS**] [**OS&Y**].

3.6 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG (1035 TO 1380 kPa))

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze[**and Brass**] Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: [**One**] [**Two**] [**Three**] piece, [**full**] [**regular**] [**reduced**] port, [**brass**] [**or**] [**bronze**] with [**brass**] [**bronze**] [**stainless-steel**] trim.
3. Bronze Lift Check Valves: Class 125, [**bronze**] [**nonmetallic**] disc.
4. Bronze Swing Check Valves: [**Class 125**] [**Class 150**], [**bronze**] [**nonmetallic**] disc.
5. Bronze Gate Valves: [**Class 125**] [**Class 150**], [**NRS**] [**RS**].

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, [**aluminum-bronze**] [**ductile-iron**] [**stainless-steel**] disc.
3. Iron, Grooved-End Butterfly Valves: [**175**] [**300**] CWP.

4. Iron Swing Check Valves: [**Class 125**] [**Class 250**], [**metal**] [**nonmetallic-to-metal**] seats.
5. Iron, Grooved-End Swing Check Valves: 300 CWP.
6. Iron, Center-Guided Check Valves: [**Class 125**] [**Class 150**] [**Class 250**] [**Class 300**], [**compact-wafer**] [**globe**], [**metal**] [**resilient**] seat.
7. Iron, Plate-Type Check Valves: [**Class 125**] [**Class 150**] [**Class 250**] [**Class 300**]; [**single**] [**dual**] plate; [**metal**] [**resilient**] seat.
8. Iron Gate Valves: [**Class 125**] [**Class 250**], [**NRS**] [**OS&Y**].

3.7 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze[**and Brass**] Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: [**Class 125**] [**Class 150**], [**bronze**] [**nonmetallic**] disc.
3. Ball Valves: [**One**] [**Two**] [**Three**] piece, [**full**] [**regular**] [**reduced**] port, [**brass**] [**or**] [**bronze**] with [**brass**] [**bronze**] [**stainless-steel**] trim.
4. Bronze Swing Check Valves: [**Class 125**] [**Class 150**], [**bronze**] [**nonmetallic**] disc.
5. Bronze Gate Valves: [**Class 125**] [**Class 150**], [**NRS**] [**RS**].
6. Bronze Globe Valves: [**Class 125**] [**Class 150**], [**bronze**] [**nonmetallic**] disc.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves: Class 150.
3. Iron, Single-Flange Butterfly Valves: 200 CWP, [**EPDM**] [**NBR**] seat, [**aluminum-bronze**] [**ductile-iron**] [**stainless-steel**] disc.
4. Iron, Grooved-End Butterfly Valves: [**175**] [**300**] CWP.
5. Iron Swing Check Valves: [**Class 125**] [**Class 250**], [**metal**] [**nonmetallic-to-metal**] seats.
6. Iron Swing Check Valves with Closure Control: Class 125, lever and [**spring**] [**weight**].
7. Iron, Grooved-End Swing Check Valves: 300 CWP.
8. Iron, Center-Guided Check Valves: [**Class 125**] [**Class 150**] [**Class 250**] [**Class 300**], [**compact-wafer**] [**globe**], [**metal**] [**resilient**] seat.
9. Iron, Plate-Type Check Valves: [**Class 125**] [**Class 150**] [**Class 250**] [**Class 300**]; [**single**] [**dual**] plate; [**metal**] [**resilient**] seat.
10. Iron Gate Valves: [**Class 125**] [**Class 250**], [**NRS**] [**OS&Y**].
11. Iron Globe Valves: [**Class 125**] [**Class 250**].

3.8 [**SANITARY-WASTE**] [**AND**] [**STORM-DRAINAGE**] VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze[**and Brass**] Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: [**Class 125**] [**Class 150**], [**bronze**] [**nonmetallic**] [**stainless-steel**] disc.

3. Ball Valves: [**One**] [**Two**] [**Three**] piece, [**full**] [**regular**] [**reduced**] port, [**brass**] [**or**] [**bronze**] with [**brass**] [**bronze**] [**stainless-steel**] trim.
4. Bronze Swing Check Valves: [**Class 125**] [**Class 150**], [**bronze**] [**nonmetallic**] disc.
5. Bronze Gate Valves: [**Class 125**] [**Class 150**], [**NRS**] [**RS**].
6. Bronze Globe Valves: [**Class 125**] [**Class 150**], [**bronze**] [**nonmetallic**] disc.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves: Class 150.
3. Iron Swing Check Valves: [**Class 125**] [**Class 250**], [**metal**] [**nonmetallic-to-metal**] seats.
4. Iron Swing Check Valves with Closure Control: Class 125, lever and [**spring**] [**weight**].
5. Iron, Grooved-End Swing Check Valves: 300 CWP.
6. Iron Gate Valves: [**Class 125**] [**Class 250**], [**NRS**] [**OS&Y**].
7. Iron Globe Valves: [**Class 125**] [**Class 250**].
8. Lubricated Plug Valves: [**Class 125**] [**Class 250**], [**regular gland**] [**cylindrical**], [**threaded**] [**flanged**].

END OF SECTION 15111

SECTION 15126 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Thermometers.
2. Gages.
3. Test plugs.

B. Related Sections:

1. Division 2 Section "Water Distribution" for domestic and fire-protection water service meters outside the building.
2. Division 15 Section "Domestic Water Piping" for domestic and fire-protection water service meters inside the building.
3. Division 15 Section "Facility Natural-Gas Piping" for gas meters.

1.3 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

B. Shop Drawings: Schedule for [**thermometers**] [**and**] [**gages**] indicating manufacturer's number, scale range, and location for each.

C. Product Certificates: For each type of [**thermometer**] [**and**] [**gage**], signed by product manufacturer.

PART 2 - PRODUCTS

2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. Palmer - Wahl Instruments Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
5.

C. Case: [**Die-cast aluminum**] [**Die-cast aluminum or brass**] [**Brass**] [**Chrome-plated brass**], [**7 inches (178 mm)**] [**9 inches (229 mm)**] long.

D. Tube: Red or blue reading, [**mercury**] [**mercury or organic-liquid**] [**organic-liquid**] filled, with magnifying lens.

E. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.

F. Window: [**Glass**] [**Glass or plastic**] [**Plastic**].

G. Connector: [**Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device**] [**Rigid, straight type**] [**Rigid, angle type**].

H. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.

I. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.2 PLASTIC-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. Ernst Gage Co.
2. Eugene Ernst Products Co.
3. Marsh Bellofram.
4. Miljoco Corp.

5. Trerice, H. O. Co.
6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
7. Winters Instruments.
8.

C. Case: Plastic, [**7 inches (178 mm)**] [**9 inches (229 mm)**] long.

D. Tube: Red or blue reading, mercury or organic-liquid filled, with magnifying lens.

E. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.

F. Window: Glass or plastic.

G. Connector: [**Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device**] [**Rigid, straight type**] [**Rigid, angle type**].

H. Stem: Metal, for thermowell installation and of length to suit installation.

I. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 DIRECT-MOUNTING, VAPOR-ACTUATED DIAL THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. KOBOLD Instruments, Inc.
3. Marsh Bellofram.
4. Trerice, H. O. Co.
5. Weiss Instruments, Inc.
6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

C. Case: [**Dry**] [**Liquid-filled**] type, [**drawn steel or cast aluminum**] [**metal or plastic**] [**plastic**], [**4-1/2-inch (114-mm)**] [**5-inch (127-mm)**] [**6-inch (152-mm)**] diameter.

D. Element: Bourdon tube or other type of pressure element.

E. Movement: Mechanical, connecting element and pointer.

F. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.

G. Pointer: Red[**or other dark-color**] metal.

H. Window: [**Glass**] [**Glass or plastic**] [**Plastic**].

I. Ring: [**Metal**] [**Brass**] [**Stainless steel**] [**Metal or plastic**] [**Plastic**].

J. Connector: [**Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device**] [**Rigid, bottom type**] [**Rigid, back type**].

K. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation.

L. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.4 REMOTE-MOUNTING, VAPOR-ACTUATED DIAL THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Marsh Bellofram.
4. Miljoco Corp.
5. Palmer - Wahl Instruments Inc.
6. REO TEMP Instrument Corporation.
7. Tel-Tru Manufacturing Company.
8. Trerice, H. O. Co.
9. Weiss Instruments, Inc.
10. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
11. Winters Instruments.

C. Case: Dry type, [**drawn steel or cast aluminum**], [**4-1/2-inch (114-mm)**] [**6-inch (152-mm)**] diameter with [**holes**] for panel mounting.

D. Element: Bourdon tube or other type of pressure element.

E. Movement: Mechanical, connecting element and pointer.

F. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.

G. Pointer: Red[**or other dark-color**] metal.

H. Window: [**Glass**] [**Glass or plastic**] [**Plastic**].

I. Ring: [**Metal**] [**Brass**] [**Stainless steel**].

J. Connector: [**Bottom**] [**Back**] union type.

K. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation.

L. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.5 BIMETALLIC-ACTUATED DIAL THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Ernst Gage Co.
3. Eugene Ernst Products Co.
4. Marsh Bellofram.
5. Miljoco Corp.
6. NANMAC Corporation.
7. Noshok, Inc.
8. Palmer - Wahl Instruments Inc.
9. REO TEMP Instrument Corporation.
10. Tel-Tru Manufacturing Company.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.

C. Description: Direct-mounting, bimetallic-actuated dial thermometers complying with ASME B40.3.

D. Case: [**Dry**] [**Liquid-filled**] type, stainless steel with [**3-inch (76-mm)**] [**5-inch (127-mm)**] diameter.

E. Element: Bimetal coil.

F. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.

G. Pointer: Red[**or other dark-color**] metal.

H. Window: [**Glass**] [**Glass or plastic**] [**Plastic**].

I. Ring: Stainless steel.

J. Connector: [**Adjustable angle**] [**Rigid, back**] [**Rigid, bottom**] type.

K. Stem: Metal, for thermowell installation and of length to suit installation.

L. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.6 THERMOWELLS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Ernst Gage Co.
4. Marsh Bellofram.
5. Miljoco Corp.
6. NANMAC Corporation.
7. Noshok, Inc.
8. Palmer - Wahl Instruments Inc.
9. REO TEMP Instrument Corporation.
10. Tel-Tru Manufacturing Company.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.

C. Manufacturers: Same as manufacturer of thermometer being used.

D. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.7 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Ernst Gage Co.
4. Eugene Ernst Products Co.

5. KOBOLD Instruments, Inc.
6. Marsh Bellofram.
7. Miljoco Corp.
8. Noshok, Inc.
9. Palmer - Wahl Instruments Inc.
10. REO TEMP Instrument Corporation.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.

C. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: [**Dry**] [**Liquid-filled**] type, [**drawn steel or cast aluminum**] [**metal or plastic**] [**plastic**], [**4-1/2-inch (114-mm)**] [**6-inch (152-mm)**] diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4 (DN 8), bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red[**or other dark-color**] metal.
7. Window: [**Glass**] [**Glass or plastic**] [**Plastic**] .
8. Ring: [**Metal**] [**Brass**] [**Stainless steel**] [**Metal or plastic**] [**Plastic**].
9. Accuracy: Grade [**A, plus or minus 1 percent of middle half**] [**B, plus or minus 2 percent of middle half**] [**C, plus or minus 3 percent of middle half**] [**D, plus or minus 5 percent of whole**] scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure (100 kPa of vacuum to 103 kPa of pressure).
11. Range for Fluids under Pressure: Two times operating pressure.

D. Remote-Mounting, Dial-Type Pressure Gages: ASME B40.100, indicating-dial type.

1. Case: Dry type, [**drawn steel or cast aluminum**], [**4-1/2-inch (114-mm)**] [**6-inch (152-mm)**] diameter with [**holes**] for panel mounting.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4 (DN 8), bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red[**or other dark-color**] metal.
7. Window: [**Glass**] [**Glass or plastic**] [**Plastic**].
8. Ring: [**Metal**] [**Brass**] [**Stainless steel**] [**Metal or plastic**] [**Plastic**].
9. Accuracy: Grade [**A, plus or minus 1 percent of middle half**] [**B, plus or minus 2 percent of middle half**] [**C, plus or minus 3 percent of middle half**] [**D, plus or minus 5 percent of whole**] scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure (100 kPa of vacuum to 103 kPa of pressure).
11. Range for Fluids under Pressure: Two times operating pressure.

E. Pressure-Gage Fittings:

1. Valves: NPS 1/4 (DN 8) brass or stainless-steel needle type.
2. Snubbers: ASME B40.5, NPS 1/4 (DN 8) brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.8 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. Flow Design, Inc.
2. MG Piping Products Co.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Co.
6. Trerice, H. O. Co.
7. Watts Industries, Inc.; Water Products Div.

C. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

D. Minimum Pressure and Temperature Rating: [**500 psig at 200 deg F (3450 kPa at 93 deg C)**].

E. Core Inserts: One or two self-sealing rubber valves.

1. Insert material for water service at 20 to 200 deg F (minus 7 to plus 93 deg C) shall be CR.
2. Insert material for water service at minus 30 to plus 275 deg F (minus 35 to plus 136 deg C) shall be EPDM.

F. Test Kit: Furnish [**one**] test kit(s) containing one pressure gage and adaptor, [**one**] [**two**] thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.

1. Pressure Gage: Small bourdon-tube insertion type with [**2- to 3-inch- (51- to 76-mm-)**] diameter dial and probe. Dial range shall be [**0 to 200 psig (0 to 1380 kPa)**].
2. Low-Range Thermometer: Small bimetallic insertion type with [**1- to 2-inch- (25- to 51-mm-)**] diameter dial and tapered-end sensing element. Dial ranges shall be [**25 to 125 deg F (minus 4 to plus 52 deg C)**].
3. High-Range Thermometer: Small bimetallic insertion type with [**1- to 2-inch- (25- to 51-mm-)**] diameter dial and tapered-end sensing element. Dial ranges shall be [**0 to 220 deg F (minus 18 to plus 104 deg C)**].
4. Carrying case shall have formed instrument padding.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install [**liquid-in-glass**] [**direct-mounting, vapor-actuated dial**] [**remote-mounting, vapor-actuated dial**] [**bimetallic-actuated dial**] thermometers in the outlet of each domestic, hot-water storage tank.

B. Install [**dry**] [**liquid-filled**]-case-type, [**vapor**] [**bimetallic**]-actuated dial thermometers at suction and discharge of each pump.

C. Provide the following temperature ranges for thermometers:

1. Domestic Hot Water: [**30 to 180 deg F, with 2-degree scale divisions (Minus 1 to plus 82 deg C, with 1-degree scale divisions)**] [**30 to 240 deg F, with 2-degree scale divisions (Minus 1 to plus 115 deg C, with 1-degree scale divisions)**].
2. Domestic Cold Water: [**0 to 100 deg F, with 2-degree scale divisions (Minus 18 to plus 38 deg C, with 1-degree scale divisions)**] [**30 to 130 deg F, with 2-degree scale divisions (Minus 1 to plus 55 deg C, with 1-degree scale divisions)**].

3.2 GAGE APPLICATIONS

A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.

B. Install [**dry**] [**liquid-filled**]-case-type pressure gages at suction and discharge of each pump.

3.3 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.

C. Install thermowells with socket extending [**a minimum of 2 inches (51 mm) into fluid**] [**one-third of diameter of pipe**] [**to center of pipe**] and in vertical position in piping tees where thermometers are indicated.

D. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

E. Install remote-mounting pressure gages on panel.

F. Install needle-valve and snubber fitting in piping for each pressure gage.

G. Install test plugs in tees in piping.

H. Install permanent indicators on walls or brackets in accessible and readable positions.

I. Install connection fittings for attachment to portable indicators in accessible locations.

J. Install thermometers and gages adjacent to machines and equipment to allow service and maintenance for thermometers, gages, machines, and equipment.

K. Adjust faces of thermometers and gages to proper angle for best visibility.

END OF SECTION 15126

SECTION 15160 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following storm drainage piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.
3. Encasement for underground metal piping.

B. Related Sections include the following:

1. Division 15 Section "Sump Pumps."

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. LLDPE: Linear, low-density polyethylene plastic.

C. PE: Polyethylene plastic.

D. PVC: Polyvinyl chloride plastic.

E. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:

1. Storm Drainage Piping: [**10-foot head of water (30 kPa)**].
2. Storm Drainage, Force-Main Piping: [**50 psig (345 kPa)**] [**100 psig (690 kPa)**] [**150 psig (1035 kPa)**].

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to [**ASCE 7, "Minimum Design Loads for Buildings and Other Structures."**] .

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. LEED Submittal:

1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.

C. Shop Drawings:

1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.
2. Controlled-Flow Storm Drainage System: Include calculations, plans, and details.

D. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, [**Service**] [**and**] [**Extra-Heavy**] class(es).

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

a. [**Available**]Manufacturers:

1) ANACO.
2) Fernco, Inc.
3) Ideal Div.; Stant Corp.
4) Mission Rubber Co.
5) Tyler Pipe; Soil Pipe Div.

2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

a. [**Available**]Manufacturers:

1) ANACO.
2) Clamp-All Corp.
3) Ideal Div.; Stant Corp.
4) Mission Rubber Co.
5) Tyler Pipe; Soil Pipe Div.

3. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.

a. [**Available**]Manufacturers:

1) MG Piping Products Co.
2) Tyler Pipe; Soil Pipe Div.
3) Clamp-All Corp.

C. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. [**Available**]Manufacturers:

a. ANACO.

b. Clamp-All Corp.
c. Tyler Pipe; Soil Pipe Div.

2.5 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.

B. Drainage Fittings: ASME B16.12[**, galvanized**], threaded, cast-iron drainage pattern.

C. Pressure Fittings:

1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, [**galvanized,**]standard pattern.
4. Cast-Iron Flanges: ASME B16.1, Class 125.
5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125[**, galvanized**].

D. Grooved-Joint Systems:

1. [**Available**]Manufacturers:

a. Anvil International.
b. Star Pipe Products; Star Fittings Div.
c. Victaulic Co. of America.
d. Ward Manufacturing, Inc.

2. Grooved-End, Steel-Piping Fittings: ASTM A 47/A 47M, [**galvanized,**]malleable-iron casting; ASTM A 106, galvanized-steel pipe; or ASTM A 536, [**galvanized,**]ductile-iron casting; with dimensions matching steel pipe.
3. Grooved-End, Steel-Piping Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

2.6 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

C. Grooved-Joint Systems:

1. [**Available**]Manufacturers:

   a. Anvil International.
   b. Star Pipe Products; Star Fittings Div.
   c. Victaulic Co. of America.
   d. Ward Manufacturing, Inc.

2. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
3. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

D. Flanges: ASME 16.1, Class 125, cast iron.

2.7 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast-copper or ASME B16.29, wrought-copper, solder-joint fittings.

B. Hard Copper Tube: ASTM B 88, Types L and M (ASTM B 88M, Types B and C), water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

C. Soft Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2.8 ABS PIPE AND FITTINGS

A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.

B. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.

C. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

D. Solvent Cement and Adhesive Primer:

1. Use ABS solvent cement that has a VOC content of 325 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.9 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Cellular-Core, Sewer and Drain Series, PVC Pipe: ASTM F 891, Series PS 100.

1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Series PS 100 sewer and drain pipe.

D. Solvent Cement and Adhesive Primer:

1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.10 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. [**Available**]Manufacturers:

a. Dallas Specialty & Mfg. Co.
b. Fernco, Inc.
c. Logan Clay Products Company (The).
d. Mission Rubber Co.
e. NDS, Inc.
f. Plastic Oddities, Inc.

2. Sleeve Materials:

a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. [**Available**]Manufacturers:

    a. Cascade Waterworks Mfg. Co.
    b. Mission Rubber Co.
    c. Smith-Blair, Inc.
    d. Viking Johnson.

C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. [**Available**]Manufacturers:

    a. ANACO.
    b. Cascade Waterworks Mfg. Co.
    c. Dresser, Inc.; DMD Div.
    d. EBAA Iron Sales, Inc.

D. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.

1. [**Available**]Manufacturers:

    a. Cascade Waterworks Mfg. Co.
    b. Dresser, Inc.; DMD Div.
    c. EBAA Iron Sales, Inc.
    d. Ford Meter Box Company, Inc. (The); Pipe Products Div.
    e. JCM Industries, Inc.
    f. Romac Industries, Inc.
    g. Smith-Blair, Inc.
    h. Viking Johnson.

2. Center-Sleeve Material: [**Manufacturer's standard**] [**Carbon steel**] [**Stainless steel**] [**Ductile iron**] [**Malleable iron**].
3. Gasket Material: Natural or synthetic rubber.
4. Metal Component Finish: Corrosion-resistant coating or material.

E. Flexible Ball Joints: Ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed ball-joint section and ductile-iron gland, rubber gasket, and steel bolts.

1. [**Available**]Manufacturers:

    a. EBAA Iron Sales, Inc.
    b. Romac Industries, Inc.
    c. American Cast Iron Pipe Company

d. Viking Johnson.

F. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. [**Available**]Manufacturers:

a. EBAA Iron Sales, Inc.
b. Romac Industries, Inc.
c. Star Pipe Products; Star Fittings Div.
d.

G. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. [**Available**]Manufacturers:

a. SIGMA Corp.
b. Metraflex Company
c. Flexicraft Industries
d. Flomec, Inc.

2.11 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Description: ASTM A 674 or AWWA C105, [**high-density, crosslaminated PE film of 0.004-inch (0.10-mm)**] [**or**] [**LLDPE film of 0.008-inch (0.20-mm)**] minimum thickness.

B. Form: [**Sheet**] [**or**] [**tube**].

C. Color: [**Black**] [**or**] [**natural**].

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground storm drainage piping [**NPS 6 (DN 150) and smaller**] shall be[**any of**] the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; [**standard,**] [**and**] [**heavy-duty**] shielded, stainless-steel couplings; and coupled joints.
3. Steel pipe, drainage fittings, and threaded joints.
4. Copper DWV tube, copper drainage fittings, and soldered joints.
5. [**Solid-wall**] [**Cellular-core**] ABS pipe, ABS socket fittings, and solvent-cemented joints.
6. [**Solid-wall**] [**Cellular-core**] PVC pipe, PVC socket fittings, and solvent-cemented joints.
7. Dissimilar Pipe-Material Couplings: [**Flexible,**] [**Shielded,**] [**Rigid, unshielded,**] nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

C. Aboveground, storm drainage piping [**NPS 8 (DN 200) and larger**] shall be[**any of**] the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless cast-iron soil pipe and fittings; [**standard,**] [**and**] [**heavy-duty**] shielded, stainless-steel couplings; and coupled joints.
3. Steel pipe, drainage fittings, and threaded joints.
4. [**Solid-wall**] [**Cellular-core**] PVC pipe, PVC socket fittings, and solvent-cemented joints.
5. Dissimilar Pipe-Material Couplings: [**Flexible,**] [**Shielded,**] nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

D. Underground storm drainage piping [**NPS 6 (DN 150) and smaller**] shall be[**any of**] the following:

1. [**Extra-heavy**] [**Service**] class, cast-iron soil pipe and fittings; [**gaskets; and gasketed**] [**calking materials; and calked**] joints.
2. Hubless cast-iron soil pipe and fittings; [**standard,**] [**and**] [**heavy-duty**] shielded, stainless-steel couplings; and coupled joints.
3. Steel pipe, drainage fittings, and threaded joints.
4. [**Solid-wall**] [**Cellular-core**] ABS pipe, ABS socket fittings, and solvent-cemented joints.
5. [**Solid-wall**] [**Cellular-core**] PVC pipe, PVC socket fittings, and solvent-cemented joints.
6. Dissimilar Pipe-Material Couplings: [**Flexible,**] [**Shielded,**] [**Rigid, unshielded,**] nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

E. Underground, storm drainage piping [**NPS 8 (DN 200) and larger**] shall be[**any of**] the following:

1. [**Extra-Heavy**] [**Service**] class, cast-iron soil pipe and fittings; [**gaskets; and gasketed**] [**calking materials; and calked**] joints.
2. Hubless cast-iron soil pipe and fittings; [**standard, shielded, stainless-steel**] [**heavy-duty shielded, stainless-steel**] [**and**] [**heavy-duty shielded, cast-iron**] couplings; and coupled joints.
3. [**Cellular-core**] [**Solid-wall**] PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Cellular-core, Sewer and Drain Series, PVC pipe; PVC socket fittings; and solvent-cemented joints.
5. Dissimilar Pipe-Material Couplings: [**Flexible,**] [**Shielded,**] nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

F. Aboveground storm drainage force mains [**NPS 1-1/2 and NPS 2 (DN 40 and DN 50)**] shall be[**any of**] the following:

1. Hard copper tube, [**Type L (Type B)**] [**Type M (Type C)**]; copper pressure fittings; and soldered joints.
2. Steel pipe, pressure fittings, and threaded joints.

G. Aboveground storm drainage force mains [**NPS 2-1/2 and NPS 6 (DN 65 and DN 150)**] shall be[**any of**] the following:

1. Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
2. Steel pipe, pressure fittings, and threaded joints.
3. Grooved-end steel pipe, grooved-joint system fittings and couplings, and grooved joints.

H. Underground storm drainage force mains [**NPS 4 (DN 100) and smaller**] shall be[**any of**] the following:

1. [**Hard**] [**Soft**] copper tube, Type L (Type B); [**wrought-**]copper pressure fittings; and soldered joints.
2. Steel pipe, pressure fittings, and threaded joints.

    a. Include grooved-joint system fittings and couplings and grooved joints where indicated.

3. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile-iron fittings; glands, gaskets, and bolts; and mechanical joints.

    a. Include grooved-joint system fittings and couplings and grooved joints where indicated.

4. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron fittings; gaskets; and gasketed joints.

    a. Include grooved-joint system fittings and couplings and grooved joints where indicated.

5. Pressure pipe couplings if dissimilar pipe materials or piping with small difference in OD must be joined.

I. Underground storm drainage force mains [**NPS 5 (DN 125) and larger**] shall be[**any of**] the following:

1. Steel pipe, pressure fittings, and threaded joints.
2. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile-iron fittings; glands, gaskets, and bolts; and mechanical-joint joints.
3. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron fittings; gaskets; and gasketed joints.
4. Pressure pipe couplings if dissimilar pipe materials or piping with small difference in OD must be joined.

3.3 PIPING INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 2 Section "Storm Drainage."

B. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

C. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

D. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 15 Section "Plumbing Specialties."

E. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

F. Install underground, steel, force-main piping.[**Install encasement on piping according to ASTM A 674 or AWWA C105.**]

G. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to storm sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

H. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

I. Install underground, ductile-iron, special pipe fittings according to AWWA C600.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

J. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 15 Section "Basic Mechanical Materials and Methods."

K. Install wall-penetration fitting system at each service pipe penetration through foundation wall. Make installation watertight.

L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

M. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

N. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

O. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:

1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

P. Install force mains at elevations indicated.

Q. Install engineered controlled-flow storm drainage piping in locations indicated.

R. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

S. Install ABS storm drainage piping according to ASTM D 2661.

T. Install PVC storm drainage piping according to ASTM D 2665.

U. Install underground [**ABS**] [**and**] [**PVC**] storm drainage piping according to ASTM D 2321.

V. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

D. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

E. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

F. Grooved Joints: Cut groove ends of pipe and assemble grooved ends of pipes, grooved-end fittings, and grooved-end-piping couplings according to AWWA C606.

G. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 15 Section "Valves."

B. Shutoff Valves: Install shutoff valve on each sump pump discharge.

1. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
2. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sump pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves.[**Use normally closed type, unless otherwise indicated.**]
2. Install backwater valves in accessible locations.
3. Backwater valve are specified in Division 15 Section "Plumbing Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 15 Section "Mechanical Vibration Controls and Seismic Restraints."

B. Pipe hangers and supports are specified in Division 15 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:

    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Division 15 Section "Hangers and Supports."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.

3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
6. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
5. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
8. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.

I. Install supports for vertical steel piping every 15 feet (4.5 m).

J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
6. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.

K. Install supports for vertical copper tubing every 10 feet (3 m).

L. Install hangers for [**ABS**] [**and**] [**PVC**] piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
5. NPS 8 to NPS 12 (DN 200 to DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

M. Install supports for vertical [**ABS**] [**and**] [**PVC**] piping every 48 inches (1200 mm).

N. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

D. Connect force-main piping to the following:

1. Storm Sewer: To exterior force main or storm manhole.
2. Sump Pumps: To sump pump discharge.

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping[**, except outside leaders,**] on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 15160

SECTION 15445 - DRY-PIT SUBMERSIBLE PUMPS and CONTROLLERS

PART 1. GENERAL

1.01 This specification includes the supply of (2) base-mounted, dry-pit submersible solids-handling pumping unit(s), UL Listed for explosion proof Class I, Division 1, Groups C and D hazardous locations. The pumps Pump rotation shall be as shown on the drawings.

1.02 QUALITY ASSURANCE

A. All pumping equipment furnished under this Section shall be of a design and manufacture that has been used in similar applications, and it shall be demonstrated to the satisfaction of the Owner that the quality is equal to equipment made by that manufacturer.
B. Unit responsibility. Pumps, complete with motor and all other specified accessories and appurtenances, shall be furnished by the pump manufacturer to insure compatibility and integrity of the individual components, and provide the specified warranty for all components.
C. The base-mounted, dry-pit submersible solids-handling pumps and motors specified in this section shall be furnished by and be the product of one manufacturer.
D. Pumps are to be engineered and manufactured under a written Quality Assurance program. The Quality Assurance program is to be in effect for at least ten years, to include a written record of periodic internal and external audits to confirm compliance with such program.

1.03 PERFORMANCE

A. The pumps shall be designed for continuous operation and will be operated continuously under normal service.
B. OPERATION CRITERIA

	Flow (GPM)	TDH (ft.)	Max. Pump Speed (RPM)	Max. Solids Passage	Max. Shutoff Head (ft.)	NPSHR @ Rated Condition (ft.)
Design Condition	4000	30	705	6”	66	11.3
Secondary Condition						

PART 2, PRODUCTS

2.01 PUMPS

A. Manufacturer

1. The Fairbanks Morse 10" Model 5435WD was used as the basis of design.
2. Available Manufactures: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, Yoemans Chicago, Flygt, Deming and Hydromatic. If the Contractor chooses to use another pump manufacturer then any changes, such as piping arrangements, physical layout, or additional expenses, etc. shall be the Contractors responsibility.
3. Manufacturer shall have installations of like or similar application with a minimum of 5 years service for a pump of this size.

B. Design

1. Rotation
   a. The pump will be (clockwise)(counterclockwise) rotation when viewed from the driver end looking at the pump.
2. Impeller
   a. Impeller shall be of the balanced non-clogging type matched to its constant velocity equalizing pressure volute and be made of close-grained cast iron conforming to ASTM A48 CL30. It shall be of one-piece construction, single suction, enclosed two-vane, radial flow design with well-rounded leading vanes and then tapered toward the trailing edge for a circular flow pattern to prevent the accumulation of solids and stringy material.
   b. The clearance between the impeller outside diameter and cutwater shall be capable of passing a 6" sphere.
   c. The impeller is to be balanced and secured to the shaft by means of a bolt, washer, and key. The arrangement shall be such that the impeller cannot be loosened from torque in either forward or reverse rotation.
   d. Wiper vanes on the back impeller shroud are not allowed.
   e. Impeller shall be trimmed to specifically meet the conditions of operation.
3. Volute/Casing
   a. Volute is to be cast with extra thick walls made of close-grained cast iron conforming to ASTM A48, Class 30. It is to be one-piece, constant velocity equalizing pressure with smooth fluid passages large enough to pass any size solid that can pass through the impeller.

b. The volute shall be side flanged tangential discharge and be capable of rotation in 45-degree increments to accommodate piping orientation. Volute discharge shall be minimum 10" diameter as measured on the inside diameter of the discharge flange opening. Diffusion vanes are not permitted.
c. The volute shall be furnished with large cleanout openings located at the impeller centerline, to allow access to the impeller.
d. The casing shall be designed to permit the removal of the rotating assembly without disturbing the suction or discharge piping. The casing shall be hydrostatically tested to 1.5 times the design head or 1.25 times the shutoff head whichever is greater.

4. Wear Rings
   a. Wear rings shall be provided on both the impeller and fronthead so that clearances can be maintained throughout the life of the rings and minimize recirculation.
   b. Impeller wear rings shall be of the axial- or face-type.
   c. Fronthead wear rings shall be of the axial- or face-type.
   d. Wear rings shall be attached to the impeller and fronthead using an interference fit and Loctite.
   e. Wear rings shall be stainless steel, with the impeller wear ring approximately 50 Brinell softer than the fronthead wear ring.
   f. Wear ring clearance adjustment shall be attained through impeller adjustment shims.
5. Base and Suction Elbow
   a. A rugged, heavy-duty fabricated steel base with openings large enough to permit access to the suction elbow and cleanout, bolted directly to the volute, shall be provided. The base shall be designed to support the assembled weight of the pump and motor.
   b. A cast iron suction elbow with ½" gauge connection, contoured handhole cleanout, and a 125 lb. flat-faced flange conforming to ANSI drilling shall be furnished.

6. Motor

   a. Pumps shall be driven by completely sealed, electric submersible squirrel cage induction motors with a maximum NEMA nameplate rating of 40 HP, 1.15 service factor, 705RPM, 460 volts, 3 -phase, 60 Hertz. The motor nameplate horsepower rating should exceed the brake horsepower requirements of the specified head and capacity conditions.
   b. Submersible equipment shall be UL Listed for Class I, Division 1, Groups C and D explosion-proof hazardous locations as defined by the National Electric Code. All electrical parts shall be housed in an

air-filled cast iron, watertight enclosure which is sealed by the use of O-rings and rabbeted joints with extra large overlaps.

c. The stator winding and lead shall be insulated with moisture-resistant Class F insulation for continuous duty in 40 degree C ambient. The motor shall be designed for continuous duty capable of ten (1) starts per hour. Automatic reset, normally closed thermal overloads shall be imbedded in the motor windings to provide overheating protection. Motor winding thermostats must be connected to an electric controller per local and state codes and the National Electric Code.

d. Motor shaft shall be one-piece, 416 stainless steel. Carbon steel shafts or shaft sleeves are not acceptable. Rotor is to be dynamically balanced to meet NEMA vibration limits; all external hardware is to be stainless steel.

e. Cable leads are to enter at the top of the motor, and are to allow the cable-to-motor connection to be accomplished in the filed without soldering. All power and control lead wires are to be double sealed s it enters the motor in such a manner that cable-wicking will not occur. This sealing system shall consist of a rubber grommet followed by epoxy that is high in adhesive qualities and has a low coefficient of expansion. Each cable wire is to have a small section of insulation removed to establish a window area of bare wire and each wire is to be untwisted and surrounded by epoxy potting material. A cable strain relief mechanism shall be an integral part of this sealing system. Cable sealing system shall be capable of withstanding an external pressure test of 1200 PSI as well as a cable assembly pull test as required by Underwriters Laboratories. Singular grommet or other similar sealing systems are not acceptable. Motor shall be supplied with 35 feet of multi-conductor type “SOW-A” or “W” power cable and control cable. Cable sizing shall conform to NEC specifications and be UL Listed.

f. Power and control leads shall be terminated on a sealed terminal board. The terminal board and its bronze lugs shall be O-ring sealed.

g. The motor cooling jacket shall be sealed to the motor housing with O-rings. A portion of the liquid being pumped shall be used to cool the motor. The liquid enters the motor cooling jacket internally via a self-cleaning, rotating flow-control disc to prevent solids from entering and accumulating in the mechanical seal area and cooling water jacket. The cooling jacket shall be designed so that on start-up there is a means to purge the air from the jacket as the cooling water enters.

7. Shaft Seal Arrangement

a. Pumps shall be provided with two separate tandem-mounted mechanical seals to prevent the pumped liquid from entering the rotor/stator cavity area to ensure reliability of operation. The upper and lower seals are mounted to rotate in the same direction.
b. The lower mechanical seal mating surfaces are to be immersed in an oil bath, sealing the pump volute chamber from the oil cavity. Oil in this cavity shall also lubricate the upper mechanical seal faces. Seal faces of both the upper and lower mechanical seals shall be held in contact by independent polymeric elastomer bellows, which act as a spring mechanism. Seals require neither maintenance nor adjustment, but shall be easily inspected and replaced. Pressure generated by the pump assists in sealing the mating surfaces of the lower seal.
c. Component material for the upper seal shall consist of a composite elastomer body, carbon steel snap ring, Buna-N O-ring, carbon rotating face and ceramic stationary face. Lower seal component construction shall include a composite elastomer body, stainless steel clamp and set screws, Buna-N O-ring, silicon carbide rotating face and tungsten carbide stationary face.
d. Two moisture detection probes shall be installed so that they will detect moisture in either the seal or stator cavity measuring resistivity between the probes. They shall be wired internally to the control cable connection at the top of the motor. Float type devices located in the rotor/stator area or single probe-to-ground moisture detectors measuring continuity are not acceptable. O-ring sealed inspection plugs shall be provided in the mechanical seal oil chamber for ease of inspection, draining and filling of oil.

8. The pump shall rotate on a grease lubricated-for-life thrust bearing and grease lubricated radial bearing with a minimum L10 life of 50,000 hours. Lower shaft bearings shall be locked in place to prevent shaft movement and to take thrust loads.

9. Control shall be from a duplex control panel. Panel shall be a NEMA 3R steel enclosure. Panel shall be wall mounted. The following items shall be standard:

10. Controller shall include the following:

a. Fused disconnect switches with lockout handles thru cover for main sewage pumps

b Magnetic starters with overload and low voltage protection

c. Hand-Off-Automatic selector switches

d“ Easy” Electric alternator and PLC

d . Control circuit transformers, 120 volt

e. Pump running lights

f. Overload reset buttons

g. (1) Wired and numbered terminal strip

h. (1) High water alarm with light, alarm buzzer and silencing switch with dry contacts for remote monitoring

i. (2) Mercury float switches for backup

j. (1) Milltronics Hydroranger Ultrasonic Level Controller and Transducer

k. Level Controller: The multi-purpose level transmitter shall be microprocessor based echo-time measuring type providing an electrical output signal proportional to the level of material, space, volume, flow or differential as may be required. It shall consist of one or two transducers and a transmitter connected by coaxial cable.

l. Transducer: Operating Principle: Acoustic impulses emitted from an ultrasonic sensor are reflected back from the material surface and are received by the sensor. The transit time of pulse travel from generation to echo is measured. The elapsed time is proportional to the distance between the sensor and material surface.

m. Primary Sensor: The acoustic sensor/transducer shall be Milltronics ultrasonic transducer with a polarized barium titanate crystal with acoustic impedance matching face

11. Testing of Pumps and Controllers

a. A certified factory performance test shall be performed on each pumping unit in accordance with Hydraulic Institute Standards, latest edition. Tests shall be sufficient to determine the curves of head, input horsepower, and efficiency relative to capacity from shutoff to 150% of design flow. A minimum of six points, including shutoff, shall be taken for each test. At least one point of the six shall be taken as near as possible to each specified condition.

b. Results of the performance tests shall be certified by a Registered Professional Engineer and submitted for approval before final shipment.

SECTION 15755 - DEHUMIDIFICATION UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes factory-assembled and -tested, [**desiccant**] [**refrigeration**]-type dehumidification units with the following operation and optional accessories and components:

1. [**Gas-furnace**] [**Hot-water-coil**] [**Steam-coil**] [**Electric**] post heater.
2. Cooling package consisting of compressors,[**remote**] condenser coil, and evaporator coil.
3. Outside- and return-air dampers.
4. Smoke detectors or firestats.
5. Energy-recovery heat exchangers.
6. Automatic controls and remote-control panel.
7. Reactivation-air pretreatment heat exchanger.
8. Reactivation-air heater.
9. Evaporative cooler.
10. Hot-gas reheat.
11. Auxiliary boiler.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories.

B. LEED Submittals:

1. Product Data for Credit EA 4: Documentation required by Credit EA 4 indicating that equipment and refrigerants comply.
2. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2004, Section 5 - "Systems and Equipment."

C. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and equipment mounting frame.
4. Wiring Diagrams: Power, signal, and control wiring.

D. Manufacturer Seismic Qualification Certification: Submit certification that dehumidification units, accessories, and components will withstand seismic forces defined in Division 15 Section "Mechanical Vibration and Seismic Controls." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Source quality-control test reports.

F. Field quality-control test reports.

G. Startup report.

H. Operation and Maintenance Data: For dehumidification units to include in emergency, operation, and maintenance manuals.

I. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of dehumidification units and are based on the specific system indicated. Refer to Division 1 Section "Quality Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of dehumidification units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Chemical Desiccant Rotor: Manufacturer's standard, but not less than [**five**] years from date of Substantial Completion.
2. Warranty Period for Compressors: Manufacturer's standard, but not less than [**five**] years from date of Substantial Completion.
3. Warranty Period for Evaporator Coil: Manufacturer's standard, but not less than [**five**] years from date of Substantial Completion.
4. Warranty Period for Fuel-Fired Heat Exchangers: Manufacturer's standard, but not less than [**10**] years from date of Substantial Completion.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: [**One**] set(s) of each type of filter specified.
2. Fan Belts: [**One**] set(s) for each belt-drive fan.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 DESICCANT DEHUMIDIFICATION UNITS

A. Description: Factory-assembled and -tested, desiccant dehumidification unit suitable for outdoor installation.

1. [**Available**]Manufacturers:

   a. Air Technology Systems, Inc.
   b. Bry-Air, Inc.
   c. Fresh Air Solutions.
   d. Governair Corporation.
   e. Kathabar Inc.
   f. Munters; Cargocaire Division.
   g. Octagon Air Systems.

B. Casing: [**Single**] [**Double**]-wall construction with corrosion-protective coating and exterior [**baked-enamel**] [**powder-coated**] finish, [**removable panels**] [**hinged access doors**] with neoprene gaskets, minimum [**1/2-inch- (13-mm-) thick thermal insulation**] [**2-inch- (50-mm-) thick, glass-fiber insulation fill with no metal structure through the insulation**], stainless-steel fasteners, knockouts for electrical and piping connections through the [**side of the unit**] [**bottom of the unit within the roof curb**], condensate drain connection, and lifting lugs.

1. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

C. Desiccant Rotor: Synthesized silica gel, enhanced with titanium, bonded to a ceramic matrix, and filling voids and encapsulating the ceramic. Driver shall be a motor with adjustable drive sheaves and belt-tensioning idler pulley or adjustable motor mount.

D. Direct-Fired, [**Natural**] [**Propane**]-Gas, Reactivation-Air Heater: Factory assembled, piped, and wired; complying with ANSI Z83.9 and NFPA 54, "National Fuel Gas Code"; and shall be AGA or ETL certified.

1. Capacity Control: Fully modulated from 10 to 100 percent input at constant flow.
2. Purge-period timer shall delay burner ignition and bypass low-limit control.
3. Gas Train: Motorized shutdown valve, main and pilot gas regulators, pilot electric gas valve, manual shutoff valve, and pilot adjustment valve.
4. Pilot: Electrically ignited by spark rod through high-voltage-ignition transformer with flame safety.
5. Factory-Installed Airflow Sensors: Verify correct airflow before energizing pilot, and sense pilot ignition before activating main gas valve.
6. Manual-Reset, Low- and High-Limit Controls: Maintain supply-air temperature between set points, and shut fan down if temperatures are exceeded.

E. Indirect-Fired, [**Power**] [**Gravity**]-Vented, [**Natural**] [**Propane**]-Gas, Reactivation-Air Heater: Factory assembled, piped, and wired; complying with ANSI Z83.9 and NFPA 54, "National Fuel Gas Code"; and shall be AGA or ETL certified.

1. Heat-Exchanger and Burner Tubes: Stainless steel.

2. Capacity Control: Motorized valve [**with two-stage operation**] [**, fully modulating from 10 to 100 percent input**].
3. Gas Train: Motorized shutdown valve, main and pilot gas regulators, pilot electric gas valve, manual shutoff valve, and pilot adjustment valve.
4. Pilot: Hot-surface ignitor and flame safety.
5. Factory-Installed Airflow Sensors: Verify correct airflow before energizing pilot, and sense pilot ignition before activating main gas valve.
6. Manual-Reset, Low- and High-Limit Controls: Maintain supply-air temperature between set points, and shut fan down if temperatures are exceeded.

F. Steam-Coil Reactivation-Air Heater: Distribution header coil fabricated according to ARI 410, with threaded steam supply and condensate connections.

1. Tubes: Copper.
2. Fins: [**Aluminum**] [**Copper**] with fin spacing [**0.125 inch (3.18 mm)**] [**0.091 inch (2.31 mm)**] [**0.071 inch (1.80 mm)**] [**0.067 inch (1.70 mm)**] [**0.056 inch (1.42 mm)**] [**0.0075 inch (0.19 mm)**].
3. Fin and Tube Joints: Mechanical bond.
4. Headers: Cast iron with drain and air vent tappings.
5. Frames: Galvanized-steel channel, 0.052 inch (1.3 mm).
6. Ratings: Design tested and rated according to ASHRAE 33 and ARI 410.

    a. Working-Pressure Ratings: 100 psig (690 kPa), 400 deg F (205 deg C).

7. Source Quality Control: Factory test to 200 psig (1380 kPa).

G. Hot-Water-Coil Reactivation-Air Heater: Continuous circuit coil fabricated according to ARI 410.

1. Tubes: Copper.
2. Fins: [**Aluminum**] [**Copper**] with fin spacing [**0.125 inch (3.18 mm)**] [**0.091 inch (2.31 mm)**] [**0.071 inch (1.80 mm)**] [**0.067 inch (1.70 mm)**] [**0.056 inch (1.42 mm)**] [**0.0075 inch (0.19 mm)**].
3. Fin and Tube Joints: Mechanical bond.
4. Headers: Cast iron with drain and air vent tappings.
5. Frames: Galvanized-steel channel, 0.052 inch (1.3 mm).
6. Ratings: Design tested and rated according to ASHRAE 33 and ARI 410.

    a. Working-Pressure Ratings: 200 psig (1380 kPa), 325 deg F (163 deg C).

7. Source Quality Control: Factory test to 300 psig (2070 kPa).

H. Electric-Resistence-Heating-Coil Reactivation-Air Heater: Comply with UL 1995.

1. Heating Element: Coiled resistance wire of 80 percent nickel and 20 percent chromium; surrounded by compacted magnesium oxide powder in tubular-steel sheath; with spiral-wound, copper-plated steel fins continuously brazed to sheath.
2. Heating Element: Open-coil resistance wire of 80 percent nickel and 20 percent chromium, supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame.

3. Overtemperature Protection: Disk-type, automatic-reset, thermal-cutout, safety device; serviceable through terminal box without removing heater from unit.
4. Thermal Cutouts: Load carrying, manual reset or replaceable, and factory wired in series with each heater stage.
5. Control: Disconnecting means, overcurrent protection, and airflow proving switch.

I. Reactivation-Air Pretreatment Heat Exchanger: Sensible-only wheel that shall be cleanable with compressed air, vacuuming, low-temperature steam, or hot water without affecting latent heat recovery. Casing shall be equipped with adjustable noncontact seals to limit cross contamination to a maximum of 0.2 percent. Wheel shall be supported on grease-lubricated ball bearings with grease fittings extended to a serviceable location inside the dehumidification unit casing. Wheel shall be driven by a motor directly connected through a gear reducer or a belt drive.

J. Reactivation-Air Pretreatment Heat Exchanger: Copper tubes and aluminum fins having a protective epoxy-phenolic coating for corrosion resistance, fabricated with capillary wick structure, filled with refrigerant, and sealed; mounted in galvanized-steel flanged casing, with airtight partition between airstreams. Refrigerant shall comply with ASHRAE 15, Group 1.

K. Reactivation-Air Pretreatment Heat Exchanger: Constructed with plates evenly spaced and sealed and arranged for counterflow heat-exchanging airstreams.

1. Plate Material: [**Embossed aluminum**] [**Stainless steel**] [**Polypropylene copolymer (high-density plastic)**] [**Proprietary resin-composite media allowing latent heat transfer**].
2. Plate Coating: [**Epoxy**] [**Air-dried phenolic**].

L. Evaporative Cooler: Factory-assembled and -wired unit with intake grilles; bituminous-coated sump; and individually removable, [**aspen wood-fiber pads with antirot salts to resist biological deterioration and provide absorbency**] [**6-inch (150-mm) glass-fiber pads with UL 900 (Class II) saturants**] [**8-inch (200-mm) glass-fiber pads with UL 900 (Class II) saturants**] [**12-inch (300-mm) glass-fiber pads with UL 900 (Class II) saturants**].

1. Water Circulation System: Sump pump with strainer; water distribution troughs at top of cooler pads; float-operated, makeup water valve; and overflow and drain connections.
2. Automatic Drain System: Two-way, normally open drain valve; three-way, float-operated makeup water valve; and ambient thermostat.
3. Comply with applicable requirements in ASHRAE 62.1-2004.

M. Direct-Fired, [**Natural**] [**Propane**]-Gas Post Heater: Factory assembled, piped, and wired; complying with ANSI Z83.9 and NFPA 54, "National Fuel Gas Code"; and shall be AGA or ETL certified.

1. Capacity Control: Fully modulating from 10 to 100 percent input at constant flow.
2. Purge-period timer shall delay burner ignition and bypass low-limit control.
3. Gas Train: Motorized shutdown valve, main and pilot gas regulators, pilot electric gas valve, manual shutoff valve, and pilot adjustment valve.
4. Pilot: Electrically ignited by spark rod through high-voltage-ignition transformer with flame safety.
5. Factory-Installed Airflow Sensors: Verify correct airflow before energizing pilot, and sense pilot ignition before activating main gas valve.

6. Manual-Reset, Low- and High-Limit Controls: Maintain supply-air temperature between set points, and shut fan down if temperatures are exceeded.

N. Indirect-Fired, [**Power**] [**Gravity**]-Vented, [**Natural**] [**Propane**]-Gas Post Heater: Factory assembled, piped, and wired; complying with ANSI Z83.9 and NFPA 54, "National Fuel Gas Code"; and shall be AGA or ETL certified.

1. Heat-Exchanger and Burner Tubes: Stainless steel.
2. Capacity Control: Motorized valve [**with two-position operation**] [**, fully modulating from 10 to 100 percent input**].
3. Gas Train: Motorized shutdown valve, main and pilot gas regulators, pilot electric gas valve, manual shutoff valve, and pilot adjustment valve.
4. Pilot: Hot-surface ignitor and flame safety.
5. Factory-Installed Airflow Sensors: Verify correct airflow before energizing pilot, and sense pilot ignition before activating main gas valve.
6. Manual-Reset, Low- and High-Limit Controls: Maintain supply-air temperature between set points, and shut fan down if temperatures are exceeded.

O. Steam-Coil Post Heater: Distribution header coil fabricated according to ARI 410, with threaded steam supply and condensate connections.

1. Tubes: Copper.
2. Fins: [**Aluminum**] [**Copper**] with fin spacing [**0.125 inch (3.18 mm)**] [**0.091 inch (2.31 mm)**] [**0.071 inch (1.80 mm)**] [**0.067 inch (1.70 mm)**] [**0.056 inch (1.42 mm)**] [**0.0075 inch (0.19 mm)**].
3. Fin and Tube Joints: Mechanical bond.
4. Headers: Cast iron with drain and air vent tappings.
5. Frames: Galvanized-steel channel, 0.052 inch (1.3 mm).
6. Ratings: Design tested and rated according to ASHRAE 33 and ARI 410.
    a. Working-Pressure Ratings: 100 psig (690 kPa), 400 deg F (205 deg C).
7. Source Quality Control: Test to 200 psig (1380 kPa).

P. Hot-Water-Coil Post Heater: Continuous circuit coil fabricated according to ARI 410.

1. Tubes: Copper.
2. Fins: [**Aluminum**] [**Copper**] with fin spacing [**0.125 inch (3.18 mm)**] [**0.091 inch (2.31 mm)**] [**0.071 inch (1.80 mm)**] [**0.067 inch (1.70 mm)**] [**0.056 inch (1.42 mm)**] [**0.0075 inch (0.19 mm)**].
3. Fin and Tube Joints: Mechanical bond.
4. Headers: Cast iron with drain and air vent tappings.
5. Frames: Galvanized-steel channel, 0.052 inch (1.3 mm).
6. Ratings: Design tested and rated according to ASHRAE 33 and ARI 410.
    a. Working-Pressure Ratings: 200 psig (1380 kPa), 325 deg F (163 deg C).
7. Source Quality Control: Test to 300 psig (2070 kPa).

Q. Electric-Resistence-Heating-Coil Post Heater: Comply with UL 1995.

1. Heating Element: Coiled resistance wire of 80 percent nickel and 20 percent chromium; surrounded by compacted magnesium oxide powder in tubular-steel sheath; with spiral-wound, copper-plated steel fins continuously brazed to sheath.
2. Heating Element: Open-coil resistance wire of 80 percent nickel and 20 percent chromium, supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame.
3. Overtemperature Protection: Disk-type, automatic-reset, thermal-cutout, safety device; serviceable through terminal box without removing heater from unit.
4. Thermal Cutouts: Load carrying, manual reset or replaceable, and factory wired in series with each heater stage.
5. Control: Disconnecting means, overcurrent protection, and airflow proving switch.

R. Supply[**and Exhaust**] Fans: [**Forward curved**] [**Backward inclined**], centrifugal, galvanized steel with [**baked-enamel**] [**powder-coated**] finish, belt driven with adjustable sheaves and self-aligning, grease-lubricated ball bearings with extended grease fittings easily accessible inside the casing.

S. Reactivation-Air Fan: [**Forward curved**] [**Backward inclined**], centrifugal, galvanized steel with [**baked-enamel**] [**powder-coated**] finish, belt driven with adjustable sheaves and self-aligning, grease-lubricated ball bearings with extended grease fittings easily accessible inside the casing.

T. Supply- and Exhaust-Air Filters: 2-inch- (50-mm-) thick, throwaway filters in filter rack[**, with a minimum efficiency report value of 6 according to ASHRAE 52.2 and 90 percent average arrestance according to ASHRAE 52.1**].

U. Reactivation-Air Filters: 2-inch- (50-mm-) thick, throwaway filters in filter rack[**, with a minimum efficiency report value of 6 according to ASHRAE 52.2 and 90 percent average arrestance according to ASHRAE 52.1**].

V. Refrigeration Package: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

1. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1-2004, "Energy Standard for Buildings except Low-Rise Residential Buildings."
2. Refrigerant Coils: Copper tubes with mechanically bonded aluminum fins; factory fabricated and tested to comply with ASHRAE 33 and ARI 410; with multiple refrigerant circuits, seamless-copper headers with brazed connections, and [**galvanized**] [**stainless**]-steel frame. Coil and fins shall have a polyester coating. Coils shall have a minimum 300-psig (2070-kPa) working-pressure rating and be factory tested to 450 psig (3105 kPa), and to 300 psig (2070 kPa) while underwater.
3. Compressors: [**Semihermetic**] [**Hermetic**], [**reciprocating**] [**scroll**] compressors with integral vibration isolators and crankcase heaters that de-energize during compressor operation; with thermal-expansion valves, filter-dryers, sight glasses, compressor service valves, and liquid- and suction-line service valves.

    a. Number of Refrigerant Circuits: Two for compressor capacities more than 7-1/2 tons.
    b. Refrigerant: [**R-22**] [**R-134a**] [**R-407C**] [**R-410A**].
    c. Refrigerant: R-134a, R-407C, or R-410A.
    d. Capacity Control:

1) Cylinder unloaders with steps as scheduled for reciprocating compressors.
2) Hot-gas bypass valve and piping on one compressor.
3) Cycle compressor.

e. Low-Pressure Cutout: Manual reset after three auto-reset failures.
f. High-Pressure Cutout: Manual reset.
g. Compressor Motor Overload Protection: Manual reset.
h. Antirecycling Timing Device: Prevent compressor restart for five minutes after shutdown.
i. Adjustable, Low-Ambient, Head-Pressure Control: Designed to operate at temperatures as low as 0 deg F (minus 18 deg C) by cycling condenser fans and controlling speed of last fan of each circuit.
j. Oil-Pressure Switch: Designed to shut down compressors on low oil pressure.

4. Condenser Fans: Propeller-type fans directly driven by motors with permanently lubricated bearings and internal thermal-overload protection.

W. Drain Pan and Connection: [**Plastic**] [**Stainless steel**]; insulated[**and complying with ASHRAE 62.1-2004**].

X. Outside-Air Intake Dampers: Return- and outside-air intake dampers with damper operator and control package.

1. Leakage: Maximum leakage [**2.5**] [**1.0**] percent at nominal airflow of 400 cfm per ton (54 L/s per kW) with 1-inch wg (250-Pa) pressure differential.
2. Damper Operator: [**115**] [**24**]-V ac, close coupled, with spring return.

Y. Remote-control panel shall contain controls and indicator lights as follows:

1. On-off fan switch.
2. Minimum outside-air damper potentiometer position LCD.
3. Supply-fan operating indicator light.
4. Mechanical cooling malfunction indicator light.
5. Clogged filter indicator light.

Z. Smoke Detectors: Photoelectric detector located in return-air plenum, to de-energize unit.

1. Operating Voltage: 24-V dc, nominal.
2. Self-Restoring: Detectors do not require resetting or readjusting after actuation to restore them to normal operation.
3. Plug-in Arrangement: Detector and associated electronic components mounted in module with tamper-resistant connection to fixed base with twist-locking plug. Terminals in fixed base accept building wiring.
4. Integral Visual-Indicating Light: LED type. To indicate detector operation.
5. Sensitivity: Can be tested and adjusted in-place after installation.
6. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the fire alarm control panel.
7. Sensor: LED or infrared light source with matching silicon-cell receiver.
8. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) of smoke obscuration when tested according to UL 268A.
9. Integral Thermal Detector: Fixed-temperature type with 135 deg F (57 deg C) setting.

AA. Electrical Convenience Outlet: 115-V ac fused, duplex straight-blade receptacles separately fused and located inside dehumidification unit casing.

BB. Operating Controls: Factory-installed microprocessor shall control and monitor unit and communicate to central-control processor, and shall operate dehumidification units and maintain humidity and temperature set points.

1. [**Duct-mounted**] [**Return-air**] humidity and room thermostat.
2. Control Outputs: Heating, cooling, and dehumidification.
3. Carbon Dioxide Sensor: Mount in return air to operate minimum outside-air damper position.
4. Discharge-air-, outdoor-air-, conditioned-space-, and control set-point-temperature LCD.
5. Outdoor enthalpy LCD.
6. Filter pressure drop LCD.
7. Status: Airflow, fans, system, unit operation, and operating mode.
8. Alarm LCD.
9. Magnehelic gage to indicate the pressure differential across process cooler and reactivation-air filters.
10. Drive motor to vary rotational speed in response to humidistat.

2.3 REFRIGERATION DEHUMIDIFICATION UNITS

A. Description: Factory assembled and tested, complying with ASHRAE 15, "Safety Code for Mechanical Refrigeration," and designed for roof or slab installation.

1. [**Available**]Manufacturers:

a. Century Refrigeration; Division of RAE Corporation.
b. Comitale National, Inc.
c. DEC International, Inc.; Therma-Stor Products.
d. DECTRON Inc.
e. Dehumidifier Corporation of America, Inc.
f. Desert Aire.
g. DryAire Systems Corp.
h. Dumont Refrigeration Corporation.
i. Governair Corporation.
j. Heat Recovery Technology, Inc. (a.k.a., Pool Pak Inc).
k. Nautica Dehumidifiers, Inc.
l. Nesbitt; a Mestek Company.
m. Northstar Industries, Inc.
n. Nyle Corporation.
o. Spec-Air.
p. Thermoplus Air Inc.

B. Casing: [**Single**] [**Double**]-wall construction with corrosion-protective coating and exterior [**baked-enamel**] [**powder-coated**] finish, [**removable panels**] [**hinged access doors**] with neoprene gaskets, minimum [**1/2-inch- (13-mm-) thick thermal insulation**] [**2-inch- (50-mm-) thick, glass-fiber insulation fill with no metal structure through the insulation**], stainless-

steel fasteners, knockouts for electrical and piping connections, condensate drain connection, and lifting lugs.

1. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

C. Supply[**and Exhaust**] Fans: [**Forward curved**] [**Backward inclined**], centrifugal, galvanized steel with [**baked-enamel**] [**powder-coated**] finish, belt driven with adjustable sheaves and self-aligning, grease-lubricated ball bearings with extended grease fittings easily accessible inside the dehumidification unit casing.

D. Filters: 2-inch- (50-mm-) thick, throwaway filters in filter rack[**, with a minimum efficiency report value of 6 according to ASHRAE 52.2 and 90 percent average arrestance according to ASHRAE 52.1**].

E. Refrigerant Coils: Copper tubes with mechanically bonded aluminum fins; factory fabricated and tested to comply with ASHRAE 33 and ARI 410; with multiple refrigerant circuits, seamless-copper headers with brazed connections, and [**galvanized**] [**stainless**]-steel frame. Coil and fins shall have a polyester coating. Coils shall have a minimum 300-psig (2070-kPa) working-pressure rating and be factory tested to 450 psig (3105 kPa), and to 300 psig (2070 kPa) while underwater.

F. Compressors: [**Semihermetic**] [**Hermetic**], [**reciprocating**] [**scroll**] compressors with integral vibration isolators and crankcase heaters that de-energize during compressor operation; with thermal- expansion valves, filter-dryers, sight glasses, compressor service valves, and liquid- and suction-line service valves.

1. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1-2004, "Energy Standard for Buildings except Low-Rise Residential Buildings."
2. Number of Refrigerant Circuits: Two for compressor capacities more than 7-1/2 tons.
3. Refrigerant: [**R-22**] [**R-134a**] [**R-407C**] [**R-410A**].
4. Refrigerant: R-134a, R-407C, or R-410A.
5. Capacity Control:

    a. Cylinder unloaders with steps as scheduled for reciprocating compressors.
    b. Hot-gas bypass valve and piping on one compressor.
    c. Cycle compressor.

6. Low-Pressure Cutout: Manual reset after three auto-reset failures.
7. High-Pressure Cutout: Manual reset.
8. Compressor Motor Overload Protection: Manual reset.
9. Antirecycling Timing Device: Prevent compressor restart for five minutes after shutdown.
10. Adjustable, Low-Ambient, Head-Pressure Control: Designed to operate at temperatures as low as 0 deg F (minus 18 deg C) by cycling condenser fans and controlling speed of last fan of each circuit.
11. Oil-Pressure Switch: Designed to shut down compressors on low oil pressure.

G. Drain Pan and Connection: [**Plastic**] [**Stainless steel**]; insulated[**and complying with ASHRAE 62.1-2004**].

H. Condenser and Condenser Fans: Galvanized-steel condenser casing complying with ASTM A 653/A 653M, and having G90 (Z275) coating designation; with coils having copper tubes mechanically expanded into aluminum fins[**with polyester coating**]. Propeller-type fans shall be directly driven by motors with permanently lubricated bearings.

I. Water-Cooling Heat Exchanger: Coaxial, vented, double-wall construction; with three-way refrigerant control valve.

J. Energy-Recovery Heat Exchanger (Pool Heater): Cupronickel, coaxial, vented, double-wall construction for potable-water service.

K. Outside-Air Intake Dampers: Return- and outside-air intake dampers with damper operator and control package.

1. Leakage: Maximum leakage [**2.5**] [**1.0**] percent at nominal airflow of 400 cfm per ton (54 L/s per kW) with 1-inch wg (250-Pa) pressure differential.
2. Damper Operator: [**115**] [**24**]-V ac, close coupled, with gear train sealed in oil and with spring return.

L. Remote-control panel shall contain controls and indicator lights as follows:

1. On-off fan switch.
2. Minimum outside-air damper potentiometer position LCD.
3. Supply-fan operating indicator light.
4. Mechanical cooling malfunction indicator light.
5. Clogged filter indicator light.

M. Smoke Detectors: Photoelectric detector located in return-air plenum, to de-energize unit.

1. Operating Voltage: 24-V dc, nominal.
2. Self-Restoring: Detectors do not require resetting or readjusting after actuation to restore them to normal operation.
3. Plug-in Arrangement: Detector and associated electronic components mounted in module with tamper-resistant connection to fixed base with twist-locking plug. Terminals in fixed base accept building wiring.
4. Integral Visual-Indicating Light: LED type. To indicate detector operation.
5. Sensitivity: Can be tested and adjusted in-place after installation.
6. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the fire alarm control panel.
7. Sensor: LED or infrared light source with matching silicon-cell receiver.
8. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) of smoke obscuration when tested according to UL 268A.
9. Integral Thermal Detector: Fixed-temperature type with 135 deg F (57 deg C) setting.

N. Electrical Convenience Outlet: 115-V ac fused, duplex straight-blade receptacles separately fused and located inside dehumidification unit casing or in roof-curb perimeter.

O. Operating Controls: Factory-installed microprocessor shall control and monitor unit and communicate to central-control processor.

1. Control Outputs: Heating, cooling, and dehumidification.

2. Discharge-air-, outdoor-air-, conditioned-space-, and control set-point-temperature LCD.
3. Outdoor enthalpy LCD.
4. Filter pressure drop LCD.
5. Status: Airflow, fans, system, unit operation, and operating mode.
6. Alarm LCD.

2.4 ROOF CURBS

A. Manufacturer's standard, insulated with corrosion-protective coating, casketing, and factory-installed wood nailer, according to NRCA standards.

1. Curb Height: Minimum [**16 inches (400 mm)**].
2. Isolation Curb: Rigid upper and lower steel structure with vibration isolation springs and vertical and horizontal restraints; with Elastomeric waterproof membrane. Minimum [**2-inch (50-mm)**] static deflection.

2.5 MOTORS

A. Comply with requirements in Division 15 Section "Motors."

2.6 SOURCE QUALITY CONTROL

A. Verification of Performance: According to [**ASHRAE 139**] [**ARI 910**].

B. Sound-Power-Level Ratings: According to ARI 575.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine roughing-in for [**hot-water**] [**steam**] [**refrigerant**] piping systems to verify actual locations of piping connections before equipment installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install units level and plumb, maintaining manufacturer's recommended clearances.

B. Concrete Bases: Anchor dehumidification units to concrete base.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.

2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Cast-in-place concrete materials and placement requirements are specified in Division 3.

C. Install dehumidification units on vibration [**and seismic**]-control devices. Vibration[**and seismic**]-control devices are specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

1. Units with Internally Isolated Fans: Secure units to anchor bolts installed in concrete bases.
2. Floor-Mounted Units: Support on concrete bases using neoprene pads having a minimum static deflection of [**0.25 inch (6.35 mm)**]. Secure units to anchor bolts installed in concrete bases.
3. Floor-Mounted Units: Support on concrete bases using housed-spring isolators having a minimum static deflection of [**0.25 inch (6.35 mm)**]. Secure units to anchor bolts installed in concrete bases.
4. Suspended Units: Suspend units from structural-steel support frame using threaded steel rods and spring hangers.

D. Curb Support: Install roof curb on roof structure, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install and secure dehumidification units on curbs, and coordinate roof penetrations and flashing with roof construction.[**Secure units to curb support with anchor bolts.**]

E. Unit Support: Install dehumidification units level on structural [**curbs**] [**pilings**]. Coordinate wall penetrations and flashing with wall construction.[**Secure units to structural support with anchor bolts.**]

F. Isolation Curb Support: Install dehumidification units on isolation curbs, and install flexible duct connectors and vibration isolation and seismic-control devices. Flexible duct connectors are specified in Division 15 Section "Duct Accessories." Vibration isolation and seismic-control devices are specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to dehumidification units mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using minimum NPS 1-1/4 (DN 32) copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan, and install clean out at changes in direction.

E. Refrigerant Piping: Comply with applicable requirements in Division 15 Section "Refrigerant Piping." Connect to supply and return coil tappings with shutoff valve and union or flange at each connection.

F. Hot- and Chilled-Water Piping: Comply with applicable requirements in Division 15 Section "Hydronic Piping." Connect to supply and return coil tappings with shutoff or balancing valve and union or flange at each connection.

G. Gas Piping: Comply with applicable requirements in Division 15 Section "Fuel Gas Piping." Connect gas piping to burner, full size of gas train inlet, and provide union with sufficient clearance for burner removal and service.

H. Steam and Condensate Piping: Comply with applicable requirements in Division 15 Section "Steam and Condensate Piping." Connect with shutoff valve and union or flange.

I. Duct installation requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination in roof-mounting frames. Where indicated, terminate return-air duct through roof structure and insulate the space between roof and bottom of unit.

J. Ground equipment according to Division 16 Section "Grounding and Bonding."

K. Connect wiring according to Division 16 Section "Conductors and Cables."

L. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect[**, test, and adjust**] field-assembled components and equipment installation, including piping and electrical connections[**, and to assist in field testing**]. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks. Repair leaks and retest until no leaks exist.
2. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning components and [**retest**] [**reinspect**] as specified above.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Perform the following final checks before startup:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Verify lubrication of bearings, pulleys, belts, and other moving parts.
6. Set outside- and return-air mixing dampers to minimum outside-air setting.
7. Install clean filters.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

C. Starting procedures for dehumidification units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace malfunctioning motors, bearings, and fan wheels.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

D. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for dehumidification unit testing, adjusting, and balancing.

E. Complete installation and startup checks according to manufacturer's written instructions.

F. Startup Report: Report findings during startup. Identify startup steps, corrective measures taken, and final results.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust initial temperature and humidity set points.

3.7 CLEANING

A. Clean dehumidification units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils' entering-air face.

B. After completing system installation, testing, and startup service of dehumidification units, clean filter housings and install new filters.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain dehumidification units. Refer to Division 1 Section "[**Closeout Procedures**] [**Demonstration and Training**]."

END OF SECTION 15755

SECTION 16010 – ELECTRICAL SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Work covered by the Contract Documents.
2. Type of the Contract.
3. Work phases.
4. Work under other contracts.
5. Products ordered in advance.
6. Owner-furnished products.
7. Use of premises.
8. Owner's occupancy requirements.
9. Work restrictions.
10. Specification formats and conventions.

B. Related Sections include the following:

1. Division 1 Section "Summary of Multiple Contracts" for division of responsibilities for the Work.
2. Division 1 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: Eastern Avenue Pumping Station – BH3107 (001)

1. Project Location: Eastern Avenue & Olive Street, NE

B. Owner: WASA

C. Engineer: Allen & Shariff

D. The Work consists of the following:

1. The Work includes the removal and replacement of storm water pumps, including new controllers, valves and piping tied into existing discharge lines. During the course of the work the pumping station shall remain in service.

2. This would require the removal of one pump, valves, piping, controllers and electrical while maintaining the operation of the remaining existing pump. Prior to the installation of the first new pump the electrical contractor shall install a new service to the building. After the construction and installation of the new pump has been tested to the satisfaction of the Owner, the second pump shall be installed. At no time shall the pumping station by without the operation of a single pump.

3. The contractor shall include the cost of providing a bypass pumping service in their proposal for a scheduled period of time as required to perform their work.

1.4 TYPE OF CONTRACT

A. Project will be constructed under a single prime contract.

1.5 WORK UNDER OTHER CONTRACTS

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.

1.6 USE OF PREMISES

A. General: Each Contractor shall have full use of premises for construction operations, including use of Project site, during construction period. Each Contractor's use of premises is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. Use of Existing Building: Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

1.7 OWNER'S OCCUPANCY REQUIREMENTS

A. Full Owner Occupancy: Owner will occupy site and **existing** building during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits, unless otherwise indicated.

1. Maintain access to existing walkways, and other adjacent occupied or used facilities. Do not close or obstruct walkways, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
2. Provide not less than 72 hours notice to Owner of activities that will affect Owner's operations.

1.8 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 16-division format and CSI/CSC's "MasterFormat" numbering system.

1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
2. Division 1: Sections in Division 1 govern the execution of the Work of all Sections in the Specifications.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

    a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 16010

SECTION 16051 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

E. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

END OF SECTION 16051

SECTION 16055 - OVERCURRENT PROTECTIVE DEVICE COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.

1. Coordination of series-rated devices is permitted where indicated on Drawings.

1.3 SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

C. Qualification Data: For coordination-study specialist.

D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals [**shall**] [**may**] be in digital form.

1. Coordination-study input data, including completed computer program input data sheets.
2. Study and Equipment Evaluation Reports.
3. Coordination-Study Report.

1.4 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:

B. Computer Software Developers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide or a comparable product by one of the following:

1. CGI CYME.
2. EDSA Micro Corporation.
3. ESA Inc.
4. Operation Technology, Inc.
5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

a. Arcing faults.
b. Simultaneous faults.
c. Explicit negative sequence.
d. Mutual coupling in zero sequence.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other Division 16 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:

    a. Circuit-breaker and fuse-current ratings and types.
    b. Relays and associated power and current transformer ratings and ratios.
    c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
    d. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
    e. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Ratings, types, and settings of utility company's overcurrent protective devices.
    e. Special overcurrent protective device settings or types stipulated by utility company.
    f. Time-current-characteristic curves of devices indicated to be coordinated.
    g. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.

h. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
i. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:

1. Switchgear and switchboard bus.
2. Medium-voltage controller.
3. Motor-control center.
4. Distribution panelboard.
5. Branch circuit panelboard.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 242.

1. Transformers:

a. ANSI C57.12.10.
b. ANSI C57.12.22.
c. ANSI C57.12.40.
d. IEEE C57.12.00.
e. IEEE C57.96.

2. Medium-Voltage Circuit Breakers: IEEE C37.010.
3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
4. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
3. Calculate the maximum and minimum ground-fault currents.

B. Comply with IEEE 242 recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

   a. Inrush current when first energized.
   b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
   c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

E. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:

   a. Device tag.
   b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.

c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
d. Fuse-current rating and type.
e. Ground-fault relay-pickup and time-delay settings.

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

a. Device tag.
b. Voltage and current ratio for curves.
c. Three-phase and single-phase damage points for each transformer.
d. No damage, melting, and clearing curves for fuses.
e. Cable damage curves.
f. Transformer inrush points.
g. Maximum fault-current cutoff point.

F. Completed data sheets for setting of overcurrent protective devices.

END OF SECTION 16055

SECTION 16060 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.
   1. Common ground bonding with lightning protection system.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:

   1. Instructions for periodic testing and inspection of grounding features at ground rings based on NFPA 70B.

      a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
      b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
5. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by10 feet (19 mm by 3 m) in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 6 AWG and smaller.

1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.

2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.

B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

F. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each, extending around the perimeter of building.

1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

C. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

D. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.

END OF SECTION 16060

SECTION 16073 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

B. Related Sections include the following:

1. Division 16 Section "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

        1) Hilti Inc.
        2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.
        4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

    a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

        1) Cooper B-Line, Inc.; a division of Cooper Industries.
        2) Empire Tool and Manufacturing Co., Inc.
        3) Hilti Inc.
        4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 5 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slottedsupport system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To New Concrete: Bolt to concrete inserts.
2. To Existing Concrete: Expansion anchor fasteners.

3. To Steel: [**Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts**] [**Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69**] [**Spring-tension clamps**].
4. To Light Steel: Sheet metal screws.
5. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate[**by means that meet seismic-restraint strength and anchorage requirements**].

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 5 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use [**3000-psi (20.7-MPa)**], 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 3 Section "[**Cast-in-Place Concrete**] [**Cast-in-Place Concrete (Limited Applications)**]."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Division 9 [**painting Sections**] [**Section "High-Performance Coatings"**] for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 16073

SECTION 16075 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1[**and IEEE C2**].

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.2 CONDUCTOR IDENTIFICATION MATERIALS

A. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.3 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.4 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black except where used for color-coding.

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 9 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
1. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl tape applied in bands. Install labels at 10-foot (3-m) maximum intervals.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.
2. Power.

C. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

D. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.

E. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

   a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
   b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
   c. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be [**self-adhesive, engraved**] [**engraved**], laminated acrylic or melamine label.
   b. Enclosures and electrical cabinets.
   c. Access doors and panels for concealed electrical items.
   d. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
   e. Emergency system boxes and enclosures.
   f. Motor-control centers.
   g. Enclosed switches.
   h. Enclosed circuit breakers.
   i. Enclosed controllers.
   j. Power transfer equipment.
   k. Monitoring and control equipment.

END OF SECTION 16075

SECTION 16120 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.
3. Sleeves and sleeve seals for cables.

B. Related Sections include the following:

1. Division 16 Section "Voice and Data Communication Cabling" for cabling used for voice and data circuits.
2. Division 16 Section "Undercarpet Cables" for flat cables for undercarpet installations.
3. Division 16 Section "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing

Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alcan Products Corporation; Alcan Cable Division.
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

C. [**Aluminum**] [**and**] [**Copper**] Conductors: Comply with NEMA WC 70.

D. Conductor Insulation: Comply with NEMA WC 70 for Types [**THW**] [**THHN-THWN**] [**XHHW**] [**UF**] [**USE**] [**and**] [**SO**].

E. Multiconductor Cable: Comply with NEMA WC 70 for [**armored cable, Type AC**] [**metal-clad cable, Type MC**] [**mineral-insulated, metal-sheathed cable, Type MI**] [**nonmetallic-sheathed cable, Type NM**] [**Type SO**] [**and**] [**Type USE**] with ground wire.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

2.4 SLEEVE SEALS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] or a comparable product by one of the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

D. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: [**EPDM**] [**NBR**] interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

2. Pressure Plates: [**Plastic**] [**Carbon steel**] [**Stainless steel**]. Include two for each sealing element.
3. Connecting Bolts and Nuts: [**Carbon steel with corrosion-resistant coating**] [**Stainless steel**] of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: [**Copper**] [**Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger**]. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: [**Type THHN-THWN, single conductors in raceway**] [**Type XHHW, single conductors in raceway**] [**Mineral-insulated, metal-sheathed cable, Type MI**] [**Type SE or USE multiconductor cable**].

B. Exposed Feeders: [**Type THHN-THWN, single conductors in raceway**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**] [**Nonmetallic-sheathed cable, Type NM**].

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: [**Type THHN-THWN, single conductors in raceway**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**] [**Nonmetallic-sheathed cable, Type NM**].

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: [**Type THHN-THWN, single conductors in raceway**] [**Underground feeder cable, Type UF**].

E. Feeders Installed below Raised Flooring: [**Type THHN-THWN, single conductors in raceway**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**].

F. Feeders in Cable Tray: [**Type THHN-THWN, single conductors in raceway**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**] [**Nonmetallic-sheathed cable, Type NM**].

G. Exposed Branch Circuits, Including in Crawlspaces: [**Type THHN-THWN, single conductors in raceway**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**] [**Nonmetallic-sheathed cable, Type NM**].

H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: [**Type THHN-THWN, single conductors in raceway**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**] [**Nonmetallic-sheathed cable, Type NM**].

I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: [**Type THHN-THWN, single conductors in raceway**] [**Underground branch-circuit cable, Type UF**].

J. Branch Circuits Installed below Raised Flooring: [**Type THHN-THWN, single conductors in raceway**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**].

K. Branch Circuits in Cable Tray: [**Type THHN-THWN, single conductors in raceway**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**].

L. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

M. Class 1 Control Circuits: Type THHN-THWN, in raceway.

N. Class 2 Control Circuits: [**Type THHN-THWN, in raceway**] [**Power-limited cable, concealed in building finishes**] [**Power-limited tray cable, in cable tray**].

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 16 Section "Electrical Supports and Seismic Restraints."

F. Identify and color-code conductors and cables according to Division 16 Section "Electrical Identification."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least [**6 inches (150 mm)**] [**12 inches (300 mm)**] of slack.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
2. For sleeve rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both wall surfaces.

G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and cable unless sleeve seal is to be installed[**or unless seismic criteria require different clearance**].

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry[**and with approved joint compound for gypsum board assemblies**].

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 7 Section "Joint Sealants."

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 7 Section "Through-Penetration Firestop Systems."

L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal underground exterior-wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 7 Section "Through-Penetration Firestop Systems."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test[**service entrance and feeder conductors, and conductors feeding the following critical equipment and services**] for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

    a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
    b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

D. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 16120

SECTION 16123 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. UTP cabling.
2. [**50/125**] [**62.5/125**]-micrometer, multimode optical fiber cabling.
3. RS-232 cabling.
4. RS-485 cabling.
5. Low-voltage control cabling.
6. Control-circuit conductors.
7. Identification products.

1.3 DEFINITIONS

A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.

B. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.

C. EMI: Electromagnetic interference.

D. IDC: Insulation displacement connector.

E. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

F. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

G. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

H. RCDD: Registered Communications Distribution Designer.

I. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.

J. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

K. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:

1. Vertical and horizontal offsets and transitions.
2. Clearances for access above and to side of cable trays.
3. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
4. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

C. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

D. Source quality-control reports.

E. Field quality-control reports.

F. Maintenance Data: For wire and cable to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: [**25**] or less.
2. Smoke-Developed Index: [**50**] [**450**] or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use [**optical fiber flashlight**] [**optical loss test set**] [**optical fiber flashlight or optical loss test set**].
2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of UTP cable for open and short circuits.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install UTP and optical fiber cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. Support of Open Cabling: NRTL labeled for support of [**Category 5e**] [**Category 6**] cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

B. Cable Trays:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

   a. Cable Management Solutions, Inc.
   b. Cablofil Inc.
   c. Cooper B-Line, Inc.
   d. Cope - Tyco/Allied Tube & Conduit.
   e. GS Metals Corp.

2. Cable Tray Materials: Metal, suitable for indoors and protected against corrosion by [**electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch (0.012 mm) thick**] [**hot-dip galvanizing, complying with ASTM A 123/A 123M, Grade 0.55, not less than 0.002165 inch (0.055 mm) thick**].

   a. Basket Cable Trays: [**6 inches (150 mm) wide and 2 inches (50 mm) deep**]. Wire mesh spacing shall not exceed 2 by 4 inches (50 by 100 mm).
   b. Trough or Ventilated Cable Trays: [**Nominally 6 inches (150 mm)**] wide.
   c. Ladder Cable Trays: [**Nominally 18 inches (455 mm)**] wide, and a rung spacing of [**12 inches (305 mm)**].
   d. Channel Cable Trays: One-piece construction, [**nominally 4 inches (100 mm)**] wide. Slot spacing shall not exceed 4-1/2 inches (115 mm) o.c.

e. Solid-Bottom or Nonventilated Cable Trays: One-piece construction, [**nominally 12 inches (305 mm)**] wide. Provide [**with**] [**without**] solid covers.

C. Conduit and Boxes: Comply with requirements in Division 16 Section "Raceways and Boxes."[**Flexible metal conduit shall not be used.**]

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

A. Description: Plywood, [**fire-retardant treated,**]3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels in Division 6 Section "Rough Carpentry."

2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

1. Belden CDT Inc.; Electronics Division.
2. Berk-Tek; a Nexans company.
3. CommScope, Inc.
4. Draka USA.
5. Genesis Cable Products; Honeywell International, Inc.
6. KRONE Incorporated.
7. Mohawk; a division of Belden CDT.
8. Nordex/CDT; a subsidiary of Cable Design Technologies.
9. Superior Essex Inc.
10. SYSTIMAX Solutions; a CommScope, Inc. brand.
11. 3M.
12. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: 100-ohm, four-pair UTP[**, formed into 25-pair binder groups covered with a blue thermoplastic jacket**].

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, [**Category 5e**] [**Category 6**].
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

a. Communications, General Purpose: Type CM or Type CMG[**; or Type MPP, Type CMP, Type MPR, Type CMR, Type MP, or Type MPG**].
b. Communications, Plenum Rated: Type CMP[**or Type MPP**], complying with NFPA 262.
c. Communications, Riser Rated: Type CMR[**; or Type MPP, Type CMP, or Type MPR**]; complying with UL 1666.

d. Communications, Limited Purpose: Type CMX[**; or Type MPP, Type CMP, Type MPR, Type CMR, Type MP, Type MPG, Type CM, or Type CMG**].
e. Multipurpose: Type MP or Type MPG[**; or Type MPP or Type MPR**].
f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
g. Multipurpose, Riser Rated: Type MPR[**or Type MPP**], complying with UL 1666.

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

1. American Technology Systems Industries, Inc.
2. Dynacom Corporation.
3. Hubbell Premise Wiring.
4. KRONE Incorporated.
5. Leviton Voice & Data Division.
6. Molex Premise Networks; a division of Molex, Inc.
7. Nordex/CDT; a subsidiary of Cable Design Technologies.
8. Panduit Corp.
9. Siemon Co. (The).
10. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.

C. Connecting Blocks: [**110 style for Category 5e**] [**110 style for Category 6**] [**66 style for Category 5e**]. Provide blocks for the number of cables terminated on the block, plus [**25**] percent spare; integral with connector bodies, including plugs and jacks where indicated.

2.5 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

1. Berk-Tek; a Nexans company.
2. CommScope, Inc.
3. Corning Cable Systems.
4. General Cable Technologies Corporation.
5. Mohawk; a division of Belden CDT.
6. Nordex/CDT; a subsidiary of Cable Design Technologies.
7. Optical Connectivity Solutions Division; Emerson Network Power.
8. Superior Essex Inc.
9. SYSTIMAX Solutions; a CommScope, Inc. brand.
10. 3M.
11. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: Multimode, [**50/125**] [**62.5/125**]-micrometer, [**24**] -fiber, [**nonconductive,**]tight buffer, optical fiber cable.

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA/EIA-568-B.3 for performance specifications.
3. Comply with [**TIA/EIA-492AAAA-B**] [**TIA/EIA-492AAAA-A**] for detailed specifications.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

    a. General Purpose, Nonconductive: Type OFN or OFNG[**, or Type OFNR or Type OFNP**].
    b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
    c. Riser Rated, Nonconductive: Type OFNR[**or Type OFNP**], complying with UL 1666.
    d. General Purpose, Conductive: Type OFC or Type OFCG[**; or Type OFNG, Type OFN, Type OFCR, Type OFNR, Type OFCP, or Type OFNP**].
    e. Plenum Rated, Conductive: Type OFCP[**or Type OFNP**], complying with NFPA 262.
    f. Riser Rated, Conductive: Type OFCR[**; or Type OFNR, Type OFCP, or Type OFNP**]; complying with UL 1666.

5. Conductive cable shall be [**steel**] [**aluminum**]-armored type.
6. Maximum Attenuation: [**3.5**] dB/km at 850 nm; [**1.5**] dB/km at 1300 nm.
7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

C. Jacket:

1. Jacket Color: [**Aqua for 50/125**] [**Orange for 62.5/125**]-micrometer cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.6 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

1. ADC.
2. American Technology Systems Industries, Inc.
3. Berk-Tek; a Nexans company.
4. Corning Cable Systems.
5. Dynacom Corporation.
6. Hubbell Premise Wiring.
7. Molex Premise Networks; a division of Molex, Inc.
8. Nordex/CDT; a subsidiary of Cable Design Technologies.
9. Optical Connectivity Solutions Division; Emerson Network Power.
10. Siemon Co. (The).

B. Cable Connecting Hardware: Comply with the Fiber Optic Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.

1. Quick-connect, simplex and duplex, [**Type SC**] [**Type ST**] [**Type LC**] [**Type MT-RJ**] connectors. Insertion loss not more than 0.75 dB.
2. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.7 RS-232 CABLE

A. Standard Cable: NFPA 70, Type CM.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Polypropylene insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. PVC jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
6. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Plastic insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. Plastic jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.8 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CM[**or Type CMG**].

1. Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.9 LOW-VOLTAGE CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

C. Paired Cable: NFPA 70, Type CMG.

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

D. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Plastic jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.10 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, [**Type THHN-THWN**] [**Type XHHN**], in raceway, complying with [**UL 83**] [**UL 44**].

B. Class 2 Control Circuits: Stranded copper, [**Type THHN-THWN, in raceway**] [**Type XHHN, in raceway**] [**power-limited cable, concealed in building finishes**] [**power-limited tray cable, in cable tray**], complying with [**UL 83**] [**UL 44**].

C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or Type TF, complying with UL 83.

2.11 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

1. Brady Corporation.
2. HellermannTyton.
3. Kroy LLC.
4. Panduit Corp.

B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Division 16 Section "Electrical Identification."

2.12 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

E. Cable will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.

B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

C. Comply with requirements in Division 16 Section "Raceways and Boxes" for installation of conduits and wireways.

D. Install manufactured conduit sweeps and long-radius elbows if possible.

E. Pathway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed or in the corner of room if multiple sheets of plywood are installed around perimeter walls of room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard if entering room from overhead.
4. Extend conduits [**3 inches (75 mm)**] above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

F. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Install 110-style IDC termination hardware unless otherwise indicated.
3. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways. Comply with requirements specified in Division 16 Section "Raceways and Boxes."

E. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.

F. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than [**60 inches (1525 mm)**] apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

G. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable [**72 inches (1830 mm)**] long shall be neatly coiled not less than [**12 inches (305 mm)**] in diameter below each feed point.

H. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (305 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (305 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.3 REMOVAL OF CONDUCTORS AND CABLES

A. Remove abandoned conductors and cables.

3.4 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, [**No 14**] AWG.
2. Class 2 low-energy, remote-control, and signal circuits, [**No. 16**] AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits, [**No 12**] AWG.

3.5 FIRESTOPPING

A. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

A. For data communication wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. For low-voltage wiring and cabling, comply with requirements in Division 16 Section "Grounding and Bonding."

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling according to TIA/EIA-606-A. Comply with requirements for identification specified in Division 16 Section "Electrical Identification."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Visually inspect UTP and optical fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not after cross connection.

a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. Optical Fiber Cable Tests:

a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

b. Link End-to-End Attenuation Tests:

1) Multimode Link Measurements: Test at 850 or 1300 nm in one direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.

2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 16123

SECTION 16130 - RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Division 2 Section "Underground Ducts and Utility Structures" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. LFNC: Liquidtight flexible nonmetallic conduit.

H. NBR: Acrylonitrile-butadiene rubber.

I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.
2. For handholes and boxes for underground wiring, including the following:

    a. Duct entry provisions, including locations and duct sizes.
    b. Frame and cover design.
    c. Grounding details.
    d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
    e. Joint details.

C. Samples for Initial Selection: For [**wireways**] [**nonmetallic wireways**] [**and**] [**surface raceways**] with factory-applied texture and color finishes.

D. Samples for Verification: For each type of exposed finish required for [**wireways**] [**nonmetallic wireways**] [**and**] [**surface raceways**], prepared on Samples of size indicated below.

E. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members in the paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

F. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 16 Section "Electrical Supports and Seismic Restraints." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

    a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified[**and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event**]."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

G. Qualification Data: For professional engineer and testing agency.

H. Source quality-control test reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.

C. Rigid Steel Conduit: ANSI C80.1.

D. Aluminum Rigid Conduit: ANSI C80.5.

E. IMC: ANSI C80.6.

F. PVC-Coated Steel Conduit: PVC-coated [**rigid steel conduit**] [**IMC**].

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

G. EMT: ANSI C80.3.

H. FMC: [**Zinc-coated steel**][**or aluminum**].

I. LFMC: Flexible steel conduit with PVC jacket.

J. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: [**Steel**] [**Die-cast**] [**Steel or die-cast**], [**set-screw**] [**compression**] [**set-screw or compression**] type.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

K. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.; Pipe & Plastics Group.
6. Condux International, Inc.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

C. ENT: NEMA TC 13.

D. RNC: NEMA TC 2, [**Type EPC-40-PVC,**]unless otherwise indicated.

E. LFNC: UL 1660.

F. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

G. Fittings for LFNC: UL 514B.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Arnco Corporation.
2. Endot Industries Inc.
3. IPEX Inc.
4. Lamson & Sessions; Carlon Electrical Products.

C. Description: Comply with UL 2024; flexible type, approved for [**plenum**] [**riser**] [**general-use**] installation.

2.4 METAL WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

C. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type [**1**] [**12**] [**3R**], unless otherwise indicated.

D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

E. Wireway Covers: [**Hinged type**] [**Screw-cover type**] [**Flanged-and-gasketed type**] [**As indicated**].

F. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hoffman.
2. Lamson & Sessions; Carlon Electrical Products.
3. Cooper B-Line, Inc.

C. Description: Fiberglass polyester, extruded and fabricated to size and shape indicated, with no holes or knockouts. Cover is gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections are flanged, with stainless-steel screws and oil-resistant gaskets.

D. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.

E. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.6 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. [**Manufacturer's standard enamel finish in color selected by Architect**] [**Prime coating, ready for field painting**].

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Thomas & Betts Corporation.
    b. Walker Systems, Inc.; Wiremold Company (The).
    c. Wiremold Company (The); Electrical Sales Division.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from [**manufacturer's standard**] [**custom**] colors.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Butler Manufacturing Company; Walker Division.
    b. Enduro Systems, Inc.; Composite Products Division.
    c. Hubbell Incorporated; Wiring Device-Kellems Division.
    d. Lamson & Sessions; Carlon Electrical Products.
    e. Panduit Corp.
    f. Walker Systems, Inc.; Wiremold Company (The).
    g. Wiremold Company (The); Electrical Sales Division.

2.7 BOXES, ENCLOSURES, AND CABINETS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.

4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

C. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

D. Cast-Metal Outlet and Device Boxes: NEMA FB 1, [**ferrous alloy**] [**aluminum**], Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

F. Metal Floor Boxes: [**Cast metal**] [**Sheet metal**] [**Cast or sheet metal**], [**fully adjustable**] [**semi-adjustable**], rectangular.

G. Nonmetallic Floor Boxes: Nonadjustable, round.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, [**cast aluminum**] [**galvanized, cast iron**] with gasketed cover.

J. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic[**, finished inside with radio-frequency-resistant paint**].

K. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.8 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.

1. Color of Frame and Cover: [**Gray**] [**Green**].

2. Configuration: Units shall be designed for flush burial and have [**open**] [**closed**] [**integral closed**] bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, [**"ELECTRIC."**] [**"TELEPHONE."**] [**as indicated for each service.**]
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes [**12 inches wide by 24 inches long (300 mm wide by 600 mm long)**] and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] or a comparable product by one of the following:

    a. Armorcast Products Company.
    b. Carson Industries LLC.
    c. CDR Systems Corporation.
    d. NewBasis.
    e.

C. Fiberglass Handholes and Boxes with Polymer-Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester-resin enclosure joined to polymer-concrete top ring or frame.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] or a comparable product by one of the following:

    a. Armorcast Products Company.
    b. Carson Industries LLC.
    c. Christy Concrete Products.
    d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.

D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of [**polymer concrete**] [**reinforced concrete**] [**cast iron**] [**hot-dip galvanized-steel diamond plate**] [**fiberglass**].

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] or a comparable product by one of the following:

    a. Carson Industries LLC.
    b. Christy Concrete Products.
    c. Nordic Fiberglass, Inc.

2.9 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

2.10 SLEEVE SEALS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] or a comparable product by one of the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

D. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: [**EPDM**] [**NBR**] interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

2. Pressure Plates: [**Plastic**] [**Carbon steel**] [**Stainless steel**]. Include two for each sealing element.
3. Connecting Bolts and Nuts: [**Carbon steel with corrosion-resistant coating**] [**Stainless steel**] of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.11 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by a independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: [**Rigid steel conduit**] [**IMC**] [**RNC, Type EPC-40-PVC**] [**RNC, Type EPC-80-PVC**].
2. Concealed Conduit, Aboveground: [**Rigid steel conduit**] [**IMC**] [**EMT**] [**RNC, Type EPC-40-PVC**].
3. Underground Conduit: RNC, Type EPC-[**40**] [**80**]-PVC, direct buried.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): [**LFMC**] [**LFNC**].
5. Boxes and Enclosures, Aboveground: NEMA 250, Type [**3R**] [**4**].
6. Application of Handholes and Boxes for Underground Wiring:

    a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: [**Polymer concrete**] [**Fiberglass enclosures with polymer-concrete frame and cover**] [**Fiberglass-reinforced polyester resin**], SCTE 77, Tier 15 structural load rating.
    b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: [**Polymer-concrete units**] [**Heavy-duty fiberglass units with polymer-concrete frame and cover**], SCTE 77, Tier 8 structural load rating.
    c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: [**EMT**] [**ENT**] [**or**] [**RNC**].
2. Exposed, Not Subject to Severe Physical Damage: [**EMT**] [**RNC identified for such use**].
3. Exposed and Subject to Severe Physical Damage: [**Rigid steel conduit**] [**IMC**]. Includes raceways in the following locations:

    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: [**EMT**] [**ENT**] [**or**] [**RNC, Type EPC-40-PVC**].
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: [**Rigid steel conduit**] [**IMC**].
7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: [**Plenum-type, optical fiber/communications cable raceway**] [**EMT**] .
8. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: [**Riser-type, optical fiber/communications cable raceway**] [**EMT**].
9. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: [**General-use, optical fiber/communications cable raceway**] [**Riser-type, optical fiber/communications cable raceway**] [**Plenum-type, optical fiber/communications cable raceway**] [**EMT**].
10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, [**stainless steel**] [**nonmetallic**] in damp or wet locations.

C. Minimum Raceway Size: [**1/2-inch (16-mm)**] [**3/4-inch (21-mm)**] trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 16 Section "Electrical Supports and Seismic Restraints."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.

I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

N. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m).

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:

   a. Outdoor Locations Not Exposed to Direct Sunlight: [**125 deg F (70 deg C)**] temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: [**155 deg F (86 deg C)**] temperature change.
   c. Indoor Spaces: Connected with the Outdoors without Physical Separation: [**125 deg F (70 deg C)**] temperature change.
   d. Attics: [**135 deg F (75 deg C)**] temperature change.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change.
3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

O. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for [**recessed and semirecessed lighting fixtures,**]equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

P. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

Q. Set metal floor boxes level and flush with finished floor surface.

R. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 2 Section "Earthwork" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Division 2 Section "Earthwork."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 2 Section "Earthwork."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of conduit.

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes and boxes with bottom below the frost line, below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed[**or unless seismic criteria require different clearance**].

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry[**and with approved joint compound for gypsum board assemblies**].

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 7 Section "Through-Penetration Firestop Systems."

L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

3.8 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 16130

SECTION 16140 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Receptacles with integral surge suppression units.
4. Wall-box motion sensors.
5. Isolated-ground receptacles.
6. Hospital-grade receptacles.
7. Snap switches and wall-box dimmers.
8. Solid-state fan speed controls.
9. Wall-switch and exterior occupancy sensors.
10. Communications outlets.
11. Pendant cord-connector devices.
12. Cord and plug sets.
13. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

B. Related Sections include the following:

1. Division 16 Section "Voice and Data Communication Cabling" for workstation outlets.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

1.7 EXTRA MATERIALS

A. Furnish extra materials described in subparagraphs below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Service/Power Poles: [**One for every 10**], but no fewer than [**one**] .
2. Floor Service Outlet Assemblies: [**One for every 10**], but no fewer than [**one**].
3. Poke-Through, Fire-Rated Closure Plugs: [**One for every five**] floor service outlets installed, but no fewer than [**two**].
4. TVSS Receptacles: [**One for every 10**] of each type installed, but no fewer than [**two of each type**].

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 5351 (single), 5352 (duplex).
b. Hubbell; HBL5351 (single), CR5352 (duplex).
c. Leviton; 5891 (single), 5352 (duplex).
d. Pass & Seymour; 5381 (single), 5352 (duplex).

B. Hospital-Grade, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498 Supplement SD.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 8300 (duplex).
b. Hubbell; HBL8310 (single), HBL8300H (duplex).
c. Leviton; 8310 (single), 8300 (duplex).
d. Pass & Seymour; 9301-HG (single), 9300-HG (duplex).

C. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Hubbell; CR 5253IG.

b. Leviton; 5362-IG.
c. Pass & Seymour; IG6300.

3. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

D. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; TR8300.
b. Hubbell; HBL8300SG.
c. Leviton; 8300-SGG.
d. Pass & Seymour; 63H.

3. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, [**feed**] [**non-feed**]-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; GF20.
b. Pass & Seymour; 2084.
c. Hubbell, duplex GFCI
d. Leviton, duplex GFCI

C. Hospital-Grade, Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with UL 498 Supplement SD.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; HGF20.

b. Hubbell; HGF8300.
c. Leviton; 6898-HG.
d. Pass & Seymour; 2091-SHG.

2.4 TVSS RECEPTACLES

A. General Description: Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 1449, with integral TVSS in line to ground, line to neutral, and neutral to ground.

1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 volts and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
2. Active TVSS Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."

B. Duplex TVSS Convenience Receptacles:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 5362BLS.
b. Hubbell; HBL5362SA.
c. Leviton; 5380.

3. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R.

C. Isolated-Ground, Duplex Convenience Receptacles:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; IG5362BLS.
b. Hubbell; IG5362SA.
c. Leviton; 5380-IG.

3. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

D. Hospital-Grade, Duplex Convenience Receptacles: Comply with UL 498 Supplement SD.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper; 8300BLS.
   b. Hubbell; HBL8362SA.
   c. Leviton; 8380.

3. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R.

E. Isolated-Ground, Hospital-Grade, Duplex Convenience Receptacles:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

   a. Cooper; IG8300HGBLS.
   b. Hubbell; IG8362SA.
   c. Leviton; 8380-IG.

3. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R. Comply with UL 498 Supplement SD. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.5 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. [**Available**]Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Cooper Crouse-Hinds.
   b. EGS/Appleton Electric.
   c. Killark; a division of Hubbell Inc.

2.6 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; L520R.
    b. Hubbell; HBL2310.
    c. Leviton; 2310.
    d. Pass & Seymour; L520-R.

B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Hubbell; IG2310.
    b. Leviton; 2310-IG.
    c. Cooper

3. Description: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.7 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.8 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.9 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
    b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
    c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
    d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

C. Pilot Light Switches, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; 2221PL for 120 V and 277 V.
    b. Hubbell; HPL1221PL for 120 V and 277 V.
    c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
    d. Pass & Seymour; PS20AC1-PLR for 120 V.

3. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; 2221L.
    b. Hubbell; HBL1221L.
    c. Leviton; 1221-2L.
    d. Pass & Seymour; PS20AC1-L.

3. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; 1995.

b. Hubbell; HBL1557.
c. Leviton; 1257.
d. Pass & Seymour; 1251.

F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 1995L.
b. Hubbell; HBL1557L.
c. Leviton; 1257L.
d. Pass & Seymour; 1251L.

2.10 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable [**slider**] [**toggle switch**] [**rotary knob**]; with single-pole or three-way switching. Comply with UL 1472.

C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.

1. 600 W; dimmers shall require no derating when ganged with other devices. [**Illuminated when "OFF."**]

D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.11 FAN SPEED CONTROLS

A. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters. Comply with UL 1917.

1. Continuously adjustable [**slider**] [**toggle switch**] [**rotary knob**], [**5 A**] [**1.5 A**].
2. Three-speed adjustable [**slider**] [**rotary knob**], 1.5 A.

2.12 OCCUPANCY SENSORS

A. Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; 6111 for 120 V, 6117 for 277 V.
    b. Hubbell; WS1277.
    c. Leviton; ODS 10-ID.
    d. Pass & Seymour; WS3000.
    e. Watt Stopper (The); WS-200.

3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

B. Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Hubbell; AT120 for 120 V, AT277 for 277 V.
    b. Leviton; ODS 15-ID.

3. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

C. Long-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Hubbell; ATP1600WRP.
    b. Leviton; ODWWV-IRW.
    c. Pass & Seymour; WA1001.
    d. Watt Stopper (The); CX-100.

3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft. (111 sq. m).

D. Long-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Hubbell; ATD1600WRP.
    b. Leviton; ODW12-MRW.

c. Watt Stopper (The); DT-200.

3. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of 1200 sq. ft. (111 sq. m).

E. Wide-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Hubbell; ATP120HBRP.
b. Leviton; ODWHB-IRW.
c. Pass & Seymour; HS1001.
d. Watt Stopper (The); CX-100-3.

3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of 1200 sq. ft. (111 sq. m).

F. Exterior Occupancy Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Leviton; PS200-10.
b. Watt Stopper (The); EW-100-120.

3. Description: Passive-infrared type, 120/277 V, weatherproof, adjustable time delay up to 15 minutes, 180-degree field of view, and 110-foot (34-m) detection range. Minimum switch rating: 1000-W incandescent, 500-VA fluorescent.

2.13 COMMUNICATIONS OUTLETS

A. Telephone Outlet:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 3560-6.
b. Leviton; 40649.
c. Hubbell; Telephone Outlet

3. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e. Comply with UL 1863.

B. Combination TV and Telephone Outlet:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 3562.
b. Leviton; 40595.
c. Hubbell; Combo TV/Telephone Outlet

3. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e; and one Type F coaxial cable connector.

2.14 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: [**Steel with white baked enamel, suitable for field painting**] [**Smooth, high-impact thermoplastic**] [**0.035-inch- (1-mm-) thick, satin-finished stainless steel**] [**0.04-inch- (1-mm-) thick, brushed brass with factory polymer finish**] [**0.05-inch- (1.2-mm-) thick anodized aluminum**] [**0.04-inch- (1-mm-) thick steel with chrome-plated finish**].
3. Material for Unfinished Spaces: [**Galvanized steel**] [**Smooth, high-impact thermoplastic**].
4. Material for Damp Locations: [**Thermoplastic**] [**Cast aluminum**] with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant [**, die-cast aluminum**] [**thermoplastic**] with lockable cover.

2.15 FLOOR SERVICE FITTINGS

A. Type: Modular, [**flush-type**] [**flap-type**] [**above-floor**], dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: [**Rectangular**] [**Round**], [**die-cast aluminum**] [**solid brass**] with satin finish.

D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: [**Blank cover with bushed cable opening**] [**Two modular, keyed, color-coded, RJ-45 Category 5e jacks for UTP cable**].

2.16 POKE-THROUGH ASSEMBLIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Pass & Seymour/Legrand; Wiring Devices & Accessories.
3. Square D/ Schneider Electric.
4. Thomas & Betts Corporation.
5. Wiremold Company (The).

C. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.

1. Service Outlet Assembly: [**Pedestal type with services indicated**] [**Flush type with two simplex receptacles and space for two RJ-45 jacks**] [**Flush type with four simplex receptacles and space for four RJ-45 jacks**].
2. Size: Selected to fit nominal [**3-inch (75-mm)**] [**4-inch (100-mm)**] cored holes in floor and matched to floor thickness.
3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
4. Closure Plug: Arranged to close unused [**3-inch (75-mm)**] [**4-inch (100-mm)**] cored openings and reestablish fire rating of floor.
5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of [**two**] [**four**], 4-pair, Category 5e voice and data communication cables.

2.17 MULTIOUTLET ASSEMBLIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Wiremold Company (The).
3. Leviton

C. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

D. Raceway Material: [**Metal, with manufacturer's standard finish**] [**PVC**].

E. Wire: No. 12 AWG.

2.18 SERVICE POLES

A. Description: Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.

1. Poles: Nominal 2.5-inch- (65-mm-) square cross section, with height adequate to extend from floor to at least 6 inches (150 mm) above ceiling, and with separate channels for power wiring and voice and data communication cabling.
2. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
3. Finishes: [**Manufacturer's standard painted finish and trim combination**] [**Satin-anodized aluminum**].
4. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, 4-pair, Category 3 or 5 voice and data communication cables.
5. Power Receptacles: Two duplex, 20-A, heavy-duty, NEMA WD 6 configuration 5-20R units.
6. Voice and Data Communication Outlets: [**Blank insert with bushed cable opening**] [**Two RJ-45 Category 5e jacks**] [**Four RJ-45 Category 5e jacks**].

2.19 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: [**Almond**] [**Black**] [**Brown**] [**Gray**] [**Ivory**] [**White**] [**As selected by Architect**], unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: [**Red**].
3. TVSS Devices: Blue.
4. Isolated-Ground Receptacles: [**Orange**] [**As specified above, with orange triangle on face**].

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles [**up**] [**down**], and on horizontally mounted receptacles to the [**right**] [**left**].
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.

3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 16 Section "Electrical Identification."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with [**black**] [**white**] [**red**]-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Test straight blade [**convenience outlets in patient-care areas**] [**hospital-grade convenience outlets**] for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).

END OF SECTION 16140

SECTION 16145 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. Time switches.
2. [**Outdoor**] [**Indoor**] [**Outdoor and indoor**] photoelectric switches.
3. Indoor occupancy sensors.
4. Outdoor motion sensors.
5. Lighting contactors.
6. Emergency shunt relays.

B. Related Sections include the following:

1. Division 13 Section "Lighting Controls" for low-voltage, manual and programmable lighting control systems.
2. Division 16 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.
3. Division 16 Section "Stage Lighting" for theatrical lighting controls.
4. Division 16 Section "Dimming Controls" for architectural dimming system equipment.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] or a comparable product by one of the following:

1. Area Lighting Research, Inc.; Tyco Electronics.
2. Grasslin Controls Corporation; a GE Industrial Systems Company.
3. Intermatic, Inc.
4. Leviton Mfg. Company Inc.
5. Lightolier Controls; a Genlyte Company.
6. Lithonia Lighting; Acuity Lighting Group, Inc.
7. Paragon Electric Co.; Invensys Climate Controls.
8. Square D; Schneider Electric.
9. TORK.
10. Touch-Plate, Inc.
11. Watt Stopper (The).
12.

D. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.

1. Contact Configuration: [**SPST**] [**DPST**] [**DPDT**].
2. Contact Rating: [**30-A inductive or resistive, 240-V ac**] [**20-A ballast load, 120/240-V ac**].

3. Program: 8 on-off set points on a 24-hour schedule[**and an annual holiday schedule that overrides the weekly operation on holidays**].
4. Program: 2 on-off set points on a 24-hour schedule, allowing different set points for each day of the week[**and an annual holiday schedule that overrides the weekly operation on holidays**].
5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program[**on selected channels**].
6. Astronomic Time: [**All**] [**Selected**] channels.
7. Battery Backup: For schedules and time clock.

E. Electromechanical-Dial Time Switches: Type complying with UL 917.

1. Contact Configuration: [**SPST**] [**DPST**] [**SPDT**] [**DPDT**].
2. Contact Rating: [**30-A inductive or resistive, 240-V ac**] [**20-A ballast load, 120/240-V ac**].
3. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
4. Astronomic time dial.
5. Eight-Day Program: Uniquely programmable for each weekday and holidays.
6. Skip-a-day mode.
7. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of [**16**] hours.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] or a comparable product by one of the following:

1. Area Lighting Research, Inc.; Tyco Electronics.
2. Grasslin Controls Corporation; a GE Industrial Systems Company.
3. Intermatic, Inc.
4. Lithonia Lighting; Acuity Lighting Group, Inc.
5. Novitas, Inc.
6. Paragon Electric Co.; Invensys Climate Controls.
7. Square D; Schneider Electric.
8. TORK.
9. Touch-Plate, Inc.
10. Watt Stopper (The).

D. Description: Solid state, with [**SPST**] [**DPST**] dry contacts rated for [**1800-VA tungsten or 1000-VA inductive**], to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range[**, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off**].
2. Time Delay: 15-second minimum, to prevent false operation.
3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

E. Description: Solid state, with [**SPST**] [**DPST**] dry contacts rated for 1800 VA to operate connected load, relay, or contactor coils; complying with UL 773.

1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range.
2. Time Delay: 30-second minimum, to prevent false operation.
3. Lightning Arrester: Air-gap type.
4. Mounting: Twist lock complying with IEEE C136.10, with base.

2.3 INDOOR PHOTOELECTRIC SWITCHES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] or a comparable product by one of the following:

1. Allen-Bradley/Rockwell Automation.
2. Area Lighting Research, Inc.; Tyco Electronics.
3. Eaton Electrical Inc; Cutler-Hammer Products.
4. Grasslin Controls Corporation; a GE Industrial Systems Company.
5. Intermatic, Inc.
6. Lithonia Lighting; Acuity Lighting Group, Inc.
7. MicroLite Lighting Control Systems.
8. Novitas, Inc.
9. Paragon Electric Co.; Invensys Climate Controls.
10. Square D; Schneider Electric.
11. TORK.
12. Touch-Plate, Inc.
13. Watt Stopper (The).

D. Ceiling-Mounted Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit[**mounted on luminaire**], to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.

1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
2. Relay Unit: Dry contacts rated for [**20**] -A ballast load at 120- and 277-V ac, for [**13**] -A tungsten at 120-V ac, and for [**1**] hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
3. Light-Level Monitoring Range: [**10 to 200 fc (108 to 2152 lx)**] [**100 to 1000 fc (1080 to 10 800 lx)**], with an adjustment for turn-on and turn-off levels within that range.
4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

E. Skylight Photoelectric Sensors: Solid-state, light-level sensor; housed in a threaded, plastic fitting for mounting under skylight, facing up at skylight; with separate relay unit[**mounted on luminaire**], to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.

1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
2. Relay Unit: Dry contacts rated for [**20**] -A ballast load at 120- and 277-V ac, for [**13**] -A tungsten at 120-V ac, and for [**1**] hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
3. Light-Level Monitoring Range: 1000 to 10,000 fc (10 800 to 108 000 lx), with an adjustment for turn-on and turn-off levels within that range.
4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

2.4 INDOOR OCCUPANCY SENSORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] or a comparable product by one of the following:

1. Hubbell Lighting.
2. Leviton Mfg. Company Inc.
3. Lithonia Lighting; Acuity Lighting Group, Inc.
4. Novitas, Inc.
5. RAB Lighting, Inc.
6. Sensor Switch, Inc.
7. TORK.
8. Watt Stopper (The).

D. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.

E. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.

1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling.

F. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).

G. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of

technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2.5 OUTDOOR MOTION SENSORS (PIR)

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] or a comparable product by one of the following:

1. Bryant Electric; a Hubbell Company.
2. Hubbell Lighting.
3. Lithonia Lighting; Acuity Lighting Group, Inc.
4. Paragon Electric Co.; Invensys Climate Controls.
5. RAB Lighting, Inc.
6. TORK.
7. Watt Stopper (The).

D. Performance Requirements: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F (minus 40 to plus 54 deg C), rated as raintight according to UL 773A.

1. Operation: Turn lights on when sensing infrared energy changes between background and moving body in area of coverage; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outdoor junction box.
    b. Relay: Internally mounted in a standard weatherproof electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

3. Bypass Switch: Override the on function in case of sensor failure.
4. Automatic Light-Level Sensor: Adjustable from 1 to 20 fc (11 to 215 lx); keep lighting off during daylight hours.

E. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).

F. Detection Coverage: [**Up to 35 feet (11 m), with a field of view of 90 degrees**] [**Up to 100 feet (30 m), with a field of view of 60 degrees**] [**Up to 35 feet (11 m), with a field of view of 180 degrees**] [**Up to 52.5 feet (16 m), with a field of view of 270 degrees**].

G. Lighting Fixture Mounted Sensor: Suitable for switching 300 W of tungsten load at 120- or 277-V ac.

H. Individually Mounted Sensor: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.

1. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
2. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

2.6 LIGHTING CONTACTORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] or a comparable product by one of the following:

1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
3. Eaton Electrical Inc.; Cutler-Hammer Products.
4. GE Industrial Systems; Total Lighting Control.
5. Grasslin Controls Corporation; a GE Industrial Systems Company.
6. Hubbell Lighting.
7. Lithonia Lighting; Acuity Lighting Group, Inc.
8. MicroLite Lighting Control Systems.
9. Square D; Schneider Electric.
10. TORK.
11. Touch-Plate, Inc.
12. Watt Stopper (The).

D. Description: Electrically operated and [**mechanically**] [**electrically**] held, combination type with [**fusible switch**] [**nonfused disconnect**], complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).

2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as [**indicated on Drawings**] [**scheduled**], matching the NEMA type specified for the enclosure.

E. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors.

1. Monitoring: On-off status.
2. Control: On-off operation.

2.7 EMERGENCY SHUNT RELAY

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide [**the product indicated on Drawings**] or a comparable product by one of the following:

1. Lighting Control and Design, Inc.
2. Lutron Electronics Co., Inc.
3. Douglas Lighting Controls, Inc.

D. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual [**or automatic**]switching contacts; complying with UL 924.

1. Coil Rating: [**120**] [**277**] V.

2.8 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 16 Section "Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. [**18**] [**22**] [**24**] AWG. Comply with requirements in Division 16 Section "Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. [**14**] [**16**] [**18**] AWG. Comply with requirements in Division 16 Section "Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 16 Section "Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 16 Section "Electrical Identification."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to [**two**] visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 13 Section "Lighting Controls."

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 16145

SECTION 16410 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Molded-case switches.
7. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to [**ASCE/SEI 7**].

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[**and the unit will be fully operational after the seismic event**]."

1.5 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.

2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.[**Submit on translucent log-log graph paper.**]

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Qualification Data: For qualified testing agency.

D. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Manufacturer's field service report.

G. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.[**Submit on translucent log-log graph paper.**]

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify [**Architect**] [**Construction Manager**] [**Owner**] no fewer than [**seven**] days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without [**Architect's**] [**Construction Manager's**] [**Owner's**] written permission.
4. Comply with NFPA 70E.

1.8 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to [**10**] percent of quantity installed for each size and type, but no fewer than [**three**] of each size and type.

2. Fuse Pullers: [**Two**] for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

C. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with [**cartridge**] [**plug**] fuse interiors to accommodate [**specified**] [**indicated**] fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Single Throw, [**240**] [**600**]-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate [**specified**] [**indicated**] fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Six Pole, Single Throw, [**240**] [**600**]-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate [**specified**] [**indicated**] fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Type HD, Heavy Duty, Double Throw, [**240**] [**600**]-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate [**specified**] [**indicated**] fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

G. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: [**One**] [**Two**] NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: [**Mechanical**] [**Compression**] type, suitable for number, size, and conductor material.
8. Service-Rated Switches: Labeled for use as service equipment.
9. Accessory Control Power Voltage: Remote mounted and powered; [**24-V ac**] [**120-V ac**] [**208-V ac**] [**240-V ac**] [**6-V dc**] [**12-V dc**] [**24-V dc**].

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

C. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Single Throw, [**240**] [**600**]-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Six Pole, Single Throw, [**240**] [**600**]-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Type HD, Heavy Duty, Double Throw, [**240**] [**600**]-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

G. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

4. Auxiliary Contact Kit: [**One**] [**Two**] NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: [**Mechanical**] [**Compression**] type, suitable for number, size, and conductor material.
7. Accessory Control Power Voltage: Remote mounted and powered; [**24-V ac**] [**120-V ac**] [**208-V ac**] [**240-V ac**] [**6-V dc**] [**12-V dc**] [**24-V dc**].

2.3 RECEPTACLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

C. Type HD, Heavy-Duty, Single-Throw Fusible Switch: [**240**] [**600**]-V ac, [**30**] [**60**] [**100**] A; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate [**specified**] [**indicated**] fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Type HD, Heavy-Duty, Single-Throw Nonfusible Switch: [**240**] [**600**]-V ac, [**30**] [**60**] [**100**] A; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

E. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

F. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).

1. Receptacle Manufacturer and Catalog Number:

2.4 SHUNT TRIP SWITCHES

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. Littelfuse, Inc.

C. General Requirements: Comply with[**ASME A17.1,**] UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

D. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

E. Control Circuit: 120-V ac; obtained from [**integral control power transformer, with primary and secondary fuses,**] with a control power [**transformer**] [**source**] of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

F. Accessories:

1. Oiltight key switch for key-to-test function.
2. Oiltight [**red**] [**green**] [**white**] [**yellow**] ON pilot light.
3. Isolated neutral lug; [**100**] [**200**] percent rating.
4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
5. Form C alarm contacts that change state when switch is tripped.
6. Three-pole, double-throw, fire-safety and alarm relay; [**120-V ac**] [**24-V dc**] coil voltage.
7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.5 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

C. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

D. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

E. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

F. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

G. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

H. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

I. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

J. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

K. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: [**Mechanical**] [**Compression**] type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; [**integrally mounted, self-powered**] [**remote-mounted and powered**] type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Communication Capability: [**Circuit-breaker-mounted**] [**Universal-mounted**] [**Integral**] [**Din-rail-mounted**] communication module with functions and features compatible with power monitoring and control system, specified in Division 16 Section "Electrical Power Monitoring and Control."
6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
8. Auxiliary Contacts: [**One SPDT switch**] [**Two SPDT switches**] with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

9. Alarm Switch: One [**NO**] [**NC**] contact that operates only when circuit breaker has tripped.
10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
11. Zone-Selective Interlocking: Integral with [**electronic**] [**ground-fault**] trip unit; for interlocking ground-fault protection function.
12. Electrical Operator: Provide remote control for on, off, and reset operations.
13. Accessory Control Power Voltage: [**Integrally mounted, self-powered**] [**Remote mounted and powered**]; [**24-V ac**] [**120-V ac**] [**208-V ac**] [**240-V ac**] [**6-V dc**] [**12-V dc**] [**24-V dc**].

2.6 MOLDED-CASE SWITCHES

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

C. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

D. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs: [**Mechanical**] [**Compression**] type, suitable for number, size, trip ratings, and conductor material.
3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: [**One SPDT switch**] [**Two SPDT switches**] with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
7. Alarm Switch: One [**NO**] [**NC**] contact that operates only when switch has tripped.
8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
9. Zone-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
10. Electrical Operator: Provide remote control for on, off, and reset operations.

11. Accessory Control Power Voltage: [**Integrally mounted, self-powered**] [**Remote mounted and powered**]; [**24-V ac**] [**120-V ac**] [**208-V ac**] [**240-V ac**] [**6-V dc**] [**12-V dc**] [**24-V dc**].

2.7 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, [**Type 1**].
2. Outdoor Locations: NEMA 250, [**Type 3R**].
3. [**Kitchen**] [**Wash-Down**] Areas: NEMA 250, [**Type 4X**], [**stainless steel**].
4. Other Wet or Damp, Indoor Locations: NEMA 250, [**Type 4**].
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
6. Hazardous Areas Indicated on Drawings: NEMA 250, [**Type 7**] [**Type 9**].

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 16 Section "Electrical Identification."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges[**as specified in Division 16 Section "Overcurrent Protective Device Coordination"**].

END OF SECTION 16410

SECTION 16441 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Transient voltage suppression devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.
8. Mimic bus.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to [**SEI/ASCE 7**].

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[**and the unit will be fully operational after the seismic event**]."

1.4 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.

5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail utility company's metering provisions with indication of approval by utility company.
7. Include evidence of NRTL listing for series rating of installed devices.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
10. Include diagram and details of proposed mimic bus.
11. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Samples: Representative portion of mimic bus with specified material and finish, for color selection.

D. Qualification Data: For qualified [**Installer**] [**testing agency**].

E. Seismic Qualification Certificates: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

F. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

G. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

C. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Comply with NEMA PB 2.

G. Comply with NFPA 70.

H. Comply with UL 891.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards and [**install temporary electric heating (250 W per section)**] [**connect factory-installed space heaters to temporary electrical service**] to prevent condensation.

C. Handle and prepare switchboards for installation according to [**NECA 400**] [**NEMA PB 2.1**].

1.7 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
b. Altitude: Not exceeding 6600 feet (2000 m).

C. Service Conditions: NEMA PB 2, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify [**Architect**] [**Construction Manager**] [**Owner**] no fewer than [**seven**] days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without [**Architect's**] [**Construction Manager's**] [**Owner's**] written permission.
4. Comply with NFPA 70E.

1.8 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: [**Five**] years from date of Substantial Completion.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

C. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: [**Panel**] [**Fixed, individually**] mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

D. Front- and Side-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

E. Front- and Rear-Accessible Switchboards:

1. Main Devices: [**Fixed, individually**] [**Drawout**] mounted.
2. Branch Devices: [**Panel**] [**Fixed, individually**] [**Panel and fixed, individually**] [**Fixed and individually compartmented**] [**Individually compartmented and drawout**] mounted.
3. Sections [**front and rear**] [**rear**] aligned.

F. Nominal System Voltage: [**480Y/277 V**] [**208Y/120 V**].

G. Main-Bus Continuous: [**5000**] [**4000**] [**3000**] [**2500**] [**2000**] [**1600**] [**1200**] A.

H. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

I. Indoor Enclosures: Steel, NEMA 250, [**Type 1**] [**Type 5**].

J. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's [**standard gray**] [**custom color**] finish over a rust-inhibiting primer on treated metal surface.

K. Outdoor Enclosures: [**Type 3R**] [**Type 3R, with interior-lighted walk-in aisle**].

1. Finish: Factory-applied finish in manufacturer's [**standard**] [**custom**] color; undersurfaces treated with corrosion-resistant undercoating.
2. Enclosure: [**Flat**] [**Downward, rearward sloping**] roof; [**bolt-on rear covers**] [**rear hinged doors**] for each section, with provisions for padlocking.
3. Doors: Personnel door at each end of aisle, minimum width of [**30 inches (762 mm)**]; opening outwards; with panic hardware and provisions for [**padlocking**] [**cylinder lock**].
4. Accessories: Fluorescent lighting fixtures, ceiling mounted; wired to a three-way light switch at each end of aisle; ground-fault circuit interrupter (GFCI) duplex receptacle; emergency battery pack lighting fixture installed on wall of aisle midway between personnel doors.
5. Walk-in Aisle Heating and Ventilating:

    a. Factory-installed electric unit heater(s), wall or ceiling mounted, with integral thermostat and disconnect and with capacities to maintain switchboard interior temperature of [**40 deg F (5 deg C)**] with outside design temperature of [**104 deg F (40 deg C)**].
    b. Factory-installed exhaust fan with capacities to maintain switchboard interior temperature of [**100 deg F (38 deg C)**] with outside design temperature of [**23 deg F (minus 5 deg C)**].
    c. Ventilating openings[**complete with replaceable fiberglass air filters**].
    d. Thermostat: Single stage; wired to control heat and exhaust fan.

6. Power for Space Heaters, Ventilation, Lighting, and Receptacle: Include a control-power transformer within the switchboard. Supply voltage shall be [**120**] [**120/240**] [**120/208**]-V ac.
7. Power for space heaters, ventilation, lighting, and receptacle provided by a remote source.

L. Barriers: Between adjacent switchboard sections.

M. Insulation and isolation for[**main bus of main section and**] main and vertical buses of feeder sections.

N. Cubical Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.

1. Space-Heater Control: [**Thermostats to maintain temperature of each section above expected dew point**] [**Manual switching of branch-circuit protective device**].
2. Space-Heater Power Source: [**Transformer, factory installed in switchboard**] [**120-V external branch circuit**].

O. Utility Metering Compartment: Fabricated, barrier compartment and section complying with utility company's requirements; hinged sealed door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.

P. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks.[**Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.**]

Q. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

R. Removable, Hinged Rear Doors and Compartment Covers: Secured by [**captive thumb screws**] [**standard bolts**], for access to rear interior of switchboard.

S. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

T. Pull Box on Top of Switchboard:

1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
2. Set back from front to clear circuit-breaker removal mechanism.
3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

U. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, [**silver-plated,**]with tin-plated aluminum or copper feeder circuit-breaker line connections.
2. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
3. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity[**, silver-plated,**] or tin-plated, high-strength, electrical-grade aluminum alloy.
4. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with [**mechanical**] [**compression**] connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
5. Ground Bus: [**1/4-by-2-inch- (6-by-50-mm-)**] [**1/4-by-1-inch- (6-by-25-mm-)**] [**Minimum-size required by UL 891,**] hard-drawn copper of 98 percent conductivity, equipped with [**mechanical**] [**compression**] connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

6. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
7. Neutral Buses: 50 percent of the ampacity of phase buses unless otherwise indicated, equipped with [**mechanical**] [**compression**] connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
8. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with [**mechanical**] [**compression**] connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
9. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

V. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

W. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

X. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

2.2 TRANSIENT VOLTAGE SUPPRESSION DEVICES

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

C. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, [**wired-in**] [**plug-in**] [**bolt-on**], solid-state, parallel-connected, [**modular (with field-replaceable modules)**] [**non-modular**] type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:

1. Fuses, rated at 200-kA interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring.
3. Integral disconnect switch.
4. Redundant suppression circuits.
5. Redundant replaceable modules.
6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
7. LED indicator lights for power and protection status.
8. Audible alarm, with silencing switch, to indicate when protection has failed.

9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
10. [**Four**] [**Six**]-digit, transient-event counter set to totalize transient surges.

D. Peak Single-Impulse Surge Current Rating: [**160 kA per mode/320 kA per phase**] [**120 kA per mode/240 kA per phase**] [**80 kA per mode/160 kA per phase**].

E. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.

F. Protection modes and UL 1449 SVR for grounded wye circuits with [**480Y/277**] [**208Y/120**] [**600Y/347**]-V, three-phase, four-wire circuits shall be as follows:

1. Line to Neutral: [**800 V for 480Y/277**] [**400 V for 208Y/120**] [**1200 V for 600Y/347**].
2. Line to Ground: [**800 V for 480Y/277**] [**400 V for 208Y/120**] [**1200 V for 600Y/347**].
3. Neutral to Ground: [**800 V for 480Y/277**] [**400 V for 208Y/120**] [**1200 V for 600Y/347**].

G. Protection modes and UL 1449 SVR for 240/120-V, three-phase, four-wire circuits with high leg shall be as follows:

1. Line to Neutral: 400 V, 800 V from high leg.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

H. Protection modes and UL 1449 SVR for 240-, 480-, or 600-V, three-phase, three-wire, delta circuits shall be as follows:

1. Line to Line: [**2000 V for 480 V**] [**1000 V for 240 V**] [**2500 V for 600 V**].
2. Line to Ground: [**1500 V for 480 V**] [**800 V for 240 V**] [**2500 V for 600 V**].

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with [**series-connected rating**] [**interrupting capacity**] to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: [**Mechanical**] [**Compression**] style, suitable for number, size, trip ratings, and conductor material.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Ground-Fault Protection: [**Integrally mounted**] [**Remote-mounted**] relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
    f. Communication Capability: [**Circuit-breaker-mounted**] [**Universal-mounted**] [**Integral**] [**Din-rail-mounted**] communication module with functions and features compatible with power monitoring and control system specified in Division 16 Section "Electrical Power Monitoring and Control."
    g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at [**55**] [**75**] percent of rated voltage.
    h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
    i. Auxiliary Contacts: [**One SPDT switch**] [**Two SPDT switches**] with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
    j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

B. Insulated-Case Circuit Breaker (ICCB): [**80**] [**100**] percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.

1. [**Fixed**] [**Drawout**] circuit-breaker mounting.
2. Two-step, stored-energy closing.
3. [**Standard**] [**Full**]-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time time adjustments.
    c. Ground-fault pickup level, time delay, and I^2t response.

4. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

5. Remote trip indication and control.
6. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Division 16 Section "Electrical Power Monitoring and Control."
7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
8. Control Voltage: [**40-V dc**] [**125-V dc**] [**250-V dc**] [**120-V ac**].

C. Bolted-Pressure Contact Switch: Operating mechanism uses rotary-mechanical-bolting action to produce and maintain high clamping pressure on the switch blade after it engages the stationary contacts.

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. Boltswitch, Inc.
    b. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    c. Pringle Electrical Manufacturing Company, Inc.
    d. Siemens Energy & Automation, Inc.
    e. Square D; a brand of Schneider Electric.

2. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
3. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.

    a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
    b. Mechanical Trip: Operation of mechanical lever, push button, or other device causes switch to open.

4. Auxiliary Switches: Factory installed, single pole, double throw, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
5. Service-Rated Switches: Labeled for use as service equipment.
6. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.

    a. Configuration: [**Integrally mounted**] [**Remote-mounted**] relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
    c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
    d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).

7. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.

D. High-Pressure, Butt-Type Contact Switch: Operating mechanism uses butt-type contacts and a spring-charged mechanism to produce and maintain high-pressure contact when switch is closed.

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    b. Eaton's Electrical Group.
    c. Ashcroft, Inc.
    d. SOR, Inc.

2. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
3. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.

    a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
    b. Mechanical Trip: Operation of mechanical lever, push button, or other device causes switch to open.

4. Auxiliary Switches: Factory installed, single pole, double throw, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
5. Service-Rated Switches: Labeled for use as service equipment.
6. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.

    a. Configuration: [**Integrally mounted**] [**Remote-mounted**] relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
    c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
    d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).

7. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.

E. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

F. Fuses are specified in Division 16 Section "Fuses."

2.4 INSTRUMENTATION

A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:

1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, [**single**] [**tapped**] [**double**] secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; [**wound**] [**bushing**] [**bar or window**] type; [**single**] [**double**] secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

    a. Phase Currents, Each Phase: Plus or minus 1 percent.
    b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
    c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
    d. Megawatts: Plus or minus 2 percent.
    e. Megavars: Plus or minus 2 percent.
    f. Power Factor: Plus or minus 2 percent.
    g. Frequency: Plus or minus 0.5 percent.
    h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
    i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
    j. Contact devices to operate remote impulse-totalizing demand meter.

2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

C. Ammeters, Voltmeters, and Power-Factor Meters: ANSI C39.1.

1. Meters: 4-inch (100-mm) diameter or 6 inches (150 mm) square, flush or semiflush, with antiparallax 250-degree scales and external zero adjustment.
2. Voltmeters: Cover an expanded-scale range of nominal voltage plus 10 percent.

D. Instrument Switches: Rotary type with off position.

1. Voltmeter Switches: Permit reading of all phase-to-phase voltages and, where a neutral is indicated, phase-to-neutral voltages.
2. Ammeter Switches: Permit reading of current in each phase and maintain current-transformer secondaries in a closed-circuit condition at all times.

E. Feeder Ammeters: 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale. Meter and transfer device with off position, located on overcurrent device door for indicated feeder circuits only.

F. Watt-Hour Meters and Wattmeters:

1. Comply with ANSI C12.1.
2. Three-phase induction type with two stators, each with current and potential coil, rated 5 A, 120 V, 60 Hz.
3. Suitable for connection to three- and four-wire circuits.
4. Potential indicating lamps.
5. Adjustments for light and full load, phase balance, and power factor.
6. Four-dial clock register.
7. Integral demand indicator.
8. Contact devices to operate remote impulse-totalizing demand meter.
9. Ratchets to prevent reverse rotation.
10. Removable meter with drawout test plug.
11. Semiflush mounted case with matching cover.
12. Appropriate multiplier tag.

G. Impulse-Totalizing Demand Meter:

1. Comply with ANSI C12.1.
2. Suitable for use with switchboard watt-hour meter, including two-circuit totalizing relay.
3. Cyclometer.
4. Four-dial, totalizing kilowatt-hour register.
5. Positive chart drive mechanism.
6. Capillary pen holding a minimum of one month's ink supply.
7. Roll chart with minimum 31-day capacity; appropriate multiplier tag.
8. Capable of indicating and recording [**five**] [**15**] [**30**] minute integrated demand of totalized system.

2.5 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

B. Control Circuits: 120-V ac, supplied from remote branch circuit.

C. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control-power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.

D. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

E. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

C. Portable Circuit-Breaker Lifting Device: Floor-supported, roller-based, elevating carriage arranged for movement of circuit breakers in and out of compartments for present and future circuit breakers.

D. Overhead Circuit-Breaker Lifting Device: Mounted at top front of switchboard, with hoist and lifting yokes matching each drawout circuit breaker.

E. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

2.7 IDENTIFICATION

A. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on a photoengraved nameplate.

1. Nameplate: At least 0.032-inch- (0.813-mm-) thick anodized aluminum, located at eye level on front cover of the switchboard incoming service section.

B. Mimic Bus: Entire single-line switchboard bus work, as depicted on factory record drawing, on an engraved laminated-plastic (Gravoply) nameplate.

1. Nameplate: At least 0.0625-inch- (1.588 mm-) thick laminated plastic (Gravoply), located at eye level on front cover of the switchboard incoming service section.

C. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram.

D. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.

E. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.

F. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to [**NECA 400**] [**NEMA PB 2.1**].

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards and accessories according to [**NECA 400**] [**NEMA PB 2.1**].

B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 3 Section "[**Cast-in-Place Concrete**] [**Cast-in-Place Concrete (Limited Applications)**]."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to switchboards.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Comply with mounting and anchoring requirements specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

F. Install filler plates in unused spaces of panel-mounted sections.

G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

H. Install spare-fuse cabinet.

I. Comply with NECA 1.

3.3 CONNECTIONS

A. Comply with requirements for terminating feeder bus specified in Division 16 Section "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.

B. Comply with requirements for terminating cable trays specified in Division 16 Section "Cable Trays." Drawings indicate general arrangement of cable trays, fittings, and specialties.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 16 Section "Electrical Identification."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 16 Section "Electrical Identification."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 16 Section "Electrical Identification."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove [**front**] [**front and rear**] panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
    c. Instruments and Equipment:

        1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Switchboard will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges [**as indicated.**] [**as specified in Division 16 Section "Overcurrent Protective Device Coordination."**]

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

A. [**Engage a factory-authorized service representative to train**] [**Train**] Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories[**, and to use and reprogram microprocessor-based trip, monitoring, and communication units**].

END OF SECTION 16441

SECTION 16442 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Load centers.
4. Electronic-grade panelboards.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. TVSS: Transient voltage surge suppressor.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to [**SEI/ASCE 7**].

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[**and the unit will be fully operational after the seismic event**]."

1.5 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.

3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

C. Qualification Data: For qualified testing agency.

D. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Panelboard Schedules: For installation in panelboards.[**Submit final versions after load balancing.**]

G. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to [**NECA 407**] [**NEMA PB 1**].

1.8 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Not exceeding [**minus 22 deg F (minus 30 deg C)**] [**23 deg F (minus 5 deg C)**] to plus 104 deg F (plus 40 deg C).
    b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify [**Architect**] [**Construction Manager**] [**Owner**] no fewer than [**two**] days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without [**Architect's**] [**Construction Manager's**] [**Owner's**] written permission.
3. Comply with NFPA 70E.

1.9 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: [**Five**] years from date of Substantial Completion.

1.11 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: [**Two**] spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: [**Two**] spares for each panelboard.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: [**Flush**] [**Surface**] [**Flush- and surface**]-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, [**Type 1**].
b. Outdoor Locations: NEMA 250, [**Type 3R**].
c. [**Kitchen**] [**Wash-Down**] Areas: NEMA 250, [**Type 4X**], [**stainless steel**].

d. Other Wet or Damp Indoor Locations: NEMA 250, [**Type 4**].
e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, [**Type 5**] [**Type 12**].

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
6. Finishes:

a. Panels and Trim: [**Steel**] [**and**] [**galvanized steel**], factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: [**Galvanized steel**] [**Same finish as panels and trim**].
c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

7. Directory Card: Inside panelboard door, mounted in [**transparent card holder**] [**metal frame with transparent protective cover**].

C. Incoming Mains Location: [**Top**] [**Bottom**] [**Top and bottom**].

D. Phase, Neutral, and Ground Buses:

1. Material: [**Tin-plated aluminum**] [**Hard-drawn copper, 98 percent conductivity**].
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
5. Split Bus: Vertical buses divided into individual vertical sections.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: [**Tin-plated aluminum**] [**Hard-drawn copper, 98 percent conductivity**].
2. Main and Neutral Lugs: [**Compression**] [**Mechanical**] type.
3. Ground Lugs and Bus-Configured Terminators: [**Compression**] [**Mechanical**] type.
4. Feed-Through Lugs: [**Compression**] [**Mechanical**] type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: [**Compression**] [**Mechanical**] type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
6. Gutter-Tap Lugs: [**Compression**] [**Mechanical**] type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.

I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

C. Panelboards: NEMA PB 1, power and feeder distribution type.

D. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than [**36 inches (914 mm)**] high, provide two latches, keyed alike.

E. Mains: [**Circuit breaker**] [**Fused switch**] [**Lugs only**].

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: [**Plug-in**] [**Bolt-on**] circuit breakers.

G. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

H. Branch Overcurrent Protective Devices: Fused switches.

I. Contactors in Main Bus: NEMA ICS 2, Class A, [**electrically**] [**mechanically**] held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
2. External Control-Power Source: [**120-V branch circuit**] [**24-V control circuit**].

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

C. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

D. Mains: [**Circuit breaker**] [**or**] [**lugs only**].

E. Branch Overcurrent Protective Devices: [**Plug-in**] [**Bolt-on**] circuit breakers, replaceable without disturbing adjacent units.

F. Contactors in Main Bus: NEMA ICS 2, Class A, [**electrically**] [**mechanically**] held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
2. External Control-Power Source: [**120-V branch circuit**] [**24-V control circuit**].

G. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

H. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.4 LOAD CENTERS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

C. Load Centers: Comply with UL 67.

D. Mains: [**Circuit breaker**] [**Lugs only**].

E. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

F. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.5 ELECTRONIC-GRADE PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. Current Technology; a subsidiary of Danahar Corporation.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
4. Liebert Corporation.
5. Siemens Energy & Automation, Inc.
6. Square D; a brand of Schneider Electric.

C. Panelboards: NEMA PB 1; with factory-installed, integral TVSS; labeled by an NRTL for compliance with UL 67 after installing TVSS.

D. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

E. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

F. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

G. Buses:

1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.
2. Copper equipment and isolated ground buses.

H. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, [**plug-in**] [**wired-in**] [**bolt-on**], solid-state, parallel-connected, [**modular (with field-replaceable modules)**] [**non-modular**] type, with sine-wave tracking suppression and filtering modules, short-circuit current rating complying with UL 1449, second edition, and matching or exceeding the panelboard

short-circuit rating, redundant suppression circuits, with individually fused metal-oxide varistors.

1. Accessories:

    a. Fuses rated at 200-kA interrupting capacity.
    b. Fabrication using bolted compression lugs for internal wiring.
    c. Integral disconnect switch.
    d. Redundant suppression circuits.
    e. Redundant replaceable modules.
    f. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
    g. LED indicator lights for power and protection status.
    h. Audible alarm, with silencing switch, to indicate when protection has failed.
    i. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
    j. [**Four**] [**Six**]-digit, transient-event counter set to totalize transient surges.

2. Peak Single-Impulse Surge Current Rating: [**160 kA per mode/320 kA per phase**] [**120 kA per mode/240 kA per phase**] [**80 kA per mode/160 kA per phase**].
3. Minimum single-impulse current ratings, using 8-by-20-mic.sec. waveform described in IEEE C62.41.2.

    a. Line to Neutral: [**70,000**] A.
    b. Line to Ground: [**70,000**] A.
    c. Neutral to Ground: [**50,000**] A.

4. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
5. Protection modes and UL 1449 SVR for grounded wye circuits with [**480Y/277**] [**208Y/120**] [**600Y/347**]-V, three-phase, four-wire circuits shall be as follows:

    a. Line to Neutral: [**800 V for 480Y/277**] [**400 V for 208Y/120**] [**1200 V for 600Y/347**].
    b. Line to Ground: [**800 V for 480Y/277**] [**400 V for 208Y/120**] [**1200 V for 600Y/347**].
    c. Neutral to Ground: [**800 V for 480Y/277**] [**400 V for 208Y/120**] [**1200 V for 600Y/347**].

6. Protection modes and UL 1449 SVR for 240/120-V, single-phase, three-wire circuits shall be as follows:

    a. Line to Neutral: 400 V.
    b. Line to Ground: 400 V.
    c. Neutral to Ground: 400 V.

7. Protection modes and UL 1449 SVR for 240/120-V, three-phase, four-wire circuits with high leg shall be as follows:

    a. Line to Neutral: 400 V, 800 V from high leg.

b. Line to Ground: 400 V.
c. Neutral to Ground: 400 V.

8. Protection modes and UL 1449 SVR for 240-, 480-, or 600-V, three-phase, three-wire, delta circuits shall be as follows:

a. Line to Line: [**2000 V for 480 V**] [**1000 V for 240 V**] [**2500 V for 600 V**].
b. Line to Ground: [**1500 V for 480 V**] [**800 V for 240 V**] [**2500 V for 600 V**].

2.6 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

C. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with [**series-connected rating**] [**interrupting capacity**] to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

a. Instantaneous trip.
b. Long- and short-time pickup levels.
c. Long- and short-time time adjustments.
d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Lugs: [**Compression**] [**Mechanical**] style, suitable for number, size, trip ratings, and conductor materials.
c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
d. Ground-Fault Protection: [**Integrally mounted**] [**Remote-mounted**] relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
e. Communication Capability: [**Circuit-breaker-mounted**] [**Universal-mounted**] [**Integral**] [**Din-rail-mounted**] communication module with functions and features compatible with power monitoring and control system specified in Division 16 Section "Electrical Power Monitoring and Control."
f. Shunt Trip: [**120**] [**24**] -V trip coil energized from separate circuit, set to trip at [**55**] [**75**] percent of rated voltage.
g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage [**without intentional**] [**with field-adjustable 0.1- to 0.6-second**] time delay.
h. Auxiliary Contacts: [**One SPDT switch**] [**Two SPDT switches**] with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
i. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
k. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
l. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
m. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in [**on**] [**off**] [**on or off**] position.
n. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

D. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 16 Section "Fuses."
2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
3. Auxiliary Contacts: [**One**] [**Two**] normally open and normally closed contact(s) that operate with switch handle operation.

2.7 PANELBOARD SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] or comparable product by one of the following:

1. Current Technology; a subsidiary of Danahar Corporation.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
4. Liebert Corporation.
5. Siemens Energy & Automation, Inc.
6. Square D; a brand of Schneider Electric.

C. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, solid-state, parallel-connected, non-modular type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:

1. Accessories:

    a. LED indicator lights for power and protection status.
    b. Audible alarm, with silencing switch, to indicate when protection has failed.
    c. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status.

D. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, [**plug-in**] [**wired-in**] [**bolt-on**], solid-state, parallel-connected, [**modular (with field-replaceable modules)**] [**non-modular**] type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:

1. Accessories:

    a. Fuses rated at 200-kA interrupting capacity.
    b. Fabrication using bolted compression lugs for internal wiring.
    c. Integral disconnect switch.
    d. Redundant suppression circuits.
    e. Redundant replaceable modules.
    f. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
    g. LED indicator lights for power and protection status.
    h. Audible alarm, with silencing switch, to indicate when protection has failed.
    i. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
    j. [**Four**] [**Six**]-digit, transient-event counter set to totalize transient surges.

2. Peak Single-Impulse Surge Current Rating: [**160 kA per mode/320 kA per phase**] [**120 kA per mode/240 kA per phase**] [**80 kA per mode/160 kA per phase**].
3. Minimum single-impulse current ratings, using 8-by-20-mic.sec. waveform described in IEEE C62.41.2.

    a. Line to Neutral: [**70,000**] A.
    b. Line to Ground: [**70,000**] A.
    c. Neutral to Ground: [**50,000**] A.

4. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
5. Protection modes and UL 1449 SVR for grounded wye circuits with [**480Y/277**] [**208Y/120**] [**600Y/347**]-V, three-phase, four-wire circuits shall be as follows:

    a. Line to Neutral: [**800 V for 480Y/277**] [**400 V for 208Y/120**] [**1200 V for 600Y/347**].
    b. Line to Ground: [**800 V for 480Y/277**] [**400 V for 208Y/120**] [**1200 V for 600Y/347**].
    c. Neutral to Ground: [**800 V for 480Y/277**] [**400 V for 208Y/120**] [**1200 V for 600Y/347**].

6. Protection modes and UL 1449 SVR for 240/120-V, single-phase, three-wire circuits shall be as follows:

    a. Line to Neutral: 400 V.
    b. Line to Ground: 400 V.
    c. Neutral to Ground: 400 V.

7. Protection modes and UL 1449 SVR for 240/120-V, three-phase, four-wire circuits with high leg shall be as follows:

    a. Line to Neutral: 400 V, 800 V from high leg.
    b. Line to Ground: 400 V.
    c. Neutral to Ground: 400 V.

8. Protection modes and UL 1449 SVR for 240-, 480-, or 600-V, three-phase, three-wire, delta circuits shall be as follows:

    a. Line to Line: [**2000 V for 480 V**] [**1000 V for 240 V**] [**2500 V for 600 V**].
    b. Line to Ground: [**1500 V for 480 V**] [**800 V for 240 V**] [**2500 V for 600 V**].

2.8 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to [**NECA 407**] [**NEMA PB 1.1**].

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to [**NECA 407**] [**NEMA PB 1.1**].

B. Equipment Mounting: Install panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 3 Section "[**Cast-in-Place Concrete**] [**Cast-in-Place Concrete (Limited Applications)**]."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to panelboards.
5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Comply with mounting and anchoring requirements specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

E. Mount top of trim [**90 inches (2286 mm)**] above finished floor unless otherwise indicated.

F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

G. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

H. Install filler plates in unused spaces.

I. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

J. Arrange conductors in gutters into groups and bundle and wrap with wire ties[**after completing load balancing**].

K. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 16 Section "Electrical Identification."

B. Create a directory to indicate installed circuit loads[**after balancing panelboard loads**]; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 16 Section"Electrical Identification."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 16 Section "Electrical Identification."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
    c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

F. Panelboards will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges [**as indicated**] [**as specified in Division 16 Section "Overcurrent Protective Device Coordination."**]

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 16442

SECTION 16461 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.
2. Buck-boost transformers.

1.3 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Division 16 Section "Electrical Supports and Seismic Restraints." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For testing agency.

E. Source quality-control test reports.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

C. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ACME Electric Corporation; Power Distribution Products Division.
2. Challenger Electrical Equipment Corp.; a division of Eaton Corp.
3. Controlled Power Company.
4. Eaton Electrical Inc.; Cutler-Hammer Products.
5. Federal Pacific Transformer Company; Division of Electro-Mechanical Corp.
6. General Electric Company.
7. Hammond Co.; Matra Electric, Inc.
8. Magnetek Power Electronics Group.
9. Micron Industries Corp.
10. Myers Power Products, Inc.
11. Siemens Energy & Automation, Inc.
12. Sola/Hevi-Duty.
13. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: [**Aluminum**] [**Copper**].

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces specified in Division 16 Section "Electrical Supports and Seismic Restraints."

C. Cores: One leg per phase.

D. Enclosure: [**Ventilated**] [**Totally enclosed, nonventilated**], NEMA 250, Type 2.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

E. Enclosure: [**Ventilated**] [**Totally enclosed, nonventilated**], NEMA 250, [**Type 3R**] [**Type 4X, stainless steel**].

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

F. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: [**Gray**] [**ANSI 49 gray**] [**ANSI 61 gray**].

G. Taps for Transformers Smaller Than 3 kVA: [**None**] [**One 5 percent tap above normal full capacity**].

H. Taps for Transformers 7.5 to 24 kVA: [**One 5 percent tap above and one 5 percent tap below normal full capacity**] [**Two 5 percent taps below rated voltage**].

I. Taps for Transformers 25 kVA and Larger: [**Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity**] [**Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity**].

J. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of [**150**] [**115**] [**80**] deg C rise above 40 deg C ambient temperature.

K. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with NEMA TP 1, Class 1 efficiency levels.
2. Tested according to NEMA TP 2.

L. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
2. Indicate value of K-factor on transformer nameplate.

M. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.

1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
2. Include special terminal for grounding the shield.
3. Shield Effectiveness:

    a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
    b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
    c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.

N. Wall Brackets: Manufacturer's standard brackets.

O. Fungus Proofing: Permanent fungicidal treatment for coil and core.

P. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

Q. Low-Sound-Level Requirements: Maximum sound levels, when factory tested according to IEEE C57.12.91, as follows:

1. 9 kVA and Less:
2. 30 to 50 kVA:
3. 51 to 150 kVA:
4. 151 to 300 kVA:
5. 301 to 500 kVA:
6. 501 to 750 kVA:
7. 751 to 1000 kVA:

2.4 BUCK-BOOST TRANSFORMERS

A. Description: Self-cooled, two-winding dry type, rated for continuous duty and with wiring terminals suitable for connection as autotransformer. Transformers shall comply with NEMA ST 1 and shall be listed and labeled as complying with UL 506 or UL 1561.

B. Enclosure: Ventilated, NEMA 250, Type 2.

1. Finish Color: [**Gray**] [**ANSI 49 gray**] [**ANSI 61 gray**].

2.5 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each [**distribution**] [**buck-boost**] transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 16 Section "Electrical Identification."

2.6 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Division 16 Section "Grounding and Bonding" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Brace wall-mounting transformers as specified in Division 16 Section "Electrical Supports and Seismic Restraints."

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions[**, seismic codes applicable to Project,**] and requirements in Division 16 Section "Electrical Supports and Seismic Restraints."

3.3 CONNECTIONS

A. Ground equipment according to Division 16 Section "Grounding and Bonding."

B. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections and prepare test reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

C. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

E. Remove and replace units that do not pass tests or inspections and retest as specified above.

F. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

G. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 16461

SECTION 16491 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in [**control circuits**] [**enclosed switches**] [**panelboards**] [**switchboards**] [**enclosed controllers**] [**and**] [**motor-control centers**].
2. Plug fuses rated 125-V ac and less for use in plug-fuse-type [**enclosed switches**] [**fuseholders**] [**and**] [**panelboards**].
3. Plug-fuse adapters for use in Edison-base, plug-fuse sockets.
4. Spare-fuse cabinets.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.[**Submit on translucent log-log graph paper.**]
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.

2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.[**Submit on translucent log-log graph paper.**]
4. Coordination charts and tables and related data.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Comply with UL 248-11 for plug fuses.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than [**40 deg F (5 deg C)**] or more than [**100 deg F (38 deg C)**], apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to [**10**] percent of quantity installed for each size and type, but no fewer than [**two**] of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 PLUG FUSES

A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

2.4 PLUG-FUSE ADAPTERS

A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

2.5 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with [**15**] percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance: [**Class L, fast acting**] [**Class L, time delay**] [**Class RK1, fast acting**] [**Class RK1, time delay**] [**Class J, fast acting**] [**Class J, time delay**] [**Class T, fast acting**].
2. Feeders: [**Class L, fast acting**] [**Class L, time delay**] [**Class RK1, fast acting**] [**Class RK1, time delay**] [**Class RK5, fast acting**] [**Class RK5, time delay**] [**Class J, fast acting**] [**Class J, time delay**].
3. Motor Branch Circuits: [**Class RK1**] [**Class RK5**], time delay.
4. Other Branch Circuits: [**Class RK1, time delay**] [**Class RK5, time delay**] [**Class J, fast acting**] [**Class J, time delay**].
5. Control Circuits: Class CC, [**fast acting**] [**time delay**].

B. Plug Fuses:

1. Motor Branch Circuits: [**Edison-base type, dual**] [**Edison-base type, single**] [**Type S, dual**] [**Type S, single**]-element time delay.
2. Other Branch Circuits: [**Edison-base type, single-element fast acting**] [**Edison-base type, dual-element time delay**] [**Edison-base type, single-element time delay**] [**Type S, dual-element time delay**] [**Type S, single-element time delay**].

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.

C. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 16 Section "Electrical Identification" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 16491

SECTION 16511 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.
5. Retrofit kits for fluorescent lighting fixtures.

B. Related Sections include the following:

1. Division 13 Section "Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.
2. Division 16 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.
3. Division 16 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
4. Division 16 Section "Stage Lighting" for theatrical lighting fixtures and their controls.
5. Division 16 Section "Dimming Controls" for architectural dimming systems.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CRI: Color-rendering index.

C. CU: Coefficient of utilization.

D. HID: High-intensity discharge.

E. LER: Luminaire efficacy rating.

F. Luminaire: Complete lighting fixture, including ballast housing if provided.

G. RCR: Room cavity ratio.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Ballast.
4. Energy-efficiency data.
5. Air and Thermal Performance Data: For air-handling lighting fixtures. Furnish data required in "Submittals" Article in Division 15 Section "Diffusers, Registers, and Grilles."
6. Sound Performance Data: For air-handling lighting fixtures. Indicate sound power level and sound transmission class in test reports certified according to standards specified in Division 15 Section "Diffusers, Registers, and Grilles."
7. Life, output, and energy-efficiency data for lamps.
8. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

    a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
    b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

1. Wiring Diagrams: Power[**and control**] wiring.

C. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Lighting fixtures.
2. Suspended ceiling components.
3. Structural members to which suspension systems for lighting fixtures will be attached.
4. Other items in finished ceiling including the following:

    a. Air outlets and inlets.
    b. Speakers.
    c. Sprinklers.
    d. Smoke and fire detectors.
    e. Occupancy sensors.
    f. Access panels.

5. Perimeter moldings.

D. Samples for Verification: Interior lighting fixtures designated for sample submission in Interior Lighting Fixture Schedule. Each sample shall include the following:

1. Lamps: Specified units installed.
2. Accessories: Cords and plugs.

E. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

F. Qualification Data: For agencies providing photometric data for lighting fixtures.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

I. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70.

E. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

F. Mockups: Provide interior lighting fixtures for room or module mockups, complete with power and control connections.

1. Obtain Architect's approval of fixtures for mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit Batteries: [**10**] years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
2. Warranty Period for Emergency Fluorescent Ballast[**and**] [**Self-Powered Exit Sign**] Batteries: [**Seven**] years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

B. Special Warranty for Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Electronic Ballasts: [**Five**] years from date of Substantial Completion.
2. Warranty Period for Electromagnetic Ballasts: [**Three**] years from date of Substantial Completion.

C. Special Warranty for [**T5**] [**T8**] [**T5 and T8**] Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: [**One**] [**Two**] year(s) from date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: [**10 for every 100**] of each type and rating installed. Furnish at least one of each type.
2. Plastic Diffusers and Lenses: [**1 for every 100**] of each type and rating installed. Furnish at least one of each type.
3. Battery and Charger Data: [**One**] for each emergency lighting unit.
4. Ballasts: [**1 for every 100**] of each type and rating installed. Furnish at least one of each type.

5. Globes and Guards: [**1 for every 20**] of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

B. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
3. Basis-of-Design Product: The design for each lighting fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.

C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

E. Metal Parts: Free of burrs and sharp corners and edges.

F. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

H. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.

3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

I. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

   a. Lens Thickness: At least [**0.125 inch (3.175 mm)**] minimum unless different thickness is indicated.
   b. UV stabilized.

2. Glass: Annealed crystal glass, unless otherwise indicated.

J. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic-interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

K. Air-Handling Fluorescent Fixtures: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser-boot assembly specified in Division 15 Section "Diffusers, Registers, and Grilles."

1. Air Supply Units: Slots in one or both side trims join with air-diffuser-boot assemblies.
2. Heat Removal Units: Air path leads through lamp cavity.
3. Combination Heat Removal and Air Supply Unit: Heat is removed through lamp cavity at both ends of the fixture door with air supply same as for air supply units.
4. Dampers: Operable from outside fixture for control of return-air volume.
5. Static Fixture: Air supply slots are blanked off, and fixture appearance matches active units.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. Electronic Ballasts: Comply with ANSI C82.11; [**instant**] [**programmed**]-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.

1. Sound Rating: [**A**] [**A, except B for T12/HO and T12/Slimline lamp ballasts**].
2. Total Harmonic Distortion Rating: Less than [**10**] [**20**] percent.
3. Transient Voltage Protection: IEEE C62.41, Category A or better.
4. Operating Frequency: [**20**] [**42**] kHz or higher.
5. Lamp Current Crest Factor: [**1.7**] or less.
6. BF: 0.85 or higher.
7. Power Factor: [**0.95**] [**0.98**] or higher.
8. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

B. Electronic Programmed-Start Ballasts for [**T5**] [**T5HO**] [**T5 and T5HO**] Lamps: Comply with ANSI C82.11 and the following:

1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: [**0.95**] [**0.98**] or higher.

C. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.

1. Ballast Manufacturer Certification: Indicated by label.

D. Single Ballasts for Multiple Lighting Fixtures: Factory-wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

E. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F (Minus 17 Deg C) and Higher: [**Electronic**] [**Electromagnetic**] [**Electronic or electromagnetic**] type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.
2. Temperatures Minus 20 Deg F (Minus 29 Deg C) and Higher: Electromagnetic type designed for use with indicated lamp types.

F. Ballasts for Low Electromagnetic-Interference Environments: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.

G. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.

1. Dimming Range: 100 to [**5**] percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to [**20**] percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

H. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.

1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.

   a. High-Level Operation: 100 percent of rated lamp lumens.
   b. Low-Level Operation: [**30**] [**50**] percent of rated lamp lumens.

2. Ballast shall provide equal current to each lamp in each operating mode.
3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher, unless otherwise indicated.
9. Power Factor: [**0.95**] [**0.98**] or higher.
10. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
11. Ballast Case Temperature: 75 deg C, maximum.

B. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.

1. Dimming Range: 100 to [**5**] percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to [**20**] percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

2.5 EMERGENCY FLUORESCENT POWER UNIT

A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.

1. Emergency Connection: Operate [**1**] fluorescent lamp(s) continuously at an output of [**1100**] lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
2. Night-Light Connection: Operate one fluorescent lamp continuously.
3. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.

    a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

4. Battery: Sealed, maintenance-free, nickel-cadmium type.
5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
6. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

B. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more fluorescent lamps, remote mounted from lighting fixture. Comply with UL 924.

1. Emergency Connection: Operate one fluorescent lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
2. Night-Light Connection: Operate one fluorescent lamp in a remote fixture continuously.
3. Battery: Sealed, maintenance-free, nickel-cadmium type.
4. Charger: Fully automatic, solid-state, constant-current type.
5. Housing: NEMA 250, Type 1 enclosure.
6. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
7. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.6 BALLASTS FOR HID LAMPS

A. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features, unless otherwise indicated:

1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C) for single-lamp ballasts.
3. Normal Ambient Operating Temperature: 104 deg F (40 deg C).
4. Open-circuit operation that will not reduce average life.
5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.

B. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Sound Rating: A.
3. Total Harmonic Distortion Rating: Less than 15 percent.
4. Transient Voltage Protection: IEEE C62.41, Category A or better.
5. Lamp Current Crest Factor: 1.5 or less.
6. Power Factor: .90 or higher.
7. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
8. Protection: Class P thermal cutout.

9. Retain subparagraph and associated subparagraphs below for bi-level ballasts.
10. Bi-Level Dimming Ballast: Ballast circuit and leads provide for remote control of the light output of the associated fixture between high- and low-level and off.

    a. High-Level Operation: 100 percent of rated lamp lumens.
    b. Low-Level Operation: [**35**] [**50**] percent of rated lamp lumens.
    c. Compatibility: Certified by ballast manufacturer for use with specific bi-level control system and lamp type indicated. Certified by lamp manufacturer that ballast operating modes are free from negative effect on lamp life and color-rendering capability.

11. Continuous Dimming Ballast: Dimming range shall be from 100 to [**35**] percent of rated lamp lumens without flicker.

    a. Ballast Input Watts: Reduced to a maximum of [**50**] percent of normal at lowest dimming setting.
    b. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated. Certified by lamp manufacturer that ballast operating modes are free from negative effect on lamp life and color-rendering capability.

C. Auxiliary Instant-On Quartz System: Factory-installed feature automatically switches quartz lamp on when fixture is initially energized and when power outages occur. System automatically turns quartz lamp off when HID lamp reaches approximately 60 percent light output.

D. High-Pressure Sodium Ballasts: Electromagnetic type, with solid-state igniter/starter. Igniter-starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.

1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.

    a. Restrike Range: 105- to 130-V ac.
    b. Maximum Voltage: 250-V peak or 150-V ac RMS.

2. Minimum Starting Temperature: Minus 40 deg F (Minus 40 deg C).
3. Open-circuit operation shall not reduce average lamp life.

2.7 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: Fluorescent, 2 for each fixture, 20,000 hours of rated lamp life.
2. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

3. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

    a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
    f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
    g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

4. Master/Remote Sign Configurations:

    a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in [**LED power supply**] [**ballast**] for power connection to remote unit.
    b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

2.8 EMERGENCY LIGHTING UNITS

A. Description: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
7. Integral Time-Delay Relay: Holds unit on for fixed interval of [**15**] minutes when power is restored after an outage.

8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.9 FLUORESCENT LAMPS

A. Low-Mercury Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.

B. T8 rapid-start[**low-mercury**] lamps, rated 32 W maximum, nominal length of 48 inches (1220 mm), 2800 initial lumens (minimum), CRI 75 (minimum), color temperature [**3500**] < K, and average rated life 20,000 hours, unless otherwise indicated.

C. T8 rapid-start[**low-mercury**] lamps, rated 17 W maximum, nominal length of 24 inches (610 mm), 1300 initial lumens (minimum), CRI 75 (minimum), color temperature [**3500**] K, and average rated life of 20,000 hours, unless otherwise indicated.

D. T5 rapid-start[**low-mercury**] lamps, rated 28 W maximum, nominal length of 45.2 inches (1150 mm), 2900 initial lumens (minimum), CRI 85 (minimum), color temperature [**3000**] K, and average rated life of 20,000 hours, unless otherwise indicated.

E. T5HO rapid-start, high-output[**low-mercury**] lamps, rated 54 W maximum, nominal length of 45.2 inches (1150 mm), 5000 initial lumens (minimum), CRI 85 (minimum), color temperature [**4100**] K, and average rated life of 20,000 hours, unless otherwise indicated.

F. Compact Fluorescent Lamps: 4-Pin, [**low mercury,**]CRI 80 (minimum), color temperature [**3500**] K, average rated life of 10,000 hours at 3 hours operation per start, [**and suitable for use with dimming ballasts,**]unless otherwise indicated.

1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
6. 55 W: T4, triple tube, rated 4300 initial lumens (minimum).

2.10 HID LAMPS

A. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), color temperature [**1900**] K, and average rated life of 24,000 hours, minimum.

1. Dual-Arc Tube Lamps: Arranged so only one of two arc tubes is lighted at one time and, when power is restored after an outage, the cooler arc tube, with lower internal pressure, lights instantly, providing an immediate 8 to 15 percent of normal light output.

B. Metal-Halide Lamps: ANSI C78.1372, with a minimum CRI [**65**], and color temperature [**4000**] K.

C. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature [**4000**] K.

D. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI [**80**], and color temperature [**4000**] K.

2.11 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 16 Section "Electrical Supports and Seismic Restraints" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, [**12 gage (2.68 mm)**].

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, [**12 gage (2.68 mm)**].

F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.12 RETROFIT KITS FOR FLUORESCENT LIGHTING FIXTURES

A. Comply with UL 1598 listing requirements.

1. Reflector Kit: UL 1598, Type I. Suitable for two- to four-lamp, surface-mounted or recessed lighting fixtures by improving reflectivity of fixture surfaces.
2. Ballast and Lamp Change Kit: UL 1598, Type II. Suitable for changing existing ballast, lamps, and sockets.

2.13 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

A. Fixture Type, see Dwg. No. E-1:

1. Basis-of-Design Product: LITHONIA FIXTURE - MODEL # DMS-2-32-120 or a comparable product by one of the following:
2. [**Available**]Manufacturers:

   a. H.E. Williams, Inc.

   b. AEI Lighting

c. Nutron Manufacturing, Inc.

3. Voltage: [**120**] [**277**] [**480**]-V ac.
4. Mounting: [**Recessed ceiling**] [**Recessed wall**] [**Semirecessed**] [**Pendant**] [**Surface ceiling**] [**Surface wall**] [**Suspended**]
5. Nominal Dimensions:
6. Ballast Type: [**Electronic instant start**] [**Electronic programmed start**] [**Electronic dimming**] [**Electronic bi-level**] [**Electromagnetic**] [**Low temperature**].
7. Ballast Type: [**Electronic**] [**Electronic continuous dimming**] [**Electronic bi-level dimming**] [**Electromagnetic**], compatible with lamp type indicated.
8. Ballast Fuse: Factory installed, slow-blow type rated between 2.65 and 3.0 times the line current.
9. Trim and Hardware: [**Spring-loaded door latches**] .
10. Minimum CU for typical RCR shall be as follows (typical cavity reflectances are ceiling, 80 percent; wall, 50 percent; and floor, 20 percent): RCR [**3**] [**5**] [**7**] CU.
11. Submit Sample.
12. Provide lighting fixtures as needed for mockups.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

C. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

D. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.

E. Adjust aimable lighting fixtures to provide required light intensities.

F. Connect wiring according to Division 16 Section "Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 16511

GEOTECHNICAL REPORT

Reconstruction of Eastern Avenue
Bridge over Kenilworth Avenue, N.E.

REPORT ON
SUBSURFACE INVESTIGATIONS AND
FOUNDATION RECOMMENDATIONS
EASTERN AVENUE BRIDGE OVER KENILWORTH AVENUE, NE
WASHINGTON, D.C.

by

Haley & Aldrich, Inc.
McLean, Virginia

for

Greenhorne & O'Mara, Inc.
Laurel, Maryland

File No. 33261-000
19 September 2008

HALEY & ALDRICH

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ALDRICH

19 September 2008
File No. 33261-000

Greenhorne & O'Mara, Inc.
6110 Frost Place
Laurel, Maryland 20707

Attention: Mr. Bimal Patel, P.E.

Subject: Report on Subsurface Investigations and Foundation Recommendations
Eastern Avenue Bridge over Kenilworth Avenue, NE
Washington, D.C.

Ladies and Gentlemen:

We are pleased to submit herewith our report entitled "Report on Subsurface Investigations and Foundations Recommendations, Eastern Avenue Bridge over Kenilworth Avenue, NE, Washington, DC". This report has been prepared in accordance with our proposal dated 20 June 2006 and your subsequent authorization.

The purpose of this study was to evaluate the subsurface soil and groundwater conditions at the proposed site and develop recommendations for the design and construction of the foundations for the renovated bridge. The main features of the study are summarized in the Executive Summary with the details presented in the text of the report.

It has been a pleasure to work with you on this project. If you have any questions or require additional information, please do not hesitate to contact us.

Sincerely yours,
HALEY & ALDRICH, INC.

David A. Schoenwolf, P.E.
Senior Vice President

Enclosures

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EXECUTIVE SUMMARY

This report presents the results of field and laboratory investigations, and provides foundation design recommendations and geotechnical construction considerations for the renovation/reconstruction of the Eastern Avenue Bridge over Kenilworth Avenue, NE. Washington, DC.

Kenilworth Avenue, NE is a six lane depressed roadway that passes below Eastern Avenue, NE through an underpass. The gravity retaining walls on either side of the depressed section of Kenilworth Avenue form the abutments of the Eastern Avenue Bridge. Currently the clearance for traffic passing below Eastern Avenue on Kenilworth Avenue is approximately 14 ft.-0 in. in both the Northbound and Southbound lanes. However, with this clearance, the bridge girders that support Eastern Avenue have been struck by passing vehicles, causing the concrete girders to be damaged. In order to reduce the potential for oversized vehicles to strike and cause damage to the girders in the future, it is proposed that bridge clearance be increased to 14 ft.-6 in.

To create the increased clearance, a Center Pier will be added to support the bridge from below. As a result, the load on the existing abutments will be reduced.

Previous subsurface explorations were performed at the site by Rummel, Klepper & Kahl of Baltimore, Maryland in 1956 for the design of the original bridge. Then, in 2000 six additional borings were drilled by Thomas L. Brown Associates, PC of Washington, DC. These borings were drilled for a preliminary study of the bridge renovation.

The current subsurface exploration program consisted of drilling nine (9) test borings, 11.5 to 42.0 ft deep, to obtain subsurface information for engineering analyses and project design. Laboratory tests were conducted on selected soil samples recovered from the subsurface explorations to aid in soil classification and to evaluate engineering properties.

The test boring program revealed the following sequence of strata below the ground surface.

At the ground surface, at boring B9, a 3-inch thick asphalt layer over a 9-inch thick Portland cement concrete pavement was encountered. Below the roadway surface of Kenilworth Avenue, there is a BASE COURSE consisting of medium dense well-graded fine to coarse SAND and with some gravel. At this location, the BASE COURSE was 12 inches thick. Below the BASE COURSE in boring B9 and immediately below the ground surface in the remainder of the test borings is an interbedded stratum of loose to medium dense gray to brown poorly-graded fine to medium SAND with varying amounts of silt and fine gravel. This stratum extended to the depths of the borings.

Ground water was encountered in all the original borings drilled in 1955, varying in depth from 30 to 35 ft. below ground surface. Groundwater was not encountered in any of the borings drilled by Thomas L. Brown Associates in 2000. However, these borings were only drilled to a depth of 6.5 ft. below the ground surface. In the recent borings groundwater was typically encountered at 26 to 27 ft. below the ground surface, corresponding to approximately El. 14.0 to El. 15.0

In consideration of the structural loads on the abutments from the renovated bridge structure and the structural loads on the new Center Pier, the most technically feasible and economical foundation to support the Center Pier is a spread footing foundation bearing on the natural soils. The soil materials at the proposed bearing level of the new center pier have adequate density/consistency for direct support of a spread footing foundation bearing at shallow depths below the ground surface. Four options have been offered for the design of the spread footings:

- **Option 1** – Spread footings bearing at a depth of 6 ft. below the roadway surface at a recommended service limit bearing pressure of 3 ksf.
- **Option 2** – Spread footings bearing at a depth of 8 ft. below the roadway surface at a recommended service limit bearing pressure of 4 ksf.
- **Option 3** – Spread footings bearing at a depth of 10 ft. below the ground surface at a recommended service limit bearing pressure of 7 ksf.

The foundation of the existing abutment walls consist of spread footings which are adequate to support the new loadings, especially since the new loads are less than the current loads.

As indicated above, the loading on the existing bridge abutments will be less with the proposed bridge renovations. Therefore, the existing bridge abutments should perform as they have in the past and no foundation renovations are required. The soil parameters for the existing bridge abutments have been provided so a structural analysis using the AASHTO LRFD Bridge Design Specifications could be performed.

Pavement design recommendations have been provided herein for the service roads that exist on the east and west sides of Kenilworth Avenue.

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LIST OF FIGURES

1. INTRODUCTION

1.1 General

This report presents the results of subsurface investigations and provides design recommendations concerning the bridge foundations for the proposed reconstruction of the Eastern Avenue Bridge over Kenilworth Avenue, NE. As shown on Figure 1, "Project Locus", the project site is located in Northeast Washington, D.C., at the intersection of Eastern Avenue and Kenilworth Avenue. The District of Columbia Department of Transportation (DDOT) is planning to reconstruct the Eastern Avenue Bridge over Kenilworth Avenue to address vertical clearance problems that have resulted in vehicular damage to the bridge. Greenhorne & O'Mara (G&O) has been retained to conduct studies and develop alternatives for rehabilitation and/or reconstruction of the bridge structure. As a result of the rehabilitation and/or reconstruction schemes, the new design loads supported on the existing abutments will change. In addition, a center pier will be installed to support Eastern Avenue, NE.

The work summarized herein has been coordinated with Greenhorne & O'Mara, Inc. of Laurel, Maryland, Project Engineer. The Owner is the District of Columbia Department of Transportation.

1.2 Purpose and Scope

The purpose of this study was to evaluate the subsurface conditions in the vicinity of the proposed bridge reconstruction and to provide geotechnical recommendations for its foundation design. The recommendations for foundation design include support for the abutments and the center pier. To achieve this objective, Haley & Aldrich, Inc. drilled a total of 9 test borings to define the subsurface soil and groundwater conditions at the site. These new test borings supplement information provided by eight test borings completed in December 1955 by Rummel, Klepper & Kahl of Baltimore, Maryland and another six test borings completed on 15 December 2000 by Sverdrup Civil, Inc. The results of these test borings have been reviewed by Haley & Aldrich and used as the basis for design of our recent subsurface exploration program.

To determine the engineering property of soils, a laboratory test program was performed after completion of the field program.

The results of our field and laboratory investigations and engineering studies have been summarized in this report.

1.3 Elevation Datum

The elevations on the roadway plans are referenced to State Plane Coordinates System NAVD 1983 (91) and the NAVD 1988 Vertical Datum. Therefore, consistent with the project design, the elevations in this report are also referenced to the same coordinate system and vertical datum.

2. FIELD AND LABORATORY INVESTIGATIONS

2.1 Previous Test Borings

2.1.1 Original Bridge Test Borings (1956)

In December 1956, eight (8) test borings were drilled as shown in the contract drawings by Rummel, Klepper & Kahl of Baltimore, Maryland for design of the gravity retaining walls in support of the existing bridge. Copies of the logs for these borings were prepared by the Department of Highways, Government of the District of Columbia, and were provided to Haley & Aldrich by Greenhorne & O'Mara. The locations of these borings are shown on a boring location plan in Appendix B along with copies of the logs.

As indicated on the logs, the borings were drilled to a depth of 35.0 to 50.0 feet below ground surface.

2.1.2 Previous Design Borings (2000)

On 15 December 2000, six (6) test borings (B-1 to B-6) were drilled by Thomas L. Brown Associates, PC of Washington, DC. Sverdrup Civil, Inc. was preparing the design for the proposed bridge reconstruction and retained Thomas L. Brown Associates to perform the geotechnical explorations. Copies of the logs for these borings were provided to Haley & Aldrich by Greenhorne & O'Mara, and are included in Appendix B, Logs of Previous Test Borings.

As indicated on the test boring logs, all the borings were drilled using a truck mounted drill rig and were drilled to a depth of approximately 6.5 to 7.0 feet beneath existing surface pavement.

2.2 Recent Test Borings

Haley & Aldrich conducted a subsurface exploration program at the project site during the period 14 to 16 August 2008 to obtain soil and groundwater information for engineering evaluations. The program consisted of drilling nine (9) test borings, designated B1 through B9. The borings were drilled by GeoServices Corporation of Forestville, Maryland using a truck-mounted CME-55 drill rig. A Haley & Aldrich representative was present in the field to monitor the borings.

The locations of the test borings are shown on Figure 2, "Exploration Location Plan." The locations of the borings were determined in the field by Haley & Aldrich by tape measurement from existing site features. Elevations of the borings were determined by Haley & Aldrich by linear interpolation between ground surface elevation contour lines shown on a topographic plan of the site provided to Haley & Aldrich on by Greenhorne & O'Mara in

electronic (AutoCAD) format. The locations and elevations of the explorations should be considered accurate only to the degree implied by the method used.

The test borings were drilled to depths ranging from 11.5 feet to 42.0 feet below ground surface. Prior to drilling boring B9, the upper six (6) feet of soil was vacuum excavated to confirm that no utilities were present at this location. The test boring location was backfilled with soil and the test boring was drilled approximately 5 ft. to the north of the vacuum excavated location.

The borings were advanced using a 3-1/4-in. inside diameter (i.d.) hollow stem auger. Split-spoon samples were typically obtained at 2.5 ft depth intervals for the upper 15 ft of the test borings and at 5 ft intervals thereafter. The standard penetration resistance was determined at each sample level by counting the number of blows required to drive a standard split-spoon sampler (1-3/8 in. i.d., 2-in. o.d.) a distance of 18 in. into undisturbed soil under the impact of a 140-lb hammer free-falling 30 in. The number of blows required to advance the sampler was recorded for each 6-in. interval. The standard penetration resistance N-value is determined by summing the number of blows required to advance the sampler the last 12 in. of the 18-in. sampling range.

Samples recovered from the borings were taken to Haley & Aldrich's office for further evaluation. Some of these samples were subsequently selected for laboratory testing. The boring logs are presented in Appendix A.

2.3 Laboratory Testing

A laboratory soil testing program was performed to determine soil classification and for correlation of engineering properties. Laboratory tests were performed on selected samples of soils recovered from borings. Testing consisted of geotechnical index tests including moisture content, Atterberg Limits, Grain Size Analyses with hydrometer, a California Bearing Ratio test and a modified Proctor compaction test. All of the tests were performed by in general conformance with applicable ASTM test procedures. Results of laboratory testing are included in Appendix C.

3. SITE AND SUBSURFACE CONDITIONS

3.1 Site Conditions

Kenilworth Avenue, NE is a six lane depressed roadway that passes below Eastern Avenue, NE through an underpass. The gravity retaining walls on either side of the depressed section of Kenilworth Avenue form the abutments of the Eastern Avenue Bridge. Currently the clearance for traffic passing below Eastern Avenue on Kenilworth Avenue is approximately 14 ft.-0 in. in both the northbound and southbound lanes. However, with this clearance, the bridge girders that support Eastern Avenue have been struck by passing vehicles, causing the concrete girders to be damaged. In order to reduce the potential for oversized vehicles to strike and cause damage to the girders in the future, it is proposed that bridge clearance be increased to 14 ft.-6 in. Topographically, the existing Eastern Avenue Bridge is at grade with the surrounding topography. Two service roads running parallel to Kenilworth Avenue on either side of the depressed roadway section are at approximately the same surface elevation as Eastern Avenue and perpendicular to the bridge.

3.2 Regional Geology

The subsurface conditions of this site have been greatly influenced by close proximity to both the Anacostia and Potomac Rivers. These rivers have deposited great depths of fluvial sediment in the area consisting primarily of sands, silts and clays. These unconsolidated fluvial deposits are Tertiary in age and form a continuous cover over underlying bedrock.

Geologic studies performed by N.H. Darton (1944) indicate depth to bedrock to be approximately 450 feet. The bedrock consists primarily of granite, gneiss, and other types of crystalline rock. The downward slope of bedrock across the region strikes from NW to SE at roughly 60 feet per mile.

It is of particular importance to note that the shorelines along the Anacostia have been greatly altered by extensive fill materials during reclamation of tidal marshes in the early 1900's. Since this site is located near delineated wetlands of the Kenilworth Aquatic Gardens, near-surface fill materials are possible.

3.3 Subsurface Conditions

Descriptions of the soil conditions encountered during the subsurface exploration program conducted at the site are provided below in order of increasing depth below ground surface. Refer to the test boring logs in Appendix A for specific descriptions of soil samples obtained from the borings. The boring logs and related information depict subsurface conditions only at the specific locations and at the particular time designated on the logs. Soil conditions at

other locations may differ from conditions occurring at the boring locations. In addition, the passage of time may result in a change in the soil conditions at these boring locations.

- *ASPHALT/CONCRETE* – At the ground surface at boring B9, a 3-inch thick asphalt layer over a 9-inch thick Portland cement concrete pavement was encountered.

- *BASE COURSE* - Below the roadway surface of Kenilworth Avenue at boring B9, there is a BASE COURSE consisting of medium dense well-graded fine to coarse SAND with some gravel. At this location the BASE COURSE was 12 inches thick.

- *FLUVIAL SEDIMENTS* – Below the BASE COURSE in boring B9 and immediately below the ground surface at the remaining test borings is an interbedded stratum of loose to medium dense gray to brown poorly-graded fine to medium SAND with varying amounts of silt and fine gravel. At approximately El. 20 a layer of medium stiff gray lean CLAY or stiff gray SILT was encountered in borings B3, B5, B6 and B9. And at approximately El. 4.5 a layer of medium dense tan well-graded GRAVEL with fine to coarse sand was encountered in test borings B3, B5, B6 and B9. This stratum of FLUVIAL sediments extended to the depths of the borings.

3.4 Groundwater

Ground water was encountered in all the original borings drilled in 1955, varying in depth from 30 to 35 ft. below ground surface. Groundwater was not encountered in any of the borings drilled by Thomas L. Brown Associates in 2000. However, these borings were only drilled to a depth of 6.5 ft. below the ground surface.

In the recent borings, groundwater was encountered in borings B3, B4, B5, B6 and B9. The depth to groundwater was observed to be typically 26 to 27 ft. below the ground surface, corresponding to approximately El. 14.0 to El. 15.0. However, at boring B3 the groundwater was encountered at a depth of 13 ft. below ground surface (El. 28.0), and at a depth of 5.3 ft. below the roadway surface in boring B9 (at El. 18.2)

It should be noted that water level readings have been made in drill holes at times and under conditions stated in the boring logs. These data have been reviewed and interpretations made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to the variations in season, rainfall, temperature, and other factors not evident at the time measurements were made and reported herein.

4. GEOTECHNICAL ENGINEERING DESIGN RECOMMENDATIONS

4.1 General

Recommendations presented herein are based on the proposed bridge layout and anticipated loadings and structural configurations provided by Greenhorne & O'Mara. If and when revisions are made by Greenhorne & O'Mara concerning final design loads, bridge configuration, etc., the design criteria presented herein should be reviewed by Haley & Aldrich for continued applicability.

The analyses and recommendations presented herein have been performed in accordance with the 2008 Interim Revisions to the AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition, 2007.

4.2 Proposed Bridge Reconstruction

The proposed Eastern Avenue Bridge reconstruction will increase the vertical clearance for traffic passing beneath the bridge on Kenilworth Avenue in order to accommodate the increased volume of large vehicle traffic. The proposed bridge is planned to be a two span structure that will be approximately 152 feet long and 85 feet wide. The existing bridge abutments, which are reinforced concrete retaining walls up to approximately 26 ft. tall, will continue to support the bridge at the ends. A new center pier will be added to shorten the span length and allow for a decreased depth of the bridge girders.

The structural loadings for the new proposed bridge reconstruction, as provided by Greenhorne & O'Mara are as follows:

Abutments

- Load Case 1: Dead Load Reaction of 5 kips/ft with a Live Load Reaction of 7 kips/ft
- Load Case 2: Dead Load Reaction of 15 kips/ft with no Live Load Reaction
- Lateral Wind Load on Abutments at the bearing seat level: 0.5 kips/ft
- Lateral Wind Load from Superstructure on Abutments at the bearing seat level: 0.1 kips/ft.
- Lateral Force due to Longitudinal Forces from the superstructure on Abutments at the bearing seat level: 0.2 kips/ft.

Center Pier Wall

- Dead Load Reaction of 4,459 kips (28.9 kips/ft) with a Live Load Reaction of 1,342 kips (8.4 kips/ft)
- Lateral Wind Load on top of the pier cap: 0.3 kips/ft
- Lateral Wind Load from Superstructure on top of the pier cap: 0.3 kips/ft.

- Lateral Force due to Longitudinal Forces from the superstructure on top of the pier cap: 0.5 kips/ft.

The structural loadings for the existing retaining wall abutments, before the new proposed bridge reconstruction occurs, as provided by Greenhorne & O'Mara are as follows:

Abutments

- Load Case 1: Dead Load Reaction of 14.5 kips/ft with a Live Load Reaction of 9 kips/ft (Note: there will be a reduction from this load to the new load)
- Lateral Wind Load on Abutments at the bearing seat level: 0.5 kips/ft
- Lateral Wind Load from Superstructure on Abutments at the bearing seat level: 0.2 kips/ft.
- Lateral Force due to Longitudinal Forces from the superstructure on Abutments at the bearing seat level: 0.5 kips/ft.

4.3 Bridge Foundation Design Recommendations

As discussed in the previous Section, the existing abutments are underlain by natural fluvial soils consisting of interbedded strata of loose to medium dense gray to brown poorly-graded fine to medium SAND with varying amounts of silt and fine gravel. In consideration of the structural loads on the abutments from the renovated bridge structure and the structural loads on the new Center Pier, the most technically feasible and economical foundation to support the Center Pier is a spread footing foundation. The soil materials at the proposed bearing level of the new center pier have adequate density/consistency for direct support of a spread footing foundation bearing at a minimum depth below the existing roadway surface of six (6) ft. However, due to the density of the soil, the bearing pressure at 6 ft. will be controlled by settlement considerations. Therefore several alternative foundation recommendations have been discussed below regarding the center pier foundation support. The foundation of the existing abutment walls consist of spread footings which are adequate to support the new loadings, especially since the new loads are less than the current loads.

4.3.1 Center Pier Foundation

Option 1 -- Spread Footing Bearing at 6 ft. Depth

As indicated on the log of test boring B9 and as discussed above, there is a 4 ft. thick layer of stiff to very stiff CLAY immediately underlying the roadway base course. Below this layer of CLAY is a layer of loose to medium dense fine to medium SAND with varying amounts of silt. In consideration of these soil conditions, it is recommended that the Center Pier be founded on a spread footing foundation that bears below the CLAY layer on the loose SAND in accordance with the following criteria. (NOTE: Based on the design drawings we have

seen to date, the Center Pier spread footing will bear at a depth of approximately 5 ft. below the top of roadway surface. We recommend that the footings bear at a level of at least one foot lower so as to not bear on the clay stratum.)

- The recommended maximum bearing pressures, based on LRFD criteria, are as follows:

  - Strength Limit State: 11.4 ksf
  - Strength Limit State Factored (0.45 Resistance Factor): 5.1 ksf
  - Service Limit State: 3.0 ksf which is a gross value, which means that the total dead and live loads plus the foundation weight should be included in the bearing pressure. The recommended bearing pressure can be increased by one-third when considering transient loads such as seismic forces.

- The least lateral dimension of Center Pier footing should be 36 in. For footings with least lateral dimension less than 36 in., the allowable bearing pressure in ksf should be one-third of the recommended allowable bearing pressure multiplied by the least lateral dimension in feet.

- The maximum depth of frost penetration in the project area is approximately 30 inches below pavement surface. Therefore the footings should bear a minimum of 30 in. below the adjacent ground surface exposed to freezing for frost protection.

- Establish the bottom of footings below a 2 horizontal to 1 vertical (2H:1V) slope line drawn upward and outward from the bottom of any adjacent utility or structure.

Option 2 – Spread Footing Bearing at 8 ft. Depth

To increase the recommended maximum allowable bearing pressure, one option is to lower the footing to bear on a more dense soil stratum. Accordingly, an analysis was performed to determine at what level the footing would need to bear to achieve a Service Limit State bearing pressure of 4 ksf. That level is 8 ft. below the existing pavement surface. The recommended maximum bearing pressures, based on LRFD criteria, are as follows:

- Strength Limit State: 12.5 ksf
- Strength Limit State Factored (0.45 Resistance Factor): 5.6 ksf
- Service Limit State: 4.0 ksf which is a gross value, which means that the total dead and live loads plus the foundation weight should be included in the bearing pressure. The recommended bearing pressure can be increased by one-third when considering transient loads such as seismic forces.

The design of a footing bearing at this depth should be in accordance with the recommendations for the footing bearing at 6 ft. below the ground surface.

However, as is discussed in the Section 5, construction of a footing at this depth will most likely require continuous steel sheeting excavation support system and groundwater pumping in order to construct the footing in-the-dry.

Option 3 – Spread Footing Bearing at 10 ft. Depth

If the footing bearing level is lowered to a depth of 10 ft. below the existing pavement surface, then the Service Limit State bearing pressure is 7 ksf. The recommended maximum bearing pressures, based on LRFD criteria, are as follows:

- Strength Limit State: 15.9 ksf
- Strength Limit State Factored (0.45 Resistance Factor): 7.2 ksf
- Service Limit State: 7.0 ksf which is a gross value, which means that the total dead and live loads plus the foundation weight should be included in the bearing pressure. The recommended bearing pressure can be increased by one-third when considering transient loads such as seismic forces.

The design of the footing foundations bearing at this level should be in accordance with the recommendations provided above.

Also, as indicated for the footing bearing at a depth of 8 ft., construction of a footing at this depth will most likely require continuous steel sheeting excavation support system and groundwater pumping in order to construct the footing in-the-dry.

4.3.2 Bridge Abutment Foundation

As previously discussed, the loading on the existing bridge abutments will be less with the proposed bridge renovations. Therefore, the existing bridge abutments should perform as they have in the past and no foundation renovations are required.

However, we understand that the existing bridge abutments will be evaluated for structural adequacy using the AASHTO LRFD Bridge Design Specifications, Interim 2008 (LRFD Specifications). In particular, the existing bridge abutments will be checked by Greenhorne & O'Mara for resistance to failure due to sliding, overturning, and bearing. The moment and shear forces in the stem and heel will also be checked.

The resistance to sliding should be investigated using Article 11.6.3.6 of the LRFD Specifications. The load combinations and load factors should be as specified in Article 3.4.1. A typical application of the load factors for sliding for the loads from the soil and the water has been provided in Figure C11.5.5-2 and Figure C11.5.5-3 of the LRFD Specifications. The recommended coefficients of lateral earth pressure are:

At-Rest Lateral Earth Pressure Coefficient, k_o	0.5
Active Lateral Earth Pressure Coefficient, k_a	0.30
Passive Lateral Earth Pressure Coefficient, k_p	3.0

The recommended value for the effective angle of internal friction, Φ_f', for the bearing soil and the existing backfill soil is 30 degrees and the value for the friction angle for dissimilar materials, δ, is 17 degrees. The recommended design ground water level for sliding should be the midpoint of the wall drainage pipe. The recommended resistance factor for shear resistance between the soil and the foundation, φ_τ, is 0.80. The recommended resistance factor for the passive resistance, φ_{ep}, is 0.50.

The bearing resistance should be investigated using Article 11.6.3.2. The resultant of the vertical forces and the eccentricity of the resultant should be determined using Figure 11.6.3.2-1 of the LRFD Specifications. A typical application of the load factors for bearing resistance for the loads from the soil and the water has been provided in Figure C11.5.5-1 and Figure C11.5.5-3 of the LRFD Specifications. The recommended lateral earth pressure coefficients, the effective angle of internal friction, and the friction angle for dissimilar materials are as provided above for sliding. The minimum factored bearing resistance, q_R, using the minimum effective bearing area that satisfies the overturning requirements (Article 11.6.3.3) is 4.0 ksf. The overturning should be investigated using Article 11.6.3.3 for foundations on soil.

4.3.3 Settlement beneath Abutments and Bridge Pier

Settlement considerations, rather than bearing capacity, generally control foundation selection and design. It is our opinion that for the recommended maximum allowable bearing pressures indicated above, the Center Pier spread footing should experience a maximum settlement of 0.5 inch. Due to the granular nature of the bearing soils, this settlement will be an elastic settlement and will occur during the construction. The long term settlement after construction is complete should be negligible.

Differential settlements are generally caused by variations in soil profile, including layer thickness, compressibility characteristics, applied load, bearing pressure and foundation dimension, and foundation stiffness.

Although soil profile within the area investigated at the foundation level is relatively uniform, differential settlement should still be anticipated. Based on our analysis, differential settlement is expected to be on the order of 0.25 inch along the length of the Center Pier spread footing. In addition, the differential settlement between the Center Pier and the abutments are anticipated to be on the order of 0.5 inches.

4.4 Pavement Design Recommendations

The on-site materials at the subgrade level of the service roads adjacent to the east and west sides of Kenilworth Avenue are considered slightly to moderately frost-susceptible. Consequently, there is some risk that paved areas could experience minor frost heaving and vertical misalignment where they are directly underlain by these soils within the depth of frost penetration. To avoid risk of any frost-induced heaving, a full-depth (30 inch frost depth potential) non-frost susceptible pavement section would be required which is not commonly provided in this area.

The pavement recommendations provided below assume some risk of such misalignment is tolerable, as is normal local practice. Recommendations for bituminous pavement sections for auto traffic and truck traffic are provided below based upon AASHTO design guidelines:

- Design California Bearing Ratio (CBR) – 30 percent*
- Design Life – 30 years
- Initial Serviceability – 5.0
- Terminal Serviceability – 2.5
- Reliability – 90 percent
- Asphalt Structural Coefficient – 0.44
- Base Course (Dense Graded Aggregate) Structural Coefficient – 0.14
- Drainage Coefficient, Asphalt – 1.1 (assumes good drainage)
- Drainage Coefficient, Base Course – 1.1 (assumes good drainage)
- 18 kip ESAL – 20,800,600 (assumes ADT = 10,000 with 7 percent trucks)

* Laboratory testing indicates a CBR of 51 percent to 60 percent. The design CBR has been reduced to 30 percent due to the density of the underlying materials which may cause the compacted soils to loosen over time.

Flexible Pavement

- **Option 1**

  Pavement: 4 in. thickness (1.5 in. wear course, 2.5 in. binder course)
  Base: 16 in. compacted thickness Dense Graded Aggregate (AASHTO M147)

- **Option 2**

  Pavement: 4.5 in. thickness (1.5 in. wear course, 3.0 in. binder course)
  Base: 12 in. compacted thickness Dense Graded Aggregate (AASHTO M147)

The pavement recommendations assume that a stable, firm subgrade is achieved beneath the base and subbase courses, and that the subgrades are prepared as recommended in Section 5.4 of this report.

Base and subbase materials should be placed and compacted in lifts to at least 95 percent of the maximum dry density as determined by ASTM D1557. Recommended procedures and equipment for compaction are provided in Section 5.4.

5. CONSTRUCTION CONSIDERATIONS

5.1 General

The primary purpose of this section of the report is to comment on items related to excavation, dewatering, lateral support, foundation construction earthwork and other geotechnical aspects of the proposed construction. This section is written primarily for the engineer having responsibility for the preparation of drawings and specifications. Since it identifies potential problems related to foundation construction and earthwork, it will also aid personnel who monitor construction activity. Prospective contractors for this project must evaluate construction problems on the basis of the Contractor's knowledge and experience in the area, taking into account proposed construction methods.

5.2 Temporary Excavation Support

It is anticipated that, in general, temporary excavations for bridge Center Pier construction could be as deep as 6.0 to 10 ft. Due to the proximity of the existing roadway and utilities, open-cut slopes are not practical nor are they recommended.

As indicated above, groundwater was encountered at a depth of approximately 5 ft. below the roadway surface in boring B9. Therefore excavations that extend below a depth of 5 ft. will need to consider groundwater control. For excavations up to 6 ft. deep, the sides of the excavations could be supported with soldier piles and lagging adequately supported with cross-lot and corner braces. However, some dewatering will be required to control water in-flow so that the footing excavation can be made in-the-dry.

For excavations deeper than 6 ft., it is recommended that the excavation support system consist of continuous steel sheeting in order to more effectively control the groundwater. The steel sheeting should be supported with cross-lot and corner braces.

The contractor should be responsible for the design, installation, operation and removal of an appropriate lateral support system in accordance with all OSHA or other applicable regulatory agency requirements.

5.3 Dewatering

As discussed above, excavations greater than 5 ft. deep for the Center Pier construction will most likely encounter groundwater. In addition, inflow from surface runoff and infiltration from other sources should be anticipated. If the excavation support systems are designed as indicated in the above paragraph, it is expected that excavation dewatering may be accomplished by open pumping from properly design and filtered sumps and trenches located in the bottoms of excavations. However, the contractor should be responsible for the design, installation, operation and removal of an appropriate excavation dewatering system.

5.4 Structural Fill

Structural backfill where required should consist of clean, sandy gravel, gravelly sand, or sand and gravel mixture, free of organic material, snow, ice, frozen soil, or other objectionable materials. The structural fill should be a well-graded granular material with a

maximum particle size of 3 inches, less than 15 percent passing the No. 200 sieve, and with a plasticity index of 20 or less.

The roadway base course material should consist of crushed stone having strong, hard, durable particles and conform to the applicable requirements of AASHTO M147.

The contractor should submit all soil materials proposed for use at least two weeks before field use to allow completion of laboratory testing prior to material placement.

To evaluate the suitability and the quality of the fill source, we recommend that the laboratory testing program presented below be performed in accordance with the indicated ASTM Test Methods.

RECOMMENDED LABORATORY TESTING PROGRAM

Test	ASTM Designation
Moisture Content	D2216
Standard Proctor	D 698
Sieve Analysis	D422
Atterberg Limits	D4318

All backfill and roadway base course materials should be placed in horizontal lifts not exceeding 8 inches in loose lift thickness. Each lift should be compacted to at least 95 percent of the maximum dry density and within 2 percentage points of the optimum moisture content; both as determined in the laboratory by ASTM D1557 test method. In confined areas where manually-guided equipment must be used, such as backfill in small excavations or around foundations, the maximum loose lift thickness should be 4 inches.

5.5 Construction Monitoring

The foundation recommendations contained herein are based on the predictable behavior of a properly engineered and constructed foundation system. Monitoring of the foundation installation is required to enable the geotechnical engineer to keep in contact with procedures and techniques used during construction. Therefore, it is recommended that a person qualified by experience and training be present to provide full-time monitoring at the site during the following earthwork and foundation construction operations:

- Spread footing foundation construction;
- Placement and compaction of roadway base course;
- Placement of compacted fill adjacent to the completed foundations.

6. LIMITATIONS

This Report was prepared pursuant to an Agreement dated 20 June 2006 between Greenhorne & O'Mara, Inc. and Haley & Aldrich. All uses of this Report are subject to, and deemed acceptance of, the conditions and restrictions contained in the Agreement. The observations and conclusions described in this Report are based solely on the Scope of Services provided pursuant to the Agreement. Haley & Aldrich has not performed any additional observations, investigations, studies or other testing not specified in the Agreement. Haley & Aldrich shall not be liable for the existence of any condition the discovery of which would have required the performance of services not authorized under the Agreement.

This Report is prepared for the exclusive use of Greenhorne & O'Mara, Inc in connection with foundation evaluation of the proposed structures. There are no intended beneficiaries other than Greenhorne & O'Mara, Inc. Haley & Aldrich shall owe no duty whatsoever to any other person or entity on account of the Agreement or the Report. Use of this Report by any person or entity other than Greenhorne & O'Mara, Inc for any purpose whatsoever is expressly forbidden unless such other person or entity obtains written authorization from Greenhorne & O'Mara, Inc and from Haley & Aldrich. Use of this Report by such other person or entity without the written authorization of Greenhorne & O'Mara, Inc and Haley & Aldrich shall be at such other person's or entity's sole risk, and shall be without legal exposure or liability to Haley & Aldrich.

Use of this Report by any person or entity, including by Greenhorne & O'Mara, Inc, for a purpose other than for foundation evaluation of the proposed structures is expressly prohibited unless such person or entity obtains written authorization from Haley & Aldrich indicating that the Report is adequate for such other use. Use of this Report by any person or entity for such other purpose without written authorization by Haley & Aldrich shall be at such person's or entity's sole risk and shall be without legal exposure or liability to Haley & Aldrich.

This report reflects site conditions observed and described by records available to Haley & Aldrich as of the date of report preparation. The passage of time may result in significant changes in site conditions, technology, or economic conditions which could alter the findings and/or recommendations of the report. Accordingly, Greenhorne & O'Mara and any other party to whom the report is provided recognize and agree that Haley & Aldrich shall bear no liability for deviations from observed conditions or available records after the time of report preparation.

Use of this Report by any person or entity in violation of the restrictions expressed in this Report shall be deemed and accepted by the user as conclusive evidence that such use and the reliance placed on this Report, or any portions thereof, is unreasonable, and that the user accepts full and exclusive responsibility and liability for any losses, damages or other liability which may result.

7. REFERENCES

1. Darton, N.H. Configuration of the Bedrock Surface of the District of Columbia and Vicinity. Geological Survey Professional Paper 217, 1950.

2. Obermeier, Stephen F. and Reed, John C. Jr. "The Geology beneath Washington D.C.- The Foundations of a Nation's Capital". Geological Hydrology and History of the Washington D.C. Area, pp. 27-50, 1989.

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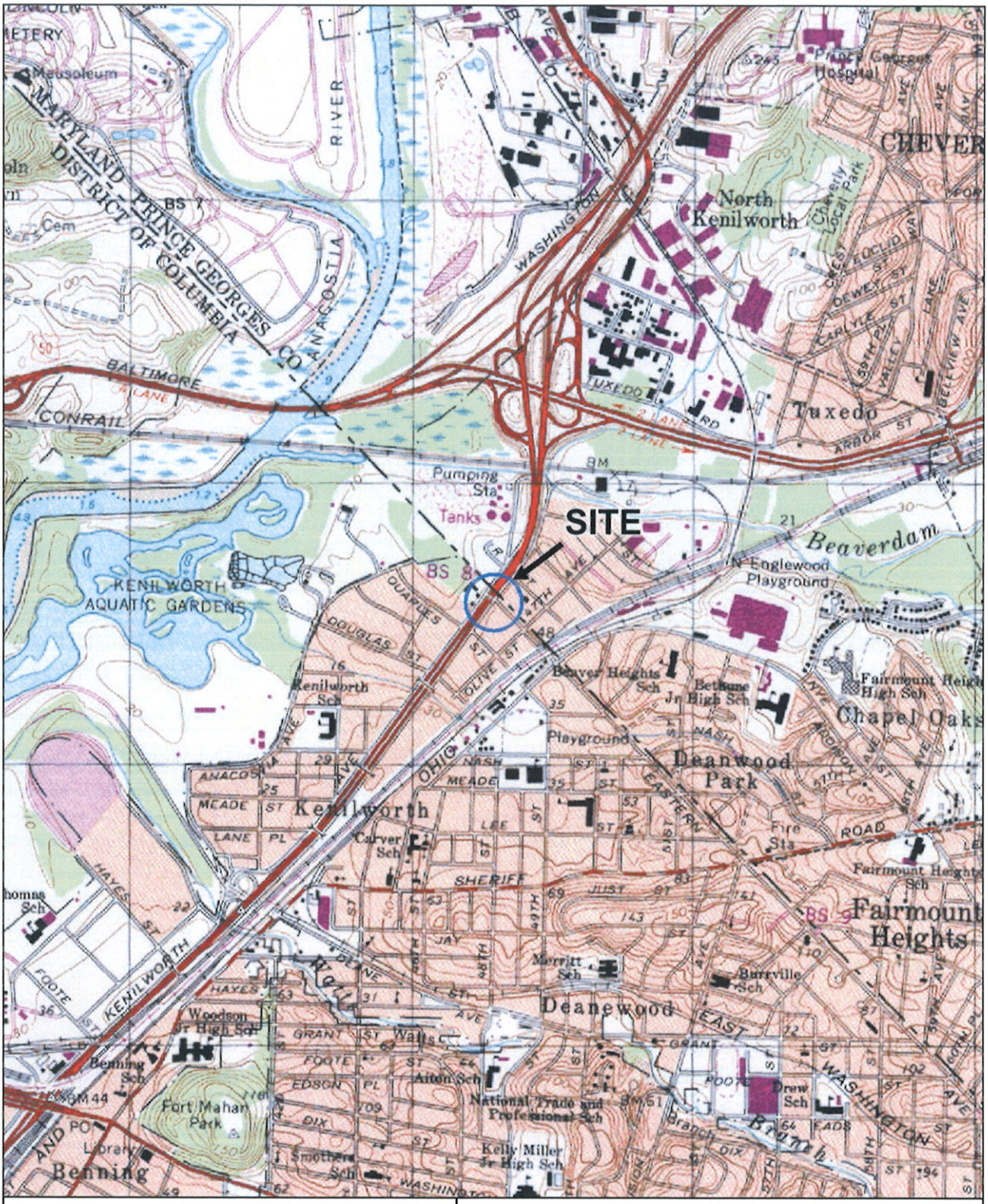

SITE COORDINATES:38°54'43"N 76°56'2"W

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W E
S

U.S.G.S. QUADRANGLE: WASHINGTON EAST, DC

HALEY & ALDRICH

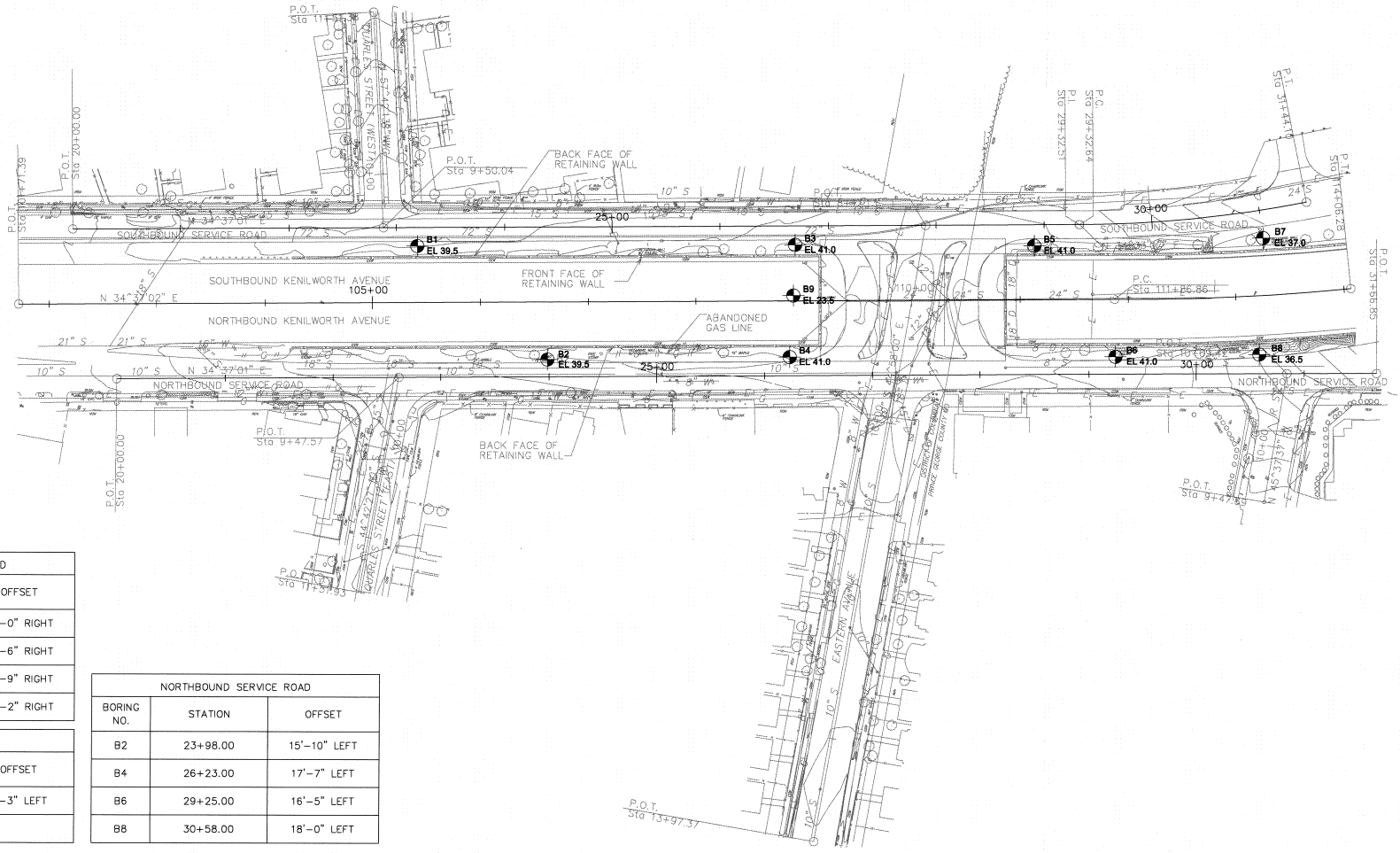
EASTERN AVENUE OVER KENILWORTH AVENUE
WASHINGTON, DISTRICT OF COLUMBIA

PROJECT LOCUS

SCALE: 1:24,000
JANUARY 2007

FIGURE 1

33261 1.PDF



SOUTHBOUND SERVICE ROAD		
BORING NO.	STATION	OFFSET
B1	23+18.00	17'–0" RIGHT
B3	26+69.00	17'–6" RIGHT
B5	28+91.00	19'–9" RIGHT
B7	31+00.00	26'–2" RIGHT

KENILWORTH AVENUE		
BORING NO.	STATION	OFFSET
B9	108+90.00	5'–3" LEFT

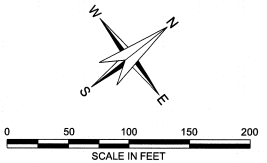
NORTHBOUND SERVICE ROAD		
BORING NO.	STATION	OFFSET
B2	23+98.00	15'–10" LEFT
B4	26+23.00	17'–7" LEFT
B6	29+25.00	16'–5" LEFT
B8	30+58.00	18'–0" LEFT

LEGEND

B2 EL 39.5 — APPROXIMATE LOCATION, DESIGNATION, AND GROUND SURFACE ELEVATION OF TEST BORINGS PERFORMED BY GEOSERVICE CORP. OF FORESTVILLE, MD BETWEEN 14 AND 16 AUGUST 2008.

NOTES:

1. BASEMAP BASED ON DRAWING ENTITLED "BORING LOCATION PLAN" DATED 12 AUGUST 2008 BY GREENHORNE & O'MARA, INC. OF LAUREL, MARYLAND.
2. LOCATIONS OF SUBSURFACE EXPLORATIONS WERE DETERMINED BY TAPING MEASUREMENTS FROM EXISTING SITE STRUCTURES AND FEATURES. GROUND SURFACE ELEVATIONS WERE INTERPOLATED FROM EXISTING GROUND SURFACE INFORMATION.
3. ELEVATIONS SHOWN ARE BASED ON NAVD 1988 VERTICAL DATUM.



HALEY & ALDRICH

REHABILITATION OF EASTERN AVENUE BRIDGE OVER KENILWORTH AVENUE (ROUTE 295)

EXPLORATION LOCATION PLAN

SCALE: AS SHOWN
OCTOBER 2008

FIGURE 2

G:\33261-000 EAST AVE BRIDGE\GLOBAL\CAD\33261-000-0D02-ELP.DWG

APPENDIX A

Logs of Recent Test Borings

HALEY & ALDRICH

TEST BORING REPORT

Boring No. B1

Project Eastern Ave. & Kenilworth Ave. Bridge Washington, DC/Prince George County, MD
Client Greehorne & O'Mara
Contractor GeoService Corp.

File No. 33261-000
Sheet No. 1 of 1
Start August 14, 2008
Finish August 14, 2008
Driller S. Gonzales
H&A Rep. M. Tschibelu
Elevation 39.5
Datum NAVD 1988
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	--	Rig Make & Model: CME 55
Inside Diameter (in.)	3 1/4	1 3/8	--	Bit Type: Cutting Head
Hammer Weight (lb)	--	140	-	Drill Mud: None
Hammer Fall (in.)	--	30	-	Casing: HSA Spun to 10'
				Hoist/Hammer: Winch Safety Hammer
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	5 8 13 14	S1 18	0.0		ML	Medium dense light brown poorly graded fine SAND, some silt, trace gravel (SM), mps 10mm, trace root fragments, no odor, dry	10	15			15	60				
	11 7 5 6	S2 19	2.5	37.5 2.0	SP	Medium dense brown poorly-graded fine to medium SAND, trace silt, trace gravel (SP), mps 25 mm, no odor, dry.	20				70	10				
5	3 2 1 2	S3 20	5.0		SP	Very loose brown poorly-graded fine to medium SAND (SP), mps 4 mm, trace fine gravel, trace silt, no odor, dry.		5			85	10				
	2 1/9 1/9	S4 21	7.5		SP	Same as above, except no gravel and lenses of silt.					85	15				
10	1 2 3 3	S5 20	10.0		SP	Very loose orange-brown poorly-graded fine to medium SAND, trace gravel, trace silt (SP), mps 8 mm, no odor, dry.		15			75	10				
				27.5 12.0		-BOTTOM OF EXPLORATION 12.0 FT.-										
						Note: No water encountered.										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O Open End Rod
T Thin Wall Tube
U Undisturbed Sample
S Split Spoon Sample
G Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 12
Rock Cored (ft) --
Samples 5S

Boring No. B1

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-07 HA-LIB07.GLB HA-TB+CORE+WELL-07.GDT \\WAS\COMMON\PROJECTS\33261_G_AND_O\000\GINT\2008-0818-HAI-GINT LOGS.GPJ Oct 10, 08

HALEY & ALDRICH

TEST BORING REPORT

Boring No. B2

Project Eastern Ave. & Kenilworth Ave. Bridge Washington, DC/Prince George County, MD
Client Greehorne & O'Mara
Contractor GeoService Corp.

File No. 33261-000
Sheet No. 1 of 1
Start August 15, 2008
Finish August 15, 2008
Driller J. Boyce
H&A Rep. M. Tschibelu
Elevation 39.5
Datum NAVD 1988
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	--	Rig Make & Model: CME
Inside Diameter (in.)	2 1/4	1 3/8	--	Bit Type: Cutting Head
Hammer Weight (lb)	--	140	-	Drill Mud: None
Hammer Fall (in.)	--	30	-	Casing: HSA Spun to 10'
				Hoist/Hammer: Cat-Head Automatic Hammer
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	8 10 8 9	S1 20	0.0		SM	Medium dense light brown fine to medium SAND (SM), some silt, trace gravel, trace root fragments, mps 0.5 mm, poorly-graded, no odor, dry.					50	50				
	8 10 8 6	S2 15	2.0		SM	Medium dense brown to gray fine to medium SAND with gravel, trace clay and silt, (SP), mps 20 mm, distincly stratified, no odor, dry.	15	15		20	30	20				
5	6 7 6 8	S3 19	4.5		SM	Medium dense brown to gray fine to medium SAND, some silt, trace fine gravel (SM), mps 15 mm, no odor, moist.	5	15		20	30	30				
	5 5 6 7	S4 18	7.0		SM	Same as above, except mps 20 mm, moist.	10	15		30	30	25				
10	3 4 3 3	S5 18	9.5		SM	Loose brown fine SAND (SM), some silt, trace gravel, mps 15mm, no odor, moist.	5			10	50	35				
				28.0 11.5		BOTTOM OF EXPLORATION 11.5 FT. Note: No water encountered.										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O Open End Rod
T Thin Wall Tube
U Undisturbed Sample
S Split Spoon Sample
G Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 11.5
Rock Cored (ft) --
Samples 5S

Boring No. B2

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY & ALDRICH

TEST BORING REPORT

Boring No. B3

Project Eastern Ave. & Kenilworth Ave. Bridge Washington, DC/Prince George County, MD
Client Greehorne & O'Mara
Contractor GeoService Corp.

File No. 33261-000
Sheet No. 1 of 2
Start August 14, 2008
Finish August 14, 2008
Driller J. Boyce
H&A Rep. M. Tschibelu
Elevation 41.0
Datum NAVD 1988
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	--	Rig Make & Model: CME
Inside Diameter (in.)	2 1/4	1 3/8	--	Bit Type: Cutting Head
Hammer Weight (lb)	--	140	-	Drill Mud: None
Hammer Fall (in.)	--	30	-	Casing: HSA Spun to 40'
				Hoist/Hammer: Cat-Head Automatic Hammer
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	3 3 3 4	S1 14	0.0		SM	Loose brown silty fine SAND with fine to coarse gravel (SM), mps 35 mm, no odor, dry.	15	15			40	30				
	4 3 3 4	S2 12	2.0	39.0 2.0	SP-SM	Loose brown poorly-graded silty fine to medium SAND (SP-SM), trace fine gravel, mps 5 mm, no odor, moist.		5		15	50	30				
				37.0												
5	4 4 3 8	S3 20	4.5	4.0	SW-SM	Loose orange-brown well-graded fine to medium SAND with gravel (SW-SM), some silt, mps 5 mm, no odor, moist.		10		15	50	25				
	8 7 8 10	S4 20	7.0		SW-SM	Medium dense brown well-graded SAND with gravel (SW-SM), some silt, mps 12 mm, no odor, moist.		10		15	50	25				
				32.0												
10	6 8 8 8	S5 20	9.5	9.0	SM	Medium dense orange-brown well-graded fine to medium SAND, some silt (SM), mps 1 mm, no odor, moist.				10	60	30				
	4 6 6 6	S6 21	12.0		SM	Same as above				10	60	30				
15	2 6 6 9	S7 20	14.5		SM	Medium dense gray-brown well-graded fine to medium SAND, some silt (SM), mps 1 mm, no odor, moist.				10	60	30				
						Note: Running sand encountered at 19.5 ft. The drillers added drilling water into the hole.										
				24.5 16.5												

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
8/14/2008	12:05	--	19.5	20.5	19.5
8/14/2008	12:55	--	38.5	40.5	13.8

Sample ID

O	Open End Rod
T	Thin Wall Tube
U	Undisturbed Sample
S	Split Spoon Sample
G	Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	40.5
Rock Cored (ft)	--
Samples	12S

Boring No. B3

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY & ALDRICH

TEST BORING REPORT

Boring No. B3
File No. 33261-000
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	3 3	S8A 10	19.5		ML	Stiff gray fine sandy SILT, some clay (ML), mps 0.5 mm, no odor, wet.					15	85				
	6 5	S8B 9	20.5	20.5 20.5	ML	Stiff orange-brown fine sandy SILT, trace clay lenses (ML), mps 0.5 mm, no odor, wet.					30	70				
				19.5 21.5												
25	6 6	S9A 10	24.5		SM	Medium dense red-brown silty SAND, trace clay lenses (SM), mps 0.5 mm, no odor, wet.					45	55				
	7 7	S9B 9	25.5	15.5 25.5	SM	Medium dense brown silty SAND (SM), trace fine gravel, mps 0.5 mm, no odor, wet.		5			40	55				
				14.5 26.5												
30	6 12 13 12	S10 18	29.5		SM	Medium dense dark gray silty SAND (SM), mps 1 mm, wet.				10	60	30				
				9.5 31.5												
35	12 13 11 12	S11 20	34.5		SW	Medium dense brown well-graded SAND with gravel (SW), trace silt, mps 12 mm, wet.	5	15		20	40	20				
				4.5 36.5												
40	10 12 14 14	S12 9	38.5		GW	Medium dense tan well-graded GRAVEL with fine to coarse sand (GW), mps 30 mm, wet.	20	35	10	30	10					
				0.5 40.5		BOTTOM OF EXPLORATION 40.5 FT.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. B3

HALEY & ALDRICH

TEST BORING REPORT

Boring No. B4

Project Eastern Ave. & Kenilworth Ave. Bridge Washington, DC/Prince George County, MD
Client Greehorne & O'Mara
Contractor GeoService Corp.

File No. 33261-000
Sheet No. 1 of 2
Start August 15, 2008
Finish August 15, 2008
Driller J. Boyce
H&A Rep. M. Tschibelu
Elevation 41.0
Datum NAVD 1988
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	--	Rig Make & Model: CME
Inside Diameter (in.)	2 1/4	1 3/8	--	Bit Type: Cutting Head
Hammer Weight (lb)	--	140	-	Drill Mud: None
Hammer Fall (in.)	--	30	-	Casing: HSA Spun to 40'
				Hoist/Hammer: Cat-Head Automatic Hammer
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	4 4 6 6	S1 18	0.0		SW-SM	Loose brown to gray-brown well-graded SAND, some fine gravel, some silt (SW-SM), mps 20 mm, no odor, dry.	15	10		15	20	40				
	6 6 4 3	S2 18	2.0	39.0 2.0	SW-SM	Loose brown to gray-brown well-graded SAND, some fine gravel, some silt (SW-SM), mps 20 mm, no odor, dry.	5			15	50	30				
5	4 4 3 3	S3 18	4.5	37.0 4.0	SW-SC	Loose orange-brown fine SAND with lenses of clayey sand (SC), trace silt, mps 1 mm, no odor, moist.					50	50				
	3 3 3 3	S4 20	7.0	34.5 6.5	SP-SC	Loose orange-brown poorly graded fine SAND, some lenses of clayey sand (SP-SC), trace silt, mps 0.5 mm, no odor, moist.					45	55				
10	2 3 3 4	S5 19	9.5		SP-SC	Loose orange-brown poorly graded fine SAND, some lenses of clayey sand (SP-SC), some silt, mps 0.5 mm, no odor, moist.					45	55				
	3 3 5 6	S6 20	12.0		SP-SC	Loose orange-brown poorly graded fine SAND, some lenses of clayey sand (SP-SC), some silt, mps 0.5 mm, no odor, moist.					45	55				
15	4 3 3 5	S7 18	14.5	27.0 14.0	SP-SC	Loose orange-brown poorly graded fine SAND, some lenses of clayey sand (SP-SC), some silt, mps 0.5 mm, no odor, moist.					30	70				
					SC	Loose gray fine SAND, some clay, trace silt, mps 1mm, no odor, wet										
				24.5 16.5												

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
8/15/2008	11:40	--	39.6	41.6	27.1

Sample ID

O Open End Rod
T Thin Wall Tube
U Undisturbed Sample
S Split Spoon Sample
G Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 41.5
Rock Cored (ft) --
Samples 12S

Boring No. B4

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

*Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-07 HA-LIB07.GLB HA-TB+CORE+WELL-07.GDT \\WAS\COMMON\PROJECTS\33261_G_AND_O\000\GINT\2008-0818-HAI-GINIT LOGS.GPJ Oct 10, 08

HALEY & ALDRICH

TEST BORING REPORT

Boring No. B4
File No. 33261-000
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	5 6 5 6	S8 16	19.5		SM	Medium dense orange-brown silty fine to medium SAND (SM), poorly-graded, mps 1 mm, no odor, wet.					40	60				
25	4 4 4 6	S9 21	24.5		SM	Loose gray-brown silty fine SAND (SM), poorly-graded, mps 1 mm, no odor, wet.					45	55				
				14.5 26.5												
30	WOH 9 14 14	S10 18	29.5		SP-SM	Medium dense poorly-graded medium to fine SAND with silt (SP-SM), mps 1 mm, no odor, wet.				10	50	40				
35	3 7 13 18	S11 19	34.5		SM	Medium dense dark gray-brown poorly-graded silty fine SAND (SM), interbedded with clay lenses, mps 0.5 mm, no odor, wet.					50	50				
				4.5 36.5												
40	8 13 17 18	S12 9	39.5		SW	Medium dense orange-brown well-graded fine to coarse SAND with gravel, mps 20 mm, no odor, wet.	10	15	10	20	40	5				
				-0.5 41.5		BOTTOM OF EXPLORATION 41.5 FT.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. B4

HALEY & ALDRICH

TEST BORING REPORT

Boring No. B5

Project Eastern Ave. & Kenilworth Ave. Bridge Washington, DC/Prince George County, MD
Client Greehorne & O'Mara
Contractor GeoService Corp.

File No. 33261-000
Sheet No. 1 of 2
Start August 14, 2008
Finish August 14, 2008
Driller S. Gonzales
H&A Rep. M. Tschibelu
Elevation 41.0
Datum NAVD 1988
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	--	Rig Make & Model: CME 55
Inside Diameter (in.)	3 1/4	1 3/8	--	Bit Type: Cutting Head
Hammer Weight (lb)	--	140	-	Drill Mud: None
Hammer Fall (in.)	--	30	-	Casing: HSA Spun to 40'
				Hoist/Hammer: Winch Safety Hammer
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	6 12 11 9	S1 22	0.0		SM	Medium dense light brown fine ro medium SAND, some silt, some gravel (SM), mps 20 mm, organic soil odor, dry.	15	10			40	35				
				39.0 2.0												
	8 8 7 7	S2 20	2.5		SW-SM	Medium dense brown well-graded fine to medium SAND, some fine gravel (SW-SM), trace silt, mps 5 mm, no odor, moist.		15		20	35	30				
5	6 7 8 12	S3 19	5.0		SW-SM	Same as above, except trace fine to medium gravel.	5	10		10	45	30				
	5 8 8 9	S4 21	7.5		SW-SM	Same as above	5	10		10	45	30				
				31.5 9.5												
10	7 7 9 10	S5 20	10.0		SP-SM	Medium dense brown poorly-graded fine SAND (SP-SM), trace silt, trace fine gravel, mps 8 mm, no odor, moist.		10		15	45	30				
	7 4 3 2	S6 19	12.5		SP-SM	Loose brown poorly-graded fine SAND (SP-SM), trace silt, mps 1 mm, no odor, moist.				10	55	35				
15	2 1	S7A 8	15.0		SP-SM	Very loose brown poorly-graded fine to medium SAND, some silt (SP-SM), mps 0.5 mm, no odor, moist.				5	60	35				
	1 2	S7B 7	16.0	25.0 16.0	SP-SM	Very loose brown poorly-graded fine to coarse SAND with fine gravel, some silt (SP-SM), mps 5 mm, no odor, moist.		5		10	50	35				
				24.0 17.0												
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
8/14/2008	11:35	--	25.0	27.0	26
8/14/2008	12:15	--	40.0	42.0	26.5

Sample ID

O Open End Rod
T Thin Wall Tube
U Undisturbed Sample
S Split Spoon Sample
G Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 42
Rock Cored (ft) --
Samples 12S

Boring No. B5

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY & ALDRICH

TEST BORING REPORT

Boring No. B5
File No. 33261-000
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	1 3 4 5	S8 21	20.0		CL	Medium stiff gray lean CLAY (CL), mps 0.1 mm, no odor, moist.					5	95				
				19.0 22.0												
25	5 6 6 5	S9 19	25.0		SP	Medium dense brown poorly-graded fine to medium SAND (SP), some silt, mps 0.2 mm, no odor, wet. Note: Running sand encountered at 30 ft. The drillers added drilling water into the hole.				10	70	20				
30	4 4 5 6	S10 14	30.0		SP	Loose brown poorly-graded fine to medium SAND (SP), trace silt, mps 0.1 mm, no odor, wet.					80	20				
				9.0 32.0												
35	9 14 12 14	S11 12	35.0		SW	Medium dense brown well-graded fine to coarse SAND with fine gravel (SW), mps 15 mm, no odor, wet.	5	10		15	55	15				
				4.0 37.0												
40	5 5	S12A 8	40.0		GW	Loose light brown well-graded fine to coarse GRAVEL, some fine to medium sand (GW), mps 20 mm, no odor, wet.	20	35		15	25	5				
	5 2	S12B 7	41.0	0.0 41.0	SP-SC	Loose gray poorly-graded fine to medium SAND, some to trace clay (SP-SC), trace fine gravel, mps 0.3 mm, no odor, wet.		5			10	85				
				-1.0 42.0		BOTTOM OF EXPLORATION 42.0 FT.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. B5

HALEY & ALDRICH

TEST BORING REPORT

Boring No. B6

Project Eastern Ave. & Kenilworth Ave. Bridge Washington, DC/Prince George County, MD
Client Greehorne & O'Mara
Contractor GeoService Corp.

File No. 33261-000
Sheet No. 1 of 2
Start August 15, 2008
Finish August 15, 2008
Driller S. Gonzales
H&A Rep. M. Tschibelu
Elevation 41.0
Datum NAVD 1988
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	--	Rig Make & Model: CME 55
Inside Diameter (in.)	3 1/4	1 3/8	--	Bit Type: Cutting Head
Hammer Weight (lb)	--	140	-	Drill Mud: None
Hammer Fall (in.)	--	30	-	Casing: HSA Spun to 40'
				Hoist/Hammer: Winch Safety Hammer
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	3 9 15 17	S1 18	0.0		SW-SM	Medium dense light brown well-graded fine SAND with silt and gravel (SW-SM), mps 20 mm, no odor, dry.	15	15			30	40				
	8 10 8 8	S2 20	2.5	39.0 2.0	SP-SM	Medium dense brown poorly-graded fine to medium SAND, some silt (SP-SM), trace fine gravel, mps 10 mm, no odor, moist.		5		10	50	35				
5	8 9 9 8	S3 21	5.0	36.5 4.5	SM	Medium dense brown silty SAND (SM), trace fine gravel, mps 15 mm, no odor, moist.		5			50	45				
	6 5 5 7	S4 22	7.5	34.0 7.0	SM	Loose brown poorly-graded medium to fine SAND (SM), some silt, trace fine gravel and lenses of clay, mps 10 mm, no odor, moist.		5			45	50				
10	5 6 6 9	S5 23	10.0	31.5 9.5	SM	Medium dense brown silty SAND (SM), trace fine gravel, mps 13 mm, no odor, moist.		5			40	55				
	7 6 8 7	S6 22	12.5		SM	Medium dense brown silty SAND (SM), mps 1 mm, no odor, moist.					55	45				
15	7 8 9 8	S7 22	15.0		SM	Medium dense brown silty SAND (SM), trace fine gravel, no odor, moist.		5			45	50				
				24.0 17.0												
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
8/15/2008	11:05	--	35.0	37.0	28.9
8/15/2008	11:30	--	40.0	42.0	26.0

Sample ID

O Open End Rod
T Thin Wall Tube
U Undisturbed Sample
S Split Spoon Sample
G Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 42
Rock Cored (ft) --
Samples 12S

Boring No. B6

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

*Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY & ALDRICH

TEST BORING REPORT

Boring No. B6
File No. 33261-000
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	3 2 1 2	S8 23	20.0		SM	Loose gray silty fine to medium SAND, mps 1 mm, no odor, wet										
				20.0 21.0	CL	Soft gray fine sandy lean CLAY (CL), trace silt, mps 0.5 mm, petroleum odor, wet.					10	90				
				19.0 22.0												
25	7 10	S9A 13	25.0		SM	Medium dense gray to orange-brown silty fine to medium SAND (SM), mps 1 mm, wet.					70	30				
	14 15	S9B 10	26.0		SM	Medium dense orange-brown fine to medium SAND, some silt (SM), mps 1.5 mm, wet.				20	40	40				
				14.0 27.0												
30	5 6 7 7	S10 24	30.0		SM	Stiff gray-brown silty fine SAND, some clay, mps 0.5 mm, moist.					80	20				
35	20 12	S11A 11	35.0		CL	Very stiff brown sandy lean CLAY (CL), mps 20 mm, wet.	10	10			20	60				
	10 11	S11B 10	36.0	5.0 36.0	SW	Medium dense brown well-graded fine to coarse SAND (SW), some gravel, some silt, mps 20 mm, wet.	20	30		30	20					
				4.0 37.0												
40	13 16	S12A 9	40.0		GW	Dense tan-gray well-graded GRAVEL with sand (GW), mps 22 mm, wet.	20	35		35	10					
	18 11	S12B 8	41.0	0.0 41.0	CL	Hard tan-gray CLAY (CL), mps 25 mm, wet.	20	15		15	10	40				
				-1.0 42.0		Note: Lean CLAY at the bottom of the spoon. BOTTOM OF EXPLORATION 42.0 FT.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. B6

HALEY & ALDRICH

TEST BORING REPORT

Boring No. B7

Project Eastern Ave. & Kenilworth Ave. Bridge Washington, DC/Prince George County, MD
Client Greehorne & O'Mara
Contractor GeoService Corp.

File No. 33261-000
Sheet No. 1 of 1
Start August 14, 2008
Finish August 14, 2008
Driller J. Boyce
H&A Rep. M. Tschibelu
Elevation 37.0
Datum NAVD 1988
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	--	Rig Make & Model: CME
Inside Diameter (in.)	2 1/4	1 3/8	--	Bit Type: Cutting Head
Hammer Weight (lb)	--	140	-	Drill Mud: None
Hammer Fall (in.)	--	30	-	Casing: HSA Spun to 10'
				Hoist/Hammer: Cat-Head Automatic Hammer
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	2 3 5 6	S1 17	0.0		SM	Loose tan silty fine SAND with fine gravel (SM), trace root fragments, mps 0.5 mm, no odor, dry.		5			65	30				
	9 8 6 4	S2 13	2.0		SM	Medium dense orange-brown SAND with gravel, some silt (SM), mps 20 mm, distincly stratified, no odor, dry.	10	10			50	30				
5	3 3 2 4	S3 17	4.5		SM	Loose orange-brown SAND, some silt (SM), trace fine gravel, mps 5 mm, no odor, moist.		5		10	60	25				
	3 4 8 8	S4 18	7.0		SM	Medium dense tan-orange silty fine to medium SAND (SM), trace fine gravel, mps 5 mm, no odor, moist.		5			55	40				
10	5 5 6 7	S5 20	9.5	27.5 9.5	SM	Same as above, except no gravel.					55	45				
				25.5 11.5		BOTTOM OF EXPLORATION 11.5 FT.										
						Note: No water encountered.										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O Open End Rod
T Thin Wall Tube
U Undisturbed Sample
S Split Spoon Sample
G Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 11.5
Rock Cored (ft) --
Samples 5S

Boring No. B7

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

*Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY & ALDRICH

TEST BORING REPORT

Boring No. B8

Project Eastern Ave. & Kenilworth Ave. Bridge Washington, DC/Prince George County, MD
Client Greehorne & O'Mara
Contractor GeoService Corp.

File No. 33261-000
Sheet No. 1 of 1
Start August 15, 2008
Finish August 15, 2008
Driller S. Gonzales
H&A Rep. M. Tschibelu
Elevation 36.5
Datum NAVD 1988
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	--	Rig Make & Model: CME 55
Inside Diameter (in.)	3 1/4	1 3/8	--	Bit Type: Cutting Head
Hammer Weight (lb)	--	140	-	Drill Mud: None
Hammer Fall (in.)	--	30	-	Casing: HSA Spun to 10'
				Hoist/Hammer: Winch Safety Hammer
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	1 3 9 13	S1 14	0.0		SM	Medium dense light brown fine SAND, some silt (SM), trace gravel, mps 20 mm, no odor, dry.	15	10			25	50				
	6 8 6 7	S2 20	2.5		SM	Medium dense brown fine SAND, some silt (SM), trace fine gravel, mps 3 mm, no odor, dry.		5		5	50	40				
5	8 6 6 5	S3 21	5.0		SM	Same as above, except moist.		5		5	50	40				
	4 3 3 5	S4 19	7.5		SM	Loose brown poorly-graded fine to medium SAND, some silt (SM), trace gravel, mps 15 mm, no odor, moist.	5	5		15	35	40				
10	4 1 1 1	S5 21	10.0		SM	Very loose brown poorly-graded fine to medium SAND, some silt (SM), trace fine gravel, mps 5 mm, no odor, moist.		5		5	50	40				
				24.5 12.0		BOTTOM OF EXPLORATION 12.0 FT. Note: No water encountered.										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O Open End Rod
T Thin Wall Tube
U Undisturbed Sample
S Split Spoon Sample
G Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 12
Rock Cored (ft) --
Samples 5S

Boring No. B8

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HALEY & ALDRICH

TEST BORING REPORT

Boring No. B9

Project Eastern Ave. & Kenilworth Ave. Bridge Washington, DC/Prince George County, MD
Client Greehorne & O'Mara
Contractor GeoService Corp.

File No. 33261-000
Sheet No. 1 of 2
Start August 16, 2008
Finish August 16, 2008
Driller S. Gonzales
H&A Rep. M. Tschibelu
Elevation 23.5
Datum NAVD 1988
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	--	Rig Make & Model: CME 55
Inside Diameter (in.)	3 1/4	1 3/8	--	Bit Type: Cutting Head
Hammer Weight (lb)	--	140	-	Drill Mud: Bentonite
Hammer Fall (in.)	--	30	-	Casing: HSA Spun to 25'
				Hoist/Hammer: Winch Safety Hammer
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0			0.0			Note: I-295 S far left lane - top 3" asphalt and bottom 9" Concrete.										
	8 13 10 14	S1 15	1.0	22.5 1.0	SW	Medium dense orange brown well-graded fine to coarse SAND, some gravel, some silt, mps 20 mm, no odor, moist.										
				21.5 2.0	CL	Very stiff gray silty CLAY, some fine sand (CL), mps 20 mm, no odor, moist.	10	10		10	15	55				
	7 6 4 4	S2 20	3.0		CL	Stiff gray-brown sandy lean CLAY (CL), mps 0.5 mm, moist.				5	20	75				
5	2 4	S3A 10	5.0		CL	Stiff gray-brown sandy lean CLAY (CL), mps 0.5 mm, moist.				10	15	75				
	5 4	S3B 11	6.0	17.5 6.0	SM	Loose orange-brown silty fine SAND (SM), mps 1 mm, no odor, wet.				5	60	35				
	4 2 4 8	S4 17	7.5		SM	Loose light gray-brown silty fine SAND (SM), some lenses of medium to coarse sand, mps 1 mm, no odor, wet.					50	50				
10	6 7 5 6	S5 16	10.0	14.0 9.5	SP-SC	Medium dense gray poorly-graded fine to medium SAND, some lenses of clay (SP-SC), mps 1 mm, wet.					55	45				
	6 10 8 7	S6 18	12.5	11.5 12.0	SM	Medium dense gray-brown silty fine SAND (SM), trace clay lenses, mps 1 mm, wet.					50	50				
15	4 16 19 11	S7 20	15.0		SM	Dense dark red-brown silty SAND (SM), trace fine gravel, with clay lenses, mps 0.5 mm, light petroleum odor, wet.		3			52	45				
				6.5 17.0												
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
8/16/2008	11:05	--	7.5		6.6
8/15/2008	11:58	--	25.0	27.0	9.5
8/15/2008	12.20	--	--	15.1	5.3

Sample ID

O Open End Rod
T Thin Wall Tube
U Undisturbed Sample
S Split Spoon Sample
G Geoprobe

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 27
Rock Cored (ft) --
Samples 9S

Boring No. B9

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

***Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-07 HA-LIB07.GLB HA-TB+CORE+WELL-07.GDT \\WAS\COMMON\PROJECTS\33261_G_AND_O\000\GINT\2008-0818-HAI-GINIT LOGS.GPJ Oct 10, 08

HALEY & ALDRICH

TEST BORING REPORT

Boring No. B9
File No. 33261-000
Sheet No. 2 of 2

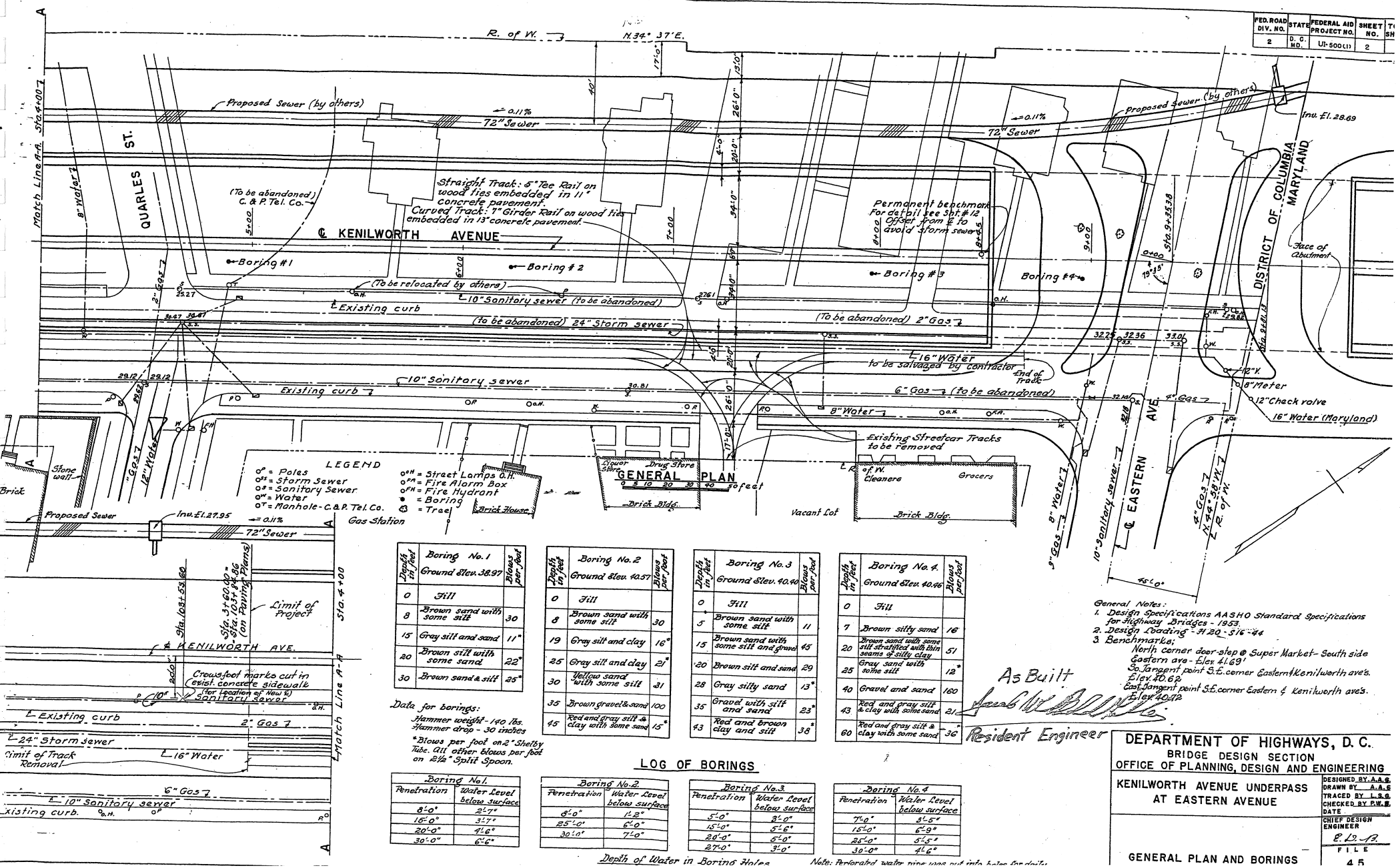
Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
20	3 8 14 11	S8 15	20.0		GW	Medium dense brown well-graded GRAVEL with fine to coarse sand (GW), mps 25 mm, no odor, wet.	15	20	15	15	30	5				
				1.5 22.0												
25	5 7 11 13	S9 24	25.0		CL	Very stiff gray-red mottled lean CLAY (CL), trace fine sand, mps 0.5 mm, no odor, wet.					10	90				
				-3.5 27.0		BOTTOM OF EXPLORATION 27.0 FT. Note: Drillers started using bentonite drilling mud at 7.5 ft.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. B9

APPENDIX B

Logs of Previous Test Borings



LEGEND

- ○P = Poles
- ○SS = Storm Sewer
- ○S = Sanitary Sewer
- ○W = Water
- ○T = Manhole - C. & P. Tel. Co.
- ○SL = Street Lamps O.H.
- ○FA = Fire Alarm Box
- ○FH = Fire Hydrant
- ● = Boring
- ⊛ = Tree

GENERAL PLAN

0 5 10 20 30 40 50 feet

Depth in feet	Boring No. 1 Ground Elev. 38.97	Blows per foot
0	Fill	
8	Brown sand with some silt	30
15	Gray silt and sand	11*
20	Brown silt with some sand	22*
30	Brown sand & silt	25*

Depth in feet	Boring No. 2 Ground Elev. 40.57	Blows per foot
0	Fill	
8	Brown sand with some silt	30
19	Gray silt and clay	16*
25	Gray silt and clay	21*
30	Yellow sand with some silt	31
35	Brown gravel & sand	100
45	Red and gray silt & clay with some sand	15*

Depth in feet	Boring No. 3 Ground Elev. 40.96	Blows per foot
0	Fill	
5	Brown sand with some silt	11
15	Brown sand with some silt and gravel	45
20	Brown silt and sand	29
28	Gray silty sand	13*
35	Gravel with silt and sand	23*
43	Red and brown clay and silt	38*

Depth in feet	Boring No. 4 Ground Elev. 40.46	Blows per foot
0	Fill	
7	Brown silty sand	16
20	Brown sand with some silt stratified with thin seams of silty clay	51
25	Gray sand with some silt	12*
40	Gravel and sand	160
43	Red and gray silt & clay with some sand	21
60	Red and gray silt & clay with some sand	36*

Data for borings:

Hammer weight - 140 lbs.
Hammer drop - 30 inches

*Blows per foot on 2" Shelby Tube. All other blows per foot on 2½" Split Spoon.

General Notes:

1. Design Specifications AASHO Standard Specifications for Highway Bridges - 1953.
2. Design Loading - H 20 - S16 - 44
3. Benchmarks:
   North corner door-step @ Super Market - South side Eastern ave - Elev. 41.69'
   So. Tangent point S.E. corner Eastern & Kenilwerth ave's. Elev. 40.62
   East Tangent point S.E. corner Eastern & Kenilworth ave's. Elev. 40.12

As Built

Resident Engineer

LOG OF BORINGS

Boring No. 1 Penetration	Water Level below surface
8'-0"	2'-7"
16'-0"	3'-7"
20'-0"	4'-6"
30'-0"	6'-6"

Boring No. 2 Penetration	Water Level below surface
8'-0"	1'-2"
25'-0"	6'-0"
30'-0"	7'-0"

Boring No. 3 Penetration	Water Level below surface
5'-0"	2'-0"
15'-0"	5'-6"
20'-0"	6'-0"
27'-0"	3'-0"

Boring No. 4 Penetration	Water Level below surface
7'-0"	3'-5"
15'-0"	6'-9"
25'-0"	5'-5"
30'-0"	4'-6"

Depth of Water in Boring Holes

Note: Perforated water pipe was put into holes for daily

FED. ROAD DIV. NO.	STATE	FEDERAL AID PROJECT NO.	SHEET NO.	TOTAL SHEETS
2	D. C. MD.	UI-500(1)	2	

DEPARTMENT OF HIGHWAYS, D. C.
BRIDGE DESIGN SECTION
OFFICE OF PLANNING, DESIGN AND ENGINEERING

KENILWORTH AVENUE UNDERPASS AT EASTERN AVENUE

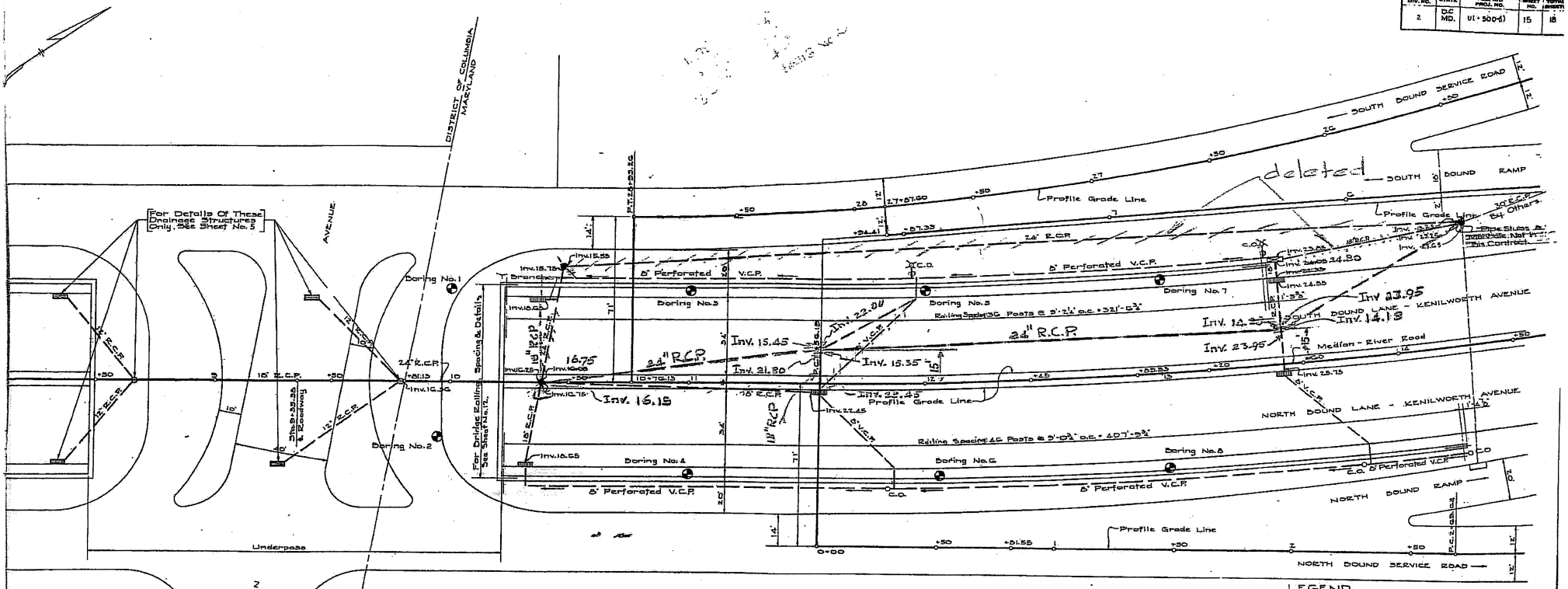
DESIGNED BY A.A.G.
DRAWN BY A.A.G.
TRACED BY L.S.G.
CHECKED BY P.W.B.
DATE

CHIEF DESIGN ENGINEER
E. D. R.

FILE
45

GENERAL PLAN AND BORINGS

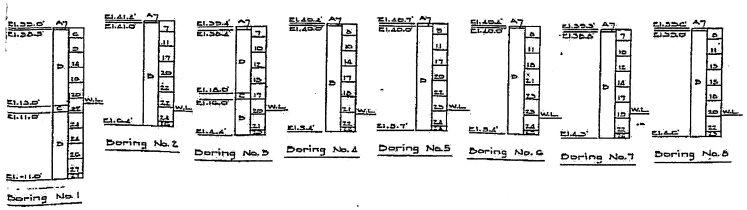
FED. ROAD DIV. NO.	STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
2	D.C. MD.	U(+500-1)	15	18



TEST BORING DATA

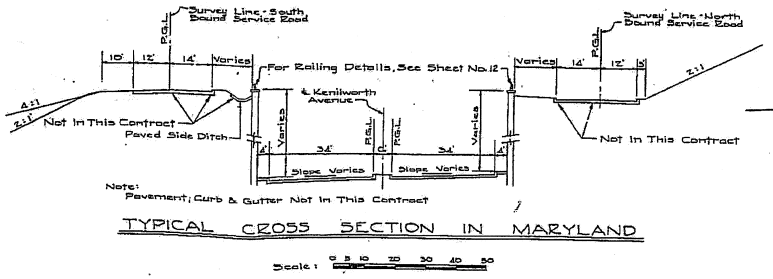
LEGEND

A – Top Soil, Highly Organic
B – Tan Sand, Fairly Well Graded And Sub-rounded
C – Kaolin Clay
W.L. – Water Level 24 Hours After Completion



PLAN

Scale: 1" = 10' 0 5 10 20 30 40 50



TYPICAL CROSS SECTION IN MARYLAND

Scale: 1" = 10' 0 5 10 20 30 40 50

LEGEND

- Md. SEC Special Type "H" Combination Inlet
- Md. SEC Standard Type "K" Inlet
- Md. SEC Standard Manhole
- Not In This Contract
- CO Cleanout

GENERAL NOTES

1.-Existing Topography Not Shown
2.-All Elevations Taken From D.C. Highway Department Level Datum.

As Built
Resident Engineer

RUMMEL, KLEPPER & KAHL
CONSULTING ENGINEERS
BALTIMORE, MARYLAND

REVISIONS

STATE OF MARYLAND
STATE ROADS COMMISSION
BALTIMORE, MD.

KENILWORTH AVENUE UNDERPASS AT EASTERN AVENUE GENERAL PLAN AND BORINGS

SCALE AS NOTED DATE DEC 1955 CONTRACT P 724-19-510

MADE BY G.L.W. APPROVED
TRACED BY G.L.W.
CHECKED BY C.R.V.
APPROVED 4/9/56
DEPUTY CHIEF ENGINEER
ASSISTANT CHIEF ENGINEER

SHEET NO. 15 OF 18

TEST BORING DATA

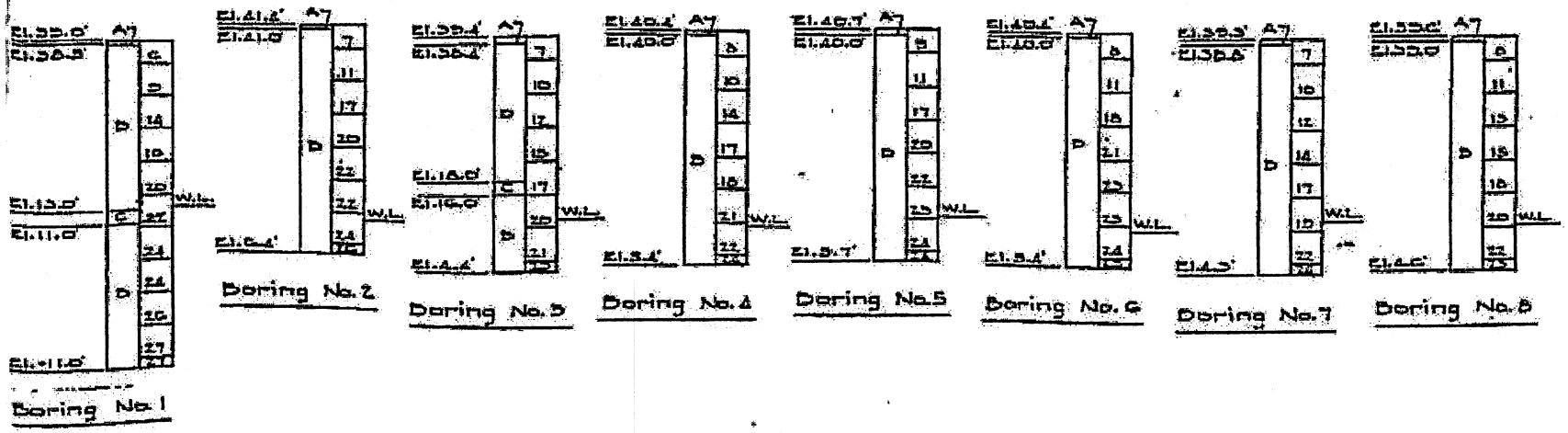
LEGEND

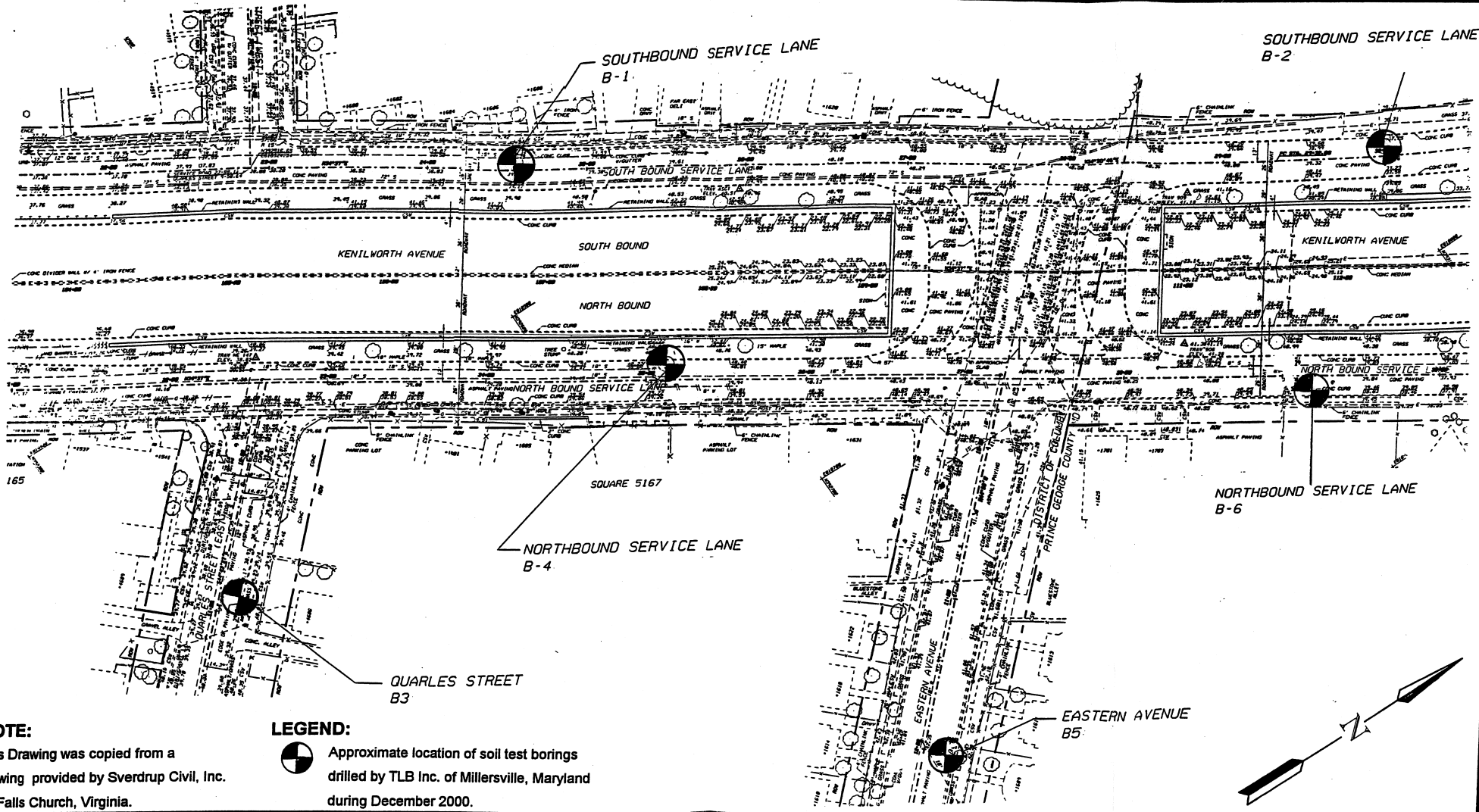
A -Top Soil, Highly Organic

B -Tan Sand, Fairly Well Graded And Sub-rounded

C -Kaolin Clay

W.L.-Water Level 24 Hours After Completion





NOTE:

This Drawing was copied from a drawing provided by Sverdrup Civil, Inc. of Falls Church, Virginia.

LEGEND:

Approximate location of soil test borings drilled by TLB Inc. of Millersville, Maryland during December 2000.

Thomas L. Brown Associates, P.C.

Consulting Engineers

EASTERN AVENUE BRIDGE OVER KENILWORTH AVENUE

NORTH EAST, WASHINGTON, DC

SITE EXPLORATION PLAN

DRAWING 99-048 - 2

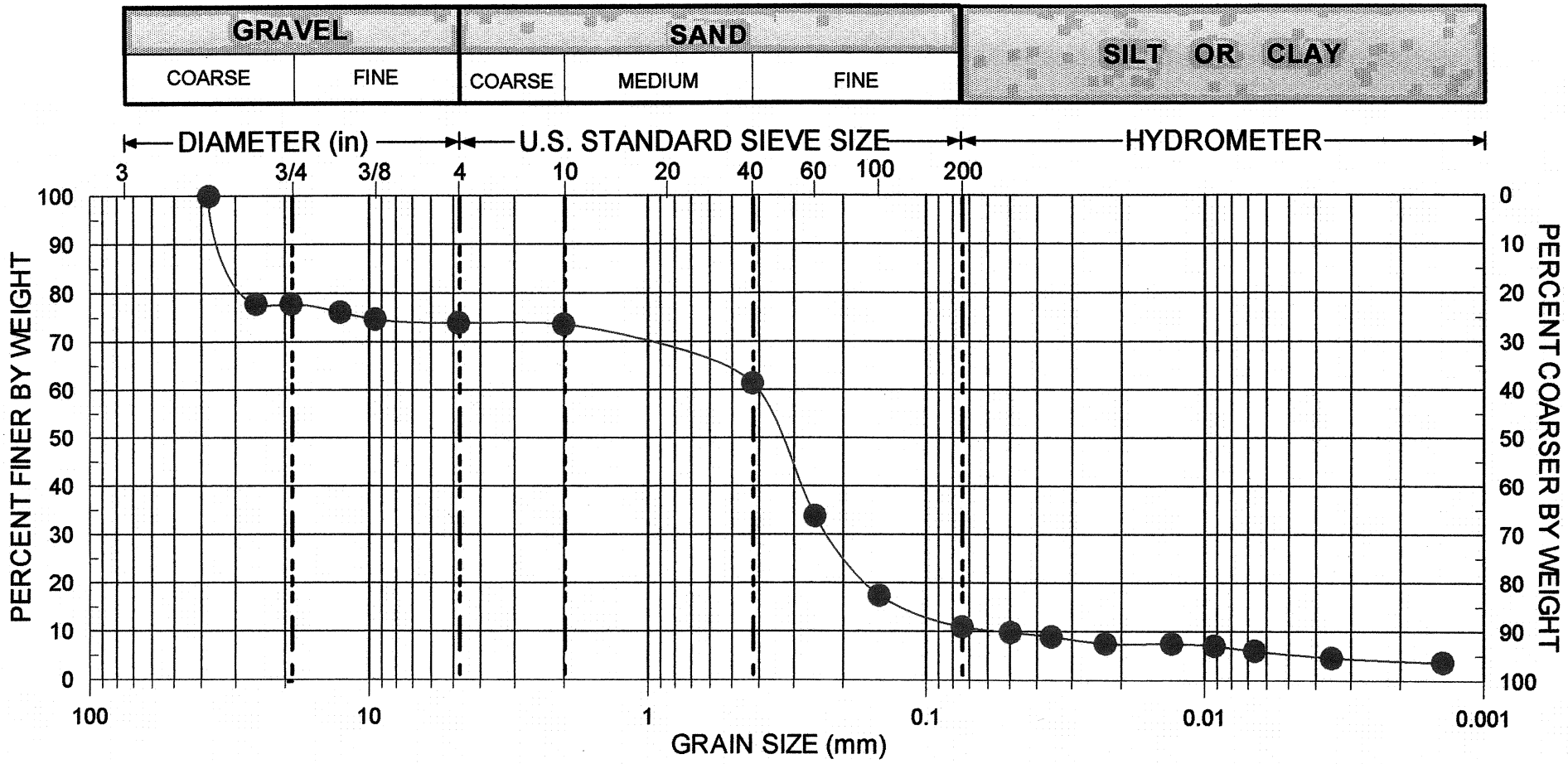
APPENDIX C

Laboratory Test Results

SUMMARY OF LABORATORY TESTING
EASTERN AVENUE OVER KENILWORTH AVENUE

Exploration Number	Sample Number	Depth (ft.)	Moisture Content (%)	ATTERBERG LIMITS Liquid Limit	Plastic Limit	Plasticity Index	Percent Passing #200	Grain Size
B1	S2	2.5	8.7				11.0	**
B1	S4	7.5	10.0					
B2	S3	4.5	8.1					
B2	S5	9.5	11.1					
B3	S3	4.5	6.2				10.1	**
B3	S7	14.5	14.9					
B3	S9A	24.5	21.8				23.8	**
B4	S3	4.5	8.5					
B4	S5	9.5	8.9					
B4	S7	14.5	20.2				32.9	**
B5	BAG	0-10"	6.4	16	NP	NP	19.6	**
B5	S4	7.5	9.0				17.7	**
B5	S6	12.5	9.5					
B6	S2	2.5	7.1					
B6	S4	7.5	11.2				30.2	**
B7	S3	4.5	6.9					
B7	S5	9.5	13.3					
B8	S2	2.5	5.8					
B8	S4	7.5	8.6					
B9	S2	3.0	19.5	35	17	18		
B9	S4	7.5	23.4				29.9	**
B9	S7	15.0	23.1					

PROJECT NAME: Eastern Avenue Over Kenilworth Avenue
LOCATION: Washington, DC
FILE NUMBER: 33261-000



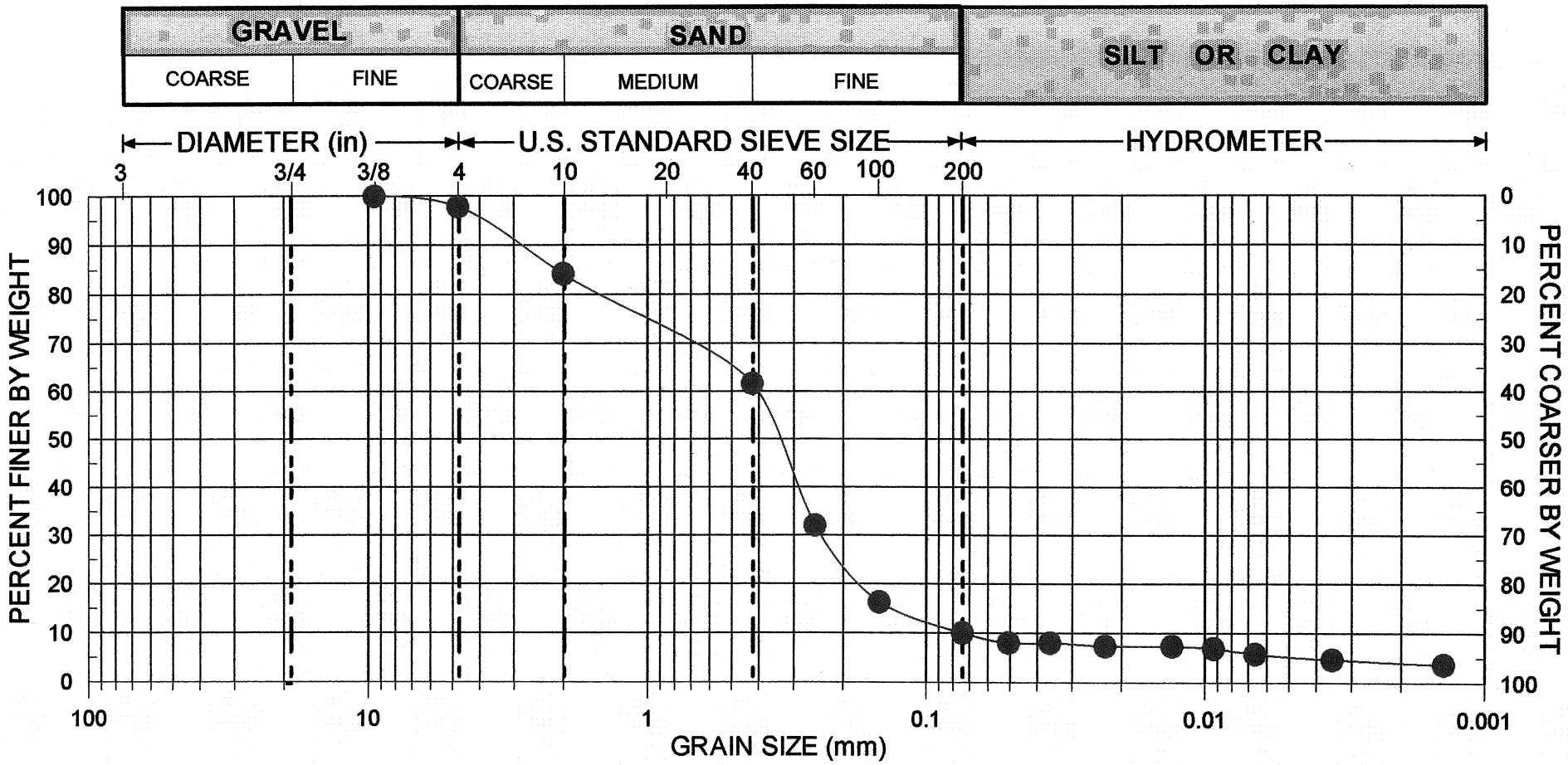
KEY	EXPLORATION NUMBER	SAMPLE NUMBER	DEPTH (ft.)	MC (%)	LL	PL	PI	SOIL DESCRIPTION
●	B1	S2	2.5	8.7	---	---	---	Dark brown well graded SAND with silt, rock, concrete and brick

GRADATION ANALYSIS

TESTED BY: JMK
CHECKED BY: DS
DATE: 8-28-08
SHEET: 1 of 8

JAY KAY TESTING
Taneytown, Maryland

PROJECT NAME: Eastern Avenue Over Kenilworth Avenue
LOCATION: Washington, DC
FILE NUMBER: 33261-000



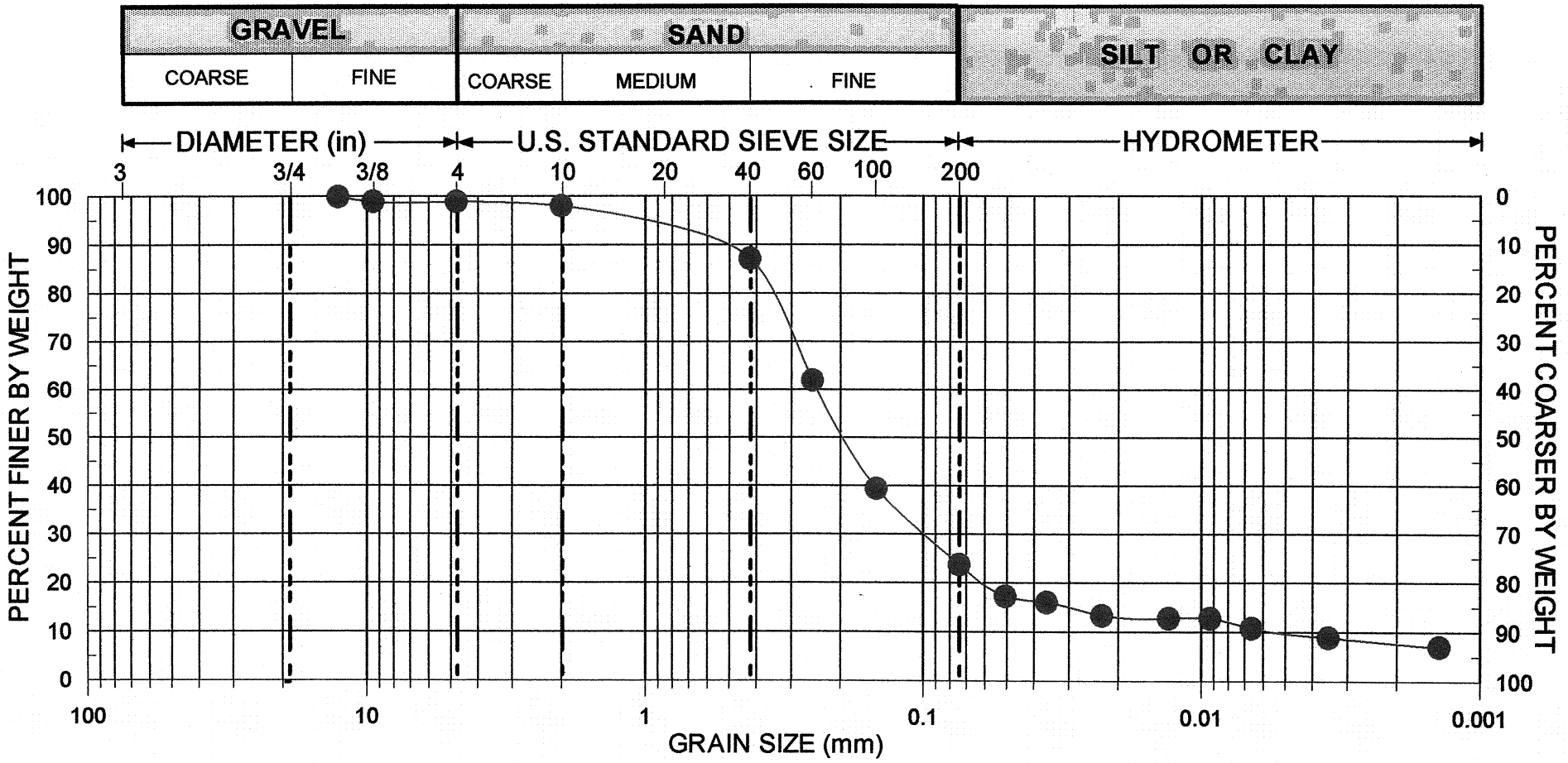
EXPLORATION KEY	SAMPLE NUMBER	DEPTH (ft.)	MC (%)	LL	PL	PI	SOIL DESCRIPTION
● B3	S3	4.5	6.2	---	---	---	Orange brown poorly graded SAND with silt

GRADATION ANALYSIS

TESTED BY: JMK
CHECKED BY: DS
DATE: 8-28-08
SHEET: 2 of 8

JAY KAY TESTING
Taneytown, Maryland

PROJECT NAME: Eastern Avenue Over Kenilworth Avenue
LOCATION: Washington, DC
FILE NUMBER: 33261-000



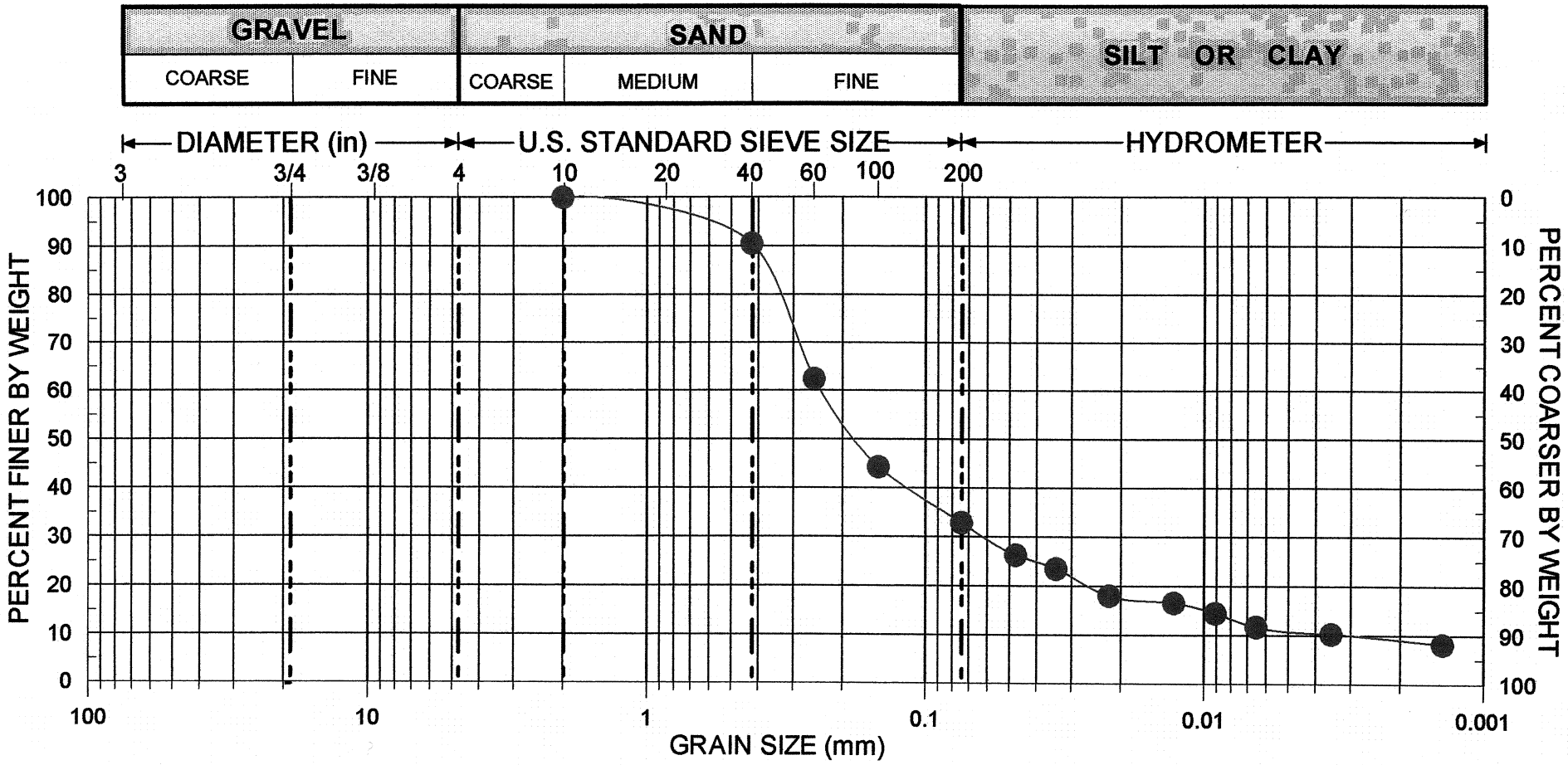
EXPLORATION KEY	SAMPLE NUMBER	DEPTH (ft.)	MC (%)	LL	PL	PI	SOIL DESCRIPTION
● B3	S9A	24.5	21.8	---	---	---	Orange brown silty SAND

GRADATION ANALYSIS

TESTED BY: JMK
CHECKED BY: DS
DATE: 8-28-08
SHEET: 3 of 8

JAY KAY TESTING
Taneytown, Maryland

PROJECT NAME: Eastern Avenue Over Kenilworth Avenue
LOCATION: Washington, DC
FILE NUMBER: 33261-000



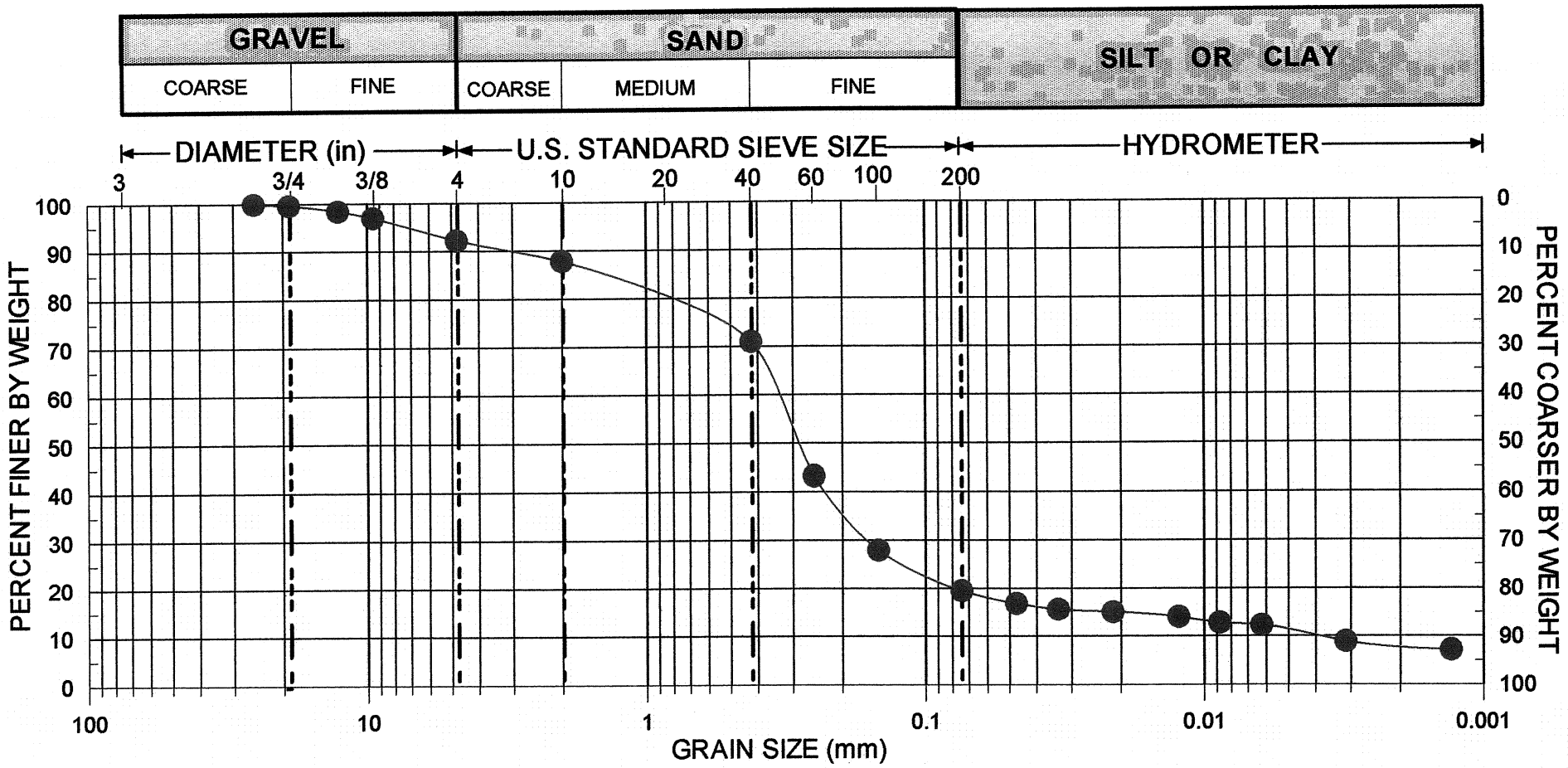
EXPLORATION KEY	SAMPLE NUMBER	DEPTH (ft.)	MC (%)	LL	PL	PI	SOIL DESCRIPTION
● B4	S7	14.5	20.2	---	---	---	Light brown silty SAND

GRADATION ANALYSIS

TESTED BY: JMK
CHECKED BY: DS
DATE: 8-28-08
SHEET: 4 of 8

JAY KAY TESTING
Taneytown, Maryland

PROJECT NAME: Eastern Avenue Over Kenilworth Avenue
LOCATION: Washington, DC
FILE NUMBER: 33261-000



KEY	EXPLORATION NUMBER	SAMPLE NUMBER	DEPTH (ft.)	MC (%)	LL	PL	PI	SOIL DESCRIPTION
●	B5	Bag	0-10.0"	6.4	16	NP	NP	Brown silty **SAND (SM) [A-2-4]**

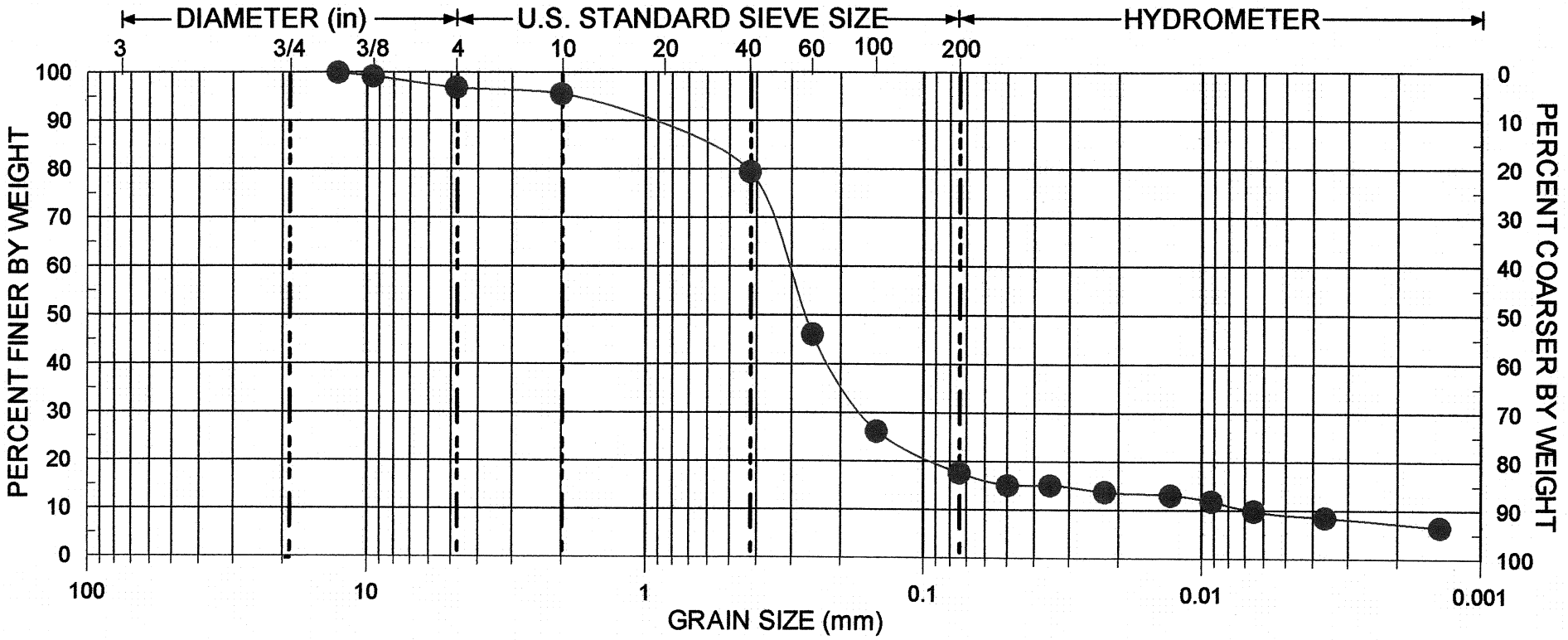
GRADATION ANALYSIS

TESTED BY: JMK
CHECKED BY: DS
DATE: 8-28-08
SHEET: 5 of 8

JAY KAY TESTING
Taneytown, Maryland

PROJECT NAME: Eastern Avenue Over Kenilworth Avenue
LOCATION: Washington, DC
FILE NUMBER: 33261-000

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



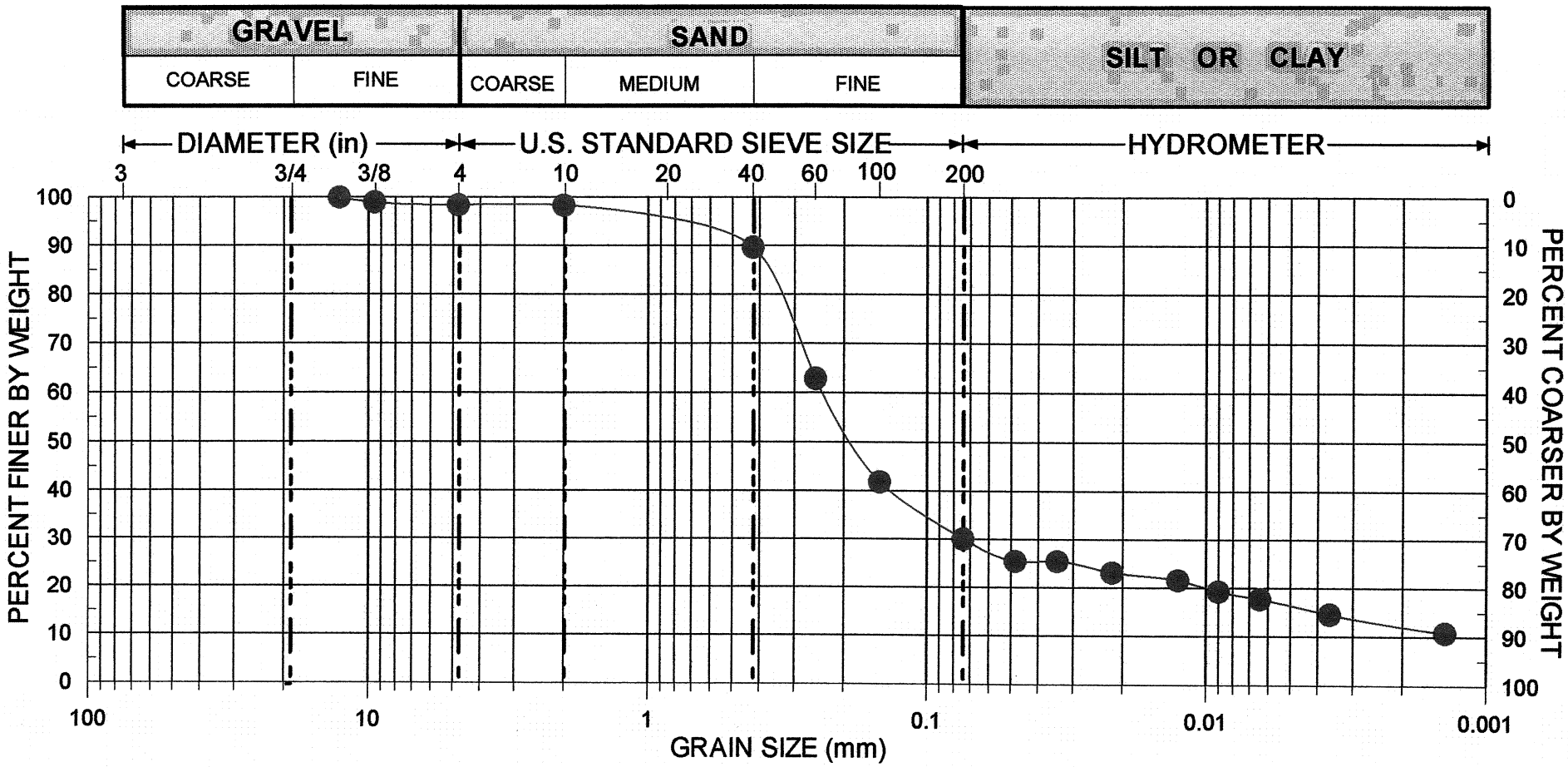
KEY	EXPLORATION NUMBER	SAMPLE NUMBER	DEPTH (ft.)	MC (%)	LL	PL	PI	SOIL DESCRIPTION
●	B5	S4	7.5	9.0	---	---	---	Brown silty SAND

GRADATION ANALYSIS

TESTED BY: JMK
CHECKED BY: DS
DATE: 8-28-08
SHEET: 6 of 8

JAY KAY TESTING
Taneytown, Maryland

PROJECT NAME: Eastern Avenue Over Kenilworth Avenue
LOCATION: Washington, DC
FILE NUMBER: 33261-000



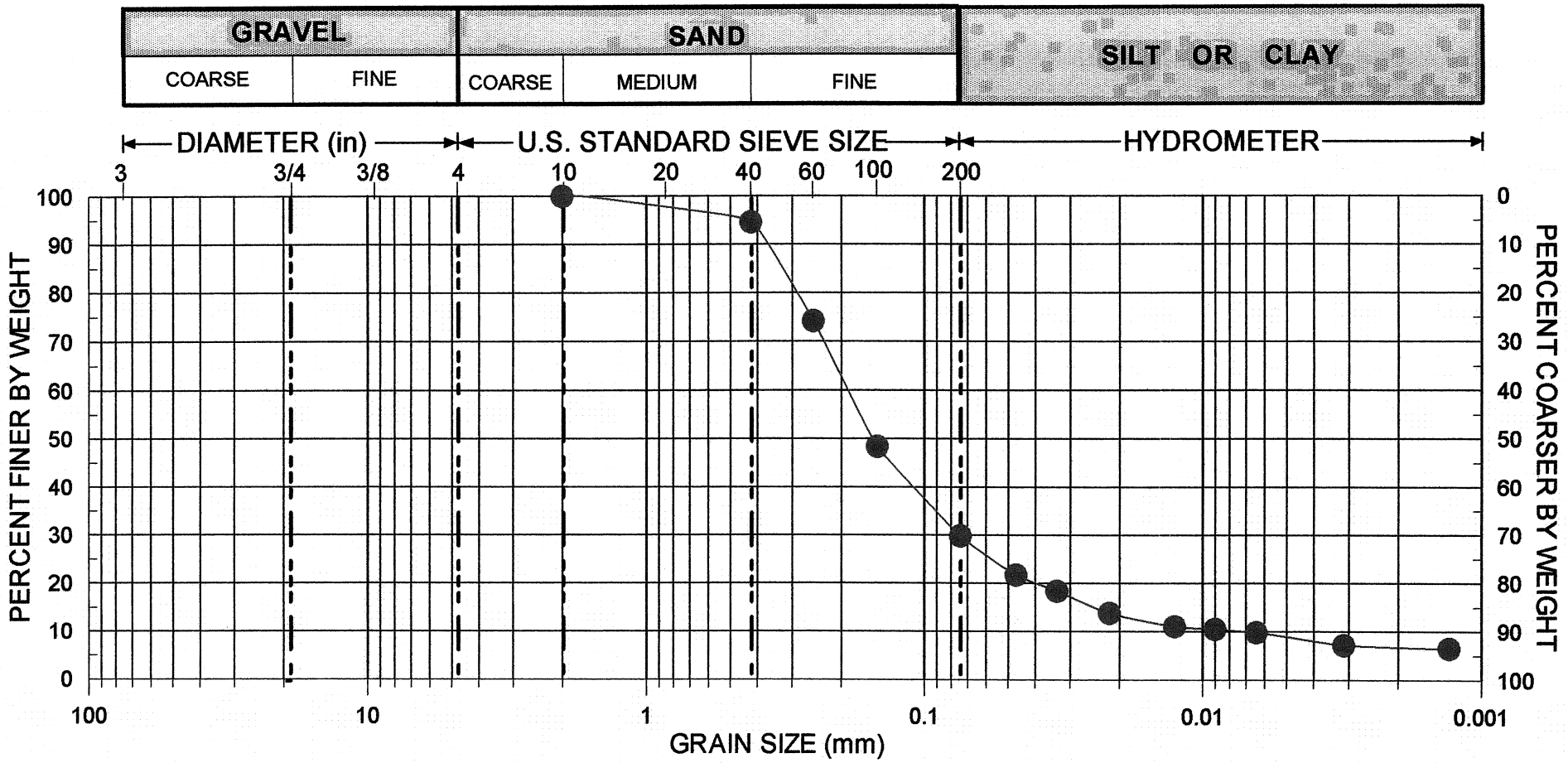
KEY	EXPLORATION NUMBER	SAMPLE NUMBER	DEPTH (ft.)	MC (%)	LL	PL	PI	SOIL DESCRIPTION
●	B6	S4	7.5	11.2	---	---	---	Orange brown silty SAND

GRADATION ANALYSIS

TESTED BY: JMK
CHECKED BY: DS
DATE: 8-28-08
SHEET: 7 of 8

JAY KAY TESTING
Taneytown, Maryland

PROJECT NAME: Eastern Avenue Over Kenilworth Avenue
LOCATION: Washington, DC
FILE NUMBER: 33261-000



EXPLORATION KEY	SAMPLE NUMBER	DEPTH (ft.)	MC (%)	LL	PL	PI	SOIL DESCRIPTION
● B9	S4	7.5	23.4	---	---	---	Brown silty **SAND**

GRADATION ANALYSIS

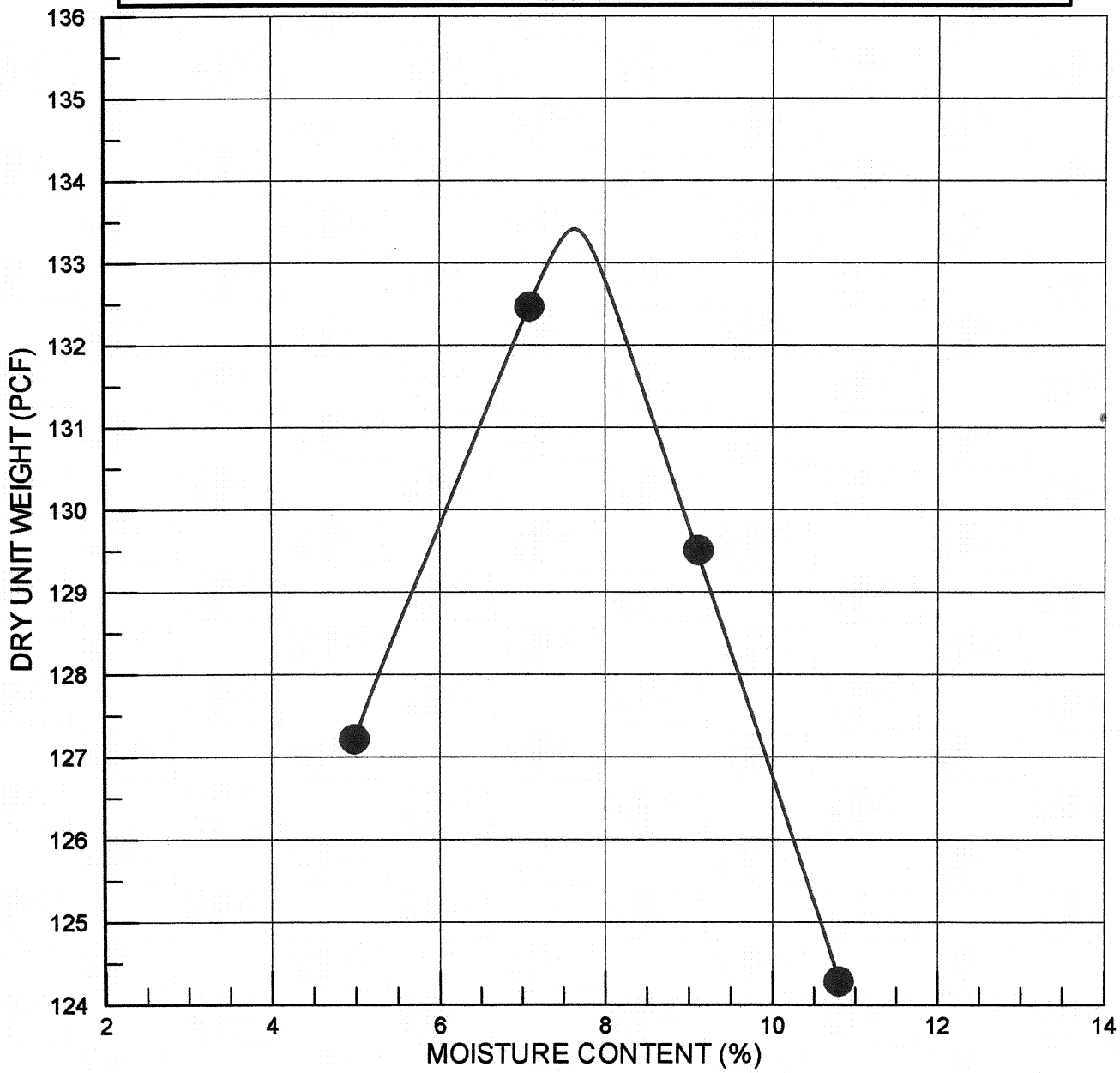
TESTED BY: JMK
CHECKED BY: DS
DATE: 8-28-08
SHEET: 8 of 8

JAY KAY TESTING
Taneytown, Maryland

MODIFIED PROCTOR TEST REPORT

PROJECT: Eastern Avenue Over Kenilworth Avenue
LOCATION: Washington, DC
FILE NO: 33261-000
DESCRIPTION OF SOIL: Brown silty SAND
SAMPLE NO.: B5 (0-10")– Bag
NATURAL MOISTURE CONTENT: 6.4 %
LIQUID LIMIT: 16 PLASTIC LIMIT: NP PLASTICITY INDEX: NP
PERCENT PASSING # 200: 19.6 % USC: SM AASHTO: A-2-4
TEST PROCEDURE USED: AASHTO T-180 C

TEST RESULTS:
Maximum Dry Unit Weight = 133.4 PCF
Optimum Moisture Content = 7.6 %



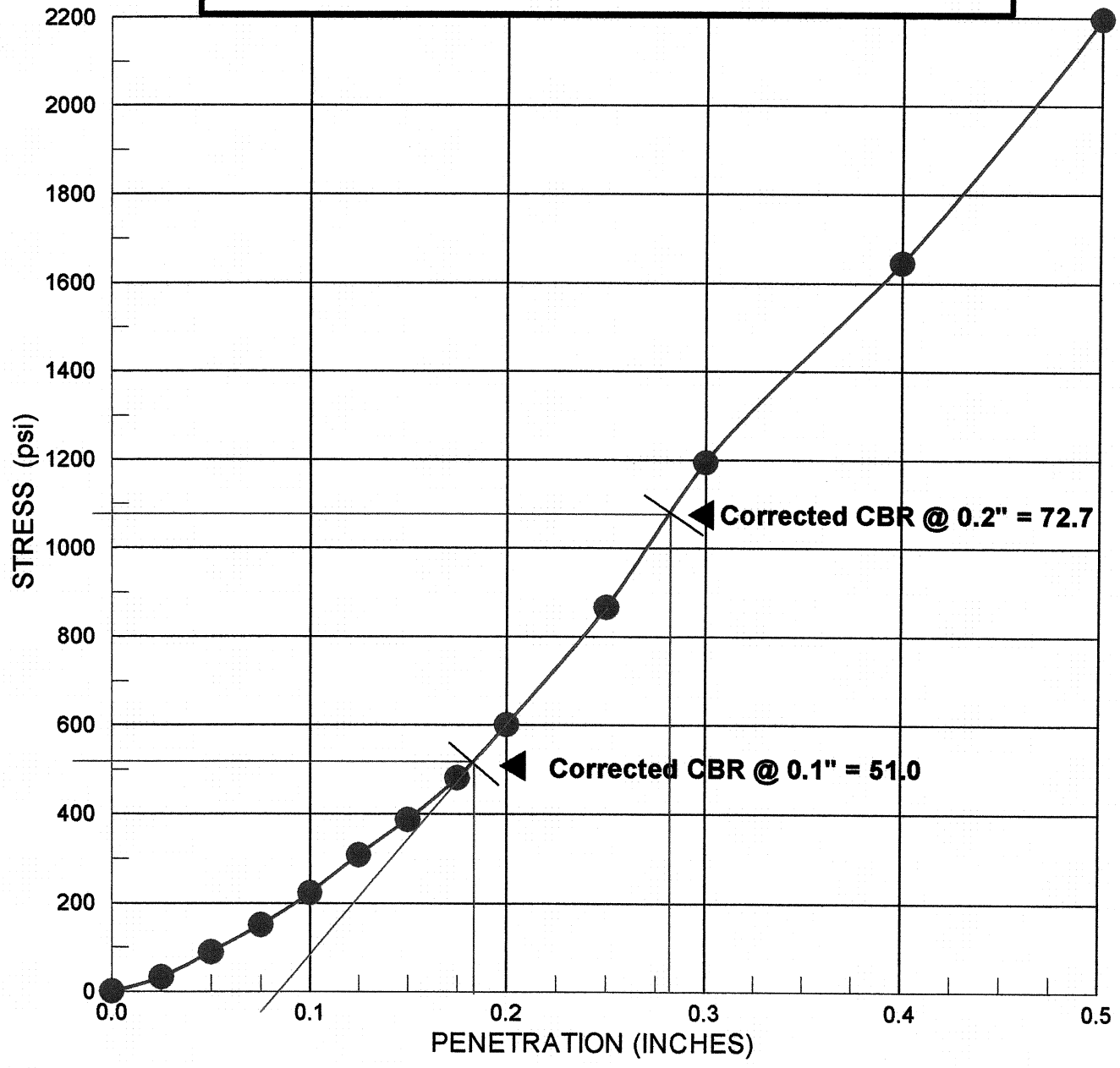
CALIFORNIA BEARING RATIO
STRESS - PENETRATION CURVE

Project: Eastern Avenue Over Kenilworth Avenue
File Number: 33261-000
Sample Location: B5 (0-10.0") - Bulk
Visual Description of Soil: Brown silty SAND

*Sample compacted according to AASHTO T-180 -Surcharge = 75 psf

TEST RESULTS	AS MOLDED	AFTER SOAK
Dry Unit Weight (pcf)	132.0	132.7
Moisture Content (%)	7.8	8.2
Percent Compaction	99.0	99.5
Percent Consolidation	---	0.1

Corrected CBR at 0.1" 51.0
Corrected CBR at 0.2" 72.7



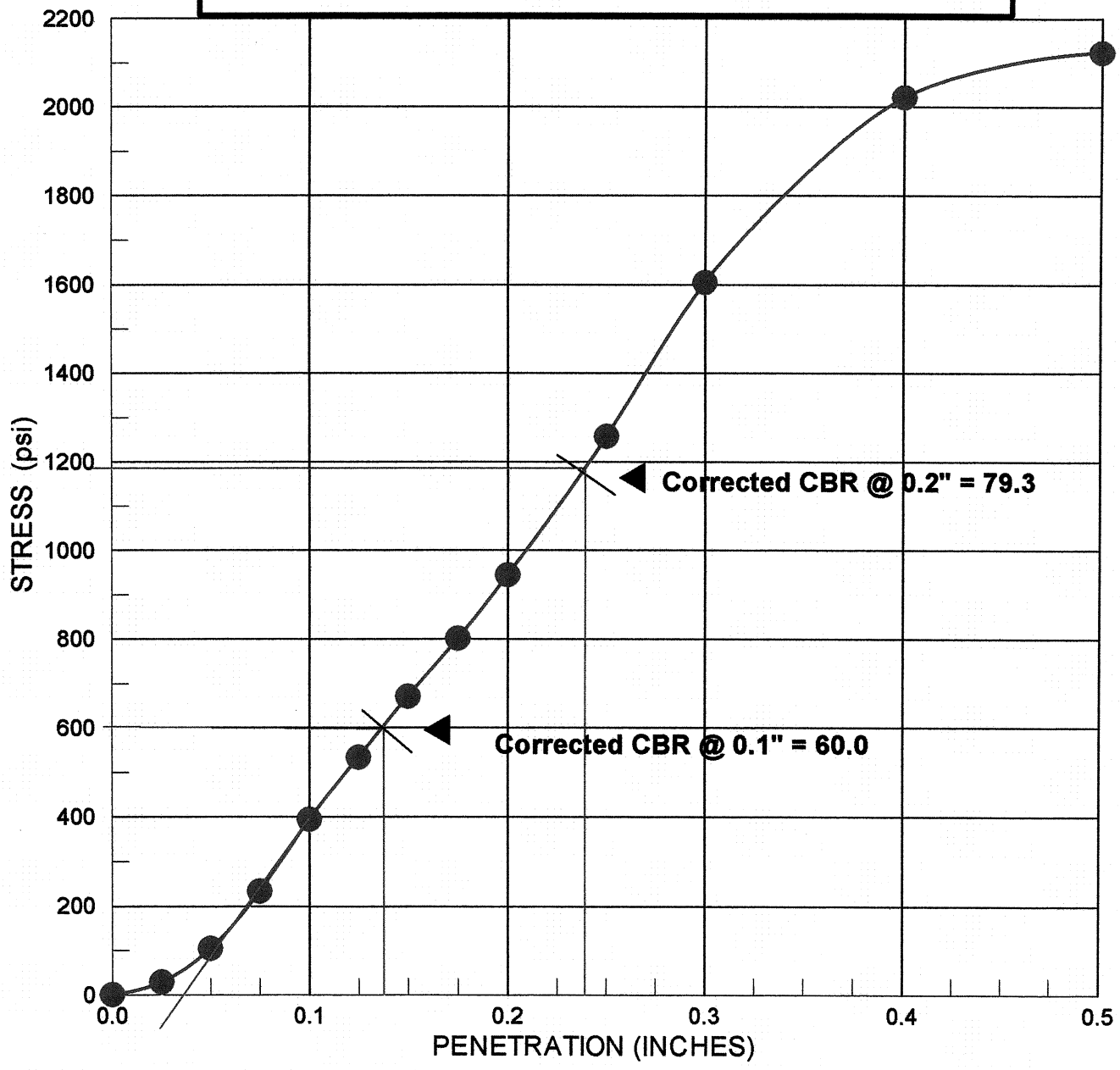
CALIFORNIA BEARING RATIO
STRESS - PENETRATION CURVE

Project: Eastern Avenue Over Kenilworth Avenue
File Number: 33261-000
Sample Location: B5 (0-10.0") - Bulk
Visual Description of Soil: Brown silty SAND

*Sample compacted according to AASHTO T-180 -Surcharge = 75 psf

TEST RESULTS	AS MOLDED	AFTER SOAK
Dry Unit Weight (pcf)	130.8	131.5
Moisture Content (%)	7.7	8.3
Percent Compaction	98.1	98.6
Percent Consolidation	---	0.1

Corrected CBR at 0.1" 60.0
Corrected CBR at 0.2" 79.3



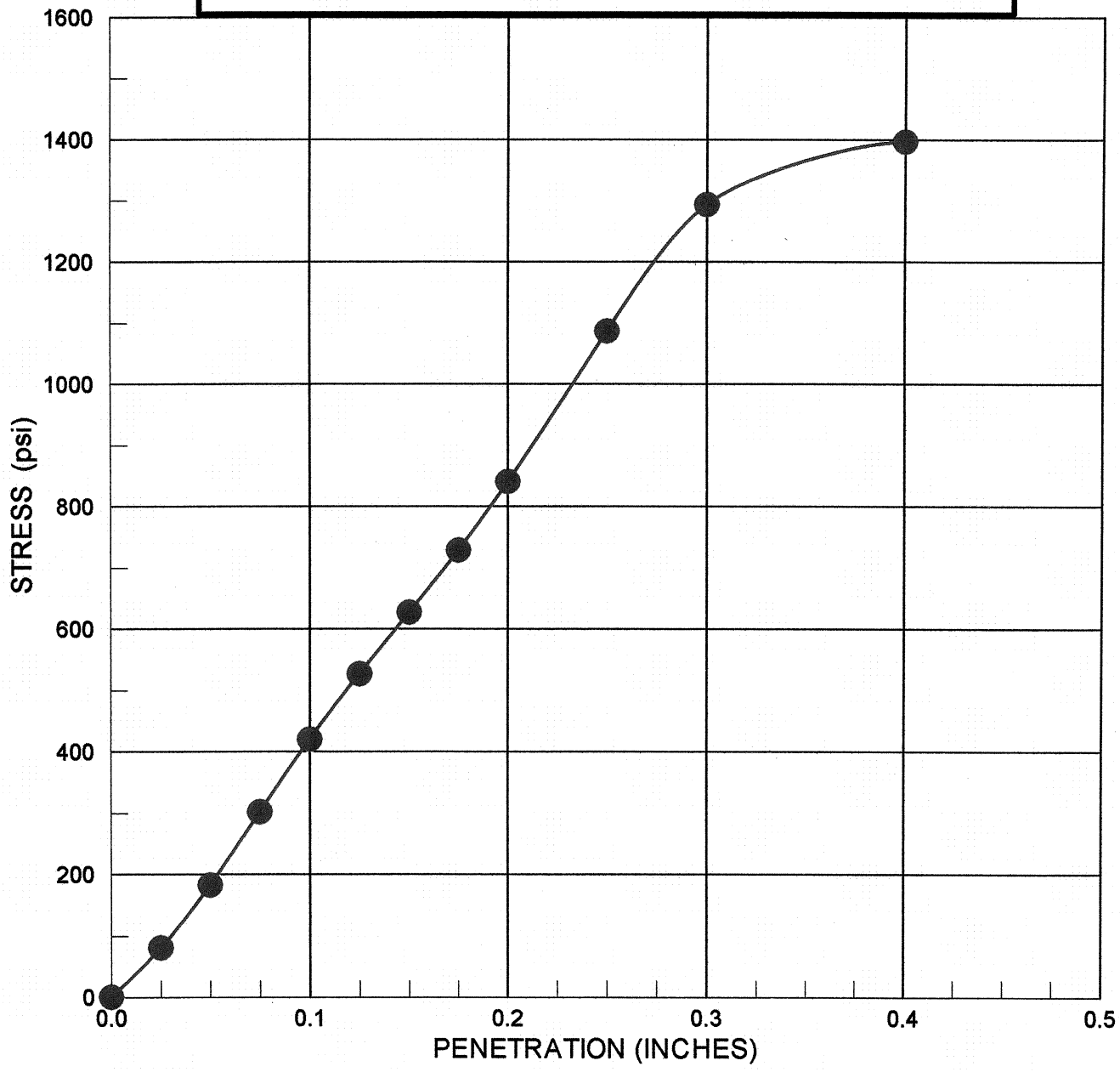
CALIFORNIA BEARING RATIO
STRESS - PENETRATION CURVE

Project: Eastern Avenue Over Kenilworth Avenue
File Number: 33261-000
Sample Location: B5 (0-10.0") - Bulk
Visual Description of Soil: Brown silty SAND

*Sample compacted according to AASHTO T-180 -Surcharge = 75 psf

TEST RESULTS	AS MOLDED	AFTER SOAK
Dry Unit Weight (pcf)	126.9	128.0
Moisture Content (%)	7.9	8.6
Percent Compaction	95.1	96.0
Percent Swell	---	0.1

Corrected CBR at 0.1" 42.0
Corrected CBR at 0.2" 56.0



THOMAS L. BROWN ASSOCIATES, P.C.
Washington, D. C.

RECORD OF SOIL EXPLORATION

Contracted With Sverdrup Civil, Inc. — Boring # B-1
Project Name Eastern Avenue Bridge over Kennilworth Avenue — Job # 99-048
Location Northeast, Washington D.C.

SAMPLER

Datum — Hammer Wt. 140 Lbs. — Hole Diameter 8.0 In. — Foreman F. Holman
Surf. Elev. 38.9± Ft. — Hammer Drop 30 In. — Rock Core Dia. N/A — Inspector —
Date Started 12/15/00 — Spoon Size 2.0 In. — Boring Method HSA — Date Completed 12/15/00

ELEV	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec	BORING & SAMPLING NOTES
38.1	10" of **CONCRETE**	0.83								1. No water encountered.
36.9	Brown, moist, dense, fine to coarse **SAND**, some gravel, little silt **(BASE COURSE)**	2.0			D	22-16-23	1	DS	13	2. 1 bag sample collected from 1.0 to 2.0 feet.
	Brown, moist, dense to medium dense, fine to medium **SAND**, trace gravel, clay **(FILL)**			5	D	8-12-15	2	DS	10	3. Boring backfilled upon completion with auger cuttings and patched at the surface with asphalt.
32.4		6.5			D	7-10-14	3	DS	12	
	Bottom of Boring at 6.5 Feet			10						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION DRY FT.
AFTER ____ HRS. ____ FT.
AFTER 24 HRS. ____ FT.
CAVED AT 3.9 FT.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30" ;COUNT MADE AT 6" INTERVALS

THOMAS L. BROWN ASSOCIATES, P.C.
Washington, D. C.

RECORD OF SOIL EXPLORATION

Contracted With Sverdrup Civil, Inc. Boring # B-2
Project Name Eastern Avenue Bridge over Kennilworth Avenue Job # 99-048
Location Northeast, Washington D.C.

SAMPLER

Datum ____ Hammer Wt. 140 Lbs. Hole Diameter 8.0 In. Foreman F. Holman
Surf. Elev. 37.96± Ft. Hammer Drop 30 In. Rock Core Dia. N/A Inspector ____
Date Started 12/15/00 Spoon Size 2.0 In. Boring Method HSA Date Completed 12/15/00

ELEV	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec	BORING & SAMPLING NOTES
37.0	11" of CONCRETE	0.92								1. No water encountered.
36.0	Brown, moist, very dense, gravelly fine to coarse SAND, trace clay (BASE COURSE)	2.0			D	13-25-26	1	DS	18	2. Bag sample taken from 1.5 to 5.5 feet.
	Brown, moist, loose to medium dense, fine to medium SAND, trace silt (FILL)			5	D	6-5-5	2	DS	14	3. Boring backfilled upon completion with auger cuttings.
31.0		7.0			D	2-6-6	3	DS	15	
	Bottom of Boring at 7.0 Feet			10						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION DRY FT.
AFTER ____ HRS. ____ FT.
AFTER 24 HRS. ____ FT.
CAVED AT 4.6 FT.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30" ;COUNT MADE AT 6" INTERVALS

THOMAS L. BROWN ASSOCIATES, P.C.
Washington, D. C.

RECORD OF SOIL EXPLORATION

Contracted With Sverdrup Civil, Inc. — Boring # B-3
Project Name Eastern Avenue Bridge over Kennilworth Avenue — Job # 99-048
Location Northeast, Washington D.C.

SAMPLER

Datum — Hammer Wt. 140 Lbs. — Hole Diameter 8.0 In. — Foreman F. Holman
Surf. Elev. 39.11± Ft. — Hammer Drop 30 In. — Rock Core Dia. N/A — Inspector
Date Started 12/15/00 — Spoon Size 2.0 In. — Boring Method HSA — Date Completed 12/15/00

ELEV	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec	BORING & SAMPLING NOTES
39.0		0.12								
38.9	1.5" OF ASPHALT	0.25								
	Dark gray, moist, GRAVEL, and fine to coarse SAND (BASE COURSE)									1. No water encountered.
	Reddish brown, moist, medium dense, fine to medium SAND, little gravel, trace silt (FILL)				D	8-6-7	1	DS	16	2. 1 bag sample taken from 1.0 to 5.5 feet.
36.1		3.0								2. Boring backfilled upon completion with auger cuttings and patched at surface with asphalt.
	Light brown, moist, medium dense to dense, fine to medium SAND, little gravel, trace silt (FILL)				D	12-9-12	2	DS	18	
				5	D	15-13-19	3	DS	18	
32.6		6.5								
	Bottom of Boring at 6.5 Feet			10						

SAMPLER TYPE
DS – DRIVEN SPLIT SPOON
PT – PRESSED SHELBY TUBE
CA – CONTINUOUS FLIGHT AUGER
RC – ROCK CORE

SAMPLE CONDITIONS
D – DISINTEGRATED
I – INTACT
U – UNDISTURBED
L – LOST

GROUNDWATER DEPTH
AT COMPLETION DRY FT.
AFTER ____ HRS. ____ FT.
AFTER 24 HRS. ____ FT.
CAVED AT 2.4 FT.

BORING METHOD
HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
DC – DRIVING CASING
MD – MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30" ;COUNT MADE AT 6" INTERVALS

THOMAS L. BROWN ASSOCIATES, P.C.
Washington, D. C.

RECORD OF SOIL EXPLORATION

Contracted With Sverdrup Civil, Inc. — Boring # B-4
Project Name Eastern Avenue Bridge over Kennilworth Avenue — Job # 99-048
Location Northeast, Washington D.C.

SAMPLER

Datum — Hammer Wt. 140 Lbs. — Hole Diameter 8.0 In. — Foreman F. Holman
Surf. Elev. 39.46± Ft. — Hammer Drop 30 In. — Rock Core Dia. N/A — Inspector —
Date Started 12/15/00 — Spoon Size 2.0 In. — Boring Method HSA — Date Completed 12/15/00

ELEV	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec	BORING & SAMPLING NOTES
38.6	10" of **CONCRETE**	0.83								1. No water encountered.
37.5	Brown, moist, very dense, fine to coarse sandy **GRAVEL**, trace clay **(BASE COURSE)**	2.0			D	24-23-30	1	DS		2. Boring offset 5.5 feet south.
	Brown, moist, medium dense to dense, fine **SAND**, trace clay **(FILL)**			5	D	5-9-9	2	DS		3. Boring backfilled upon completion with auger cuttings and patched at the surface with asphalt.
33.0		6.5			D	5-15-19	3	DS		
	Bottom of Boring at 6.5 Feet			10						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION DRY FT.
AFTER ____ HRS. ____ FT.
AFTER 24 HRS. ____ FT.
CAVED AT 2.7 FT.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30" ;COUNT MADE AT 6" INTERVALS

THOMAS L. BROWN ASSOCIATES, P.C.
Washington, D. C.

RECORD OF SOIL EXPLORATION

Contracted With Sverdrup Civil, Inc. — Boring # B-5
Project Name Eastern Avenue Bridge over Kennilworth Avenue — Job # 99-048
Location Northeast, Washington D.C.

SAMPLER

Datum — Hammer Wt. 140 Lbs. — Hole Diameter 8.0 In. — Foreman F. Holman
Surf. Elev. 42.30± Ft. — Hammer Drop 30 In. — Rock Core Dia. N/A — Inspector —
Date Started 12/15/00 — Spoon Size 2.0 In. — Boring Method HSA — Date Completed 12/15/00

ELEV	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec	BORING & SAMPLING NOTES
41.5	3" of **ASPHALT** underlain by 6" of **CONCRETE**	0.75								1. No water encountered.
	Reddish brown, moist, medium dense to dense, fine to medium **SAND**, trace silt				D	12-13-14	1	DS	17	2. 1 bag sample taken from 1.0 to 5.5 feet.
	(FILL)			5	D	4-5-5	2	DS	18	3. Boring backfilled upon completion with auger cuttings and patched at the surface with asphalt.
35.8		6.5			D	2-20-18	3	DS	18	
	Bottom of Boring at 6.5 Feet			10						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION DRY FT.
AFTER ____ HRS. ____ FT.
AFTER 24 HRS. ____ FT.
CAVED AT 2.4 FT.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30" ;COUNT MADE AT 6" INTERVALS

THOMAS L. BROWN ASSOCIATES, P.C.
Washington, D. C.

RECORD OF SOIL EXPLORATION

Contracted With Sverdrup Civil, Inc. — Boring # B-6
Project Name Eastern Avenue Bridge over Kennilworth Avenue — Job # 99-048
Location Northeast, Washington D.C.

SAMPLER

Datum ____ Hammer Wt. 140 Lbs. Hole Diameter 8.0 In. Foreman F. Holman
Surf. Elev. 39.04± Ft. Hammer Drop 30 In. Rock Core Dia. N/A Inspector ____
Date Started 12/15/00 Spoon Size 2.0 In. Boring Method HSA Date Completed 12/15/00

ELEV	SOIL DESCRIPTION Color, Moisture, Density, Plasticity, Size Proportions	STRA DEPTH	SOIL SYMBOL	DEPTH SCALE	SAMPLE Cond	Blows/6"	No.	Type	Rec	BORING & SAMPLING NOTES
38.1	11" of CONCRETE	0.92								1. Boring offset 24.0 feet northeast.
37.0	Brown, moist, medium dense, fine to coarse sandy **GRAVEL (BASE COURSE)**	2.0			D	8-12-11	1	DS	14	2. No water encountered.
	Reddish brown to brown, moist, very loose to medium dense, fine to coarse **SAND**, little gravel, trace silt				D	2-2-2	2	DS	18	3. Boring backfilled upon completion with auger cuttings and patched at the surface with asphalt.
	(FILL)			5						
32.5		6.5			D	2-9-7	3	DS	18	
	Bottom of Boring at 6.5 Feet			10						

SAMPLER TYPE
DS - DRIVEN SPLIT SPOON
PT - PRESSED SHELBY TUBE
CA - CONTINUOUS FLIGHT AUGER
RC - ROCK CORE

SAMPLE CONDITIONS
D - DISINTEGRATED
I - INTACT
U - UNDISTURBED
L - LOST

GROUNDWATER DEPTH
AT COMPLETION DRY FT.
AFTER ____ HRS. ____ FT.
AFTER 24 HRS. ____ FT.
CAVED AT 3.0 FT.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

STANDARD PENETRATION TEST DRIVING 2" OD SAMPLER 1' WITH 140# HAMMER FALLING 30" ;COUNT MADE AT 6" INTERVALS

AMERICAN RECOVERY AND REINVESTMENT SIGN

Reconstruction of Eastern Avenue
Bridge over Kenilworth Avenue, N.E.

Sign Design:

- All economic recovery sign design layout and color should be similar to the sign design attached with this guidance.

Sign Placement:

- With respect to placement of traffic control signs, regulatory, warning, and guide signs have a higher priority than the economic recovery signs.
- In no case shall these signs be placed such that it obscure road users' view of other traffic control devices.
- Economic recovery signs should be placed where they can be easily identified with the corresponding projects.
- If the placement of economic recovery signs conflicts with newly installed higher priority signs, or traffic signals, or temporary traffic control devices, or other priority devices, the economic recovery sign should be relocated.
- Due to public safety concerns, economic recovery signs should not be allowed at the following locations:
    - On the front, back, adjacent to or around any traffic control device, including traffic signs, signals, changeable message signs, traffic control device posts or structures, or bridge piers.
    - At key decision points where a driver's attention is more appropriately focused on traffic control devices, roadway geometry, or traffic conditions. These locations include, but are not limited to exit and entrance ramps, intersections controlled by traffic signals or by stop or yield signs, highway-rail grade crossings, and areas of limited sight distance.

PROJECT FUNDING SOURCE SIGN ASSEMBLY
AMERICAN RECOVERY AND REINVESTMENT ACT
SIGN LAYOUT DETAILS

PROJECT FUNDING SOURCE
SIGN ASSEMBLY

PROJECT FUNDING SOURCE SIGN ASSEMBLY
AMERICAN RECOVERY AND REINVESTMENT ACT
SIGN LAYOUT DETAILS

PROJECT FUNDING SOURCE SIGN

NOTE: SIGN SHALL NOT BE INSTALLED WITHOUT PROJECT FUNDING SOURCE PLAQUE (SEE SHEET 3).

Dimensions in inches

A	B	C	D	E	F	G	H	J	K	L	M	N	P
120	84	1.5	6	5 D	4.5	8 D*	3.75	6 D* (4.5 L.C.)	14.5	10	27.917	5	10.831
84	60	1	5	4 C	3.5	6 C*	3	4 D* (3 L.C.)	9.25	7	19.047	4	7.362

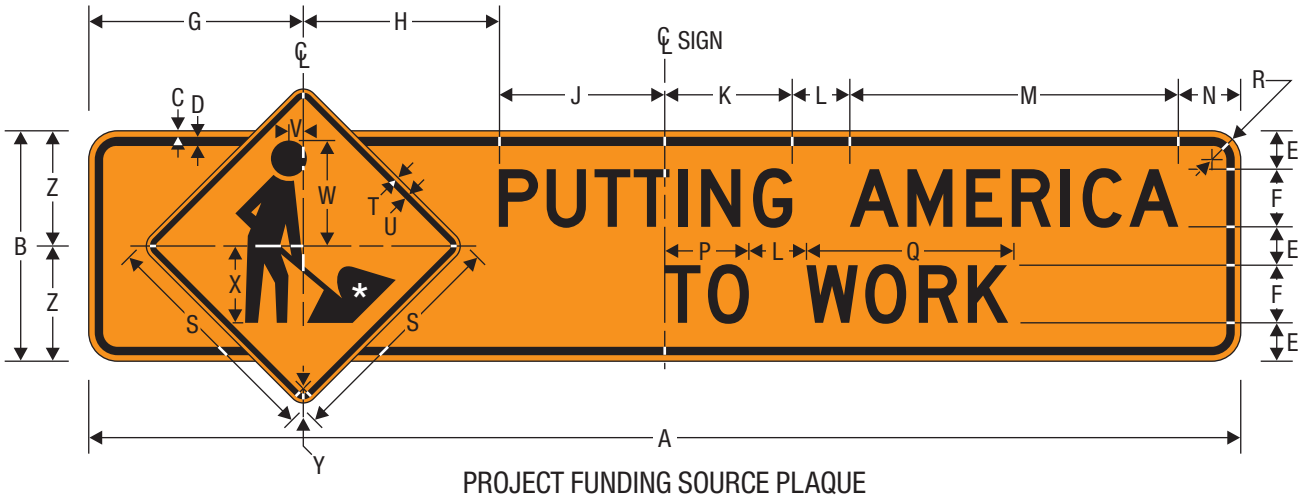
Q	R	S	T	U	V	W	X	Y	Z	AA	BB	CC	DD
14.087	8.106	11.556	49.42	2.742	5.258	46.904	6.812	46.76	22.472	8	16.288	5	30
9.484	5.162	7.763	31.722	2.415	3.585	30.552	4.542	30.911	14.737	6	10.175	4	21

EE	FF	GG
11	4.5	3
7.5	2.25	2.25

* Increase character spacing 50%
** See Pictograph page 4
*** See Pictograph page 5

COLORS: LEGEND, BORDER — WHITE (RETROREFLECTIVE)
BACKGROUND — GREEN (RETROREFLECTIVE)

PROJECT FUNDING SOURCE SIGN ASSEMBLY
AMERICAN RECOVERY AND REINVESTMENT ACT
SIGN LAYOUT DETAILS



PROJECT FUNDING SOURCE PLAQUE

NOTE: PLAQUE SHALL NOT BE INSTALLED WITHOUT SIGN (SEE SHEET 2).

* See *Standard Highway Signs* Page 6-59 for symbol design.

Dimensions in inches

A	B	C	D	E	F	G	H	J	K	L	M	N	P
120	24	0.625	0.875	4	6 D	22.349	20.370	17.281	13.28	6	34.22	6.5	8.765
84	18	0.375	0.625	3.5	4 D	16.607	15.686	9.707	10.667	4	22.813	5	5.843

Q	R	S	T	U	V	W	X	Y	Z
21.013	3	24	0.375	0.625	1.5	11	8	1.5	12
14.009	2.25	18	0.375	0.625	1	7	6	1.5	9

COLORS: LEGEND, BORDER – BLACK
BACKGROUND – ORANGE (RETROREFLECTIVE)

PROJECT FUNDING SOURCE SIGN ASSEMBLY
AMERICAN RECOVERY AND REINVESTMENT ACT
SIGN LAYOUT DETAILS

RECOVERY
Vector-Based, Vinyl-Ready Pictograph

COLORS:	LEGEND, OUTLINE	– WHITE (RETROREFLECTIVE)
	BORDER	– BLUE (RETROREFLECTIVE)
	BACKGROUND (UPPER)	– BLUE (RETROREFLECTIVE)
	BACKGROUND (LOWER RIGHT)	– RED (RETROREFLECTIVE)
	BACKGROUND (LOWER LEFT)	– GREEN (RETROREFLECTIVE)

PROJECT FUNDING SOURCE SIGN ASSEMBLY
AMERICAN RECOVERY AND REINVESTMENT ACT
SIGN LAYOUT DETAILS

USDOT TIGER
Vector-Based, Vinyl-Ready Pictograph

COLORS:
OUTLINE — WHITE (RETROREFLECTIVE)
USDOT LEGEND — BLACK
TIGER DIAGONALS — BLACK, ORANGE (RETROREFLECTIVE)

EASTERN AVE. OVER KENILWORTH AVE., N.E.
WORK ZONE TRANSPORTATION MANAGEMENT PLAN

Reconstruction of Eastern Avenue
Bridge over Kenilworth Avenue, N.E.

Eastern Ave. over Kenilworth Ave., N.E.

Work Zone Transportation Management Plan

Washington, D.C.

Prepared for:
District Department of Transportation
Infrastructure Project Management Administration/Team 4

Prepared by:

Greenhorne & O'Mara, Inc.
Baltimore, MD

G&O Reference No. 0852.006

May 2009

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List of Figures

1. Executive Summary

Roles and Responsibilities

The District Department of Transportation (DDOT) is responsible for the creation, implementation, and enforcement of this plan, which has been prepared in accordance with the "District of Columbia Work Zone Safety & Mobility Policy", dated October 2007. The following individuals are responsible for specific activities to carry out the plan (items in blue to be filled in for construction phase):

TMP Management

Project Managers (design) ..... Ali Shakeri/Mike Jelen
IPMA Team 4 Traffic..... Asnake Negussie, Kendrick Miles
TMP Manager (DDOT).....TBD
TMP Manager (Designer) .....Josh Smith
TMP Manager (Contractor).....TBD

Stakeholders

TBD in conjunction with Stakeholder Meeting

Approval Contacts

District Department of Transportation.....TBD
Mass Transit Administration
Temporary Bus Stop Relocation ..... Gilbert Williams (202-673-1746)

Washington Metropolitan Transit Authority
Service/Route Changes .....David Erion (202-962-1266)
Temporary Bus Stop Relocation..... David Brlansky (202-962-1937)

Maryland State Highway Administration, District 3
District Engineer..... Darrell Mobley (301) 513-7346
Assistant District Engineer – Traffic ..... Brian Young (301) 513-7404
Lane Closure Permits .....Augie Rebish (301) 513-7350

TMP Implementation Task Leaders

DDOT Press Officer/Director of Communications ..... Karen Le Blanc
IPMA Communication Specialist..... Alberta Paul
TMP Monitors .....Applied Research (Name(s) TBD)

Emergency Contacts

TBD in conjunction with Stakeholder Meeting

Project Type, Background, Goals & Constraints

The Eastern Ave. N.E. bridge over Kenilworth Ave. N.E. will be reconstructed. The existing bridge has a vertical clearance of approximately 15' over Kenilworth Ave. and has been struck by heavy vehicles several times in recent years. As a result, the bridge structure is damaged and deteriorating.

This is a significant project as defined by DDOT's "Work Zone Safety & Mobility Policy" because it is a project on an expressway that will "occupy a location for more than three days with either intermittent or continuous lane closures."

The profile of Kenilworth Ave. is depressed to cross under Eastern Ave. at their intersection. The existing Eastern Ave. bridge crosses over all six lanes of Kenilworth Ave. in a single span, and it has a signalized intersection on top for turns between Eastern Ave. and the Kenilworth Ave. service roads. Ramps between mainline Kenilworth Ave. and its parallel service roads provide access between Kenilworth Ave. and Eastern Ave. Bordering the intersection on the northwest is the Kenilworth Aquatic Gardens, administered by the National Park Service.

The bridge will be rebuilt to provide a clearance of 16'-0". An accelerated schedule for design and construction is necessary to minimize the risk to the traveling public. The new bridge will also be designed with aesthetic treatments and landscaping to provide a more pedestrian-friendly environment for the local community and a landmark gateway into Washington, D.C. from Maryland. This project also involves the rehabilitation of a pumping station near Minnesota Avenue, but this work will not impact any roadways.

Limited space for mainline Kenilworth Ave. traffic under the existing Eastern Ave. bridge, combined with heavy volumes on Kenilworth Ave. during the peak period, are key constraints associated with this project. After comparison of several design alternatives, a two-span bridge design with new piers constructed in the Kenilworth Ave. median was selected as the preferred design concept. This will allow for the required under-clearance without lowering Kenilworth Ave. and with only minimal elevation increase to the Eastern Ave. and service road profiles.

Proposed Construction Phasing/Staging

Two alternative schemes were considered for the major portion of maintenance of traffic affecting mainline Kenilworth Ave.:

- **MOT Option 1** – close one of the three lanes in each direction on mainline Kenilworth Ave. for approximately two months to provide space for constructing piers in the Kenilworth Ave. median. The two month duration is anticipated to be feasible based on the use of prefabricated structural components.
- **MOT Option 2** – provide space for constructing bridge piers in the Kenilworth Ave. median by diverting one lane in each direction from mainline Kenilworth Ave. on the Kenilworth Ave. ramps and service roads and shifting the remaining two lanes in each direction to the right.

After the approximately two-month period for constructing the bridge piers, both MOT Option 1 and MOT Option 2 could be implemented in conjunction with either full closure of the Eastern Ave. bridge or construction of the bridge deck in phases. These decisions were determined to be interrelated,

however, and the decision of how to maintain traffic on Eastern Ave. was determined to be subordinate to the decision of how to maintain traffic on Kenilworth Ave.

As described below, MOT Option 2 was selected as the preferred MOT alternative. Following is high-level outline of the anticipated sequence of construction for MOT Option 2[1]:

Phase 1A – Construct temporary ramp, ramp widening, curb radius, and signal improvements needed for Phases 1B and 2A Maintenance of Traffic

Phase 1B – Detour traffic and remove the existing bridge superstructure.

- Close the Eastern Ave. bridge and detour traffic, both to accelerate bridge construction and so that turning movements do not conflict with the diverted traffic on the ramps during Phase 2. Temporarily remove the existing traffic signal at Eastern Ave. / Kenilworth Ave. intersection and provide pedestrian detours.
- Detour traffic from southbound Kenilworth Ave. off-ramp at Nannie Helen Burroughs Ave. Provide revised traffic flow pattern via U-turn lane and revised signal timing plan along Nannie Helen Burroughs Ave. to accommodate detour flows.

Phase 2A – Construct new storm drain features beneath Kenilworth Ave. under Eastern Ave. bridge

- Close the right lane in each direction on Kenilworth Ave. and divert the closed lanes onto the ramps and service roads. Use temporary concrete traffic barrier along the center of each service road to separate local and through traffic.

Phase 2B – Construct Eastern Ave. bridge piers in median of Kenilworth Ave by retaining Phase 2A configuration and shifting the left two lanes in each direction on mainline Kenilworth Ave. to the outside. Remove existing bridge superstructure during nighttime closure of two lanes on mainline Kenilworth Ave., with all mainline traffic diverted to service road lane. Construct modifications to the existing abutments.

Phase 3 – Complete Eastern Ave. bridge and begin reconstructing the Kenilworth Ave. service roads to final grade, approximately 6" higher than existing

- After completion of bridge piers, remove diversion of through traffic onto service roads and restore mainline Kenilworth Ave. to original conditions. Retain Phase 2 detours.
- Install prefabricated superstructure units during nighttime closure of two lanes on mainline Kenilworth Ave., with all mainline traffic diverted to service road lane.
- Complete construction of bridge and begin reconstruction of service roads.
- Construct curb, gutter, and portion of sidewalk at Eastern Ave. / Kenilworth Ave. service road intersection under Subphase 3A pedestrian detour near the end of Phase 3

Phases 4-6 – Reconstruct Kenilworth Ave. service roads in segments, retaining detours from Phase 2 and providing additional detours as necessary.

Phase 7 – Restore curb radius, traffic signal, and all other roadway features to existing conditions at the Nannie Helen Burroughs / Kenilworth Ave. service road intersections.

[1] Drawing MT 02 in the Maintenance of Traffic Plans governs should any discrepancy be found between this document and the maintenance of traffic plans.

Special Considerations

Due to the unusual nature of the traffic control plan strategy, many special items will be included in the traffic control plans to ensure maximum driver comprehension and safety. These include temporary changes to overhead signing, service road pavement reconstruction and widening, temporary reduced speed limits, automated speed enforcement, rumble strips, temporary parking restrictions, restriction of pedestrian access, and restriction of work to summer months for traffic and school transportation reasons.

General Schedule and Timeline

Refer to the contract special provisions for the required completion time.

Need for Detours

All left turns at the Eastern Ave. / Kenilworth Ave. intersection will have to be detoured to facilitate using the inside halves of the ramps and service roads as through lanes for expressway traffic. If turning movements were maintained at this intersection, temporary signals would need to be used to assign right-of way alternatively to the ramp turning traffic and the expressway lanes diverted onto the service roads. This would effectively negate the diverted lane's ability to function as an expressway lane and it would be consequently underutilized by drivers because of the extra delay experienced on it.

Representatives from the Maryland State Highway Administration have been consulted and concur with a detour from westbound Eastern Ave. to southbound Kenilworth Ave. that uses the U.S. 50 interchange loop ramps. For traffic from southbound Kenilworth Ave. to Eastern Ave., signal timing will be temporarily modified at the Nannie Helen Burroughs Ave. intersections to accommodate the detour flows.

Related Projects

MD 201 over Amtrak - The Maryland State Highway Administration is currently reconstructing the MD 201 bridge over Amtrak's railroad lines just north of the Eastern Ave. project's limits. The new bridge will increase the number of lanes in the southbound direction from three to four. Construction is expected to be complete by December 2008.

Kenilworth Ave. over Nannie Helen Burroughs Ave. - DDOT is currently reconstructing the Kenilworth Ave. bridges over Nannie Helen Burroughs Ave. just south of the Eastern Ave. project's limits. Construction is expected to be complete by April 2009. As part of the reconstruction, the intersections of Nannie Helen Burroughs Ave. with the Kenilworth Ave. ramps and service roads are being reconstructed to provide additional capacity. It is expected this project will be complete just before the Notice to Proceed date for the Eastern Ave. project.

Nannie Helen Burroughs Ave. from Kenilworth Ave. to Eastern Ave. - DDOT is currently designing improvements as part of this Great Streets Initiative project.

Minnesota Ave. from Sheriff Road, N.E. to Good Hope Road, S.E. - DDOT is currently designing improvements as part of this Great Streets Initiative project. This project will include the intersection of Minnesota Ave. and Nannie Helen Burroughs Ave., which is approximately 300 ft from the intersection

of Nannie Helen Burroughs Ave. and the northbound Kenilworth Ave. service road. Signal timing at this intersection will need to be modified in conjunction with signal timing modifications at the other Nannie Helen Burroughs Ave. intersections for the Phase 1B-6 detour.

Related Project Coordination

If possible the Nannie Helen Burroughs Ave. project should be scheduled such that construction activity is avoided or minimized during the Eastern Ave. project.

Minnesota Ave. south of Nannie Helen Burroughs Ave. is situated such that it is not expected to receive any diverted traffic from the Phase 1B-6 detour movements. Thus, it may be desirable to schedule work along Minnesota Ave. south of Nannie Helen Burroughs Ave. at the same time as the Phase 1B-6 detours are in effect. Such scheduling would have the added potential benefit of reducing complaints from motorists approaching the Minnesota / Burroughs intersection from the north, south, or east. However, it is understood that the Minnesota Avenue project is on a delayed schedule relative to the Eastern Avenue project, so this may not be feasible.

Existing Roadway Characteristics

Kenilworth Ave. N.E. (DC 295) is a six-lane principal urban expressway that carries an average annual daily traffic of approximately 140,000 vehicles/day. Through the study area, two one-way, 24'-26' wide service roads run parallel to Kenilworth Ave. on either side, providing local access to homes and businesses.

Because of the limited number of bridge crossings over the Anacostia River to the west of the Kenilworth Ave. corridor and the limited number of crossings of WMATA's at-grade orange line rail tracks to the east, disruption to operations at the subject interchange will affect both local and regional trips.

Existing and Historical Traffic Data

Volumes – Previously-taken traffic volume data show heavy peak period, peak direction traffic on Kenilworth Ave., with volumes near 6,000 vehicles per hour. Previous traffic counts were also gathered for locations along the service roads and along Nannie Helen Burroughs Ave. for evaluation of detour signal timing. At the Minnesota Ave. / Nannie Helen Burroughs Ave. intersection, heavy volumes and constrained conditions under the bridge for the WMATA Orange Line tracks will influence the ability to time the traffic signal system for detour flows.

Speed – The posted speed limits in the project area are 45 MPH on mainline Kenilworth Ave., 25 MPH on the Kenilworth Ave. service roads, and 30 MPH on Eastern Ave. DDOT's online speed study map indicates that measured 85th percentile speeds are 61 MPH along mainline Kenilworth Ave. and 37 MPH on Eastern Ave. Informal field observations by G&O indicated that 85th percentile speeds along the Kenilworth Ave. service roads would likely be between 40 and 50 MPH.

Heavy Vehicles – A previous study found that on Kenilworth Ave. at Eastern Ave., trucks accounted for 5-6% of daily traffic and 4-7% of traffic during the peak hour. To be conservative, 7% trucks will be assumed along Kenilworth Ave. and at all intersections throughout the study area.

Data Collection and Modeling Approach

No additional data collection was undertaken as part of this study. A baseline pre-construction model of the Kenilworth Ave. corridor was created in Synchro/SimTraffic to model the Kenilworth Ave. / Eastern Ave. interchange, the Kenilworth Ave. service roads and ramps south of the interchange, and the signals along Nannie Helen Burroughs Ave. that would be affected by MOT Option 2.

Synchro/SimTraffic was selected as the appropriate software model based on its ability to model and optimize coordinated signal systems, and because its ease of use lends itself well to meeting accelerated project schedule constraints associated with the urgency of avoiding additional overheight vehicle collisions at the Eastern Ave. bridge.

Existing Traffic Operations

Existing signal timing data was obtained from DDOT for the signalized intersections in the study area. At the intersection of Eastern Ave. and the Kenilworth Ave. service roads, the existing signal operates in pre-timed mode. The intersection of Nannie Helen Burroughs Ave. and the northbound Kenilworth Ave. service road operates in actuated-coordinated fashion, being coordinated with the signal at Nannie Helen Burroughs Ave. and Minnesota Ave.

Crash Data

Crash data from 2001-2003 indicates a crash rate of 156 crashes per Million Vehicle Miles Traveled on the segment of Kenilworth Ave. south of Eastern Ave.

For the intersection of Eastern Ave. and the Kenilworth Ave. service roads, accident data was obtained from DDOT for a three year period. The data indicates that there were a total of 70 accidents in the three year study period between 2003 and 2005. Rear-end type accidents represent the highest proportion making up approximately 40% of all the reported collisions. Sideswipes, left turn accidents, broadsides, and fixed object accidents make up the next largest categories and represent approximately 44% of the accidents. There was one pedestrian collision reported at this intersection.

The degree to which safety is affected by the selected MOT Option is largely a corollary to which option is expected to produce the most congestion. Longer delay will result in increased driver frustration and aggressiveness, and longer duration of congestion will likely increase the incidence of queues and rear-end accidents, particularly on mainline Kenilworth Ave.

However, some additional degradation of safety must be assumed for MOT Option 2 because of the relatively unusual traffic pattern of dividing the lanes with all lanes proceeding through. Drivers who do not see or comprehend the posted signs related to this temporary condition may make erratic and dangerous movements as they approach the gore area for the lane split in order to get in the lane they perceive is correct for their intended destination.

Stakeholder Concerns/Issues

Under MOT Option 1, a concern for the Maryland State Highway Administration would be additional congestion backing up from southbound DC 295 at the project site onto southbound MD 201 and

westbound U.S. 50, particularly during the AM peak hour. Spillback would be a similar concern for the U.S. National Park Service, which operates the Baltimore-Washington Parkway (MD 295).

Under MOT Option 2, parking would need to be restricted along the Kenilworth Ave. service roads, and bus stops would need to be temporarily relocated. Coordination with WMATA would be required for the bus stop relocation. School transportation and emergency responder officials would need to be advised of the detours.

After the selection of MOT Option 2 based on analysis described later in this report, a stakeholder meeting was held. Representatives from various neighborhood groups, business groups, and public agencies were invited. Only four persons attended the meeting, and no significant concerns were identified.

Traffic Predictions during Construction

With construction anticipated to begin within 12 months, traffic volumes are not expected to change significantly.

Of relevance for MOT Option 2, the current Kenilworth Ave. project includes a ramp and two new signalized intersections being constructed to replace a single unsignalized intersection between Nannie Helen Burroughs Ave. and the southbound Kenilworth Ave. service road.

A two-month period was selected as the basis for comparing delay values for the baseline pre-construction conditions vs. the proposed conditions during construction that will be described later. A two-month period was selected because that is the approximate time it is expected to complete construction of the piers in the Kenilworth Ave. median.

The SimTraffic model described above was used in combination with other assumptions to produce a total two-month delay estimate of 857,538 vehicle-hours for the study area network.

Qualitative Summary of Anticipated Work Zone Impacts

MOT Option 1 is anticipated to create severe queuing, congestion, and spillback on Kenilworth Ave. and other facilities nearby and throughout the area north and east of downtown Washington, D.C. Peak hour drivers would divert to other parallel signal controlled arterial routes such as New York Ave., Rhode Island Ave., Bladensburg Road, and East Capitol Street,, and cut-through traffic would likely increase on local streets in the vicinity of these arterials. Additional delay on the transit system may also occur due to peak hour capacity problems, and many trips diverted to transit will represent additional person delay for those who would normally use their vehicles.

MOT Option 2 is not expected to be without significant impacts. Increased delay will occur on both Kenilworth Ave. due to both the intensity of the work activity expected and due to the somewhat unusual nature of the proposed traffic pattern, with through lanes being diverted onto the ramps. Increased delays will also occur along the detour routes. Pedestrians will need to be detoured approximately 0.5 mile round-trip to the nearest pedestrian bridge over Kenilworth Ave.

However, the traffic movements being detoured are much less traveled than the primary movements on Kenilworth Ave. The delays on Kenilworth Ave. would be anticipated to be on the order of magnitude of

a minor traffic incident of the type that occurs frequently in this corridor and is cleared from the roadway in a matter of minutes rather than a lane closure that lasts throughout the entire day. Pedestrian volumes observed at the Eastern Ave. / Kenilworth Ave. service road intersection in past studies have been small. Consequently, the overall impacts of MOT Option 2 are expected to be much less than those for MOT Option 1.

Further refinements to MOT Option 2 have been considered in an attempt to minimize delay along Nannie Helen Burroughs Avenue during construction, as detailed in a memo attached to this report as Attachment 2.

Impacts Assessment of Alternative Project Design Strategies

Several design features have been investigated in the alternatives considered in the Eastern Avenue Bridge TS&L Study to provide greater clearance between the bottom of proposed bridge and the top of Kenilworth Ave.:

- Lowering Kenilworth Ave
- Raising Eastern Ave. & Service Road Profiles
- Constructing Two-Span Bridge

The third option, construction of a two-span bridge, was selected as the preferred alternative for the final bridge design and will be the only bridge design option treated in this TMP. The other options were concluded to have costs and impacts to existing structures and businesses that were too great to warrant further consideration.

Impacts Assessment of Alternative Construction Approach & Phasing Strategies

Other design and construction method features have been considered to shorten the duration of construction and thus mitigate impacts to traffic:

- Prefabricated Bridge Piers
- Phased Construction of Bridge Deck
- Construction of Bridge Deck Adjacent to Site

The prefabricated bridge piers were determined to be feasible and would provide significant benefit in terms of advancing the project schedule. The other two options were determined to be problematic in causing increased duration of lane closures on Kenilworth Ave. and compatible only with MOT Option 1.

Impacts Assessment of Alternative Project & Work Zone Management Strategies

In addition to the options already discussed, the following **Temporary Traffic Control Strategies and Devices** have been considered for this project:

- Full Roadway Closures - may be necessary for short-term overnight work.
- Reversible Lanes - Considered, but determined to be infeasible.
- Ramp Closures – will be implemented as per the traffic control plans
- Night Work – will be implemented as per the contract special provisions

- Weekend Work – will be implemented as per the contract special provisions
- Work Hour Restrictions for Peak Travel – will be implemented as per the contract special provisions
- Pedestrian Access Improvements - Considered, but the high cost would outweigh the likely minimal benefits to the low number of pedestrians using the intersection.
- Temporary Guide Signs & Changeable Message Signs – will be implemented as per the traffic control plans

The following **Project Coordination, Contracting, and Innovative Construction Strategies** have been considered:

- A+B Bidding
- Incentive/Disincentive Clauses
- Lane rental

Among these three options, a disincentive clause was selected based on the analysis shown in the memo in Attachment 2.

The following **Public Information Strategies** will be implemented for this project:

- **Construction newsletter** to be distributed by the contractor as specified in the contract special provisions.
- Lane closure / detour information on **DDOT's website**
- **Coordination** with media, schools, businesses, and emergency services (Needs to be updated above as per stakeholder list)

Phases 2A and 2B will involve an unusual traffic pattern where one through lane in each direction will use the off-ramp and service road to bypass the work area. In the southbound direction, this lane split will occur just beyond a horizontal curve. The somewhat restricted sight distance will enhance the need to increase driver awareness in advance of the work area. Consequently, other Public information Strategies that should be considered include:

- **Press releases/media alerts**, supplemented with graphics describing the proposed MOT layout for Phase 2
- **Coordination with Maryland SHA** (for MOT Options 1 or 2) and possibly Virginia DOT (for MOT Option 1 only) about the use of overhead variable message signs for displaying construction related messages (i.e. "LANE SHIFT ON DC 295 AT DC/MD LINE / CONSIDER ALTERNATE ROUTES")
- **Dynamic Speed Message signs**
- **Highway Advisory Radio**
- **511 Traveler Information Systems**
- **Wizard CB Alert System**

Selection of MOT Option 1 over MOT Option 2, with its greater estimated impacts to traffic, would have merited greater expenditure on public information strategies.

The following **Transportation Operations Strategies** will be implemented for this project:

- **Temporary Parking Restrictions.** Temporary parking restrictions will be needed along the Kenilworth Ave. service roads under MOT Option 2.
- **Speed Limit Reduction / Variable Speed Limits.** Temporary speed limits will be in effect during MOT Option 2 Phases 2A and 2B, as shown in the maintenance of traffic plans.
- **Traffic screens.** Under MOT Option 2, traffic screens will be installed on top of the temporary concrete traffic barrier on the Kenilworth Ave. service roads that separates the temporary expressway lane from the lane maintained for local use. This will reduce driver distraction and thoroughly discourage pedestrians from crossing into the expressway lane.
- **Tow/freeway service patrol.** This will be included as per the contract specifications.
- **Incident/emergency response plan.** To be completed by the contractor as per the contract special provisions.

Because of the unusual traffic pattern occurring during Phases 2A and 2B, it is additionally recommended that automated speed enforcement be used during these phases.

Assumptions Made for Quantitative Comparison of Anticipated Work Zone Impacts

For this analysis the basic hypothesis being tested is that MOT Option 2 will result in less severe congestion than MOT Option 1. For testing this hypothesis, several conservative assumptions will be made to increase confidence in the result of the analysis. Specifically, where some uncertainty exists about forecast conditions during construction, modeling assumptions that err on the side of representing *reduced* congestion will be assumed for MOT Option 1 (best-case scenario), while modeling assumptions that err on the side of representing *additional* congestion (worst-case scenario) will be assumed for MOT Option 2.

MOT Option 1 – The following best-case scenario assumptions were made:

- 10% of all traffic on mainline Kenilworth Ave. would divert away from Kenilworth Ave. to other routes or other modes such as transit, or would cancel their trips. Delay associated with these diversions would not be estimated or included in the analysis.
- Upstream ramps and interchanges outside the area modeled would not be impacted negatively by the left lane closures on DC 295 at Eastern Ave.
- Weekend delay is assumed to be negligible and will be ignored.

MOT Option 2 – The following worst-case scenario assumptions were made:

- No trip diversion, mode diversion, or trip cancellation would occur on mainline Kenilworth Ave. as a result of the work zone. Trips that would normally use the detoured movements would not be cancelled or diverted.
- Mainline Kenilworth Ave. would experience a reduction in capacity due to the intensity of work in the area and the unusual nature of the work zone. This capacity reduction is assumed equal to 1,050 vehicles per hour, or a “half of a lane”.
- Weekend traffic volumes and delays will be assumed to be the same as for weekdays.

Analysis Tool Selection Methodology and Justification

MOT Options 1 and 2, described in Section 3 above, involve different strategies that require different modeling approaches and analysis software. For MOT Option 1, the Maryland State Highway Administration's (SHA) Lane Closure Analysis Program (LCAP) was used to estimate delays along mainline Kenilworth Ave. For MOT Option 2, Synchro/SimTraffic was used in addition to LCAP to quantify delay occurring on the ramps and at signalized intersections.

Detour Modeling

The impact of detoured traffic on the U.S. 50 interchange was not estimated directly because SHA representatives indicated a similar detour is currently in place and has not caused capacity problems. Volumes for the currently detoured movement were found to be higher than the volumes proposed to be detoured to the same U.S. 50 ramps for the Eastern Ave. project. Other ramps between Kenilworth Ave. and its service roads would need to be closed temporarily and detoured to adjacent ramps to avoid short weave segments that could result in abrupt and unsafe lane changing maneuvers.

Along Nannie Helen Burroughs Ave., capacity for the detoured volumes was found to compete with queue spillback problems at the Nannie Helen Burroughs Ave. / Minnesota Ave. intersection. A signal timing pattern could not be found for traditional approaches to temporary intersection geometries without causing extensive backups onto mainline Kenilworth Ave. Consequently, a layout was developed to convert the right-most lane on westbound Nannie Helen Burroughs Ave. into a U-turn lane, with traffic moving eastbound along it to avoid conflict with the other traffic along Nannie Helen Burroughs Ave. A temporary traffic barrier, truck signing, corner radius modifications, a ramp detour, and signal modifications would be necessary to facilitate this layout.

Measures of Effectiveness

Total network delay in vehicle-hours was selected as the measure of effectiveness for this analysis. Queuing was considered as a potential measure, but queue lengths do not add up conveniently when it is desired to consider multiple queues occurring on different roadways as is the case for MOT Option 2.

Traffic Analysis Results

The baseline pre-construction Synchro model, together with the LCAP program above, estimated a combined total two-month delay of 41,376,463 vehicle-hours. For MOT Option 2, the Synchro/SimTraffic model was updated to reflect proposed construction conditions, and estimates for travel time delay due to vehicular and pedestrian detours were added in as well. The resulting total two-month delay for MOT Option 2 is 5,113,211 vehicle-hours. This delay estimate is much lower than the estimate for MOT Option 1, even though the MOT Option 2 analysis did not consider trip diversion or cancellation. To summarize:

Baseline Pre-Construction Delay =	857,538 veh-hrs
MOT Option 1 Delay =	41,376,463 veh-hrs
MOT Option 2 Delay =	5,113,211 veh-hrs

MOT Option 2 would be expected to produce a 600% increase in delay versus the baseline, pre-construction conditions. However, it is clearly the "lesser of two evils" in terms of delay. Even with all

the conservative assumptions made to try and tilt the comparison in the favor of the more conventional MOT Option 1, MOT Option 1 would be expected to produce about 8 times as much delay as MOT Option 2 based on the assumptions documented herein.

Selected Alternative

G&O recommends MOT Option 2 as the selected construction phasing strategy. The work zone impacts management strategies listed at the end of Section 5 are recommended.

Monitoring requirements To be determined

Evaluation reports To be determined

Public Information and Outreach Plan

A stakeholder meeting was held on March 19, 2009 at the First Baptist Church of Deanwood to explain the construction process and phasing. Three representatives from the ANC's attended, along with one from Councilmember Alexander's office. No significant concerns with the construction phasing scheme were identified. A follow-up PDF brochure was provided to the ANC representatives to assist in informing their constituents about the upcoming project.

As per the contract special provisions, the contractor will distribute a construction newsletter to inform the public about construction progress and upcoming traffic switches.

Incident Management Trigger Points

To be determined.

Decision and phone tree

To be determined.

Contractor's contingency plan

To be determined.

Standby equipment or personnel

Tow trucks to be provided as per the contract special provisions.

TMP Implementation Costs & Funding Sources

To be determined.

Special Considerations (As Needed)

To be determined.

2. Roles and Responsibilities

The District Department of Transportation (DDOT) is responsible for the creation, implementation, and enforcement of this plan, which has been prepared in accordance with the "District of Columbia Work Zone Safety & Mobility Policy", dated October 2007. The following individuals are responsible for specific activities to carry out the plan (items in blue to be filled in for construction phase):

TMP Management. The persons responsible for the overall development and implementation of the TMP. The updated Rule (Rule) requires that both the agency and the contractor designate a trained person at the project level who has the primary responsibility and sufficient authority for implementation of the TMP.

Project Managers (design)	Ali Shakeri	(XXX) XXX-XXXX
	Mike Jelen	(XXX) XXX-XXXX
IPMA Team 4 Traffic	Asnake Negussie	(XXX) XXX-XXXX
	Kendrick Miles	(XXX) XXX-XXXX
TMP Manager (DDOT)	TBD	(XXX) XXX-XXXX
TMP Manager (Designer)	Josh Smith	(410) 583-6700
TMP Manager (Contractor)	TBD	(XXX) XXX-XXXX

Stakeholders. This committee provides input and information to the TMP manager, and assists in the decision-making process. Depending on the type and complexity of the project, the stakeholders committee may include the highway patrol, police, city traffic engineers, business representatives, transit and school representatives, as well as emergency and towing services.

Rest of List TBD in conjunction with Stakeholder Meeting

Approval Contacts. The persons who need to give final approval to the TMP or to components of its implementation.

District Department of Transportation	TBD	(XXX) XXX-XXXX
Lane Closure Permits	TBD	(XXX) XXX-XXXX
Mass Transit Administration		
Temporary Bus Stop Relocation	Gilbert Williams (202-673-1746)	
Washington Metropolitan Transit Authority		
Service/Route Changes	David Erion (202-962-1266)	
Temporary Bus Stop Relocation	David Brlansky (202-962-1937)	

The contractor shall contact Mr. Williams in MTA to develop alternate bus stop locations for the temporary impacts to transit service in the project area. Mr. Williams works directly with Mr. Erion and Mr. Brlansky who plan for service/route changes and bus stop changes, respectively. Mr. Williams, Mr. Erion and Brlansky will be the contacts for the service impacts and temporary bus stop relocations.

Maryland State Highway Administration, District 3

District Engineer	Darrell Mobley	(301) 513-7346
Assistant District Engineer – Traffic	Brian Young	(301) 513-7404
Lane Closure Permits	Augie Rebish	(301) 513-7350

Mr/Ms. TBD and Mr. Rebish shall be contacted at least one week prior to traffic switches and for approval of overnight lane closures to occur in their respective jurisdictions.

TMP Implementation Task Leaders. These are project engineers responsible for implementing specific tasks recommended by the TMP.

DDOT Press Officer/Director of Communications	Karen Le Blanc	(XXX) XXX-XXXX
IPMA Communication Specialist	Alberta Paul	(XXX) XXX-XXXX
Incident Management Coordinator	TBD	(XXX) XXX-XXXX

TMP Monitors. TMP monitors conduct windshield surveys (observations based on driving through the work zone) and site visits to assess firsthand the effectiveness of the phasing and staging plans and TMP strategies. They inform the TMP manager when strategies are not working according to plan.

TMP Monitors ..... Applied Research (Name(s) TBD)

Emergency Contacts. This lists the contact person(s) with each emergency service agency, including police, fire, and ambulance.

TBD in conjunction with Stakeholder Meeting

3. Project Description

Project Background

Figure 1 is an aerial photo showing existing conditions at the intersection of Eastern Ave. and Kenilworth Ave. The profile of Kenilworth Ave. is depressed to cross under Eastern Ave. at their intersection. The Eastern Ave. bridge crosses over all six lanes of Kenilworth Ave. in a single span, and it has a signalized intersection on top for turns between Eastern Ave. and the Kenilworth Ave. service roads. Ramps between mainline Kenilworth Ave. and its parallel service roads provide access between Kenilworth Ave. and Eastern Ave. Bordering the intersection on the northwest is the Kenilworth Aquatic Gardens, administered by the National Park Service.

Figure 1. Site Location

Project Type

The Eastern Ave. N.E. bridge over Kenilworth Ave. N.E. will be reconstructed. The existing bridge has a vertical clearance of approximately 15' over Kenilworth Ave. and has been struck by heavy vehicles several times in recent years. As a result, the bridge structure is damaged and deteriorating.

This is a significant project as defined by DDOT's "Work Zone Safety & Mobility Policy" because it is a project on an expressway that will "occupy a location for more than three days with either intermittent or continuous lane closures." One of the maintenance traffic (MOT) options described below and considered in detail in Section 5 involves continuous lane closures, and the other would require intermittent lane closures and diversion of another lane.

Project Goals & Constraints

The bridge will be rebuilt to provide a minimum clearance of 16'-0". An accelerated schedule for design and construction is necessary to minimize the risk to the traveling public. The new bridge will also be designed with aesthetic treatments and landscaping to provide a more pedestrian-friendly environment for the local community and a landmark gateway into Washington, D.C. from Maryland.

This project also involves the rehabilitation of a pumping station near Minnesota Avenue, but this work will not impact any roadways. Consequently, it is assumed that there will be no transportation management impacts from this portion of the work.

Limited space for mainline Kenilworth Ave. traffic under the existing Eastern Ave. bridge, combined with heavy volumes on Kenilworth Ave. during the peak period, are key constraints associated with this project. Section 5 describes design alternatives that were investigated in order to deal with these constraints. After comparison of these design alternatives, a two-span bridge design with new piers constructed in the Kenilworth Ave. median was selected as the preferred design concept. This design will allow for increased vertical clearance under the bridge by providing shorter individual spans that require shorter girder depths. This will allow for the required under-clearance without lowering Kenilworth Ave. and with only minimal elevation increase to the Eastern Ave. and service road profiles.

Proposed Construction Phasing/Staging

Two alternative schemes were considered for the major portion of maintenance of traffic affecting mainline Kenilworth Ave.:

- **MOT Option 1** – close one of the three lanes in each direction on mainline Kenilworth Ave. for approximately one month to provide space for constructing piers in the Kenilworth Ave. median. The two-month duration is anticipated to be feasible based on the use of prefabricated structural components.
- **MOT Option 2** – provide space for constructing bridge piers in the Kenilworth Ave. median by diverting one lane in each direction from mainline Kenilworth Ave. on the Kenilworth Ave. ramps and service roads and shifting the remaining two lanes in each direction to the right.

After the approximately two-month period for constructing the bridge piers, both MOT Option 1 and MOT Option 2 could be implemented in conjunction with either full closure of the Eastern Ave. bridge or construction of the bridge deck in phases. These decisions were determined to be interrelated, however, and the decision of how to maintain traffic on Eastern Ave. was determined to be subordinate to the decision of how to maintain traffic on Kenilworth Ave.

Section 4 of this report describes existing and anticipated conditions used as input for the analysis of MOT Options 1 and 2. Section 5 describes in detail the analysis methods and how they were used to decide between the two options to select a preferred MOT alternative.

As described in Section 5, MOT Option 2 was selected as the preferred MOT alternative. Following is the anticipated sequence of construction for MOT Option 2[2]:

[2] Drawing MT 02 in the Maintenance of Traffic Plans governs should any discrepancy be found between this document and the maintenance of traffic plans

Phase 1A – Construct improvements needed for Phases 1B and 2A Maintenance of Traffic:

1. Construct temporary ramp from southbound Kenilworth Ave. service road to mainline southbound Kenilworth Ave. north of the pedestrian bridge near Douglas St.
2. Widen ramp from northbound Kenilworth Ave. service road to northbound mainline Kenilworth Ave. north of Eastern Ave.
3. Widen ramp from southbound mainline Kenilworth Ave. to southbound Kenilworth Ave. service road of Eastern Ave.
4. Modify signal and curb radius at intersection of southbound Kenilworth Ave. off-ramp and Nannie Helen Burroughs Ave. to accommodate revised traffic pattern and revised signal phasing for detour during Phases 1B through 6.

Phase 1B – Remove existing bridge superstructure

1. Continue work on Phase 1A Items 1-3 while proceeding to Phase 1B.
2. After completion of Phase 1A item 4, close Eastern Ave. bridge and detour traffic via Kenilworth Ave. service roads, Nannie Helen Burroughs Ave. interchange, and U.S. 50 interchange. Detour traffic from southbound Kenilworth Ave. off-ramp at Nannie Helen Burroughs Ave. to next ramp to the south via Kenilworth Ave. service road, Foote Place, and Kenilworth Terrace. Provide revised traffic flow pattern via U-turn lane and revised signal timing plan along Nannie Helen Burroughs Ave. to accommodate detour flows.
3. Detour pedestrian movements at Eastern Ave. bridge to pedestrian bridge over Kenilworth Ave. near Douglas St. and Polk Street.
4. Remove existing traffic signal at Eastern Ave. / Kenilworth Ave. intersection and provide stop sign control for through movement along northbound Kenilworth Ave. service road. Right turn movement from westbound Eastern Ave. to have right-of-way.
5. Close right lane on westbound Eastern Ave. to allow for adequate right turning radius for trucks at intersection.
6. Shift Kenilworth Ave. service road traffic to the outside and place temporary concrete traffic barrier along the center of each service road.
7. Remove existing Eastern Ave. bridge superstructure.
8. Widen northbound Kenilworth Ave. service road on the left side.

Phase 2A – Construct new storm drain manholes and pipes

1. Retain detours from Phase 1B.
2. After completion of all items in Phases 1A and 1B, shift the outside lane of traffic in each direction on mainline Kenilworth Ave. onto the service road ramps and along the inside half of the service roads, left of the barrier placed in Phase 1B.
3. Close the right lane in each direction on mainline Kenilworth Ave. under the Eastern Ave. bridge and construct MH-1, MH-2, MH-3, MH-5, MH-6, MH-7, and connecting 18” RCP storm drain pipes. See drainage and erosion and sediment control plans for details.

Phase 2B – Construct Eastern Ave. bridge piers in median of Kenilworth Ave.

1. Shift the left two lanes in each direction on mainline Kenilworth Ave. to the outside to create a 26’ wide area in the Kenilworth Ave. median for construction.
2. Construct MH-4 and MH-8 near the Kenilworth Ave. median. Construct 18” RCP storm drain pipe between MH-4 and MH-5 by closing additional lanes as necessary during nighttime hours only. See drainage and erosion and sediment control plans for details.

3. Construct the new bridge piers. Use prefabricated bridge components to minimize the duration of construction and the consequent impact to traffic. As necessary, close additional lanes on mainline Kenilworth Ave. during allowable hours only as per the contract special provisions for delivery and installation of prefabricated bridge components.

Phase 3 – Complete bridge construction

1. After completion of bridge piers, remove diversion of through traffic onto service roads and restore mainline Kenilworth Ave. to original conditions. Retain Phase 1B detours and temporary concrete barrier along service roads.
2. Remove temporary ramp from southbound Kenilworth Ave. service road to mainline southbound Kenilworth Avenue.
3. Resurface mainline Kenilworth Avenue and install final proposed pavement markings.
4. Complete construction of bridge abutments and superstructure.
5. Construct inside half of southbound Kenilworth Ave. service road to final grade.
6. Wedge and level along northbound Kenilworth Ave. service road for Phase 4 traffic transition over new approach slab.

Subphase 3A – Reconstruct Kenilworth Ave. service roads

1. Retain all vehicular traffic patterns and vehicular traffic control devices from Phase 3.
2. Near the end of Phase 3 and concurrent with other Phase 3 work, close crosswalk across Eastern Avenue at northbound Kenilworth Avenue service road intersection. Detour pedestrian traffic to crosswalk at Olive Street as shown.
3. On northeast and southeast corners of Eastern Avenue/northbound Kenilworth Avenue service road intersection and along southbound Kenilworth Avenue service road where shown, reconstruct curb, gutter, pedestrian ramps, and adjacent half of the sidewalks to proposed, elevated grade. Maintain minimum width on existing sidewalks for pedestrian passage adjacent to sidewalk construction as per contract specifications.

Phase 4 – Reconstruct Kenilworth Ave. service roads and Eastern Avenue

1. Retain detours from Phase 1B. Retain pedestrian detour from Subphase 3A.
2. Shift southbound Kenilworth Ave. service road traffic to inside half of service road constructed during Phase 3.
3. Shift northbound Kenilworth Ave. service road traffic to temporary alignment raised to final grade with wedge and level during Phase 3.
4. Reconstruct southeast quadrant of Eastern Ave. / Kenilworth Ave. northbound service road intersection to final grade while maintaining northbound through, northbound right turn, and westbound right turn movements.
5. Complete Phases 4 and 5 on consecutive days of the same weekend to minimize weaving conflicts between detour movements along northbound service road (which would cause unacceptable congestion during weekday peak hour periods). See special provisions for allowable hours.

Phase 5 – Reconstruct Kenilworth Ave. service roads and Eastern Avenue

1. Retain detours from Phase 1B. Retain pedestrian detour from Subphase 3A.
2. Open both lanes of traffic on southbound Kenilworth Ave. service road.
3. Detour northbound right turn movement at Eastern Ave. / Kenilworth Ave. northbound service road intersection via S Street and Olive Street.

4. Make Eastern Ave. temporarily one-way westbound for approximately 200 ft just east of Kenilworth Ave. northbound service road intersection.
5. Maintain one lane of traffic for right turns on westbound Eastern Ave. by shifting lane all the way to the left side of the roadway.
6. Reconstruct northeast quadrant of Eastern Ave. / Kenilworth Ave. northbound service road intersection to final grade while maintaining northbound through and westbound right turn movements.
7. Complete Phases 4 and 5 on consecutive days of the same weekend to minimize weaving conflicts between detour movements along northbound service road (which would cause unacceptable congestion during weekday peak hour periods). See special provisions for allowable hours.

Phase 6 – Complete intersection construction on top of new bridge

1. Retain detours from Phase 1B. Remove Phase 5 detour via S Street and Olive Street. Remove Subphase 3A pedestrian detour via Olive Street.
2. Construct final landscaping and intersection traffic islands left of northbound Kenilworth Ave. service road.
3. Construct remainder of proposed sidewalk on the northeast and southeast corners of the Eastern Avenue/northbound Kenilworth Avenue service road intersection. Maintain minimum width on newly constructed sidewalks and around new pedestrian ramps for pedestrian passage adjacent to sidewalk construction as per contract specifications.
4. Construct proposed traffic signal at Eastern Avenue/Kenilworth Avenue service road intersection. See signal plans for details.
5. Construct cantilever sign structure C-1 in gore between northbound Kenilworth Avenue and Eastern Avenue/northbound Kenilworth Avenue service road off-ramp.

Phase 7 – Restore pre-construction conditions along detour routes

1. Activate proposed traffic signal and open new intersection on Eastern Avenue bridge over Kenilworth Avenue to traffic.
2. Remove all detours.
3. Restore pre-construction conditions along Kenilworth Ave. service roads and along Nannie Helen Burroughs Avenue as shown.

Special Considerations

Due to the unusual nature of the traffic control plan strategy, the following items will be included in the traffic control plans to ensure maximum driver comprehension and safety:

1. Major temporary changes to overhead signing to indicate the ramps are to be used temporarily by through traffic. Some traffic exiting at interchanges just downstream of the project (Nannie Helen Burroughs Ave., U.S. 50, MD 201) will need to be directed to use the lane right of the "split". Existing traffic volumes exiting at those interchanges will be checked to see if they exceed the capacity of the right temporary lane on the service road.
2. Pavement on the service roads will need to be reconstructed at least in spot locations to be suitable for higher speed traffic.
3. Temporary reduced speed limits and speed cameras will be considered for enforcement to limit speeds across all three through lanes to the maximum safe design speed on the service road. Rumble strips will be considered for warning drivers of the reduced speed condition.

4. Traffic barrier and a visual/noise screen will be used between the two lanes of traffic on the Kenilworth service roads to separate the inside lane with temporary freeway traffic from the outside lane to be maintained for local traffic.
5. Impacts to truck turns from driveways and side streets onto the service road will be investigated. If the barrier between service road lanes does not leave enough space for right turns by a single-unit truck, the service roads will be widened into the 12-foot grass strip between the service roads and the top of the retaining walls.
6. Parking on the service roads will be temporarily restricted.
7. Pedestrian movements that normally occur across the existing bridge would need to be restricted also. Pedestrians will be detoured south to the pedestrian bridge across Kenilworth Ave. just south of Douglas Street and Polk Street. Screens of the type generally used to restrict glare or shield drivers' view from activities in the work zone will be mounted atop the barrier between the local and expressway lane along the service roads, as described in item 4 above, so that pedestrians are further discouraged from unauthorized entry into either the expressway lanes or the work area.
8. Consideration will be given to limiting Phase 2 to the summer months when Congress is not in session and peak hour traffic heading into Washington, D.C. will consequently be somewhat lighter. Also, there are several schools in the vicinity, and so avoiding months when school is in session would avoid school children needing to use the pedestrian detour.

General Schedule and Timeline

Refer to the contract special provisions for the required completion time.

Need for Detours

All left turns at the Eastern Ave. / Kenilworth Ave. intersection will have to be detoured to facilitate using the inside halves of the ramps and service roads as through lanes for expressway traffic. If turning movements were maintained at this intersection, temporary signals would need to be used to assign right-of way alternatively to the ramp turning traffic and the expressway lanes diverted onto the service roads. This would effectively negate the diverted lane's ability to function as an expressway lane and it would be consequently underutilized by drivers because of the extra delay experienced on it. The traffic control plan would then become effectively very similar to simply closing one of the three lanes on Kenilworth Ave. (see MOT Option 1 considered in Section 5 of this TMP).

The surrounding local road network and proposed detour routes are shown in Figure 2. The left turning movement from westbound Eastern Ave. to southbound Kenilworth Ave. will be detoured to turn right onto the northbound Kenilworth Ave. service road, merge onto northbound MD 201, and U-turn via the loop ramps at the U.S. 50 interchange in Maryland to return to southbound DC 295. The left turning movement from southbound Kenilworth Ave. to eastbound Eastern Ave. will be detoured by having traffic continue south on the southbound Kenilworth Ave. service road to Nannie Helen Burroughs Ave., turn left at Nannie Helen Burroughs Ave., and then turn left again to return to Eastern Ave. via northbound Kenilworth Ave. Signal timing will be temporarily modified at the Nannie Helen Burroughs Ave. intersections to accommodate the detour flows.

Figure 2. Project Location, Local Surroundings & Detour Routes

Related Projects

MD 201 over Amtrak - The Maryland State Highway Administration is currently reconstructing the MD 201 bridge over Amtrak's railroad lines just north of the Eastern Ave. project's limits. The new bridge will increase the number of lanes in the southbound direction from three to four. A continuous auxiliary lane will be provided along southbound MD 201 from the eastbound U.S. 50 off-ramp to the off-ramp for Eastern Ave. just north of the Maryland / D.C. line to replace the no merge area condition that existed prior to the project. Construction is expected to be complete by December 2008. Proposed

signing and pavement marking conditions from SHA's project will be used when developing detailed traffic control plans for the Eastern Ave. project.

Kenilworth Ave. over Nannie Helen Burroughs Ave. - DDOT is currently reconstructing the Kenilworth Ave. bridges over Nannie Helen Burroughs Ave. just south of the Eastern Ave. project's limits. Construction is expected to be complete by April 2009. A movable barrier / reversible lane system on mainline Kenilworth Ave. is providing three lanes for traffic southbound during the morning peak hour and three lanes for northbound traffic during the evening hour while maintaining two lanes in the off-peak direction. As part of the reconstruction, the intersections of Nannie Helen Burroughs Ave. with the Kenilworth Ave. ramps and service roads are being reconstructed to provide additional capacity. As it is expected this project will be complete just before the Notice to Proceed date for the Eastern Ave. project, proposed signing and pavement marking conditions from this project will be used when developing detailed traffic control plans for the Eastern Ave. project. These proposed conditions will also be used when designing revised signal timing for the Phase 1B-6 detour.

Nannie Helen Burroughs Ave. from Kenilworth Ave. to Eastern Ave. - DDOT is currently designing improvements as part of this Great Streets Initiative project. This project is expected to include installation of new PEPCO utility lines in the vicinity of the detour route along Nannie Helen Burroughs Avenue. This work and all other work in the immediate vicinity of the detour-related traffic control devices for the Eastern Avenue over Kenilworth project must be completed either prior to the beginning of Phase 1B or after the end of Phase 6 so as not to conflict with the maintenance of traffic and the avoidance of excessive congestion along the detour route.

Minnesota Ave. from Sheriff Road, N.E. to Good Hope Road, S.E. - DDOT is currently designing improvements as part of this Great Streets Initiative project. This project will include the intersection of Minnesota Ave. and Nannie Helen Burroughs Ave., which is approximately 300 ft from the intersection of Nannie Helen Burroughs Ave. and the northbound Kenilworth Ave. service road. The signals along Nannie Helen Burroughs Ave. at the Kenilworth Ave. ramps and at Minnesota Ave. are coordinated, and the Minnesota / Burroughs intersection is the most constrained of these signals in terms of capacity during the evening peak hour. DDOT has indicated that capacity improvements at this intersection are not anticipated as part of the Great Streets project. Signal timing at this intersection will need to be modified in conjunction with signal timing modifications at the other Nannie Helen Burroughs Ave. intersections for the Phase 1B-6 detour.

This project is anticipated to be scheduled after the completion of the Eastern Avenue over Kenilworth Avenue project, so conflicts in construction scheduling are not expected.

Related Project Coordination

Normally, it is desirable to schedule adjacent construction projects simultaneously if they are situated consecutively along the roadway. In this way, any bottleneck in capacity is felt only upon encountering the first project and the two projects appear as one to the roadway user. However, if adjacent projects are along parallel routes, it is desirable to schedule them at different times so that one route can handle an increase in traffic due to diversion from the other route during construction.

Nannie Helen Burroughs Ave. is situated such that during the Phase 1B-6 detours it is likely to carry some diverted traffic originating just south of Eastern Ave. for those who find it more convenient than the signed detour up to U.S. 50 and back. The U.S. 50 detour will be signed primarily for the

convenience of trucks and unfamiliar drivers, and it would be inappropriate to direct these vehicles through local, residential streets to get from Eastern Ave. to Nannie Helen Burroughs Ave. But it should be anticipated that many drivers familiar with the area will ignore the posted detour after a few days and divert to Nannie Helen Burroughs Ave. So, if possible the Nannie Helen Burroughs Ave. project should be scheduled such that construction activity is avoided or minimized during the Eastern Ave. project.

Minnesota Ave. south of Nannie Helen Burroughs Ave. is situated such that it is not expected to receive any diverted traffic from the Phase 1B-6 detour movements. Thus, it may be desirable to schedule work along Minnesota Ave. south of Nannie Helen Burroughs Ave. at the same time as the Phase 1B-6 detours are in effect.

Such scheduling would have the added potential benefit of reducing complaints from motorists approaching the Minnesota / Burroughs intersection from the north, south, or east. When the Phase 1B-6 detour is in effect for the Eastern Ave. project, revised signal timing will negatively impact users of this intersection. Those entering this intersection from the west after traveling along southbound Kenilworth Ave. and eastbound Nannie Helen Burroughs Ave. will see the detour signs to Eastern Ave. and will thus be more likely aware of the reason for the detour and the revised signal timing.

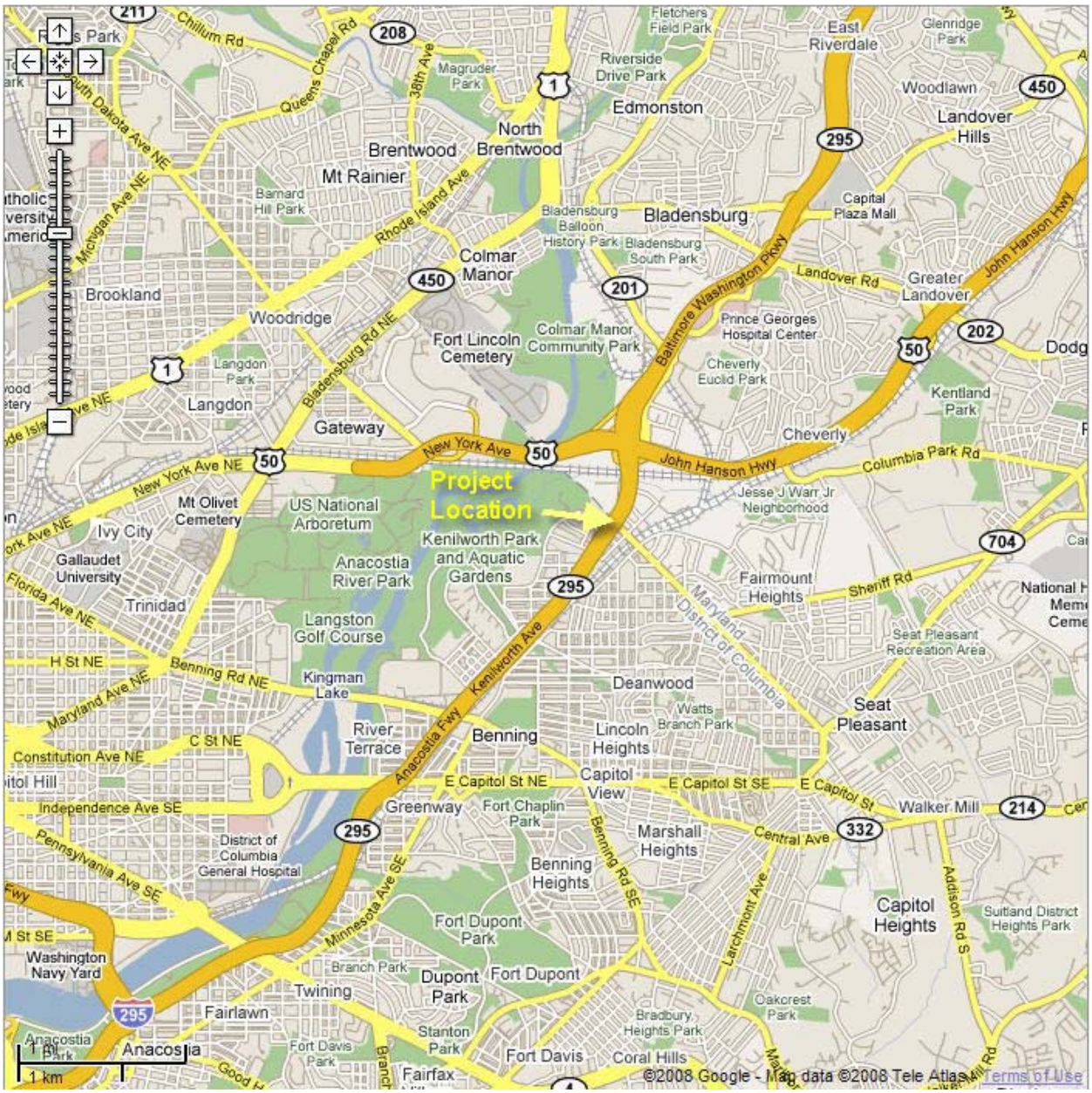
However, others entering the Minnesota / Burroughs intersection will not have visual cues about why the intersection performance has been degraded and may be frustrated by this in the absence of visible construction work. If the work from the Minnesota Ave. Great Streets project is active and visible, it may help to both meter traffic into the over-capacity intersection and to reduce driver frustration about a delay that might otherwise appear to be without cause. However, it is understood that the Minnesota Avenue project is on a delayed schedule relative to the Eastern Avenue project, so this may not be feasible.

4. Existing and Anticipated Construction Conditions

Existing Roadway Characteristics

Figure 3 is a map of the project location and the surrounding region. Kenilworth Ave. N.E. (DC 295) is a six-lane principal urban expressway that serves as a primary north-south gateway between Washington D.C. and Prince George's County, Maryland. It carries an average annual daily traffic of approximately 140,000 vehicles/day. Kenilworth Ave. is the only expressway facility available for trips between downtown Washington, D.C. and points to the north and east. U.S. 50 (John Hanson Highway / New York Ave.) just to the north feeds a large portion of the traffic on the subject segment of DC 295.

Figure 3. Project Location & Surrounding Region



Through the study area, two one-way, 24'-26' wide service roads run parallel to Kenilworth Ave. on either side, providing local access to homes and businesses. (See Figure 2 in the previous section for a larger-scale view of the project area and local surroundings).

Eastern Ave. N.E. is a minor arterial (as per DDOT's online Functional Classification Map) that runs in a northwest-to-southeast direction (henceforth referred to as east-west for simplicity in this report) beginning at Kenilworth Ave. and continuing southeast along the boundary between Washington, D.C. and Prince George's County, Maryland.

Figure 2 shows the location of the Deanwood Metro Station just to the south of the project site. Figures 2 and 3 also illustrate the key location of the Kenilworth Ave. / Eastern Ave. interchange. Because of the limited number of bridge crossings over the Anacostia River to the west of the Kenilworth Ave. corridor and the limited number of crossings of WMATA's at-grade orange line rail tracks to the east, disruption to operations at the subject interchange will affect both local and regional trips.

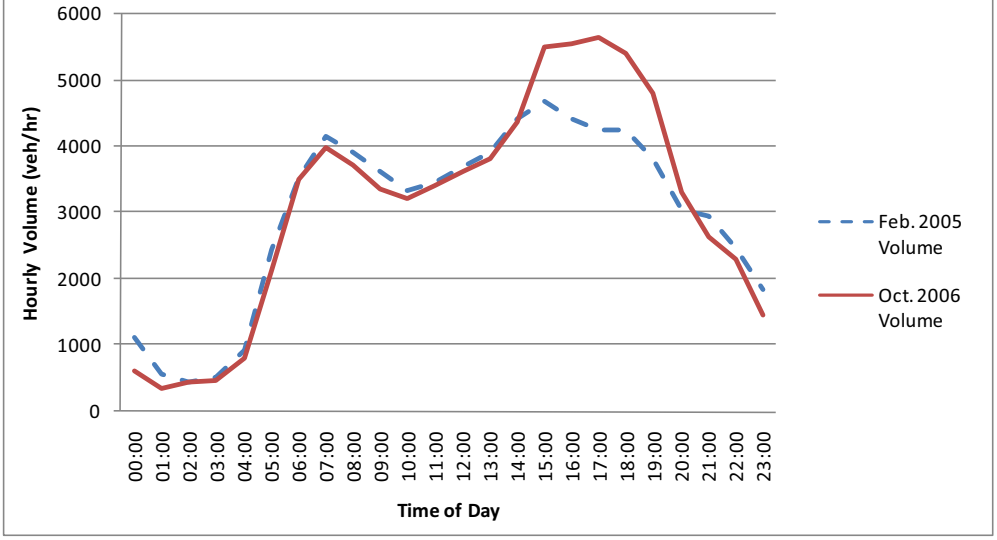
Existing and Historical Traffic Data

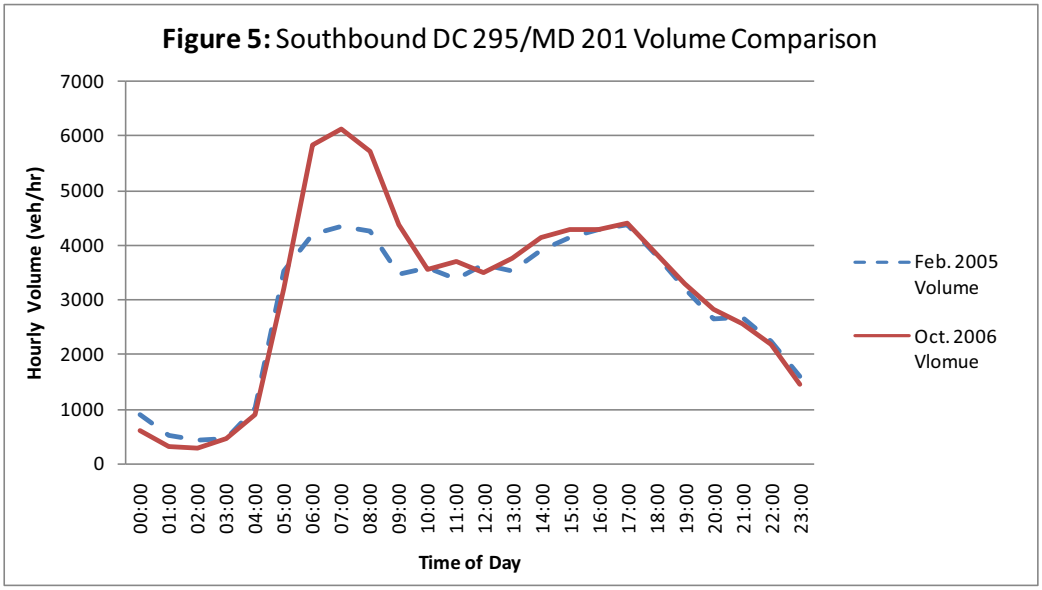
Volumes - Existing traffic volume data for locations within the project area are available from various sources. Automated machine counts along mainline Kenilworth Ave. north of Eastern Ave. were examined from two sources:

1. 72-hour counts taken in February 2005 for DDOT's Kenilworth Avenue Corridor Study
2. 48-hour counts taken in October 2006 by the Maryland State Highway Administration (SHA)

Figures 4 and 5 compare the counts from these two sources.

Figure 4: Northbound DC 295/MD 201 Volume Comparison





Figures 4 and 5 show a dramatic increase in the peak period, peak direction volumes on Kenilworth Ave., with the 2006 counts being significantly higher in the peak period and peak direction. To be conservative and because they are more recent, the 2006 counts will be used for all further analysis of mainline Kenilworth Ave. volumes.

At the Kenilworth Ave. / Eastern Ave. intersection and along the Kenilworth Ave. service roads, recent count data is available from three sources:

1. Machine counts at ramp locations along the Kenilworth Ave. service roads taken by O.R. George and Associates for DDOT's Kenilworth Avenue Corridor Study in October and November 2004
2. Turning movement counts taken at the Kenilworth Ave. / Eastern Ave. intersection by O.R. George and Associates for DDOT's Kenilworth Avenue Corridor Study in October 2004
3. Turning movement counts taken by Sabra Wang & Associates at the Kenilworth Ave. / Eastern Ave. intersection in May 2006 for the earlier Kenilworth Ave. at Eastern Ave. study

Examination of this data revealed that traffic volumes at the Kenilworth Avenue / Eastern Avenue intersection were higher in the first two data sets from 2004 than in the more recent data collected in 2006. To be conservative for purposes of this study, the 2004 volumes will be used even though they are older, in case some artificial constraint such as a traffic incident or construction project constrained demand during the 2006 data collection.

The detour routes proposed for MOT Option 2 in Section 3 above require significant volumes of traffic to be routed along Nannie Helen Burroughs Ave. Counts along Nannie Helen Burroughs Ave. were obtained from the following sources:

1. Turning movement counts taken at intersections along Nannie Helen Burroughs Ave. by O.R. George and Associates for DDOT's Kenilworth Avenue Corridor Study in October 2004 and February 2005

2. Turning movement counts taken by A. Morton Thomas & Associates at the Minnesota Ave. / Nannie Helen Burroughs Ave. intersection in October 2006 as part of the Minnesota Ave. Great Streets project

Though the Nannie Helen Burroughs Ave. at Minnesota Ave. intersection is not directly along the detour route, it is located only about 300 feet east of the Nannie Helen Burroughs Ave. / Kenilworth Ave. northbound ramp intersection and is part of a coordinated signal system that includes the three signals along Nannie Helen Burroughs Ave. that will be carrying detour traffic. The volumes at this intersection are significant for determining whether they will govern the operation of the signal system that will be in place at the time of construction and thus have an impact on how detour signal timing should be designed.

The two sources above both had very similar traffic volumes for the Nannie Helen Burroughs Ave. / Minnesota Ave. intersection.

Figure 6 shows AM and PM peak hour traffic volumes for the relevant locations in the project area. Since at least 13 hours of count data was available for each of these locations, this hourly demand data will be used in the analysis described in Section 5 in addition to the peak hour data shown for evaluation of both the pre-construction baseline conditions and the proposed MOT conditions to give better estimates of daily delay instead of just peak hour delay.

Speed – The posted speed limits in the project area are 45 MPH on mainline Kenilworth Ave., 30 MPH on the Kenilworth Ave. service roads, and 25 MPH on Eastern Ave. DDOT's online speed study map, dated April 12, 2007, indicates that measured 85th percentile speeds are 61 MPH along mainline Kenilworth Ave. and 37 MPH on Eastern Ave. Informal field observations by G&O indicated that 85th percentile speeds along the Kenilworth Ave. service roads would likely be between 40 and 50 MPH.

Heavy Vehicles - The Kenilworth Ave. corridor study completed for DDOT in 2006 found that on Kenilworth Ave. at Eastern Ave., 4.9% of daily northbound vehicles were trucks and 6.3% of daily southbound vehicles were trucks. The study was conducted over three consecutive days. Peak hour truck percentages were between 4.1% and 7.1%. To be conservative and for simplicity in the analysis to be described in Section 5, 7% trucks will be assumed along Kenilworth Ave. and at all intersections throughout the study area.

Data Collection and Modeling Approach

No additional data collection was undertaken as part of this study. A baseline pre-construction model of the Kenilworth Ave. corridor was created in Synchro/SimTraffic to model the Kenilworth Ave. / Eastern Ave. interchange, the Kenilworth Ave. service roads and ramps south of the interchange, and the signals along Nannie Helen Burroughs Ave. that would be affected by MOT Option 2.

Synchro/SimTraffic was selected as the appropriate software model based on its ability to model and optimize coordinated signal systems, and because its ease of use lends itself well to meeting accelerated project schedule constraints associated with the urgency of avoiding additional overheight vehicle collisions at the Eastern Ave. bridge. Though SimTraffic can be used to model freeway systems, it is not generally regarded as being well-suited to this purpose compared to other models such as CORSIM that are very labor-intensive to set up. This was a drawback to using SimTraffic that was determined to be acceptable given the imperative nature of the project schedule and given that other methods (described

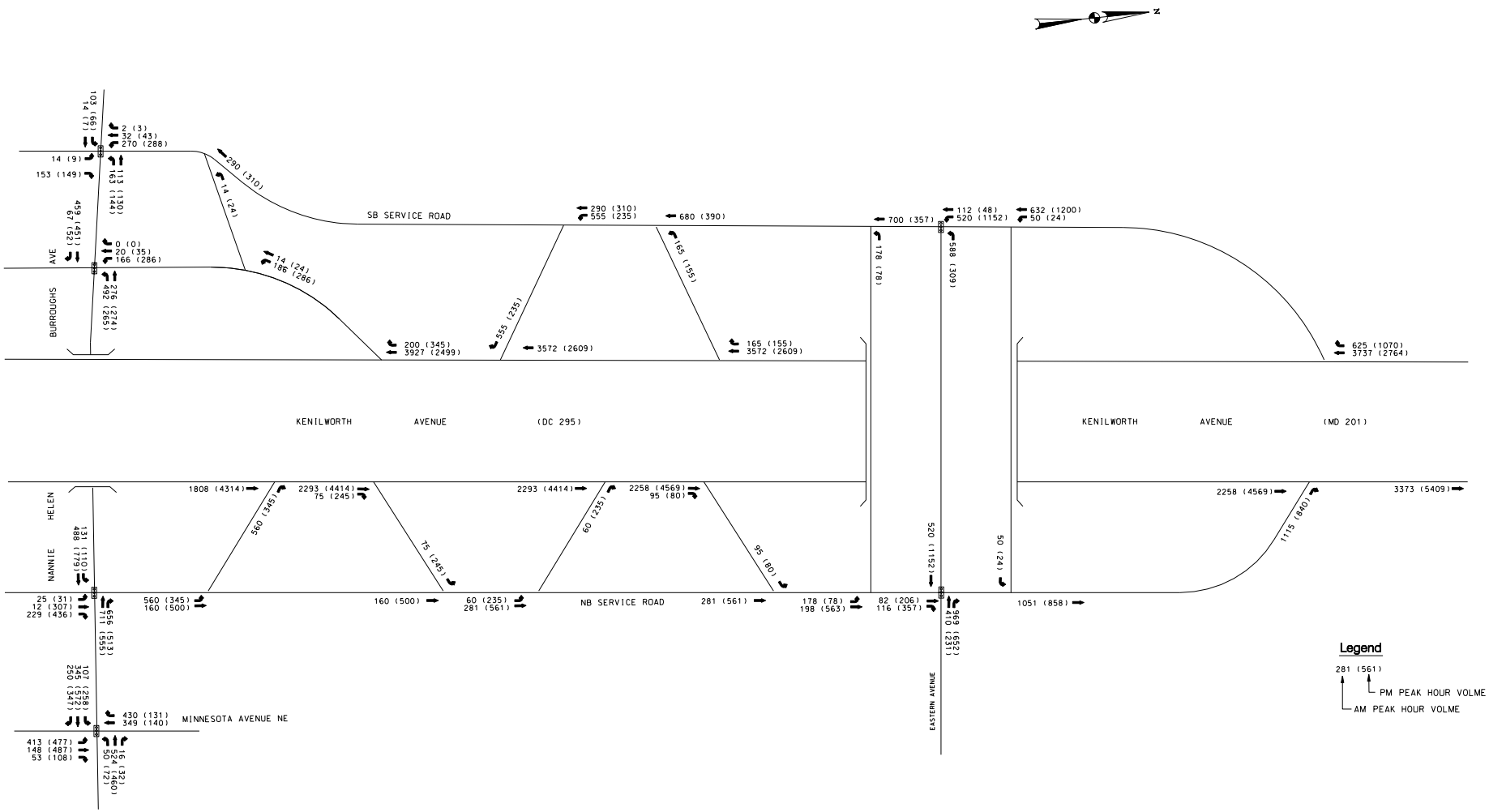


Figure 6: Baseline Pre-Construction Traffic Volumes

NOT TO SCALE

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later in Section 5) would be available for estimating the delay caused on the expressway portion of the network.

Figure 7 is a screen capture from Synchro that illustrates the extent of the network modeled. To be comparable in output to the LCAP software described in Section 5 for estimating reduction of freeway capacity, 13-hour traffic count volumes were prepared for each intersection in the Synchro/SimTraffic network in one-hour intervals in a format that could be read by the software. Signal timing plans were also prepared in a format that could be read in automatically. The resulting 13-hour simulations that were recorded thus reflected the variations in traffic flow throughout the day instead of just capturing the peak hour as is done for more traditional simulation analysis.

Existing Traffic Operations

Mainline Kenilworth Ave. operates in a free-flow condition without traffic controls. The ramps to Kenilworth Ave. operate under yield control. Most of these ramps have no merge area or very short merge areas which contribute to congestion during peak periods.

Stop control exists on side streets intersecting with the Kenilworth Ave. service roads, and the intersection of the southbound service road with Nannie Helen Burroughs Ave. and Kenilworth Terrace is also stop controlled.

Existing signal timing data was obtained from DDOT for the signalized intersections in the study area. At the intersection of Eastern Ave. and the Kenilworth Ave. service roads, the existing signal operates in pre-timed mode. The intersection of Nannie Helen Burroughs Ave. and the northbound Kenilworth Ave. service road operates in actuated-coordinated fashion, being coordinated with the signal at Nannie Helen Burroughs Ave. and Minnesota Ave.

Crash Data

Crash data from 2001-2003 indicates a crash rate of 156 crashes per Million Vehicle Miles Traveled on the segment of Kenilworth Ave. south of Eastern Ave. (We can insert some more recent crash data along mainline Kenilworth Ave. if DDOT can provide it).

For the intersection of Eastern Ave. and the Kenilworth Ave. service roads, accident data was obtained from DDOT for a three year period. The data indicates that there were a total of 70 accidents in the three year study period between 2003 and 2005. The table below presents the accident data:

Year	No. of Accidents
2003	19
2004	28
2005	23

Figure 8 presents the graphical representation of the collision types. As can be seen, rear-end type accidents represent the highest proportion making up approximately 40% of all the reported collisions. Sideswipes, left turn accidents, broadsides, and fixed object accidents make up the next largest

Figure 7: Baseline Pre-Construction Synchro Network

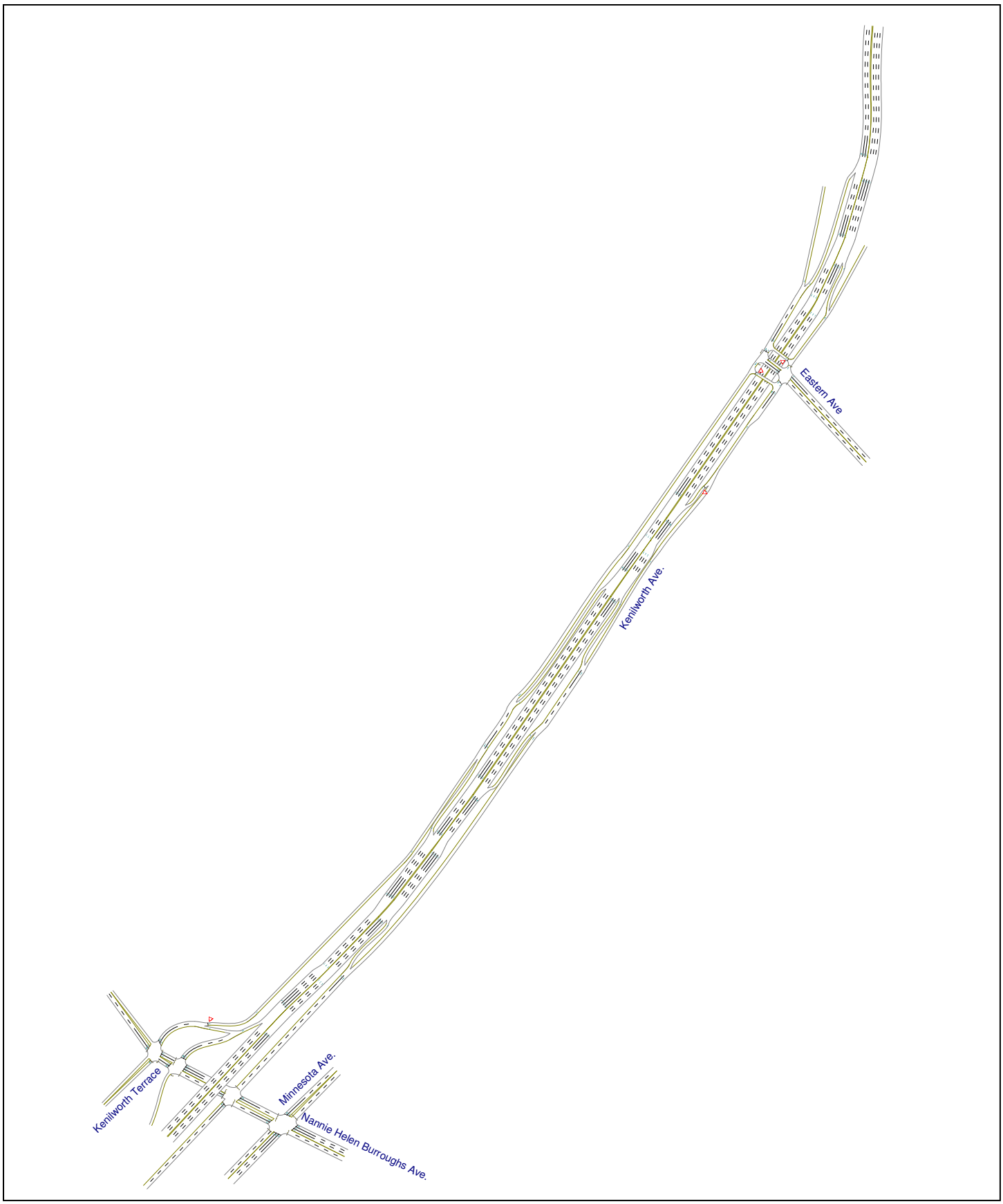

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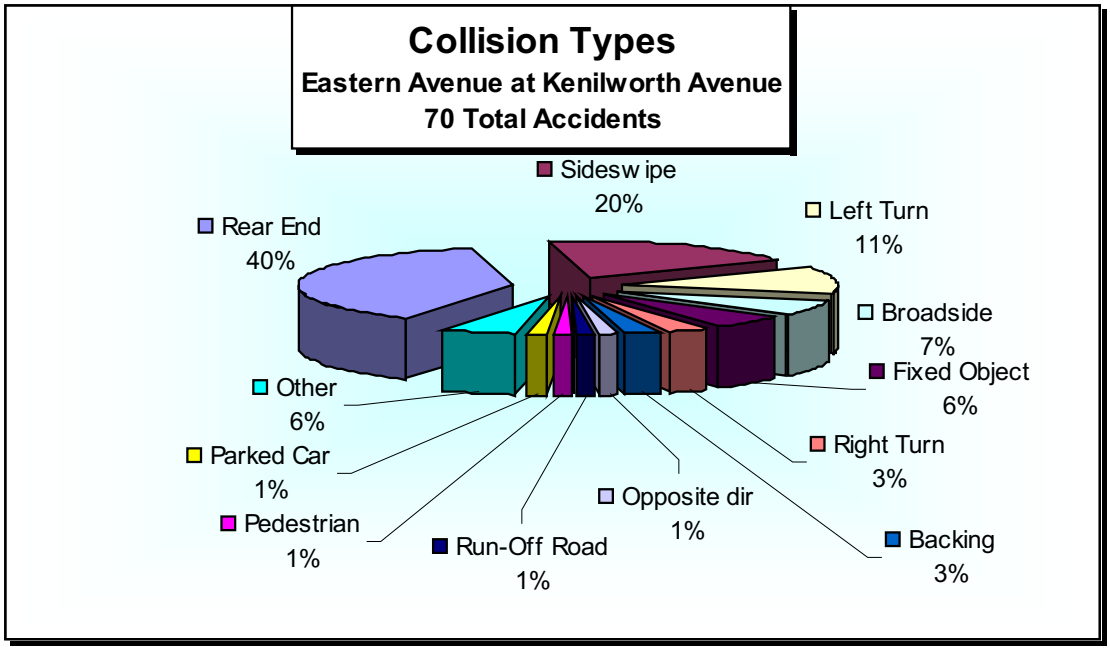
Figure 8. Collision Types



categories and represent approximately 44% of the accidents. There was one pedestrian collision reported at this intersection.

Almost 50% of the accidents occurred between the hours of 6:30 pm and 7:30 am indicating that lighting and/or poor visibility of the signals may have had an impact. However, field observations have indicated street lights at this intersection.

The degree to which safety is affected by the selected MOT Option is largely a corollary to which option is expected to produce the most congestion. Longer delay will result in increased driver frustration and aggressiveness, and longer duration of congestion will likely increase the incidence of queues and rear-end accidents, particularly on mainline Kenilworth Ave.

However, some additional degradation of safety must be assumed for MOT Option 2 because of the relatively unusual pattern of dividing the lanes with all lanes proceeding through. Drivers who do not see or comprehend the posted signs related to this temporary condition may make erratic and dangerous movements as they approach the gore area for the lane split in order to get in the lane they perceive is correct for their intended destination.

Stakeholder Concerns/Issues

Under MOT Option 1, a concern for the Maryland State Highway Administration would be additional congestion backing up from southbound DC 295 at the project site onto southbound MD 201 and westbound U.S. 50, particularly during the AM peak hour. Spillback would be a similar concern for the U.S. National Park Service, which operates the Baltimore-Washington Parkway (MD 295).

Under MOT Option 2, parking would need to be restricted along the Kenilworth Ave. service roads, and bus stops would need to be temporarily relocated. Coordination with WMATA would be required for the bus stop relocation. School transportation and emergency responder officials would need to be advised of the detours.

Traffic Predictions during Construction

With construction anticipated to begin within 12 months, traffic volumes are not expected to change significantly. As mentioned in Section 3 above, the MD 201 over Amtrak and Kenilworth Ave. over Nannie Helen Burroughs Ave. projects are expected to be complete prior to the beginning of construction for the subject Eastern Ave. bridge project over Kenilworth Ave.

Of relevance for MOT Option 2, the current Kenilworth Ave. project includes a ramp and two new signalized intersections being constructed to replace a single unsignalized intersection between Nannie Helen Burroughs Ave. and the southbound Kenilworth Ave. service road. The new signals will be part of the coordinated signal system that currently includes the existing signal at Nannie Helen Burroughs Ave. and the northbound Kenilworth Ave. service road and the existing signal at Nannie Helen Burroughs Ave. and Minnesota Ave. See Figure 9 for an aerial photograph of the intersections along Nannie Helen Burroughs Ave. Figure 7 shows the future, baseline geometry of the ramps and intersections at this interchange.

The A. Morton Thomas & Associates study for the Minnesota Ave. Great Streets project indicated that the Nannie Helen Burroughs Ave. / Minnesota Ave. intersection is significantly over capacity, with LOS F (115 seconds of delay/vehicle in the AM peak hour and 130 seconds of delay/vehicle in the PM peak hour). Programmed improvements at this intersection for the Minnesota Avenue Great Streets Project will improve AM capacity (improving LOS to E and reducing delay to 77 seconds/vehicle) but will have no affect on PM capacity since the primary direction of travel in the PM peak hour is eastbound and the WMATA Orange Line bridges make capacity expansion on the eastbound approach cost prohibitive. In any case, these programmed improvements are not expected to be complete or even underway by the time construction begins on the subject project and the signal system under MOT Option 2 would need to be modified to accommodate detour flows.

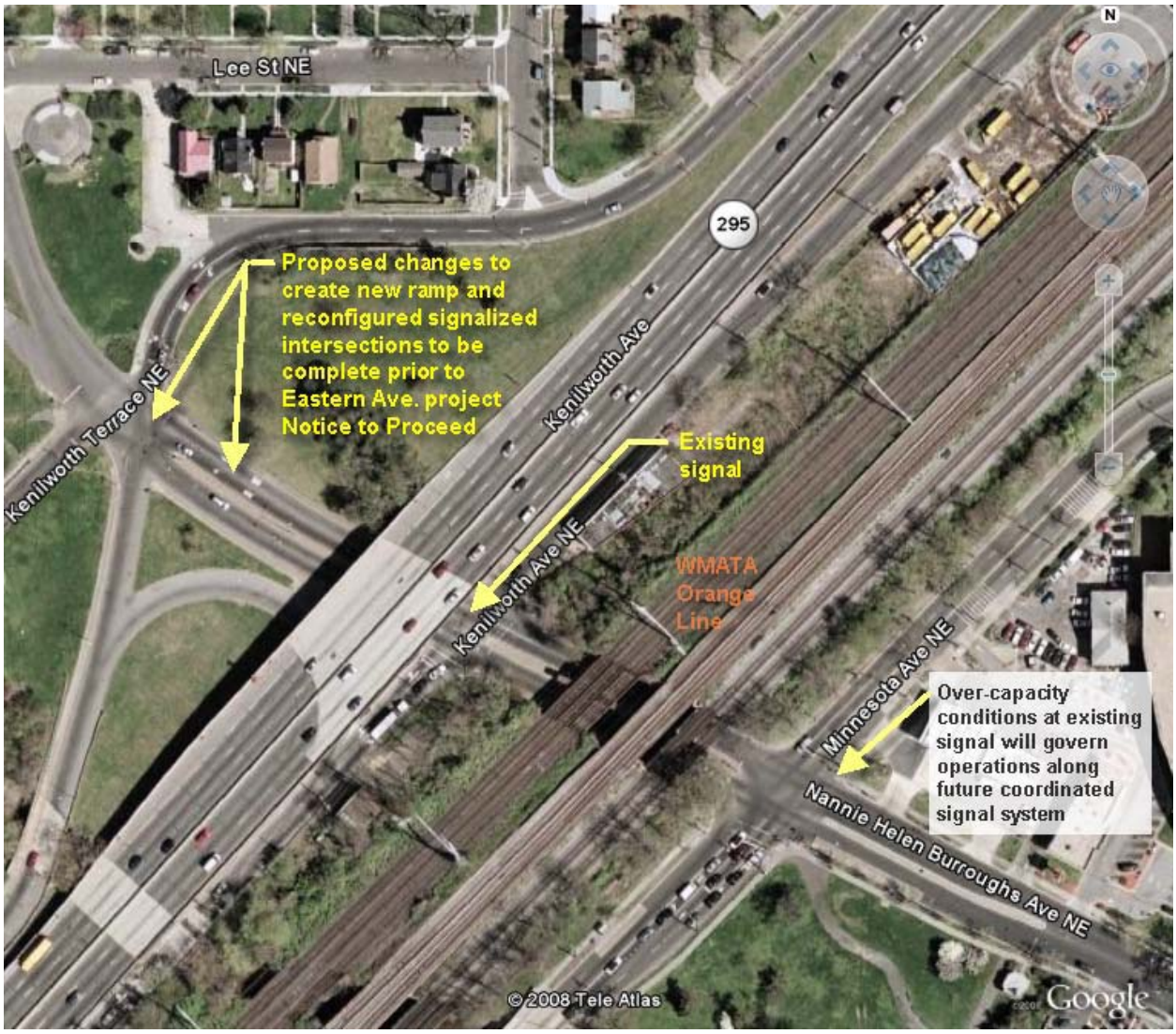
Some inconsistencies were identified in the draft signal timing plan provided by DDOT for the Nannie Helen Burroughs Ave. system. As such, G&O used the Synchro software to produce optimized signal timing plans that were used in the SimTraffic model.

A two-month period was selected as the basis for comparing delay values for the baseline pre-construction conditions vs. the proposed conditions during construction that will be described in Section 5. A two-month period was selected because that is the approximate time it is expected to complete construction of the piers in the Kenilworth Ave. median.

The SimTraffic model described above and shown in Figure 7 estimated a total delay of 12,993 vehicle-hours for the 13-hour period recorded between 6 AM and 7 PM. This delay value was multiplied by a factor of 1.5 to arrive at a 24-hour delay estimate of 19,490 vehicle-hours, assuming that overnight volumes will be roughly half as much as during the daytime. In viewing the animations produced by the simulation software, most delay was observed to occur during the peak periods. Assuming that weekend volumes would be lower and weekend delays would thus be negligible, multiplying this value by 22 weekdays per month for two months yields a total two-month delay estimate of 857,538 vehicle-

hours for the study area network. This value will serve as the basis of comparison for the analysis of construction scenarios in Section 5 that follows.

Figure 9. Nannie Helen Burroughs Ave. intersections



5. Work Zone Impacts Assessment Report

Qualitative Summary of Anticipated Work Zone Impacts

MOT Option 1, described in Section 3 above, is anticipated to create severe queuing, congestion, and spillback on Kenilworth Ave. and other facilities nearby and throughout the area north and east of downtown Washington, D.C. As such, a Maintenance of Traffic Alternatives Analysis (MOTAA) has been undertaken to compare MOT Option 1 with MOT Option 2, also described in Section 3.

MOT Option 1 is expected to have impacts to many other transportation system users besides those who normally drive on Kenilworth Ave. With a lane closed on Kenilworth Ave. during peak hours, drivers would divert to other parallel signal controlled arterial routes such as New York Ave., Rhode Island Ave., Bladensburg Road, and East Capitol Street, and cut-through traffic would likely increase on local streets in the vicinity of these arterials that are already over-capacity during peak periods. The congestion on these alternative routes would be multiplied to an extent that is outside the scope of this study to attempt to estimate or measure. Additional delay on the transit system may also occur due to peak hour capacity problems, and many trips diverted to transit will represent additional person delay for those who would normally use their vehicles.

MOT Option 2 is not expected to be without significant impacts. Increased delay will occur on both Kenilworth Ave. due to both the intensity of the work activity expected and due to the somewhat unusual nature of the proposed traffic pattern, with through lanes being diverted onto the ramps. Increased delays will also occur along the detour routes. Pedestrians will need to be detoured approximately 0.5 mile round-trip to the nearest pedestrian bridge over Kenilworth Ave.

However, the traffic movements being detoured are much less traveled than the primary movements on Kenilworth Ave. The delays on Kenilworth Ave. would be anticipated to be on the order of magnitude of a minor traffic incident of the type that occurs frequently in this corridor and is cleared from the roadway in a matter of minutes rather than a lane closure that lasts throughout the entire day. Pedestrian volumes observed at the Eastern Ave. / Kenilworth Ave. service road intersection in past studies have been small – just 23 pedestrians over a 13-hour period during O.R. George's 2004 traffic count. Consequently, the overall impacts of MOT Option 2 are expected to be much less than those for MOT Option 1.

Further refinements to MOT Option 2 have been considered in an attempt to minimize delay along Nannie Helen Burroughs Avenue during construction, as detailed in a memo attached to this report as Attachment 2.

Impacts Assessment of Alternative Project Design Strategies

Several design features have been investigated in the alternatives considered in the Eastern Avenue Bridge TS&L Study to provide greater clearance between the bottom of proposed bridge and the top of Kenilworth Ave.:

- **Lowering Kenilworth Ave.** Consideration was given to lowering Kenilworth Ave. to achieve the needed increase in clearance. This would avoid the need for constructing piers in the median. However, it was determined that extensive excavation on Kenilworth Ave. would need to be

undertaken. The cross section of Kenilworth Ave. is very constrained under the bridge, with three 11-foot lanes in each direction, a 2' concrete barrier median, 2' inside shoulders, 1' outside shoulders, and 4' clearance from the concrete curbs at the edges of the outside shoulders to the vertical abutment retaining walls. The foundations for the bridge abutments are too shallow to pursue this option without reconstructing the retaining walls of the bridge. During construction, this would impact traffic on both mainline Kenilworth Ave. and its service roads. Consequently, it was determined that maintenance of traffic would be too difficult and the project would be too expensive with this option.

- **Raising Eastern Ave. & Service Road Profiles.** This option would have replaced the existing single- span bridge with a new single span bridge and raised the profiles of Eastern Ave. and the service roads to be about 18" higher than existing to provide the additional clearance. However, this would have resulted in significant impacts to existing driveways and properties along Eastern Ave. and the service roads because of the close proximity of buildings to the edge of roadway. These impacts were deemed too great to warrant further consideration of this option.

- **Constructing Two-Span Bridge.** This option would achieve most of the necessary additional clearance by constructing a row of piers along the Kenilworth Ave. median barrier and providing a 2-span bridge, allowing for a reduction in the depth of the girders on the new bridge. The profile of Eastern Ave. and the Kenilworth Ave. service roads would still need to be raised by approximately 6" under this option, but this was determined to be feasible with the proximity of buildings along the service roads.

The third option, construction of a two-span bridge, was selected as the preferred alternative for the final bridge design and will be the only bridge design option treated in this Transportation Management Plan.

Impacts Assessment of Alternative Construction Approach & Phasing Strategies

Other design and construction method features have been considered to shorten the duration of construction and thus mitigate impacts to traffic:

- **Prefabricated Bridge Piers.** By constructing the piers at an off-site location and hauling them to the site for installation, the duration of impact to mainline Kenilworth Ave. could be reduced. Land immediately adjacent to the project site is not available for construction. The Kenilworth Aquatic Gardens property administered by the National Park Service was considered for this use, but the environmental and regulatory restrictions associated with the use of this site were determined to be a high risk to maintaining the critical accelerated project schedule. It was determined that the piers could be constructed off-site in components small enough to haul along Kenilworth Ave. as special "oversize" vehicle deliveries during overnight hours. Additional lane closures on Kenilworth Ave. would be needed at night to accommodate these delieveries and allow for crane set-up for lifting the piers into place.

- **Phased Construction of Bridge Deck.** In addition to the higher-impact decision of how to maintain Kenilworth Ave. traffic around the median pier construction (MOT Option 1 vs. MOT Option 2) exists the lower-impact decision of how to maintain the Eastern Ave. bridge traffic. The two decisions are intertwined because of the nature of MOT Options 1 and 2 described

previously. Consideration was given to removing half of the existing bridge deck, maintaining traffic on the other half, and constructing the new piers below in two phases. It was determined that this would lengthen the duration of impact to mainline Kenilworth Ave. Further, the option of maintaining the Eastern Ave. traffic would only be available under MOT Option 1 because the diverted expressway lanes in MOT Option 2 require that no turning movements be made at the Eastern Ave. intersection in order for them to function in a free-flowing manner.

If the detours and expressway lane diversions of MOT Option 2 were to be used for the pier construction without rebuilding the bridge deck at the same time, they would need to be implemented during construction of the first half of the new piers, removed to provide capacity while the first half of the bridge deck is reconstructed, and re-implemented in an additional sub-phase for constructing the second half of the piers after traffic is switched onto the first part of the bridge to be completed. Otherwise, it would be difficult or impossible to construct either pre-fabricated or normally constructed piers underneath the existing bridge structure. The additional sub-phase would add to the duration of construction and thus cause greater impact to traffic. Consequently, it was decided that this construction phasing strategy should only be considered in conjunction with MOT Option 1 if it is used.

Even with MOT Option 1, maintaining traffic on the bridge would be problematic. The skew of Eastern Avenue relative to the bridge girder lines (which must be perpendicular to Kenilworth Ave.) would require abrupt lane shifts in very constrained spaces even to maintain one lane in each direction across the bridge. The large volume of trucks using this bridge is not compatible with such constrained and abrupt lane shifts. Furthermore, by only maintaining one lane of traffic in each direction across the bridge, the reduction in capacity would cause heavy queuing. A rough SimTraffic model indicated the queuing would be particularly bad during the PM peak hour for the southbound left turn movement from the Kenilworth Ave. ramp to eastbound Eastern Ave., which would be reduced from two lanes to one. Queues may back up from the signal well beyond the beginning of the ramp and onto mainline Kenilworth Ave., which would already be congested due to the left lane closure for the pier construction.

- **Construction of Bridge Deck Adjacent to Site.** Consideration was also given to laying the proposed new bridge girders temporarily across Kenilworth Ave. at a location just to the north or south of the existing bridge and constructing the entire new bridge deck on top of these girders while maintaining all lanes of traffic both below and on the existing bridge. When this construction is complete, the bridge traffic would be detoured, the existing bridge would be demolished, and the new bridge girders and deck would be quickly moved into place using a system designed and constructed for that purpose.

  This option would likely add a great amount of expense to the project. While it would have the advantage of allowing Eastern Ave. to remain open during more of construction, it would have the disadvantage of requiring lengthier lane closures on Kenilworth Ave. Specifically, this option was determined to provide an advantage only under MOT Option 1, since in MOT Option 2 the location of the northbound diverted expressway lane would preclude the girders from being laid out for the bridge deck construction, meaning this work would have to wait until the diverted expressway lanes are returned to mainline Kenilworth Ave. By that time in the construction schedule, the new deck could already be constructed in place just as quickly and without the expense of later moving it. So, it was determined that this option should only be given further consideration if MOT Option 1 is selected.

Impacts Assessment of Alternative Project & Work Zone Management Strategies

In addition to the options already discussed, the following **Temporary Traffic Control Strategies and Devices** have been considered for this project:

- **Full Roadway Closures.** Full roadway closure of Kenilworth Ave., with one lane in each direction diverted/detoured onto the service roads, may be necessary for short-term overnight work such as demolition, installation of prefabricated bridge components, or construction of manholes and storm drain pipes underneath Kenilworth Ave. Analysis of allowable hours for these closures was conducted using Maryland SHA's Lane Closure Analysis Program (LCAP) to determine the allowable hours for each type of lane closure that are found in the contract specifications.

- **Reversible Lanes.** A reversible lane system is currently under use on mainline Kenilworth Ave. where it bridges over Nannie Helen Burroughs Ave. as part of that construction project. This system allows three lanes of traffic to be maintained in the peak direction while maintaining two lanes in the off-peak direction so as to provide the same peak-period, peak-direction capacity within a cross-section constrained by construction activity. This system is possible at the Nannie Helen Burroughs Ave. interchange only because the Kenilworth Ave. lanes bridge over the top of the interchange. With other design alternatives for the Eastern Ave. bridge that did not involve piers in the median of Kenilworth Ave., such a system may have been possible. However, construction of these piers leaves only four lanes available for traffic below the bridge. A reversible lane system in such circumstances would have to cut through the existing median barrier upstream and downstream from Eastern Ave. and would only be able to provide only one lane in the off-peak direction while providing three lanes for the peak direction. A quick examination of the recent traffic volumes on Kenilworth Ave. indicates that a single lane would not be sufficient for handling the demand volume of off-peak traffic. A single lane could also pose problems for emergency vehicle access in an incident. As a consequence of all these factors, a reversible lane system was eliminated from further consideration.

- **Ramp Closures.** MOT Option 2 includes ramp closures of the southbound Kenilworth Ave. ramp to Nannie Helen Burroughs Ave. and two of the ramps between Kenilworth Ave. and its service roads. These are necessary to provide for uninterrupted flow of detour traffic and to avoid heavy weaving movements along certain segments. The detoured movements have all been accounted for and modeled as described later in this section of the TMP.

- **Night Work.** Much of the work will need to be completed at night due to need to maintain heavy daytime volumes of traffic. Though part of the surrounding community is industrial and commercial, large residential areas are located southwest and northeast of the site. Construction noise and the impacts to nearby residences will need to be considered when determining what types of work activities will be allowed at night.

- **Weekend Work.** Much of the work may be feasible to complete on the weekends. However, weekend traffic volume data is not currently available for locations in this project area, so it has not been possible to quantitatively assess the impacts of allowing work during specific weekend hours.

- **Work Hour Restrictions for Peak Travel.** In both MOT Option 1 and MOT Option 2, the traffic patterns and barrier placement would need to remain static throughout the day. However, traffic capacity is impacted by the intensity of work activity occurring adjacent to the open lanes, as drivers are prone to slow down to observe construction or to avert perceived conflicts with moving machinery, etc. Consequently, we recommend that work activity within 12' of mainline Kenilworth Ave. should be prohibited completely between the hours of 5 AM and 9 AM and from 3 PM to 8 PM.

- **Pedestrian Access Improvements.** For MOT Option 2, the closure of the Eastern Ave. bridge would require pedestrians to detour about 0.5 mile round-trip to the south to use the existing pedestrian bridge over Kenilworth Ave. near Polk Street and Douglas Street. Brief consideration was given to providing a temporary pedestrian bridge closer to Eastern Ave. or to having the contractor pay for WMATA to have a free shuttle bus to circulate along the vehicular detour route to pick up and discharge affected pedestrians. However, the number of pedestrians making this crossing is low – O.R. George's intersection turning movement count at Kenilworth Ave. and Eastern Ave. in October 2004 counted only 23 pedestrians on the bridge for the 13 hours between 6 AM and 7 PM. Thus, the high cost of such temporary access improvements would outweigh the likely minimal benefits.

- **Temporary Guide Signs.** For MOT Option 2, significant temporary changes will be needed for overhead guide signing along Kenilworth Ave. to minimize potential confusion about the through lanes being diverted onto the ramps. **Changeable Message Signs** will also be used to help convey important warning and guidance messages related to the maintenance of traffic pattern and schedule.

- **Temporary Traffic Signals.** The existing signal at the intersection of Eastern Ave. and the Kenilworth Ave. service roads would be removed temporarily under MOT Option 2 and replaced with stop-sign control while the detours are in effect. Along Nannie Helen Burroughs Ave., temporary changes in the traffic signal equipment and operation will be needed to accommodate the detour flows.

The following **Project Coordination, Contracting, and Innovative Construction Strategies** have been considered:

- **A+B Bidding.** FHWA recommends considering A+B bidding to reduce construction time. Part A refers to the contractor's bid for the actual items of work, and Part B is the total of the number of days bid to complete the project multiplied by the daily road user cost stipulated in the contract. The combined values of the A and B portions determine the winning bid. The contractor's payment is based on both Part A and the actual number of days used under Part B.

- **Incentive/Disincentive Clauses.** FHWA recommends considering this strategy, which involves the use of incentives and/or disincentives in the construction contract to minimize construction duration.

- **Lane rental.** FHWA recommends considering this strategy, which involves a charge assessed to the contractor when a portion of the roadway is obstructed and unavailable to traffic. The lane rental charge can vary according to time of day, day of week, number of lanes impacted, and

duration. The contractor's bid includes an estimate of the number of hours that closures will be in place, with the actual payment to the contractor based on the actual use of closures.

Among these three options, a disincentive clause was selected based on the analysis shown in the memo in Attachment 2.

The following **Public Information Strategies** will be implemented for this project:

- **Construction newsletter** to be distributed by the contractor as specified in the contract special provisions.
- Lane closure / detour information on **DDOT's website**
- **Coordination** with media, schools, businesses, and emergency services (Needs to be updated above as per stakeholder list)

Phases 2A and 2B will involve an unusual traffic pattern where one through lane in each direction will use the off-ramp and service road to bypass the work area. In the southbound direction, this lane split will occur just beyond a horizontal curve. The somewhat restricted sight distance will enhance the need to increase driver awareness in advance of the work area. Consequently, other Public information Strategies that should be considered include:

- **Press releases/media alerts**, supplemented with graphics describing the proposed MOT layout for Phase 2
- **Coordination with Maryland SHA** (for MOT Options 1 or 2) and possibly Virginia DOT (for MOT Option 1 only) about the use of overhead variable message signs for displaying construction related messages (i.e. "LANE SHIFT ON DC 295 AT DC/MD LINE / CONSIDER ALTERNATE ROUTES")
- **Dynamic Speed Message signs**
- **Highway Advisory Radio**
- **511 Traveler Information Systems**
- **Wizard CB Alert System.** FHWA recommends consideration of this device that continuously broadcasts, over CB radio, a message that warns approaching drivers of the work zone ahead. The information can be broadcast over any selected CB channel, but since most truckers listen to channel 19, broadcasting over that channel means truckers generally have to take no action to receive the message. Truckers tend to find the system effective at alerting them to a work zone ahead so they can be prepared for altered conditions, such as lane closures, that may require them to change lanes or reduce speed.

The following **Transportation Operations Strategies** will be implemented for this project:

- **Temporary Parking Restrictions.** Temporary parking restrictions will be needed along the Kenilworth Ave. service roads under MOT Option 2.
- **Speed Limit Reduction / Variable Speed Limits.** Temporary speed limits will be in effect during MOT Option 2 Phases 2A and 2B, as shown in the maintenance of traffic plans.
- **Traffic screens.** Under MOT Option 2, traffic screens will be installed on top of the temporary concrete traffic barrier on the Kenilworth Ave. service roads that separates the temporary expressway lane from the lane maintained for local use. This will reduce driver distraction and thoroughly discourage pedestrians from crossing into the expressway lane.
- **Tow/freeway service patrol.** This will be included as per the contract specifications.

- **Incident/emergency response plan.** To be completed by the contractor as per the contract special provisions.

Because of the unusual traffic pattern occurring during Phases 2A and 2B, it is additionally recommended that automated speed enforcement be used during these phases.

Assumptions Made for Quantitative Comparison of Anticipated Work Zone Impacts

For this analysis the basic hypothesis being tested is that MOT Option 2 will result in less severe congestion than MOT Option 1. For testing this hypothesis, several conservative assumptions will be made to increase confidence in the result of the analysis. Specifically, where some uncertainty exists about forecast conditions during construction, modeling assumptions that err on the side of representing *reduced* congestion will be assumed for MOT Option 1 (best-case scenario), while modeling assumptions that err on the side of representing *additional* congestion (worst-case scenario) will be assumed for MOT Option 2.

If the hypothesis is proven correct and MOT Option 2, with expressway lane diversion and local detours, is proven to produce less congestion than MOT Option 1, with its closure of lanes on mainline Kenilworth Ave., then any error introduced by these conservative assumptions in the analysis would in effect "widen the gap" between the two options instead of creating the possibility that the preferred option would change.

MOT Option 1 – The following best-case scenario assumptions were made:

- 10% of all traffic on mainline Kenilworth Ave. would divert away from Kenilworth Ave. to other routes or other modes such as transit, or would cancel their trips.
- Any delay associated with these diversions would not be estimated or included in the analysis.
- The left-side on-ramp from southbound Kenilworth Ave. (MD 201) to southbound Kenilworth Ave. (DC 295), located about 0.30 miles north of the Eastern Ave. off-ramp, will not be impacted negatively by the left lane closure on southbound DC 295 at Eastern Ave.
- Operations on U.S. 50 will not be negatively impacted by queues spilling back from the southbound lane closure.
- Operations at interchanges further south along DC 295 at East Capitol Street, Benning Road, Nannie Helen Burroughs Ave., etc. will not be negatively impacted by queues spilling back from the northbound lane closure.
- Any delay that may occur on weekends is assumed to be negligible and will be ignored to be conservative and since weekend traffic volumes are not available.

Again, many of these assumptions are not very reasonable given that peak-hour peak direction volumes are near capacity without a lane closure at approximately 6,000 vehicles/hour on Kenilworth Ave. Nonetheless, the assumptions are introduced to simplify the analysis and increase confidence in the result of the hypothesis test described above.

MOT Option 2 – As described in Section 4 above, a Synchro/SimTraffic model was developed to model both the pre-construction baseline and proposed MOT conditions for MOT Option 2. The following worst-case scenario assumptions were made:

- No trip diversion, mode diversion, or trip cancellation would occur on mainline Kenilworth Ave. as a result of the work zone.
- Trips that would normally use the detoured movements would not be cancelled, divert to other modes, or divert to routes other than the signed detour routes.
- Mainline Kenilworth Ave. would experience a reduction in capacity due to the intensity of work in the area and the unusual nature of the "Lanes Divide / All Lanes Thru" work zone. This capacity reduction is assumed equal to 1,050 vehicles per hour, or a "half of a lane" and its effects will be estimated using the LCAP program.
- Weekend traffic volumes and delays will be assumed to be the same as weekday volumes and delays.

In reality, delay will be lesser on weekends and many trips normally using the detoured movements will likely divert to other routes. For instance, examination of the regional map in Figure 3 and the traffic volumes in Figure 6 assists in drawing the conclusion that during the PM peak hour, the majority of the heavy 1,150 veh/hr movement normally turning left from southbound Kenilworth Ave. onto eastbound Eastern Ave. likely have their trip origins in downtown Washington D.C. and use eastbound U.S. 50 to get to southbound Kenilworth Ave. This is because land use patterns make it unlikely that a large number of commuters working to the north or east would be using southbound MD 295 or westbound U.S. 50 to get to the residential areas along Eastern Ave.

From downtown Washington D.C., many of these normal users of Eastern Ave. destined for points south of Eastern Ave. may find their travel time shorter by using one of the other Anacostia River crossings and coming north on DC 295 to Nannie Helen Burroughs Ave. rather than traveling the full length of the signed detour to Eastern Ave before proceeding to their destination. Likewise, some destined for points far enough east along Eastern Ave. may find it easier to continue east on U.S. 50 past Kenilworth Ave. and use other interchanges and local streets to arrive at their destination.

Analysis Tool Selection Methodology and Justification

MOT Options 1 and 2, described in Section 3 above, involve different strategies that require different modeling approaches and analysis software.

MOT Option 1 would close the left lane in each direction on mainline Kenilworth Ave. to construct the median piers. A Synchro/SimTraffic model was not created for MOT Option 1 because the SimTraffic model was not expected to capture the full extent of delay represented by queues spilling out of the network with a full-time lane closure. Instead for this option, the Maryland State Highway Administration's Lane Closure Analysis Program (LCAP, Version 1.0) was used to estimate delays along mainline Kenilworth Ave. due to this lane closure.

The LCAP program implements the same analysis procedure as QuickZone, listed on page 3 of Appendix B of the "District of Columbia Work Zone Safety and Mobility Policy, October 2007" for freeway lane closure analysis, but using a simplified user interface for data input. The assumed work zone capacity is 1,490 vehicles per hour per lane for a normal 3-lane section that is reduced to two lanes during construction, as per the table on page 2 of Appendix B of the "District of Columbia Work Zone Safety and Mobility Policy, October 2007". Traffic demand volumes for a 48-hour (Wednesday-Thursday) period were entered into the LCAP program to determine the expected impacts of the lane closures. The average of the two days was taken as the result.

Because MOT Option 2 would involve detours and revised signal timing operations and not involve significant impacts to the mainline Kenilworth Ave. expressway, the baseline pre-construction Synchro/SimTraffic model described in Section 4 was modified with revised estimate delay for construction/detour operations under this option. Figure 10 shows how the traffic volumes were re-routed to account for the detours to be implemented. As with the baseline model described in Section 4, the model for MOT Option 2 included 13-hours of simulated variation in both traffic volumes and signal timing inputs.

Detour Modeling

In modeling MOT Option 2, the following detours are reflected in Figure 10:

- **Detour via U.S. 50:** Left turns from Eastern Ave. to southbound Kenilworth Ave. (and U-turns from northbound to southbound Kenilworth Ave. at Eastern Ave.) will be detoured by using mainline northbound Kenilworth Ave. and then U-turning at the U.S. 50 ramps to return to southbound Kenilworth Ave. Representatives from the Maryland State Highway Administration's District 3 Traffic Office were consulted about the selection of this detour route.

  Consideration was first given to using the Kenilworth Ave. service road as the detour route since it U-turns under the SHA bridge just south of the Amtrak rail lines approximately 0.25 mile north of Eastern Ave. However, a field investigation found this roadway to be in poor pavement condition and littered with debris. Furthermore, a check of right-of-way records revealed that the north end of this roadway on the east side is within the right-of-way of the adjacent salvage yard. It was determined that negotiation with the salvage yard owner could become a sticking point and delay the schedule. The numerous trucks using this wide-open area to access the salvage yard and turn around also made this an undesirable route for adding additional traffic.

  The SHA District 3 representatives concurred that U-turns on the U.S. 50 ramps would be acceptable. At the time of the meeting in July 2008, they indicated that as part of the Amtrak bridge reconstruction project, the directional ramp from U.S. 50 eastbound to southbound Kenilworth Ave. was currently closed and being detoured along the next three successive loop ramps in the interchange, including the two loop ramps in question for the Eastern Ave. detour (the northbound-to-westbound and westbound-to-southbound loop rams). They indicated that the volumes on the eastbound-to southbound directional ramp were low enough that they had not been causing unmanageable congestion along any of the ramp junctions or weaving areas.

  Volumes for this eastbound-to-southbound directional ramp (Ramp 6) had been taken in May 2004 and were obtained from SHA's website. These volumes were compared with the 13-hour volumes being used in the Eastern Ave. analysis for the subject left-turn movement to be detoured. The highest volume on Ramp 6 was 770 veh/hr, occurring between 2:00-3:00 PM. Volumes on this ramp varied from about 400-700 veh/hr throughout daytime hours. The volumes recorded for the subject left-turn movement from Eastern Ave. were much lower, with the highest hourly volume being 430 veh/hr from 7:00-8:00 AM.

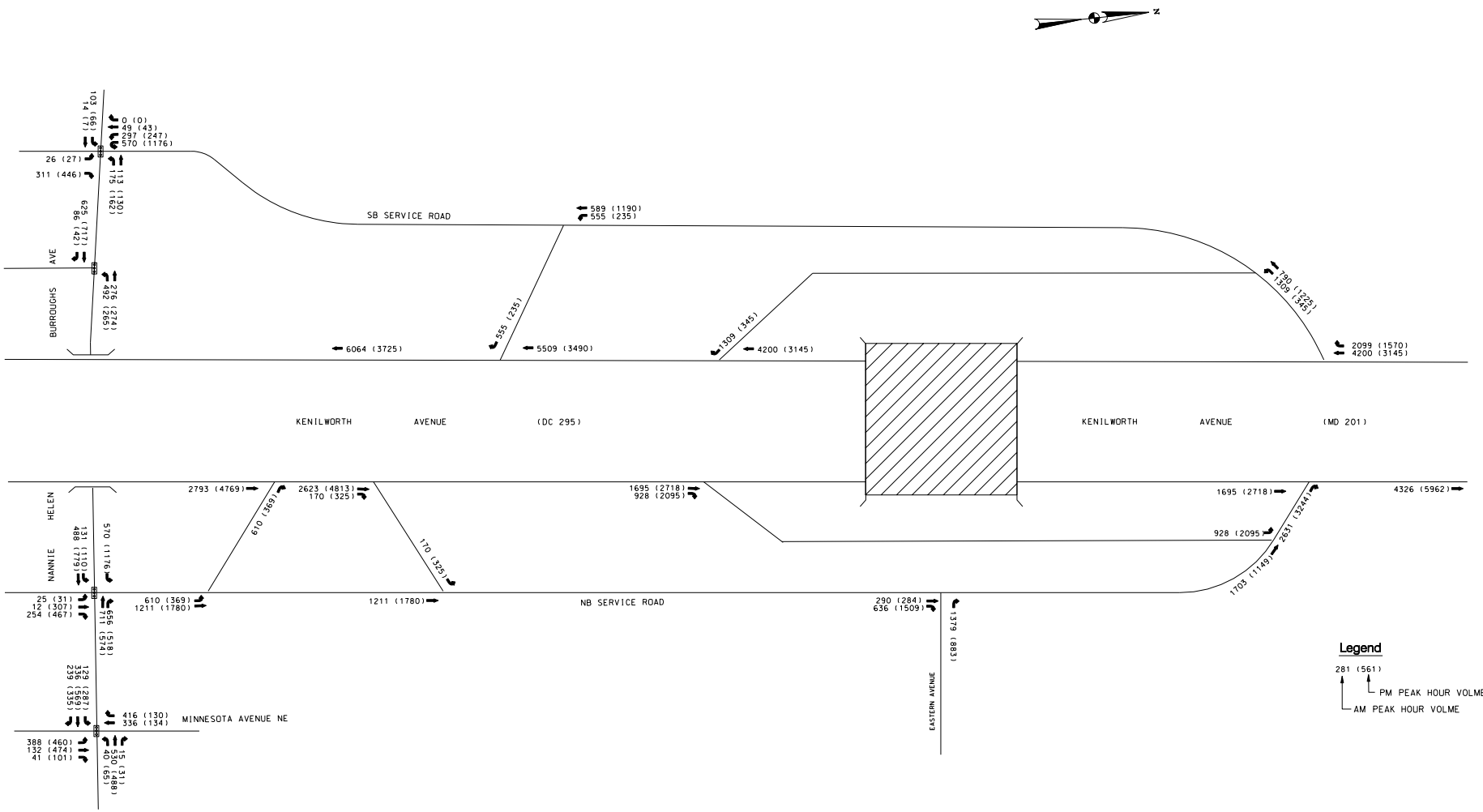


Figure 10: MOT Option 2 Traffic Volumes

NOT TO SCALE

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Because the proposed detour route is currently handling detour volumes that, at least before construction were much higher than the volume of traffic proposed to be detoured, it was assumed that any merging or weaving delay caused by this detour could be safely ignored, thereby eliminating the complexity associated with incorporating the Kenilworth Ave. / U.S. 50 interchange directly into the traffic model. The detoured volumes were simply added as both northbound and southbound trips on the northernmost link for Kenilworth Ave. in the model.

For the SimTraffic modeling of this detour, stop and signal control in various configurations were tried at the intersection of Eastern Ave. with the northbound Kenilworth Ave. service road, where volumes from both this detour and the Nannie Helen Burroughs Ave. detour described below will be rearranged into different traffic patterns. With an increased volume of right-turning traffic from the Eastern Ave. approach due to the U.S. 50 detour, signal control caused this approach to experience excessive delay and queuing. The right turns from the northbound service road onto Eastern Ave. will also be significantly higher due to the detoured traffic returning from Nannie Helen Burroughs Ave., but they will be able to move in a free-flowing manner with only occasional yielding to a pedestrian. The minor movement at this intersection will temporarily be the through movement from the northbound approach. This can be effectively controlled with a stop sign while allowing the westbound right turn movement to flow free, similar to control established at many shopping center entrances.

- **Detour via Nannie Helen Burroughs Ave.:** The traffic normally turning left from the southbound Kenilworth Ave. off-ramp to eastbound Eastern Ave. (and the traffic U-turning from the same southbound Kenilworth Ave. off-ramp) will be detoured south along the Kenilworth Ave. service road to the interchange at Nannie Helen Burroughs Ave., where they will U-turn to return north along northbound Kenilworth Ave. to the Eastern Ave. intersection. Various combinations of different types of traffic control were modeled along this route until a combination was found that produced an acceptable level of delay and minimal queuing in the animated SimTraffic simulation runs.

  When trying to model the use of consecutive left turns to and from Nannie Helen Burroughs Ave. for this detour traffic, a basic design conflict between competing objectives was discovered. Refer again to Figure 9 at the end of Section 4. The Nannie Helen Burroughs Ave. / Minnesota Ave. signal is expected to be well over-capacity during the PM peak hour, meaning queues on the eastbound approach will grow throughout the hour and spill back into the other intersections to the west. Because of the heavy volume of detoured traffic needing to travel through these other intersections, a signal timing pattern different than the timing plan provided by DDOT was sought that would eliminate this queue spillback.

  A longer signal timing split was modeled for the eastbound approach together with a shorter overall cycle length, producing the desired effect. However, shortening the system cycle length to eliminate this queue spillback created congestion on the southbound Kenilworth Ave. service road approach to Nannie Helen Burroughs Ave., as that signal would require a long cycle length to process the 1,150 veh/hr of detoured traffic that would be added to that approach. Various lane configurations were tried and various ramps at this interchange were modeled with detours to try to free up enough capacity for both the detoured traffic movement. The problems with signal progression resulted in vehicles getting “stuck” and locking up the simulated network, preventing any meaningful extraction of statistics for performance measure.

The approach which was finally arrived upon and which is modeled for MOT Option 2 is to convert the right-most lane on westbound Nannie Helen Burroughs Ave. into a U-turn lane, with traffic moving eastbound along it to avoid conflict with the other traffic along Nannie Helen Burroughs Ave. A temporary traffic barrier would be needed to separate this contra-flow U-turn lane, which would only be available to passenger vehicles. Trucks would be directed via appropriate signing to make the normal left turn movements. The corner radius at the intersection of Nannie Helen Burroughs Ave. and the southbound Kenilworth Ave. service road would need to be modified because as recently constructed it is too small for this type of a tight left turn. Modification of this radius will require a temporary modification to the traffic signal at the intersection. Finally, the new ramp from southbound mainline Kenilworth Ave. to Nannie Helen Burroughs Ave. would need to be temporarily closed and detoured to the south so as to not interrupt the flow of traffic when crossing the temporary U-turn lane. Refer to the Maintenance of Traffic Plans attached at the end of this document for details.

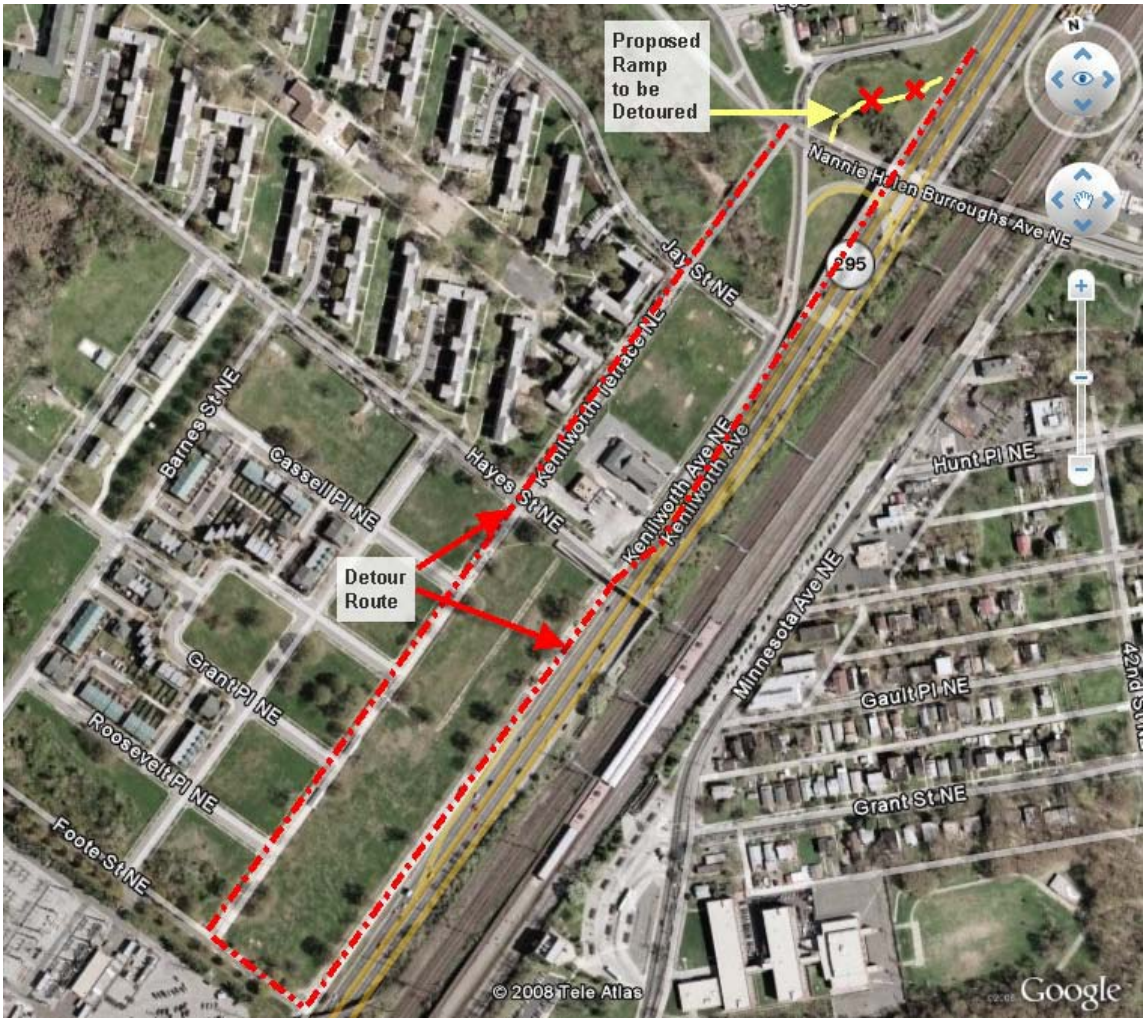
- **Southbound Kenilworth Ave. to Nannie Helen Burroughs Ave. Ramp Detour:** This detour, necessitated as described in the point above, would be made by continuing south along mainline Kenilworth Ave. to the exit to the south, then via the southbound Kenilworth Ave. service road, a right turn onto Foote Place, and a right turn onto Kenilworth Terrace to return to Nannie Helen Burroughs Ave. Traffic volumes along this detour route are not available except for the Kenilworth Terrace approach volumes at the intersection with Nannie Helen Burroughs Ave. These volumes are light, and examination of the roadway network and land use patterns on aerial photographs along this route indicate that volumes are likely to be light along its entire length. See Figure 11.

- **Service Road Ramp Detours:** The off-ramp from southbound mainline Kenilworth Ave. to the southbound service road and the on-ramp from the northbound Kenilworth Ave. service road to the mainline, both near Ord Street, will be closed because they are too close to the location where the diverted expressway lanes will diverge onto or merge in from the service roads. Leaving these other ramps open to local traffic would create very short weave segments that could result in abrupt and unsafe lane changing maneuvers. Volumes for the southbound off-ramp movement were diverted to the upstream off-ramp north of Eastern Ave., and the volumes from the northbound on-ramp were diverted north to the downstream on-ramp north of Eastern Ave. Each of these detoured movements was incorporated directly into the Synchro/SimTraffic model for each of the 13 hours considered.

Measures of Effectiveness

Total network delay in vehicle-hours was selected as the measure of effectiveness for this analysis. Queuing was considered as a potential measure, but queue lengths do not add up conveniently when it is desired to consider multiple queues occurring on different roadways with varying numbers of lanes, as is the case for MOT Option 2. Though SimTraffic and LCAP estimate queues using vastly different methods, it was felt that the differences would not be significant enough for this order-of-magnitude comparison.

Figure 11. Southbound Kenilworth Ave. to Nannie Helen Burroughs Ave. detour



Traffic Analysis Results

MOT Option 1 - Table 1, attached at the end of this document, shows the best-case scenario output from the LCAP program for the northbound direction of Kenilworth Ave. Table 2, also attached at the end of this document, shows the results for the southbound direction.

Adding the average daily vehicle hours of delay for the northbound and southbound directions from these two tables gives a total average weekday delay of 920,885 vehicle hours. At 22 weekdays per month, the total two-month delay would be 40,518,925 vehicle-hours. Adding this figure to the baseline pre-construction two-month delay estimate of 857,538 vehicle-hours from Section 4 for the signal and merging delay that is not incorporated in the LCAP estimate gives a total two-month delay of 41,376,463 vehicle-hours. This will serve as the basis for comparison with MOT Option 2.

MOT Option 2 - Results from the LCAP analysis for MOT Option 2 based on the 1,050 veh/hr capacity reduction described above are attached as Tables 3 and 4 at the end of this report. Adding the average daily vehicle hours of delay for the northbound and southbound directions from these two tables gives a

total average weekday delay of 2,391 vehicle hours. Assuming this delay occurs daily for each of the 30 days in the month, the two-month delay is calculated as 143,481 vehicle-hours.

The total 13-hour delay from SimTraffic for the MOT Option 2 detours and their associated delay was 54,526 vehicle-hours. Multiplying by a factor of 1.5 to estimate the 24-hour delay yields a value of 81,789 vehicle-hours. And finally, assuming for conservative purposes that the same delay would occur on both weekdays and weekend days throughout the month, multiplying this value times 30 days per month for two months gives a two-month delay of 4,907,340 vehicle-hours.

While the travel time due to extra signal and merging delay for detoured vehicles is by nature included in the SimTraffic model results, delay due to the time spent traveling at full speed along the detour routes is not considered explicitly and must be calculated separately. A calculation of this type was made for each of the detours in MOT Option 2. For example, the detour distance for the Nannie Helen Burroughs Ave. detour route was estimated to be approximately 1.8 miles long. At an average speed of 40 MPH, the route would be traversed in 2.7 minutes. Multiplying 2.7 minutes times the counted 13-hour volume of 9,506 vehicles yields a 13-hour delay total of 427.8 vehicle-hours. Multiplying this total by 1.5 to convert to a 24-hour delay estimate gives a total weekday delay of 641.7 vehicle hours, which is then converted to a two-month total by multiplying by 60.

For the three primary vehicular detours, delay estimates were calculated in this fashion. For the pedestrian detour required, delay was also calculated in similar fashion, assuming that a person-hour of delay for a pedestrian is equivalent to a vehicle-hour of delay for a motorist and assuming a walking speed of 3.0 ft/s. Total two-month detour delay estimated in this fashion was 61,960 vehicle-hours for the vehicle detours and 429 person-hours for the pedestrian detour.

Adding all the sources of delay for MOT Option 2 results in 5,113,211 vehicle-hours of delay. This delay estimate is drastically lower than the estimate for MOT Option 1, even though the MOT Option 2 analysis did not consider diversion or cancellation of trips. To summarize:

Baseline Pre-Construction Delay =	857,538 veh-hrs
MOT Option 1 Delay =	41,376,463 veh-hrs
MOT Option 2 Delay =	5,113,211 veh-hrs

MOT Option 2 would be expected to produce a 600% increase in delay versus the baseline, pre-construction conditions. However, it is clearly the “lesser of two evils” in terms of delay. Even with all the conservative assumptions made to try and tilt the comparison in the favor of the more conventional MOT Option 1, MOT Option 1 would be expected to produce about 8 times as much delay as MOT Option 2 based on the assumptions documented herein.

The full set of delay calculations are attached at the end of this document.

Selected Alternative

G&O recommends MOT Option 2 as the selected construction phasing strategy.

6. TMP Monitoring

Monitoring requirements ..... To be determined

Evaluation reports ..... To be determined

7. Public Information and Outreach Plan

A stakeholder meeting was held on March 19, 2009 at the First Baptist Church of Deanwood to explain the construction process and phasing. Three representatives from the ANC's attended, along with one from Councilmember Alexander's office. No significant concerns with the construction phasing scheme were identified. A follow-up PDF brochure was provided to the ANC representatives to assist in informing their constituents about the upcoming project.

As per the contract special provisions, the contractor will distribute a construction newsletter to inform the public about construction progress and upcoming traffic switches.

8. Incident Management

Trigger Points ..... To be determined.

Decision and phone tree ..... To be determined.

Contractor's contingency plan ..... To be determined.

Standby equipment or personnel .....

Tow trucks to be provided as per the contract special provisions.

9. TMP Implementation Costs

Itemized costs ..... To be determined.

Cost responsibilities/share opportunities..... To be determined.

Funding source(s)..... To be determined.

10. Special Considerations (As Needed)

To be determined.

11. Attachments

1. PS&E Maintenance of Traffic Plans
2. Memo "Analysis of MOT Refinements for Detour via Nannie Helen Burroughs Avenue", April 14, 2009
3. LCAP Analysis and Delay Calculations

Other items to be determined.

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MEMORANDUM.....*from the Baltimore Office*

TO: **MIKE JELEN, ZAHRA DORRIZ, LUAN TRAN**

FROM: JOSH SMITH

CC: ASNAKE NEGUSSIE, KENDRICK MILES, JOHN CHRISTMAN, BIMAL PATEL

SUBJECT: **RECONSTRUCTION OF EASTERN AVENUE OVER KENILWORTH AVENUE**

ANALYSIS OF MOT REFINEMENTS FOR DETOUR VIA NANNIE HELEN BURROUGHS AVENUE

DATE: APRIL 14, 2009

Based on meetings held with DDOT on April 3, 2009 and April 8, 2009, G&O has investigated alternatives for improving the flow of traffic along Nannie Helen Burroughs Avenue while traffic is detoured to that location from the closed Eastern Avenue bridge over Kenilworth Avenue, NE.

G&O was tasked with investigating four options for refining the maintenance of traffic along Nannie Helen Burroughs Avenue. These options are in addition to those considered in the Work Zone Transportation Management Plan (TMP) previously prepared by G&O for this project. The TMP investigated two primary MOT Options, which were identified as follows:

- **Option 1:** Close the inside left lane in each direction on mainline Kenilworth Avenue in order to construct piers for the new bridge in the narrow Kenilworth Avenue median.
- **Option 2:** Divert the outside expressway lane in each direction on mainline Kenilworth Avenue onto the Kenilworth Avenue service roads to maintain three lanes each way for peak-hour, peak-direction capacity. The left two lanes in each direction would be shifted right to allow for a median work zone to build the piers. Maintaining the expressway capacity under this option requires closing the intersection on the bridge so that the diverted expressway through lanes do not conflict with turning traffic.

The MOT Alternatives Analysis conducted by G&O and documented as part of the TMP found Option 2 to be the recommended alternative, and plans have been prepared for advertisement in accordance with Option 2. Movements normally made across the bridge will be detoured via Kenilworth Avenue and its service roads to the U.S. 50 and Nannie Helen Burroughs Avenue interchanges and back to Eastern Avenue.

Maryland SHA has agreed to the U.S. 50 detour and is not requiring further traffic analysis, based on past experience with a similar detour for another project. Because the signal system along Nannie Helen Burroughs Avenue will require timing and phasing changes to accommodate the maintenance of traffic plans and because these changes may cause additional delay or inconvenience for motorists who currently use that interchange, DDOT desires to consider additional options that could improve traffic flow on Nannie Helen Burroughs Avenue.

During the meetings held April 3 and 8, 2009, the four additional options to be considered were referred to as Options 1 through 4. To avoid confusion with the TMP, however, for this discussion they will be labeled Options 2-1 through 2-4, since they retain most of the characteristics of Option 2 as considered in the TMP. Each option is described as follows:

- **Option 2-1** Detoured movement makes U-turn at Nannie Helen Burroughs Avenue
- **Option 2-2** Detoured movement makes consecutive left turns at Nannie Helen Burroughs Avenue
- **Option 2-3** Detour all traffic to U-turn at Benning Road interchange
- **Option 2-4** Detour passenger car traffic on the free-flow U-turn as Option 2-1 while providing a separate detour for trucks via the Benning Road interchange

Study during the TMP preparation indicated that the PM peak hour is critical for both the detoured traffic flows and for the volumes along Nannie Helen Burroughs Avenue. Consequently, the AM peak hour operation has not been explicitly considered for the purposes of this memo. Each option will be compared to existing conditions as follows.

Site Visit

G&O visited the Eastern Avenue/Kenilworth Avenue site on Friday, April 3, 2008 and counted traffic on the southbound left turn and southbound-to-northbound U-turn movements to verify that the volumes being used for analysis are still accurate for the detour to occur along Nannie Helen Burroughs Avenue. Between 5:05 PM and 6:05 PM, there were 1,143 left turns and 41 U-turns, for a total of 1,184 vehicles that would need to have been detoured south to Nannie Helen Burroughs Avenue had the detour been in place on that particular afternoon. This is very close to the assumed PM peak hour detour volume of 1,176 veh/hr that has been assumed throughout the TMP analysis.

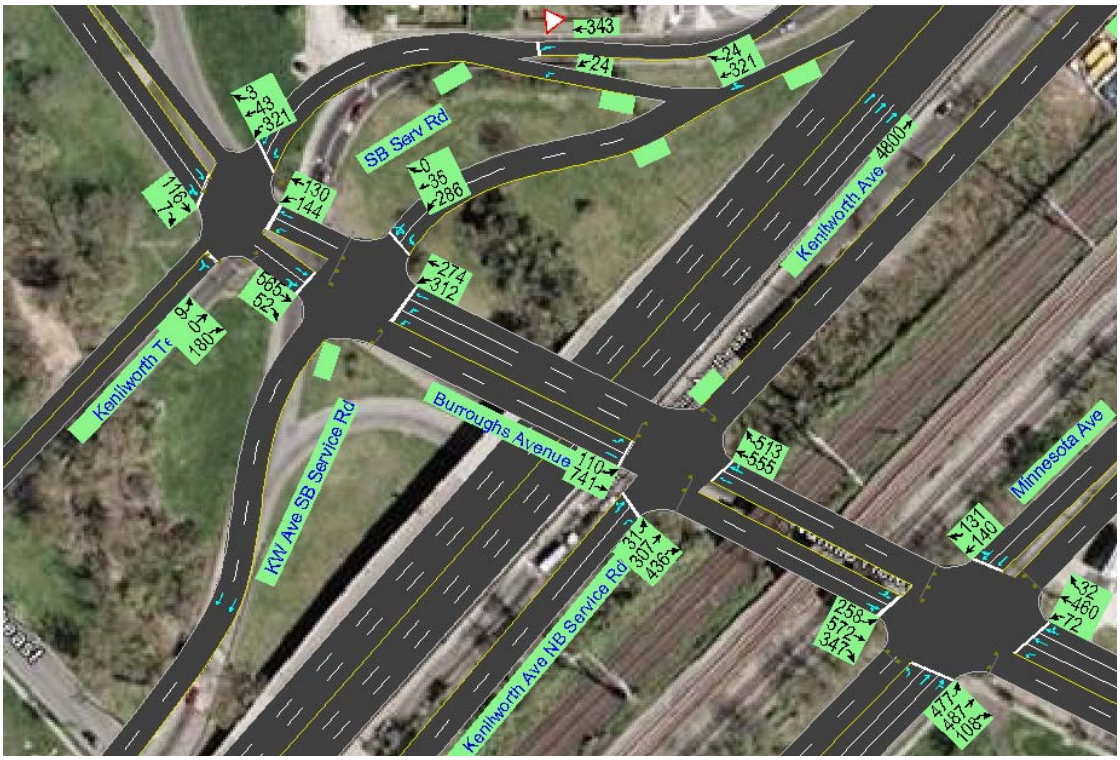
However, only 14 trucks were observed, equivalent to 1.2%, much lower than the 7% that had been conservatively assumed in the TMP and the previous Synchro modeling. The 7% value had been based on available data for heavy vehicle traffic in the vicinity.

Existing Conditions

For the purposes of this study, existing conditions will be assumed to include the completed lane geometry from the Kenilworth Avenue over Nannie Helen Burroughs Avenue project. To be conservative, the 7% trucks assumption from previous analysis was retained, with the understanding that actual delays and queues may be somewhat reduced based on the actual peak hour truck percentage being closer to the 1% measured in the field.

Figure 1 shows the existing lane configurations and volumes along Nannie Helen Burroughs Avenue:

Figure 1: Existing lanes and volumes along Nannie Helen Burroughs Avenue



The volumes in Figure 1 represent a slight rebalancing versus those used in the TMP report to provide greater accuracy and to prevent vehicles from entering or disappearing at mid-block locations that are not realistic.

Note also that the existing conditions assume double left turn lanes from westbound Nannie Helen Burroughs Avenue to the southbound Kenilworth Avenue service road. The signal plans in the advertised Kenilworth Avenue over Nannie Helen Burroughs Avenue project include only a single signal head for exclusive/permissive phasing for this left turn movement. DDOT has indicated to G&O that they intend to use a change order to provide two left turn signal heads for exclusive only left turn phasing for this movement. However, G&O has not received any specific information or plans about this proposed change order.

Signal timing and phasing was provided for each of the Nannie Helen Burroughs Avenue signals by Kendrick Miles of DDOT. The two western signals are to be operated by one controller and were thus placed under the "Group Control" feature in the Synchro model.

Synchro reports level of service (from west to east) of C, D, E, and F for each of the four signals in the system. The intersection of Nannie Helen Burroughs Avenue and Minnesota Avenue would be LOS F, with an average of 95.3 seconds of delay per vehicle. Synchro predicts eastbound queues would be expected to spill back into the Kenilworth Avenue northbound service road intersection on about 50% of all cycles during the PM peak hour. This would cause

serious coordination and congestion problems. The timing and phasing provided by DDOT were modified in an attempt to minimize these expected impacts for a better baseline condition. The results reported reflect the timing that gives the best results according to Synchro that could be discovered after several iterations of timing adjustments.

Observation of the SimTraffic runs for the existing conditions model verified what was reported by Synchro. Queues in the model run frequently backed up from the Minnesota Avenue intersection into the rest of the intersections to the west along Nannie Helen Burroughs Avenue. This resulted into queues backing up onto mainline Kenilworth Avenue from the northbound off-ramp to the service road. Long queues also developed on the southbound Kenilworth Avenue service road approaching Nannie Helen Burroughs Avenue, and on the northbound, southbound, and westbound approaches to the intersection of Nannie Helen Burroughs Avenue and Minnesota Avenue.

For comparison with Option 2-3, the existing Synchro/SimTraffic model was extended south to include the Kenilworth Avenue/Benning Road interchange. Traffic volumes for the Benning Road interchange were obtained from the same Kenilworth Avenue corridor study that was used for preparation of the TMP. These lane configurations and volumes are shown in Figure 2. Though they can be modeled in SimTraffic for visualization purposes, Synchro does not report level of service for merging movements such as those that are shown in Figure 2. Consequently, the merging movement for the left side merge onto northbound Kenilworth Avenue from the Benning Road interchange was analyzed using Highway Capacity Software, which reports LOS E for the existing conditions. SimTraffic animations confirmed that the existing merge causes significant backups on northbound Kenilworth Avenue.

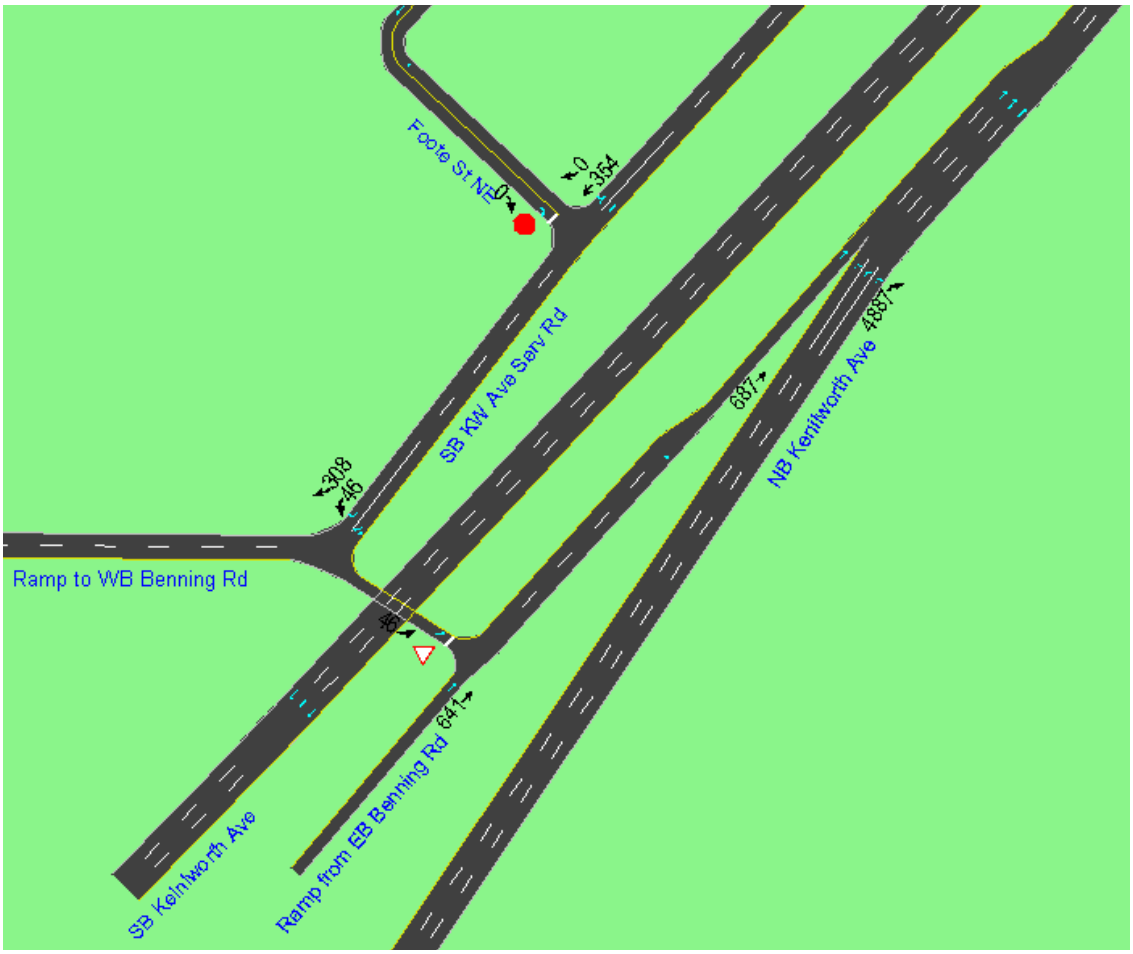
Overall delay in the existing network (which includes the Eastern Avenue at Kenilworth Avenue interchange) was reported by SimTraffic to be 1,372 vehicle-hours, or 7.3 minutes of average delay per vehicle. These values are based on the average from five hour-long SimTraffic runs. G&O recommends these as the best "single-number" measures of comparison in Synchro/SimTraffic for evaluating how the network operates as a whole for a given scenario.

Analysis of Option 2-1

Option 2-1 would route all southbound left turns and southbound-to-northbound U-turns normally made at Eastern Avenue south along the southbound Kenilworth Avenue service road. Passenger cars would be provided with a special temporary free-flow U-turn lane to avoid the signals on Nannie Helen Burroughs Avenue and return to Eastern Avenue via the northbound Kenilworth Avenue service road.

The U-turn lane would be provided by temporarily taking the new westbound lane on Nannie Helen Burroughs Ave. that will be constructed during the last phase of the Kenilworth Avenue over Nannie Helen Burroughs Ave. project. An adequate turning radius for passenger cars entering the U-turn lane would be provided by reconstructing the northeast corner of the Nannie Helen Burroughs Ave. /southbound Kenilworth Ave. service road intersection.

Figure 2: Existing lanes and volumes at Benning Road interchange



Currently, granite curb has been laid at this location by the Kenilworth Avenue over Nannie Helen Burroughs Avenue project and the pedestrian ramps have been poured, but sidewalk has not been poured and signal components have not been installed. A change order from DDOT to the Kenilworth Avenue over Nannie Helen Burroughs Avenue project could be made directing the contractor to defer construction of the conflicting sidewalk and traffic signal pole to the Eastern Avenue over Kenilworth Avenue project. The Kenilworth Avenue over Nannie Helen Burroughs Avenue project would instead leave a temporary signal pole on a portable concrete base in place on the northeast corner of this intersection at the end of their contract. The Eastern Avenue over Kenilworth Avenue contractor would then complete the conflicting work during Phase 7, either by a change to the Eastern Avenue plans before advertisement or by addendum after advertisement.

Trucks and busses would need to make consecutive left turns at the signals along Nannie Helen Burroughs Avenue because of the extra impacts of providing adequate corner radii for them, both entering the U-turn lane and exiting the U-turn lane at the intersection of Nannie Helen Burroughs Avenue and the northbound Kenilworth Avenue service road.

Figure 3: Option 2-1 Proposed temporary lanes & volumes along Nannie Helen Burroughs Ave. (1% trucks)

Lane configurations and volumes for Option 2-1 are shown in Figure 3 for the 1% trucks assumption and in Figure 4 for the 7% trucks assumption.

G&O analyzed Option 2-1 both with 7% trucks to be conservative for comparison with the other options and with 1% trucks to provide DDOT with a practical picture of how the detour can be reasonably expected to operate. Under each of these assumptions, signal timing and phasing were optimized using the Synchro optimization functions and then adjusted by hand using the Synchro time-space diagram with the intent of minimizing both overall delays and queue spillback into adjacent intersections, particularly those serving off-ramps from mainline Kenilworth Avenue. The SimTraffic simulation animations were viewed multiple times and adjustments were made to timings and offsets as a consequence in an iterative process in an attempt to devise the best timing plans possible.

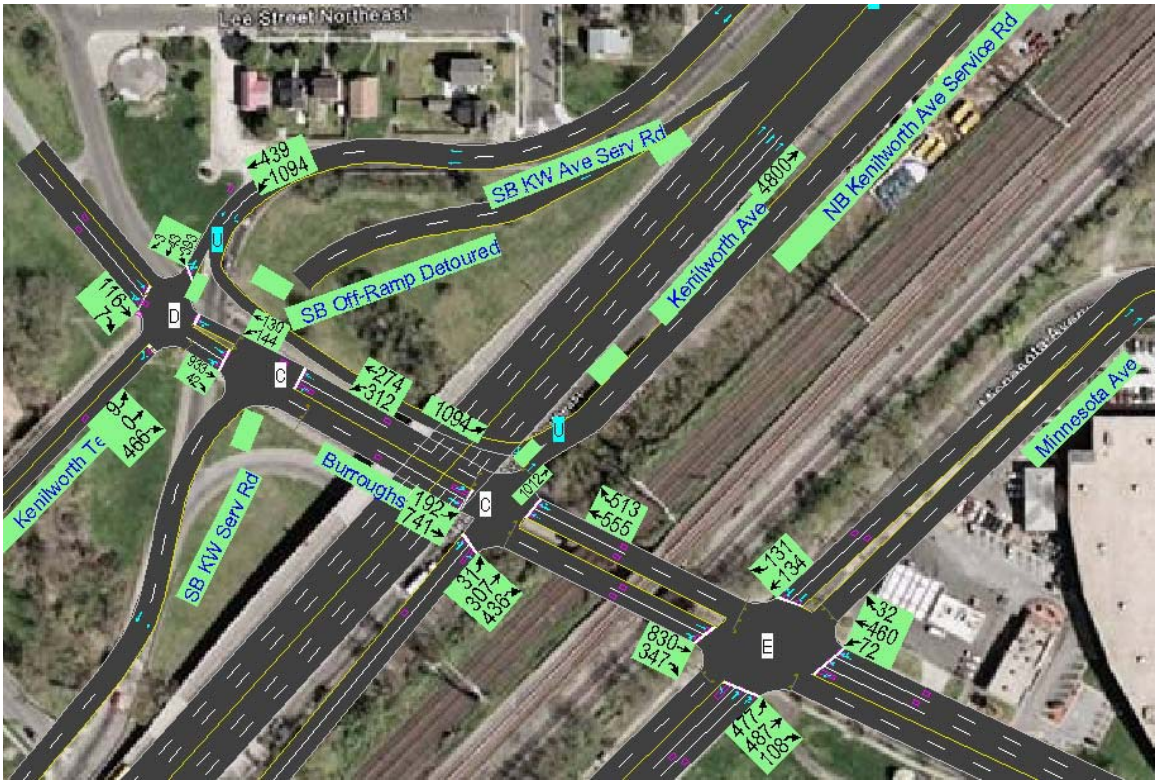
Additionally, two refinements were made to the Synchro/SimTraffic model for the Nannie Helen Burroughs Avenue signals that were not included in the TMP:

A. The order in which Phases 4 and 8 are serviced at the Burroughs Avenue/ southbound service road/Kenilworth Terrace intersection were reversed so that detoured traffic from the northbound Kenilworth Terrace approach goes first before the southbound

service road approach. This will improve the coordination for the northbound approach, reducing its delay and queues. This approach was given this priority because it will carry detoured traffic from the southbound Kenilworth Avenue off-ramp to Nannie Helen Burroughs Avenue. The detoured traffic will already have experienced some delay due to the length of the detour, so it was decided to give that traffic higher priority in the signal coordination.

B. At the Nannie Helen Burroughs Avenue/Minnesota Avenue intersection, left turns from the eastbound approach were modeled to be restricted during the afternoon peak hours. This time-of-day restriction should help to keep traffic flowing on the eastbound approach since there is no existing, dedicated left turn lane and the through capacity is reduced significantly whenever a vehicle stops to wait for a gap to turn left through the heavy, opposing westbound traffic. This should keep the queues from backing up from Minnesota Avenue into the rest of the signals to the west on Nannie Helen Burroughs Avenue. There should be other opportunities for the left turns to be made along Nannie Helen Burroughs Avenue at either 44th Street, 48th Street, 49th Street, or Division Avenue for traffic trying to get to Sherriff Road. If this is done without a specific, signed detour, then traffic will likely disperse a little bit better among those options. (This left turn restriction might be considered for permanent use if it works well during construction).

Figure 4: Option 2-1 Proposed temporary lanes & volumes along Nannie Helen Burroughs Ave. (7% trucks)



For the 1% trucks assumption, Synchro projects LOS C, B, C, and D for each intersection along Nannie Helen Burroughs Avenue, moving from west to east. For the 7% trucks assumption, Synchro projects LOS D, C, C, and E for the same intersections, respectively. So, assuming 7% trucks vs. 1% trucks degrades the LOS by roughly one letter grade.

SimTraffic reports that for an average of five hour-long simulations, the overall delay in the network as 1,562 vehicle-hours for the 7% trucks assumption and as 1,315 vehicle-hours for the 1% trucks assumption. These values are equivalent to 8.1 minutes and 6.6 minutes of average delay per vehicle, respectively.

A disadvantage of this option is the cost associated with reconstructing the new curb on the northeast corner of the Nannie Helen Burroughs Avenue / southbound Kenilworth Avenue service road intersection and the temporary widening of the southbound service road where concrete barrier wall has recently been constructed. At $600 for the replacement of the pedestrian ramp and $25/linear foot for replacement of the granite curb (est. 76 LF), the cost for this work is estimated to be about $2,500. To be highly conservative in accounting for other items not considered, a total cost of $50,000 will be assumed for these improvements. At the end of this memo, this cost will be compared to the costs to road users associated with extra delay caused by each detour option.

Analysis of Option 2-2

Option 2-2 would route all southbound left turns and southbound-to-northbound U-turns normally made at Eastern Avenue south along the southbound Kenilworth Avenue service road. All vehicles would then make consecutive left turns at the Nannie Helen Burroughs Avenue signals and return to Eastern Avenue via the northbound Kenilworth Avenue service road.

The heavy vehicle percentage assumed for this option was 7% for ease of comparison with the other options analyzed. The lane configurations and traffic volumes assumed for this option are shown in Figure 5.

This option would not involve any reconstruction of the new work built by the Kenilworth Avenue over Nannie Helen Burroughs Avenue project. Instead, double left turn lanes would be provided temporarily for the southbound Kenilworth Avenue service road approaching Nannie Helen Burroughs Avenue and for eastbound Nannie Helen Burroughs Avenue approaching turning onto the northbound Kenilworth Avenue service road.

The same temporary, time-of-day left turn restriction for the eastbound left turn from Nannie Helen Burroughs Avenue to northbound Minnesota Avenue that was modeled for Option 2-1 was also modeled for Option 2-2 to simplify the comparison between the two options.

Consistent with the optimization process described for other scenarios, a combination of Synchro optimizations and hand adjustments were performed in an iterative fashion to try to maximize the coordination and the capacity of the signals along Nannie Helen Burroughs Avenue for Option 2-2. However, the over-capacity condition of the intersection of Nannie

Helen Burroughs Avenue and the northbound Kenilworth Avenue service road was a key constraint that prevented any signal timing optimizations from functioning effectively.

Figure 5: Option 2-2 Proposed temporary lanes & volumes along Nannie Helen Burroughs Ave.

Synchro predicts the level of service would be F for each of the four intersections under this option. Observation of the SimTraffic animations likewise demonstrated the very high level of congestion that would be experienced throughout the network under this option.

Again for the average of five hour-long simulation runs, SimTraffic predicts that the overall delay caused by Option 2-2 would be 1,372 vehicle-hours, or 14.3 minutes of average delay per vehicle.

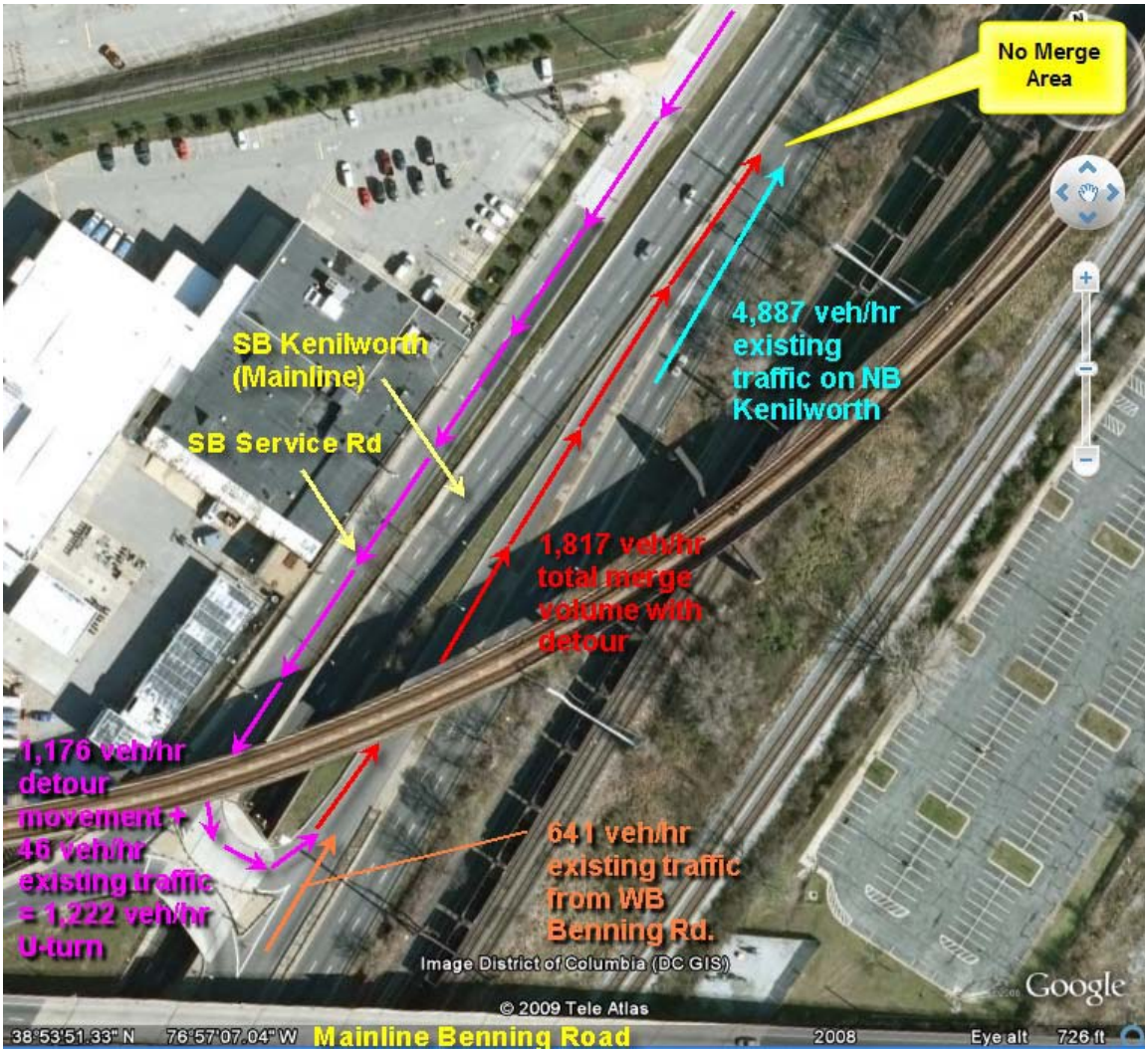
Analysis of Option 2-3

Figure 6 illustrates the detour volume and the path it would follow via the Benning Road interchange ramps if the detour were to avoid Burroughs Avenue. The volumes shown in Figure 6 are taken from Figure D.8 of the Kenilworth Ave. study by STV and Figure 10 of G&O's TMP report for the Eastern Avenue over Kenilworth Avenue project.

The detour would result in roughly 1,800 vehicles/hour in a single lane trying to merge from the left side with almost no merge area into an existing stream of 4,900 vehicles/hour spread over three lanes with no shoulders.

Again, Synchro does not provide level of service results for merging movements of the type shown in Figure 6. As such, G&O performed analysis using Highway Capacity Software. HCS results were LOS F. The degree of oversaturation was quite severe, with volumes being about 20% over capacity on one of the standard capacity checks.

Figure 6: Option 2-3 Proposed volumes at Benning Road interchange



Again for the average of five hour-long simulation runs, SimTraffic predicts that the overall delay caused by Option 2-3 would be 2,678 vehicle-hours, or 16.9 minutes of average delay per vehicle.

The wide right shoulder available for restriping that was discussed in the April 3, 2009 meeting is not actually available at the location where the merge needs to happen. It is located farther north as seen in Figure 7. The wide-shoulder area is zoomed in on in Figure 8.

Option 2-4

With the site visit mentioned above indicating that the detoured volume is likely made up of only 1% trucks instead of 7% during the critical peak hour, the need for this option is largely removed. There would only be about 10-15 trucks detoured in the peak hour instead of 85-90 trucks. Consequently, G&O does not consider it practical or necessary to detour cars to the Nannie Helen Burroughs U-turn and trucks to the Benning Road interchange as had been previously discussed for Option 2-4, especially since the refinements to Option 2-1 as discussed above have eliminated the excessive delay observed in the SimTraffic model that gave rise to the brainstorming to find another route for trucks.

Figure 7: Option 2-3 Location of wide right shoulder relative to merging area

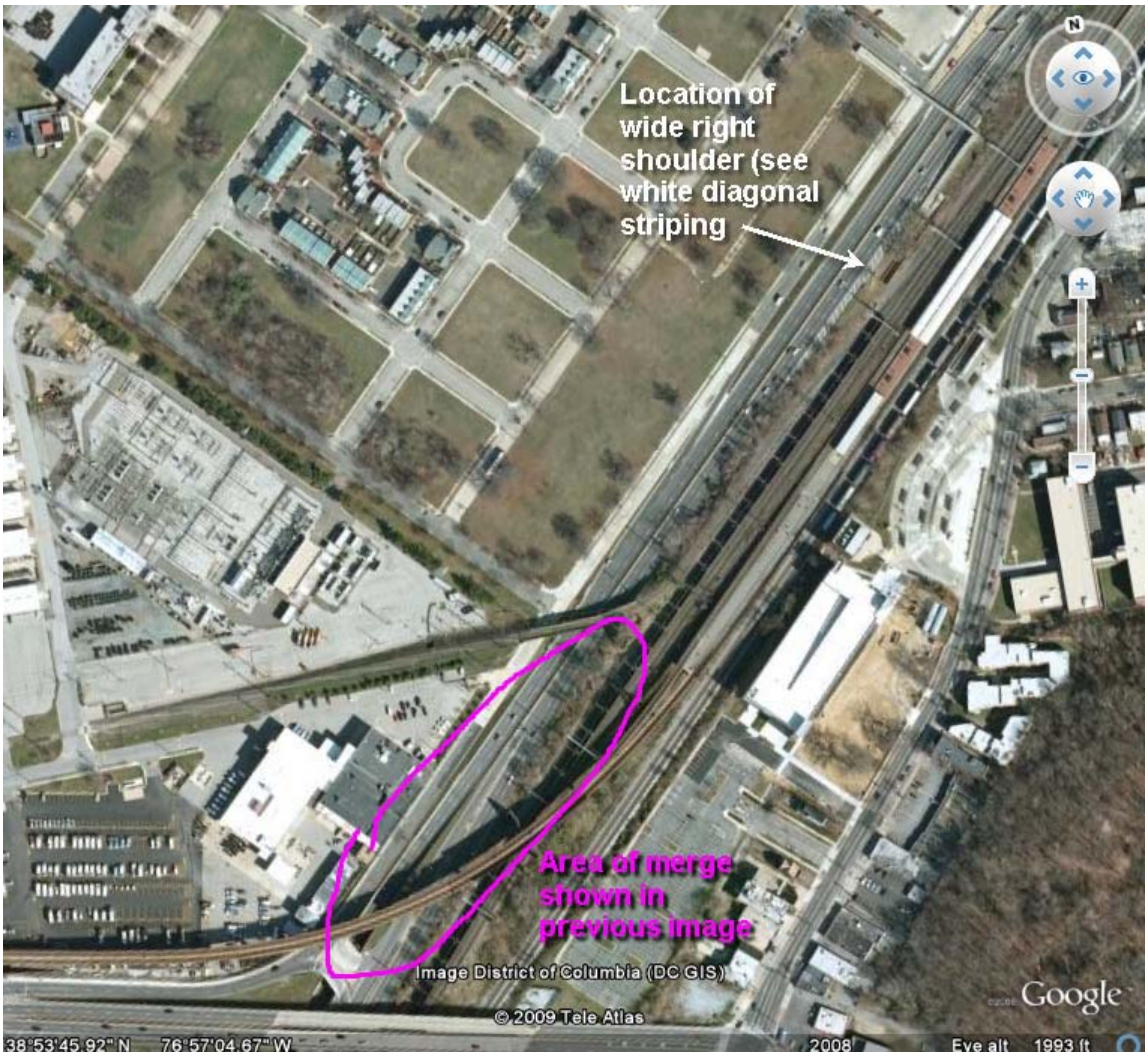


Figure 8: Option 2-3 Close-up of wide right shoulder area from Figure 7

Comparison of Options

G&O has provided DDOT with video clips from the SimTraffic animations of each of the options described above (with the exception of Option 2-4, which was discarded from consideration before modeling).

Results from the remaining three options are compared with the existing, pre-construction conditions in Table 1.

Table 1: Delay Comparison of Existing Conditions with Options 2-1 through 2-3

			Delay							Cost								
			Synchro Intersection LOS															
Option	Description	Truck %	Kenilworth Terrace @ Burroughs Ave	SB Kenilworth Serv Rd @ Burroughs Ave	NB Kenilworth Serv Rd @ Burroughs Ave	Minnesota Ave @ Burroughs Ave	SimTraffic Total PM Network Delay (veh-hr)	SimTraffic Average PM Delay/Veh (min)	Total 8-month Detour Travel Time Delay (veh-hr)	Idling Delay Cost (Time Value + Idling Fuel) @ $18.42/hr[4]	Detour Travel Time Delay Cost (Time Value Only) @ $17.19/hr[5]	Variable Operating Cost Rate @ $0.30/mile[6]	Total Road User Cost	Differential Road User Cost vs. Existing Conditions	Estimated Construction Cost[7]	Total Project Cost (Road User + Constr.)	Differential Road User Cost per Day	Safety
Existing	Preconstruction Conditions on Burroughs Ave.	7%[1]	C	D	E	F	1,372	7.3	---	$13,347,633	$0	$0	$13,347,633	---	---	---	---	---
2-1	U-turn at Burroughs Ave. for detour	7%[1]	D	C	C	E	1,562	8.1	236,340	$15,190,665	$4,062,685	$2,774,323	$22,027,672	$8,680,039	$10,336,791	$19,016,830	$36,167	**Pro:** Lower delay usually correlates to lower accident rates. **Con:** Minor risk of wrong-way vehicles entering U-turn lane.
2-1[2]	U-turn at Burroughs Ave. for detour	1%[2]	C	B	C	D	1,315	6.6	---[3]	---[3]	---[3]	---[3]	---[3]	---[3]	---[3]	---[3]	---[3]	
2-2	Left Turns at Burroughs Ave. for detour	7%[1]	F	F	F	F	2,377	14.3	236,340	$23,115,214	$4,062,685	$2,774,323	$29,952,222	$16,604,589	$10,286,791	$26,891,380	$69,186	**Pro:** No risk of wrong-way vehicles entering U-turn lane. **Con:** Higher delay usually correlates to higher accident rates.
Existing	Existing Conditions at Benning Road interchange	7%[1]	---	---	---	---	1,372	7.3	---	$13,347,633	$0	$0	$13,347,633	---	---	---	---	---
3	U-turn at Benning Road interchange for detour	7%[1]	---	---	---	---	2,678	16.9	307,177	$26,044,613	$5,280,373	$3,624,367	$34,949,353	$21,601,720	$10,286,791	$31,888,511	$90,007	**Pro:** No risk of wrong-way vehicles entering U-turn lane. **Con:** Higher delay usually correlates to higher accident rates. **Con:** Left-side merge w/ no accel. area would be dangerous.

= Recommended Option

Notes:

1 - 7% trucks assumed for conservative comparison based on daily truck % data

2 - 1% trucks assumed for one hour of observed PM peak hour traffic on Friday 4/3/2009

3 - not a valid comparison due to varied assumptions about truck %

4 - based on method in NJDOT Road User Cost Manual and Nov. 2008 Bureau of Labor Statistics Indeces (for average U.S. urban area) assumes daily delay is 3 x the delay calculated in PM peak hour and that the duration of the work is 8 months at 22 weekdays/month

5 - based on method in NJDOT Road User Cost Manual and Nov. 2008 Bureau of Labor Statistics Indeces (for average U.S. urban area) assumes detour travel time delay is calculated as in TMP report except for 8 months duration instead of 2 month duration

6 - based on method in NJDOT Road User Cost Manual and Nov. 2008 Bureau of Labor Statistics Indeces (for average U.S. urban area) assumes total detour mileage traveled is calculated as in TMP report except for 8 months duration instead of 2 month duration

7 - based on 90% Cost Estimate for Option 2-1 and simplified, over-conservative estimate for cost savings for Options 2-2 and 2-3

The results in Table 1 are summarized in terms of the delay values calculated from the analyses described in previous sections, as well as by cost and safety pros and cons.

Delay

Option 2-1 is clearly the most favorable in terms of having the best LOS at the intersections and the lowest average number of minutes of delay per vehicle in the network (8.1 min.) Option 2-2 and Option 2-3 would each result in average delays approximately twice as long as Option 1-1.

Note that in both assumptions about the truck percentage, the intersection LOS at the Nannie Helen Burroughs Avenue/Minnesota Avenue intersection improves to either D or E versus the existing condition of F. This effect is due to the time-of-day left turn restriction that would be implemented for the left turns from eastbound Nannie Helen Burroughs Avenue to northbound Minnesota Avenue.

The time needed to traverse the extra distance along the detour route versus the time that would have been needed to make the same movement in the existing condition is a component of delay that is not included in the Synchro/SimTraffic modeling. Options 2-1 and 2-2 are estimated to result in the same amount of this additional travel time delay component. As calculated previously for the TMP report, this "total detour travel time delay" value is estimated to be:

275 vehicle-hours/day for the 1.55 mile detour via +U.S. 50 +
642 vehicle-hours/day for the for the 1.80 mile detour via Nannie Helen Burroughs Avenue +
116 vehicle-hours/day for the 1.0 mile detour of the Kenilworth Avenue southbound off-ramp to Nannie Helen Burroughs Avenue via Foote Street and Kenilworth Terrace =
1,033 vehicle-hours/day for weekdays

Assuming, as in the TMP, that daily weekend volumes would be 80% of weekday volumes, then the total estimated vehicular travel delay for Options 2-1 and 2-2 would be:

(1,033 veh-hrs/day * 22 weekdays/month * 8 months) +
(0.8 * 1,033 veh-hrs/weekend day * 8 weekend days/month * 8 months) = 234,623 veh-hrs

Adding in the 7.2 person-hours of delay per day for the pedestrian detour from the TMP report @ 30 days/month * 8 months yields (234,623 + 7.2 * 30 * 8) = 236,340 veh-hrs total travel delay for Options 2-1 and 2-2.

For Option 2-3, the detour distance to Benning Road would be increased from 1.8 miles to 3.0 miles versus the Nannie Helen Burroughs Avenue detour. The 642 vehicle-hours/day in the above calculation would be replaced by 1,069 vehicle-hours/day. Adding this value and subtracting the 116 vehicle-hours/day of delay from the above calculation for the eliminated Kenilworth Avenue southbound off-ramp detour results in a total travel delay estimate of 307,177 veh-hrs total travel delay for Option 2-3.

Thus, the elimination of the Kenilworth Avenue southbound off-ramp detour in Option 2-3 is more than compensated for in terms of total detour mileage driven by the extended length of the primary Eastern Avenue detour.

Cost

Cost for each option is assumed to be the construction cost plus the "road user cost". The road user cost is a value that attempts to approximate the value of lost time, fuel, vehicle maintenance, etc. that is caused by detouring or idling in congestion under a particular alternative.

The road user cost was calculated by assuming a dollar value for each of three different components. The first component is the dollar value of time spent idling in congestion. This time was assumed to be equivalent to the SimTraffic total network delay for the PM peak hour, and the hourly cost of $18.42/hour for the combined value of time plus idling fuel and maintenance costs was obtained using a method proscribed in the New Jersey Department of Transportation's Road User Cost Manual, utilizing data from the November 2008 Bureau of Labor Statistics Indeces for the average U.S. urban area. The resulting hourly cost of delay was then multiplied by the time the detour is to be in effect during Phases 1B through 6.

The daily delay for simplifying purposes was assumed to be 3 times the delay calculated by SimTraffic for the peak hour. The duration of the detours were estimated to be 8 months based on the currently proposed construction schedule, and 22 weekdays per month were assumed. Delay on weekends was neglected as another simplifying assumption since no traffic data is available for weekends.

The second component of road user cost is the value of time only on an hourly basis for delay that occurs while detoured vehicles are in motion along the detour routes. This value was calculated to be $17.19/hr based on the same methods described above from the NJDOT Road User Cost Manual. This value was multiplied by the Total Detour Travel Delay Times calculated at the end of the Delay section above to obtain the Detour Travel Time Delay Costs shown in Table 1.

The third and final component of road user cost is the value of fuel and maintenance only on a per mile basis for extra travel that occurs while detoured vehicles are in motion along the detour routes. This value was calculated to be $0.30/mile based on the same methods described above from the NJDOT Road User Cost Manual.

The total detour mileage for the 8-month detours was calculated as follows:

1.55 miles x 6,708 veh/weekday =10,397 veh-mi/weekday along U.S. 50 detour +
1.80 miles x 14,259 veh/weekday = 25,666 veh-mi/weekday along Burroughs Ave. detour +
1.0 mile x 4,640 veh/weekday = 4,640 veh-mi/weekday along Kenilworth Terrace detour =
40,703 total veh-mi/weekday for Options 2-1 and 2-2.

1.55 miles x 6,708 veh/weekday =10,397 veh-mi/weekday along U.S. 50 detour +
3.0 miles x 14,259 veh/weekday = 25,666 veh-mi/weekday along Benning Rd. detour =
53,174 total veh-mi/weekday for Options 2-3

Using the same 80% assumption as before for weekend volumes, total mileages driven for the 8-month detours would be 9,247,744 miles for Options 2-1 and 2-2 and 12,081,224 miles for Option 2-3.

These values were multiplied by the $0.30 per mile rate and the three components of road user cost were added to arrive at the total road user cost for each option. The existing road user cost was then subtracted from the total road user cost for each option to arrive at the differential road user cost. This is the measure of the road user cost caused by the construction activity.

Note that Option 2-1 has the lowest differential road user cost at approximately $8.7 million. Option 2-2 would cost road users almost twice as much at $16.6 million. And Option 2-3 would cost road users about 2.5 times as much at $21.6 million.

The estimated total construction cost for Option 2-1 is approximately $10,337,000. This includes $50,000 that, as mentioned above in the analysis for Option 2-1, is conservatively priced as the need to remove new construction along the southbound Kenilworth Avenue service road to accommodate the detour and then to replace it again at the end of the project. If all other costs of providing the Option 2-2 and 2-3 detours are considered negligible, subtracting $50,000 from $10,337,000 yields a construction cost of $10,287,000 for Options 2-2 and 2-3.

The differential road user costs were added to the construction costs for each option to arrive at the total project cost for each option. These costs represent the total estimated costs to be paid by the public for completion of the project under each option, both in terms of the tax dollars funded through DDOT and federal funds and in terms of extra delay, fuel, and maintenance costs incurred as a direct result of the construction activity.

Note that Option 2-1 has by far the lowest road user cost and the lowest total project cost, at only a minor relative markup on the actual construction cost. Any errors in the analysis, which G&O has attempted to make conservative, would need to account for almost $8 million in total project cost difference between Options 2-1 and 2-2 in order for Option 2-2, with the second lowest total project cost, to receive serious consideration on the combined basis of delay and cost.

The differential road user costs were divided by the 240 calendar days expected for construction to arrive at daily differential road user costs. These costs could theoretically be used for incentive/disincentive purposes to reward or punish the contractor for early or late project completion at a rate that would fully compensate the public or the contractor for the value of the public's saved or lost time and vehicle operating costs.

However, note that even the lowest of the daily differential road user costs, about $36,000 per day for Option 2-1, represents over $1,000,000 per month. If used as a disincentive at this rate, the value of the contractor's bid could be reduced by roughly a third with a 3-month delay in completing the job. Such a high level of risk would likely result in either fewer bids or higher bids as proposers find ways to incorporate this risk into their price. Consequently, G&O recommends a disincentive no greater than $5,000 per day for late project completion.

A higher daily value such as $10,000 per day could be used at DDOT's discretion as an incentive for early completion, recognizing that the construction cost count rise sharply if the contractor finds a way to complete the project significantly ahead of schedule.

Safety

Also outlined in Table 1 are the qualitative safety benefits and drawbacks of each option. Option 2-1, with its lower delay and congestion, would be likely to result in fewer accidents, particularly rear-end accidents that tend to correlate highly with drivers encountering unexpected queues. A safety drawback to Option 2-1 would be the minor risk of unauthorized or wrong-way vehicles entering the U-turn lane along Nannie Helen Burroughs Avenue. G&O believes that the risk of this occurring is outweighed by the previously-mentioned safety benefit.

Conversely, Options 2-2 and 2-3 do not have the safety liability of potential confusion or wrecklessness caused by the presence of the U-turn lane. However, delay and congestion in the entire study area could more than double, resulting in a significantly higher number of accidents during construction. Option 2-3 has the added disadvantage of featuring a left-side merge with very heavy traffic on both the ramp and mainline and with little to no room for acceleration by the merging vehicles. As noted by DDOT staff during the April 8, 2009 meeting, the left-hand merge is widely considered to be the most difficult maneuver for a driver to make. Given the adverse conditions that would be introduced under this option, a drastic reduction in safety would have to be tolerated.

Recommendations for DDOT Action

Based on the superior delay, cost, and safety benefits of Option 2-1, G&O recommends that DDOT pursue this option for maintenance of traffic during the Eastern Avenue over Kenilworth Avenue bridge reconstruction.

In conjunction with this recommendation, G&O recommends that DDOT pursue the following items of business:

1. A change order should be issued to the Kenilworth Avenue over Nannie Helen Burroughs Avenue contractor. The change order should direct the contractor to:

    a. Delete work related to the sidewalk and permanent signal pole on the northeast corner of the Nannie Helen Burroughs Avenue / Kenilworth Terrace / southbound Kenilworth Avenue service road intersection.

b. Add a temporary signal pole on a temporary, portable concrete base, to be left in place at the end of construction.

c. Provide one westbound left turn lane and two westbound through lanes instead of two left turn lanes and one through lane on the westbound approach of Nannie Helen Burroughs Avenue at the intersection with the southbound Kenilworth Avenue on-ramp (Ramp A).

d. Delete any final permanent pavement markings on the westbound lanes of Nannie Helen Burroughs Avenue wherever they would conflict with item (c) above or which would otherwise conflict with the proposed pavement markings for the Eastern Avenue project detour.

e. Delete the crosswalk pavement markings on the north side of Nannie Helen Burroughs Avenue for the crosswalks crossing the southbound Kenilworth Avenue service road, the off-ramp from southbound mainline Kenilworth Avenue (Ramp A), and the northbound Kenilworth Avenue service road.

f. Delete the final 2" topcoat of paving on any areas where final pavement markings are not to be installed as per items (c), (d), or (e) above.

g. Add temporary, painted markings in lieu of any deleted markings specified in items (c), (d), or (e) above.

h. If not specified already, direct the contractor to use demountable copy for the down arrows on the overhead signs to be mounted on the new Kenilworth Avenue bridge over the westbound lanes of Nannie Helen Burroughs Avenue.

i. Add "Sidewalk Closed" signs and related pedestrian detour signs as currently shown on the Eastern Avenue plans to be left in place at the end of construction to detour around unfinished sidewalk.

2. Any change order previously prepared or intended to be prepared that directs the Kenilworth Avenue over Nannie Helen Burroughs Avenue contractor to modify the signal heads on the westbound approach of Nannie Helen Burroughs Avenue at the intersection with the southbound Kenilworth Avenue on-ramp (Ramp A) DDOT should be nullified or withheld so that a single signal head is provided for exclusive/permissive left-turn phasing for that approach.

3. The Eastern Avenue over Kenilworth Avenue project should be amended to:

   a. Add the deleted items from 1(a), 1(d), 1(e), 1(f), and 2 above.

   b. Delete any removal of sidewalk or signal features that are currently assumed to be built by the Kenilworth Avenue over Nannie Helen Burroughs Avenue

contractor, but which have not yet been constructed, in conjunction with item 1(a) above.

c. Delete ”Sidewalk Closed” signs and related pedestrian detour signs as currently shown on the Eastern Avenue plans in conjunction with item 1(i) above.

Table 1: LCAP Results for MOT Option 1, Northbound Direction

Start Time	End Time	Base Demand	Approach Volume	Roadway Volume	Vehicles In Queue	Delay Length (Minutes)	Veh-Hrs Delay (Veh in Queue x Delay Length)	Workzone Up
Wed-0:00	Wed-1:00	191	191	191	0	0.00		X
Wed-1:00	Wed-2:00	100	100	100	0	0.00		X
Wed-2:00	Wed-3:00	382	382	382	0	0.00		X
Wed-3:00	Wed-4:00	428	428	428	0	0.00		X
Wed-4:00	Wed-5:00	772	772	772	0	0.00		X
Wed-5:00	Wed-6:00	2000	2000	2000	0	0.00		X
Wed-6:00	Wed-7:00	3311	2980	3311	331	6.66	37	X
Wed-7:00	Wed-8:00	3664	2980	3995	1015	20.44	346	X
Wed-8:00	Wed-9:00	3663	2980	4678	1698	34.19	968	X
Wed-9:00	Wed-10:00	3002	2980	4700	1720	34.63	993	X
Wed-10:00	Wed-11:00	3004	2980	4724	1744	35.11	1,021	X
Wed-11:00	Wed-12:00	3171	2980	4915	1935	38.96	1,256	X
Wed-12:00	Wed-13:00	3401	2980	5336	2356	47.44	1,863	X
Wed-13:00	Wed-14:00	3540	2980	5896	2916	58.71	2,853	X
Wed-14:00	Wed-15:00	3968	2980	6884	3904	78.60	5,114	X
Wed-15:00	Wed-16:00	4909	2980	8813	5833	117.44	11,417	X
Wed-16:00	Wed-17:00	5002	2980	10835	7855	158.15	20,704	X
Wed-17:00	Wed-18:00	5078	2980	12933	9953	200.40	33,243	X
Wed-18:00	Wed-19:00	4983	2980	14936	11956	240.72	47,967	X
Wed-19:00	Wed-20:00	3725	2980	15681	12701	255.72	54,132	X
Wed-20:00	Wed-21:00	2704	2980	15405	12425	250.17	51,806	X
Wed-21:00	Wed-22:00	2531	2980	14956	11976	241.13	48,130	X
Wed-22:00	Wed-23:00	1993	2980	13969	10989	221.26	40,524	X
Wed-23:00	Thr-0:00	1219	2980	12208	9228	185.80	28,576	X
Thr-0:00	Thr-1:00	937	2980	10165	7185	144.66	17,323	X
Thr-1:00	Thr-2:00	540	2980	7725	4745	95.54	7,556	X
Thr-2:00	Thr-3:00	429	2980	5174	2194	44.17	1,615	X
Thr-3:00	Thr-4:00	412	2606	2606	0	0.00	0	X
Thr-4:00	Thr-5:00	687	687	687	0	0.00	0	X
Thr-5:00	Thr-6:00	1830	1830	1830	0	0.00	0	X
Thr-6:00	Thr-7:00	3010	2980	3010	30	0.60	0	X
Thr-7:00	Thr-8:00	3500	2980	3530	550	11.07	101	X
Thr-8:00	Thr-9:00	3065	2980	3615	635	12.79	135	X
Thr-9:00	Thr-10:00	3068	2980	3703	723	14.56	175	X
Thr-10:00	Thr-11:00	2787	2980	3510	530	10.67	94	X
Thr-11:00	Thr-12:00	2984	2980	3514	534	10.75	96	X
Thr-12:00	Thr-13:00	3133	2980	3667	687	13.83	158	X
Thr-13:00	Thr-14:00	3357	2980	4044	1064	21.42	380	X
Thr-14:00	Thr-15:00	3918	2980	4982	2002	40.31	1,345	X
Thr-15:00	Thr-16:00	5024	2980	7026	4046	81.46	5,493	X
Thr-16:00	Thr-17:00	5014	2980	9060	6080	122.42	12,405	X
Thr-17:00	Thr-18:00	5096	2980	11176	8196	165.02	22,542	X
Thr-18:00	Thr-19:00	4752	2980	12948	9968	200.70	33,343	X
Thr-19:00	Thr-20:00	4931	2980	14899	11919	239.98	47,672	X
Thr-20:00	Thr-21:00	3270	2980	15189	12209	245.82	50,020	X
Thr-21:00	Thr-22:00	2241	2980	14450	11470	230.94	44,148	X
Thr-22:00	Thr-23:00	2164	2980	13634	10654	214.51	38,090	X
Thr-23:00	Fri-0:00	0	6300	10654	4354	41.47	3,009	
Fri-0:00	Fri-1:00	0	4354	4354	0	0.00	0	
	2-Day Total	134,316				2-Day Total	636,651	
	Average	67,158				Average	318,326	

Legend: Gray = Over Capacity, **Yellow** = Delay over 10 Minutes Red = Delay over 30 Minutes

Table 2: LCAP Results for MOT Option 1, Southbound Direction

Start Time	End Time	Base Demand	Approach Volume	Roadway Volume	Vehicles In Queue	Delay Length (Minutes)	Veh-Hrs Delay (Veh in Queue x Delay Length)	Workzone Up
Wed-0:00	Wed-1:00	246	246	246	0	0.00		X
Wed-1:00	Wed-2:00	80	80	80	0	0.00		X
Wed-2:00	Wed-3:00	145	145	145	0	0.00		X
Wed-3:00	Wed-4:00	413	413	413	0	0.00		X
Wed-4:00	Wed-5:00	851	851	851	0	0.00		X
Wed-5:00	Wed-6:00	2929	2929	2929	0	0.00		X
Wed-6:00	Wed-7:00	5411	2980	5411	2431	48.95	1983	X
Wed-7:00	Wed-8:00	5738	2980	8169	5189	104.48	9036	X
Wed-8:00	Wed-9:00	5373	2980	10562	7582	152.66	19291	X
Wed-9:00	Wed-10:00	4202	2980	11784	8804	177.26	26010	X
Wed-10:00	Wed-11:00	3292	2980	12096	9116	183.54	27886	X
Wed-11:00	Wed-12:00	3600	2980	12716	9736	196.03	31809	X
Wed-12:00	Wed-13:00	3257	2980	12993	10013	201.60	33644	X
Wed-13:00	Wed-14:00	3314	2980	13327	10347	208.33	35927	X
Wed-14:00	Wed-15:00	3545	2980	13892	10912	219.70	39956	X
Wed-15:00	Wed-16:00	3751	2980	14663	11683	235.23	45803	X
Wed-16:00	Wed-17:00	3872	2980	15555	12575	253.19	53064	X
Wed-17:00	Wed-18:00	3979	2980	16554	13574	273.30	61830	X
Wed-18:00	Wed-19:00	3405	2980	16979	13999	281.86	65763	X
Wed-19:00	Wed-20:00	2911	2980	16910	13930	280.47	65116	X
Wed-20:00	Wed-21:00	2518	2980	16448	13468	271.17	60869	X
Wed-21:00	Wed-22:00	2375	2980	15843	12863	258.99	55523	X
Wed-22:00	Wed-23:00	1922	2980	14785	11805	237.68	46764	X
Wed-23:00	Thr-0:00	1282	2980	13087	10107	203.50	34280	X
Thr-0:00	Thr-1:00	805	2980	10912	7932	159.70	21112	X
Thr-1:00	Thr-2:00	449	2980	8381	5401	108.74	9788	X
Thr-2:00	Thr-3:00	345	2980	5746	2766	55.69	2567	X
Thr-3:00	Thr-4:00	409	2980	3175	195	3.93	13	X
Thr-4:00	Thr-5:00	768	963	963	0	0.00		X
Thr-5:00	Thr-6:00	2852	2852	2852	0	0.00		X
Thr-6:00	Thr-7:00	5068	2980	5068	2088	42.04	1463	X
Thr-7:00	Thr-8:00	5287	2980	7375	4395	88.49	6482	X
Thr-8:00	Thr-9:00	4906	2980	9301	6321	127.27	13408	X
Thr-9:00	Thr-10:00	3649	2980	9970	6990	140.74	16396	X
Thr-10:00	Thr-11:00	3122	2980	10112	7132	143.60	17069	X
Thr-11:00	Thr-12:00	3034	2980	10166	7186	144.68	17328	X
Thr-12:00	Thr-13:00	3033	2980	10219	7239	145.75	17585	X
Thr-13:00	Thr-14:00	3432	2980	10671	7691	154.85	19849	X
Thr-14:00	Thr-15:00	3900	2980	11591	8611	173.38	24883	X
Thr-15:00	Thr-16:00	3932	2980	12543	9563	192.54	30688	X
Thr-16:00	Thr-17:00	3833	2980	13396	10416	209.72	36407	X
Thr-17:00	Thr-18:00	3950	2980	14366	11386	229.25	43504	X
Thr-18:00	Thr-19:00	3496	2980	14882	11902	239.64	47537	X
Thr-19:00	Thr-20:00	2987	2980	14889	11909	239.78	47592	X
Thr-20:00	Thr-21:00	2555	2980	14464	11484	231.22	44256	X
Thr-21:00	Thr-22:00	2242	2980	13726	10746	216.36	38750	X
Thr-22:00	Thr-23:00	1997	2980	12743	9763	196.57	31985	X
Thr-23:00	Fri-0:00	0	6300	9763	3463	32.98	1903	
	2-Day Total	135,780				2-Day Total	1,205,118	
	Average	67,890				Average	602,559	

Legend: **Gray** = Over Capacity, **Yellow** = Delay over 10 Minutes Red = Delay over 30 Minutes

Table 3: LCAP Results for MOT Option 2, Northbound Direction

Start Time	End Time	Base Demand	Approach Volume	Roadway Volume	Vehicles In Queue	Delay Length (Minutes)	Veh-Hrs Delay (Veh in Queue x Delay Length)	Workzone Up
Wed-0:00	Wed-1:00	213	213	213	0	0.00		X
Wed-1:00	Wed-2:00	112	112	112	0	0.00		X
Wed-2:00	Wed-3:00	425	425	425	0	0.00		X
Wed-3:00	Wed-4:00	476	476	476	0	0.00		X
Wed-4:00	Wed-5:00	858	858	858	0	0.00		X
Wed-5:00	Wed-6:00	2223	2223	2223	0	0.00		X
Wed-6:00	Wed-7:00	3680	3680	3680	0	0.00		X
Wed-7:00	Wed-8:00	4072	4072	4072	0	0.00		X
Wed-8:00	Wed-9:00	4071	4071	4071	0	0.00		X
Wed-9:00	Wed-10:00	3336	3336	3336	0	0.00		X
Wed-10:00	Wed-11:00	3338	3338	3338	0	0.00		X
Wed-11:00	Wed-12:00	3524	3524	3524	0	0.00		X
Wed-12:00	Wed-13:00	3779	3779	3779	0	0.00		X
Wed-13:00	Wed-14:00	3934	3934	3934	0	0.00		X
Wed-14:00	Wed-15:00	4410	4410	4410	0	0.00		X
Wed-15:00	Wed-16:00	5455	5250	5455	205	2.34	8	X
Wed-16:00	Wed-17:00	5558	5250	5763	513	5.86	50	X
Wed-17:00	Wed-18:00	5643	5250	6156	906	10.35	156	X
Wed-18:00	Wed-19:00	5537	5250	6443	1193	13.63	271	X
Wed-19:00	Wed-20:00	4140	5250	5333	83	0.95	1	X
Wed-20:00	Wed-21:00	3005	3088	3088	0	0.00		X
Wed-21:00	Wed-22:00	2813	2813	2813	0	0.00		X
Wed-22:00	Wed-23:00	2215	2215	2215	0	0.00		X
Wed-23:00	Thr-0:00	1355	1355	1355	0	0.00		X
Thr-0:00	Thr-1:00	1042	1042	1042	0	0.00		X
Thr-1:00	Thr-2:00	601	601	601	0	0.00		X
Thr-2:00	Thr-3:00	477	477	477	0	0.00		X
Thr-3:00	Thr-4:00	458	458	458	0	0.00		X
Thr-4:00	Thr-5:00	764	764	764	0	0.00		X
Thr-5:00	Thr-6:00	2034	2034	2034	0	0.00		X
Thr-6:00	Thr-7:00	3345	3345	3345	0	0.00		X
Thr-7:00	Thr-8:00	3889	3889	3889	0	0.00		X
Thr-8:00	Thr-9:00	3406	3406	3406	0	0.00		X
Thr-9:00	Thr-10:00	3410	3410	3410	0	0.00		X
Thr-10:00	Thr-11:00	3097	3097	3097	0	0.00		X
Thr-11:00	Thr-12:00	3316	3316	3316	0	0.00		X
Thr-12:00	Thr-13:00	3482	3482	3482	0	0.00		X
Thr-13:00	Thr-14:00	3731	3731	3731	0	0.00		X
Thr-14:00	Thr-15:00	4354	4354	4354	0	0.00		X
Thr-15:00	Thr-16:00	5583	5250	5583	333	3.81	21	X
Thr-16:00	Thr-17:00	5572	5250	5905	655	7.49	82	X
Thr-17:00	Thr-18:00	5663	5250	6318	1068	12.21	217	X
Thr-18:00	Thr-19:00	5281	5250	6349	1099	12.56	230	X
Thr-19:00	Thr-20:00	5480	5250	6579	1329	15.19	336	X
Thr-20:00	Thr-21:00	3634	4963	4963	0	0.00		X
Thr-21:00	Thr-22:00	2491	2491	2491	0	0.00		X
Thr-22:00	Thr-23:00	2405	2405	2405	0	0.00		X
Thr-23:00	Fri-0:00	0	0	0	0	0.00		X
	2-Day Total	149,272				2-Day Total	1,373	
	Average	74,636				Average	687	

Legend: **Gray** = Over Capacity, **Yellow** = Delay over 10 Minutes Red = Delay over 30 Minutes

Table 4: LCAP Results for MOT Option 2, Southbound Direction

Start Time	End Time	Base Demand	Approach Volume	Roadway Volume	Vehicles In Queue	Delay Length (Minutes)	Veh-Hrs Delay (Veh in Queue x Delay Length)	Workzone Up
Wed-0:00	Wed-1:00	274	274	274	0	0.00		X
Wed-1:00	Wed-2:00	89	89	89	0	0.00		X
Wed-2:00	Wed-3:00	162	162	162	0	0.00		X
Wed-3:00	Wed-4:00	460	460	460	0	0.00		X
Wed-4:00	Wed-5:00	946	946	946	0	0.00		X
Wed-5:00	Wed-6:00	3255	3255	3255	0	0.00		X
Wed-6:00	Wed-7:00	6013	5250	6013	763	8.72	111	X
Wed-7:00	Wed-8:00	6376	5250	7139	1889	21.59	680	X
Wed-8:00	Wed-9:00	5971	5250	7860	2610	29.83	1,298	X
Wed-9:00	Wed-10:00	4670	5250	7280	2030	23.20	785	X
Wed-10:00	Wed-11:00	3658	5250	5688	438	5.01	37	X
Wed-11:00	Wed-12:00	4001	4439	4439	0	0.00		X
Wed-12:00	Wed-13:00	3619	3619	3619	0	0.00		X
Wed-13:00	Wed-14:00	3683	3683	3683	0	0.00		X
Wed-14:00	Wed-15:00	3940	3940	3940	0	0.00		X
Wed-15:00	Wed-16:00	4168	4168	4168	0	0.00		X
Wed-16:00	Wed-17:00	4303	4303	4303	0	0.00		X
Wed-17:00	Wed-18:00	4422	4422	4422	0	0.00		X
Wed-18:00	Wed-19:00	3784	3784	3784	0	0.00		X
Wed-19:00	Wed-20:00	3235	3235	3235	0	0.00		X
Wed-20:00	Wed-21:00	2798	2798	2798	0	0.00		X
Wed-21:00	Wed-22:00	2639	2639	2639	0	0.00		X
Wed-22:00	Wed-23:00	2136	2136	2136	0	0.00		X
Wed-23:00	Thr-0:00	1425	1425	1425	0	0.00		X
Thr-0:00	Thr-1:00	895	895	895	0	0.00		X
Thr-1:00	Thr-2:00	499	499	499	0	0.00		X
Thr-2:00	Thr-3:00	384	384	384	0	0.00		X
Thr-3:00	Thr-4:00	455	455	455	0	0.00		X
Thr-4:00	Thr-5:00	854	854	854	0	0.00		X
Thr-5:00	Thr-6:00	3169	3169	3169	0	0.00		X
Thr-6:00	Thr-7:00	5632	5250	5632	382	4.37	28	X
Thr-7:00	Thr-8:00	5875	5250	6257	1007	11.51	193	X
Thr-8:00	Thr-9:00	5452	5250	6459	1209	13.82	278	X
Thr-9:00	Thr-10:00	4055	5250	5264	14	0.16	0	X
Thr-10:00	Thr-11:00	3470	3484	3484	0	0.00		X
Thr-11:00	Thr-12:00	3372	3372	3372	0	0.00		X
Thr-12:00	Thr-13:00	3371	3371	3371	0	0.00		X
Thr-13:00	Thr-14:00	3814	3814	3814	0	0.00		X
Thr-14:00	Thr-15:00	4334	4334	4334	0	0.00		X
Thr-15:00	Thr-16:00	4369	4369	4369	0	0.00		X
Thr-16:00	Thr-17:00	4260	4260	4260	0	0.00		X
Thr-17:00	Thr-18:00	4390	4390	4390	0	0.00		X
Thr-18:00	Thr-19:00	3885	3885	3885	0	0.00		X
Thr-19:00	Thr-20:00	3320	3320	3320	0	0.00		X
Thr-20:00	Thr-21:00	2840	2840	2840	0	0.00		X
Thr-21:00	Thr-22:00	2492	2492	2492	0	0.00		X
Thr-22:00	Thr-23:00	2219	2219	2219	0	0.00		X
Thr-23:00	Fri-0:00	0	0	0	0	0.00		X
	2-Day Total	150,898				2-Day Total	3,409	
	Average	75,449				Average	1,705	

Legend: Gray = Over Capacity, **Yellow** = Delay over 10 Minutes Red = Delay over 30 Minutes

Delay Calculations

Baseline Pre-Construction Conditions

Signal and Merging Delay on Kenilworth Ave., Service Roads, Eastern Ave.,
Nannie Helen Burroughs Ave. ***prior to*** detours for one month closure of Eastern Ave. bridge

Baseline Delay for 13-Hour SimTraffic Simulation =

6-11 AM	8,847	veh-hrs			
11 AM-3 PM	387	veh-hrs			
3-7 PM	3,759	veh-hrs			
Total	12,993	veh-hrs			
x	1.5	for extra traffic during other 11 hrs of day =		19,490	veh-hrs
x	22	weekdays / month x 2 months =		**857,538**	veh-hrs

MOT Option 1 - Close one lane in each direction on Kenilworth Ave. to construct piers

LCAP Delay on Kenilworth Ave. due to 24/7 one-lane closure in each direction:

NB Average Daily Delay	318,326	veh-hrs
SB Average Daily Delay	602,559	veh-hrs
Total Avg. Weekday Delay	920,885	veh-hrs

The analysis above assumes volumes 10% lower than Oct. 2006 volumes to account for diversion away from Kenilworth Ave. However, travel time delay to the 10% diverted trips is ignored for conservative purposes.

If weekend delay is assumed to be negligible, **total weekday lane closure delay for Option 1**, with a two-month long closure of the inside lanes on Kenilworth Ave. (at 22 weekdays/month) = 40,518,925 veh-hrs

Total Monthly Delay for MOT Option 1 = 41,376,463

MOT Option 2 - Shift one lane in each direction from Kenilworth Ave. to service roads; Detour turns across closed Eastern Ave. bridge

Delay due to reduced capacity associated with unusual nature of "Lanes Divide" work zone:

From LCAP program, assuming 1,050 veh/hr overall reduction in capacity
(equivalent to 1/2 of 1 expressway lane at 2,100 veh/hr/lane)

NB Average Daily Delay	687	veh-hrs		
SB Average Daily Delay	1,705	veh-hrs		
Total Avg. Weekday Delay	2,391	veh-hrs		
Total Two-Month Delay =	143,481	veh-hrs @	30	days / month

Signal and Merging Delay on Kenilworth Ave., Service Roads, Eastern Ave.,
Nannie Helen Burroughs Ave. ***due to*** detours for one month closure of Eastern Ave. bridge

Proposed MOT Delay for 13-Hour SimTraffic Simulation =

6 AM - 2 PM	38,036	veh-hrs		
2-7 PM	16,490	veh-hrs		
	54,526	veh-hrs		
x	1.5	for extra traffic during other 11 hrs of day =	81,789	veh-hrs
x	30	days/month * 2 months (with weekend = weekday delay) =	4,907,340	veh-hrs

Travel Time Delay for detoured traffic for one month closure of Eastern Ave. bridge:

Left turns from Eastern Ave. to Southbound Kenilworth Ave. &
U-turns from Northbound to Southbound Kenilworth Ave.:

Detour Distance	1.05	miles @	50	MPH avg. speed =	1.26	min	
Detour Distance	0.50	miles @	25	MPH avg. speed =	1.20	min	
					2.46	min	
	x Average 13-Hour Volume of		4,472	veh =	183.35	veh-hrs	
x 1.5	for extra traffic during other 11 hrs of day =				275.03	veh-hrs	

Left turns from Southbound Kenilworth Ave. to Eastern Ave. &
U-turns from Southbound to Northbound Kenilworth Ave.:

Detour Distance	1.8	miles @	40	MPH avg. speed =	2.70	min	
	x Average 13-Hour Volume of		9,506	veh =	427.77	veh-hrs	
x 1.5	for extra traffic during other 11 hrs of day =				641.66	veh-hrs	

Kenilworth Ave. Southbound Ramp to Nannie Helen Burroughs Ave.

Detour Distance	1.0	miles @	40	MPH avg. speed =	1.50	min	
	x Average 13-Hour Volume of		3,093	veh =	77.325	veh-hrs	
x 1.5	for extra traffic during other 11 hrs of day =				115.99	veh-hrs	

If weekend volumes are assumed to be the same as weekday volumes to be conservative, then
Total Travel Delay for two-month long detours (30 days/month) = 61,960 veh-hrs

For pedestrian detour, assume 1 person-hour delay is equivalent to one veh-hour of delay:

Ped. Detour Distance =	2,800	feet @ 3 ft/s =	15.6	min delay/person		
x 23	pedestrians per 13-hour day x 1.2 for other 11 hrs =				7.2	pers-hrs
Total Ped Delay for two-month long detour (30 days/month) =					429	pers-hrs

Total Monthly Delay Due to MOT Option 2 = 5,113,211 veh-hrs

1 INSPECTION REPORT – REHABILITATION OF EASTERN AVENUE PUMPING STATION

Reconstruction of Eastern Avenue
Bridge over Kenilworth Avenue, N.E.

DISTRICT OF COLUMBIA
WATER AND SEWER AUTHORITY

INSPECTION REPORT

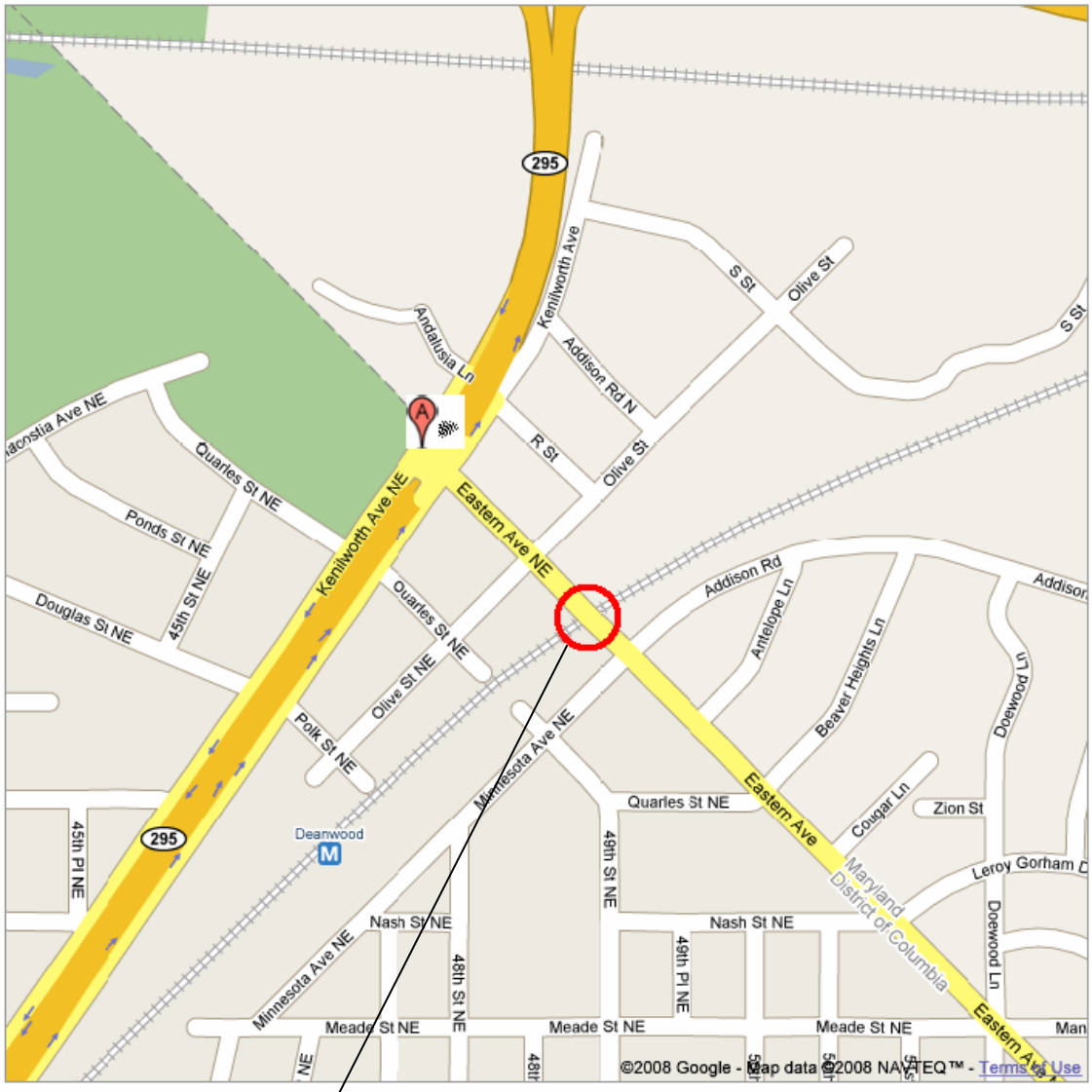
REHABILITATION OF
EASTERN AVENUE PUMPING STATION

PDH Associates, Inc.

May 25, 2008

EASTERN AVENUE N.E.
STORMWATER PUMP STATION

VISUAL INSPECTION REPORT AND REPAIR RECOMMENDATIONS



Pump Station at Railroad Underpass

PDH Associates, Inc.

EASTERN AVENUE N.E.
STORMWATER PUMP STATION

TABLE OF CONTENTS

EASTERN AVENUE N.E.
STORMWATER PUMP STATION

General;

The Stormwater Pump Station, built around 1935, is located on the Eastern Avenue, N.E. underpass at the railroad crossing. It is designed to collect downgrade stormwater from the lowest spot on Eastern Avenue and discharging it into the nearby storm sewer using two pumps. This is the two-level concrete structure abutting the South abutment of the railroad bridge over Eastern Avenue, N.E.
On June 27, 2008, PDH Associates, Inc. conducted a visual inspection of the accessible structural elements of the reinforced concrete structure to evaluate its existing structural condition. The following findings and recommended repairs are based on the visual inspection.

Findings:

Roof Slab: The roof slab was inspected from a distance by standing on a ladder and observing the slab covered with debris. However, it was inspected from the underside, and it is in fair condition without any trace of water leakage.

Exterior Wall and Drainage Trough:
The front wall facing Eastern Avenue is only accessible from the outside for inspection. It appears in fair condition. The 6 foot wide entrance door in this wall needs to be replaced with a new one (Photo No. 1).
The concrete drainage trough exhibited spalled / chipped concrete (Photo No. 2), and some debris. There are a couple of holes at bottom slab of drainage trough (Photo No. 3). The grating to cover this trough is missing.

Motor Room: This single room is on the ground floor and it houses the motors and electrical panels. The floor slab has two openings that go down to the second level pump chamber and the sump area. The floor slab is in fair condition, except the area around the openings sound hollow with delamination and spall (Fig 1). The grating covering the 6' by 4' opening showed signs of corrosion and a deformed lattice (Photo No. 6). The wall at top of the door opening has a couple of spalled concrete with exposed rebar (Photo No. 7). The wall paint is peeling off, and there are some holes in the wall (Photo No. 8). Overall this room is in fair condition.

Pump Chamber:
There are two pumps in this chamber. The partition wall between this room and the sump room has a crack (photo No. 9). As encountered in Photo No's. 10 and 11, the pump chamber ceiling and the beam underside of the opening exhibit some spalled concrete and exposed rebar. The South East corner wall of this chamber also has some spalled areas (Photo No. 12). The steel rod rungs / steps exhibit some effects of corrosion.

Sump: During inspection the sump was filled with several inches of water. The built-up material (presumably water proofing membrane) on the walls appeared to be

wrinkling on the wall surface (Photo No. 14). The concrete ceiling under the 12" float pipe has some spalled area (Photo No. 15). The steel rods / steps in this room also show signs of rusting.

Recommendation;

General:

- Inspect and repair all deficiencies in joints, cracks, leakage, scaling, spalling, exposed reinforcing, and delamination of the all concrete area which were not accessible during the visual inspection.

Roof Slab:

- Remove all debris and thoroughly clean top surface
- Inspect clean area and seal all cracks
- Repair concrete surface if any deficiencies are encountered

Exterior Wall / Front Wall and Drainage Trough:

- Remove and replace entrance door
- Clean and repaint the door frame
- Repair drainage trough surface including ledge for grating
- Repair the bottom slab of drainage trough
- Install new grating to cover drainage trough

Motor Room:

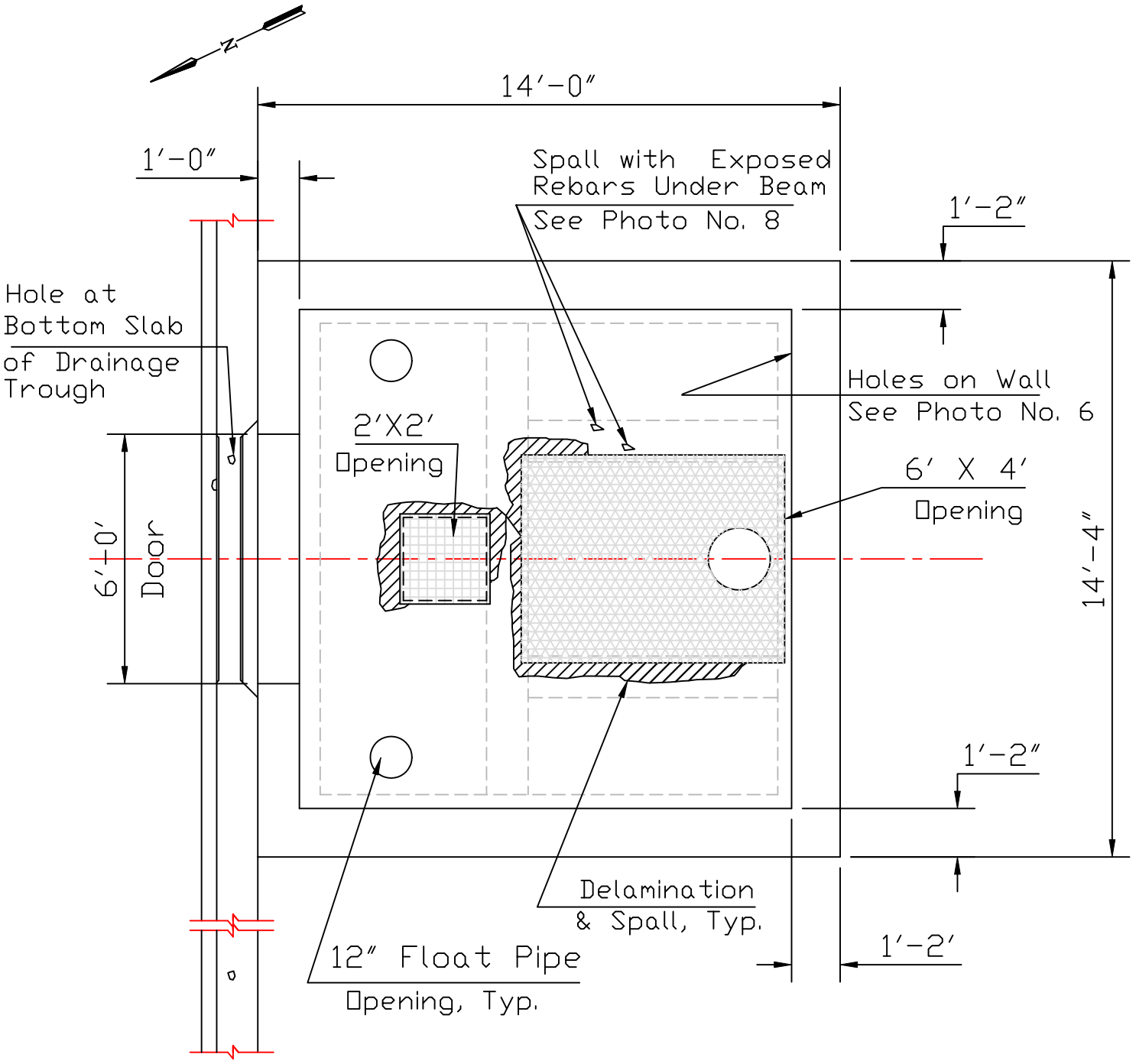
- Remove all delaminated concrete around the floor openings and repair the concrete including all floor concrete splled area.
- Repair the concrete wall at top of door opening.
- Fill the existing holes with grout
- Clean and repaint the walls and ceiling with a waterproof coating system
- Replace the grating cover and framing at the pump chamber access opening
- Provide a vent system to reduce the humidity level in the motor room

Pump Chamber:

- Repair cracked and spalled areas on the wall
- Repair the spalled areas under the beam and ceiling
- Clean and repaint the walls and ceiling with a waterproof coating system
- Steps - clean the steel rods and paint

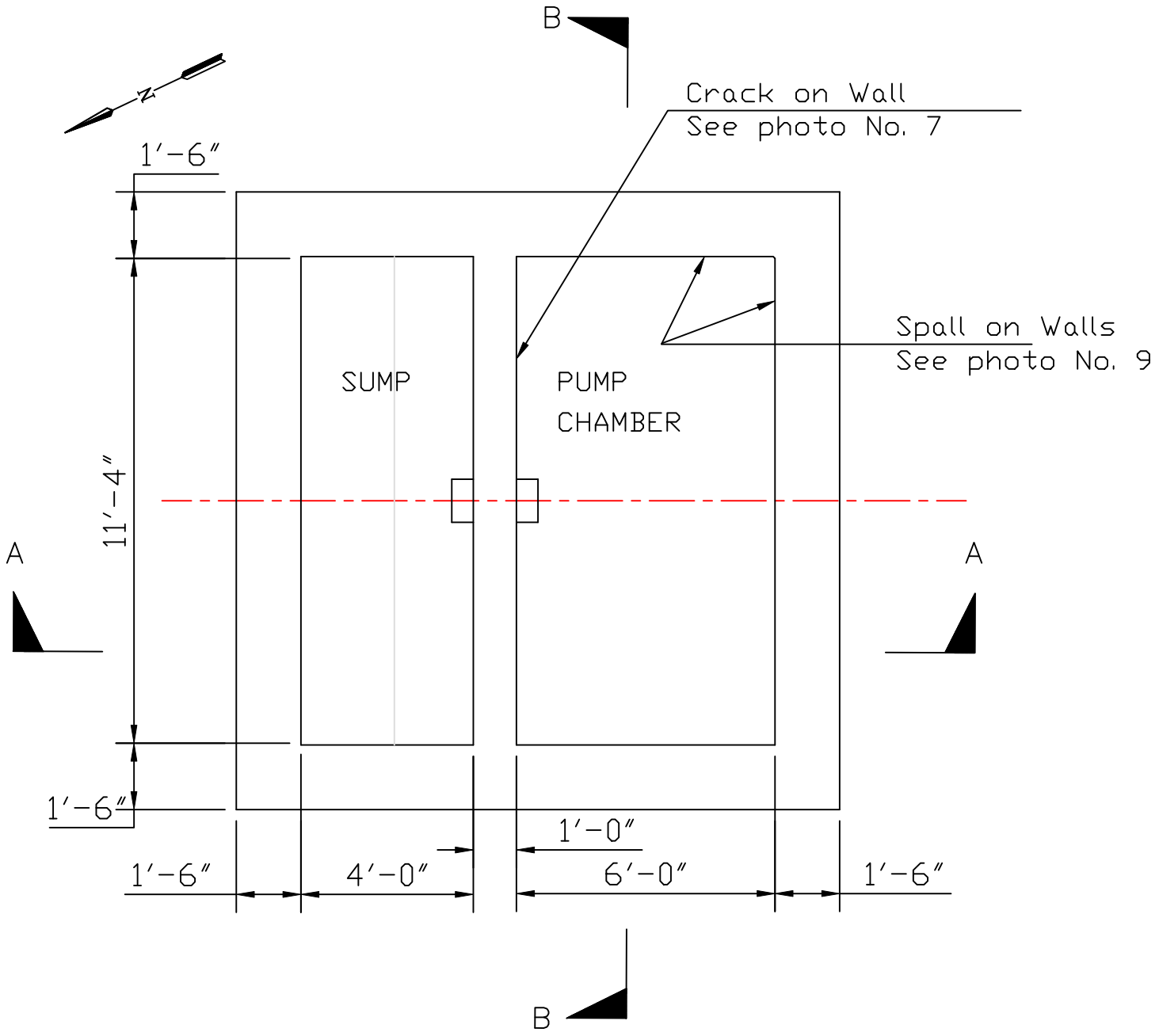
Sump:

- Remove the built-up material and apply new waterproofing coating on the walls and ceiling
- Repair the concrete ceiling
- Steps - clean the steel rods and paint



MOTOR ROOM - PLAN

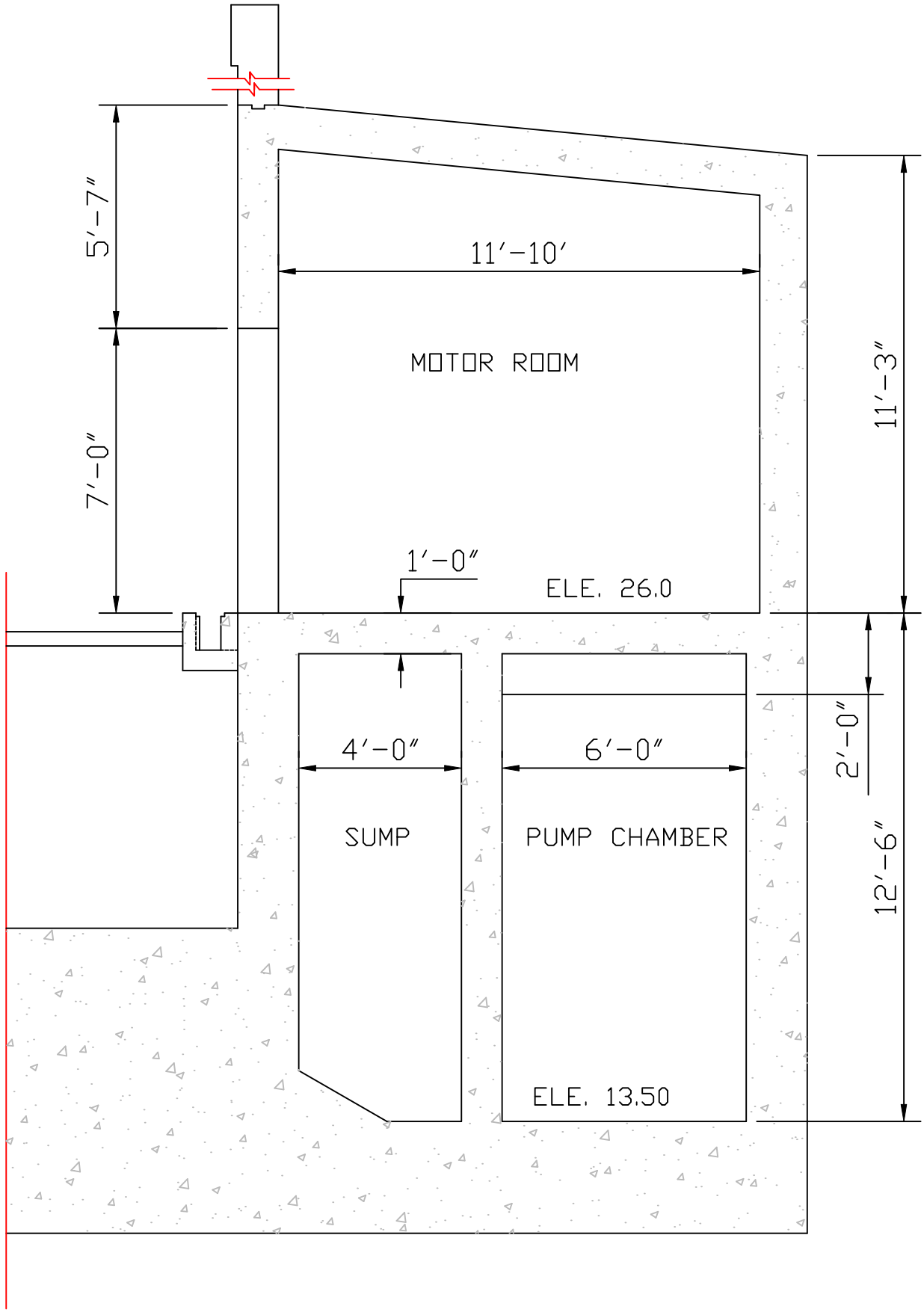
Fig. 1



SUMP AND PUMP CHAMBER - PLAN

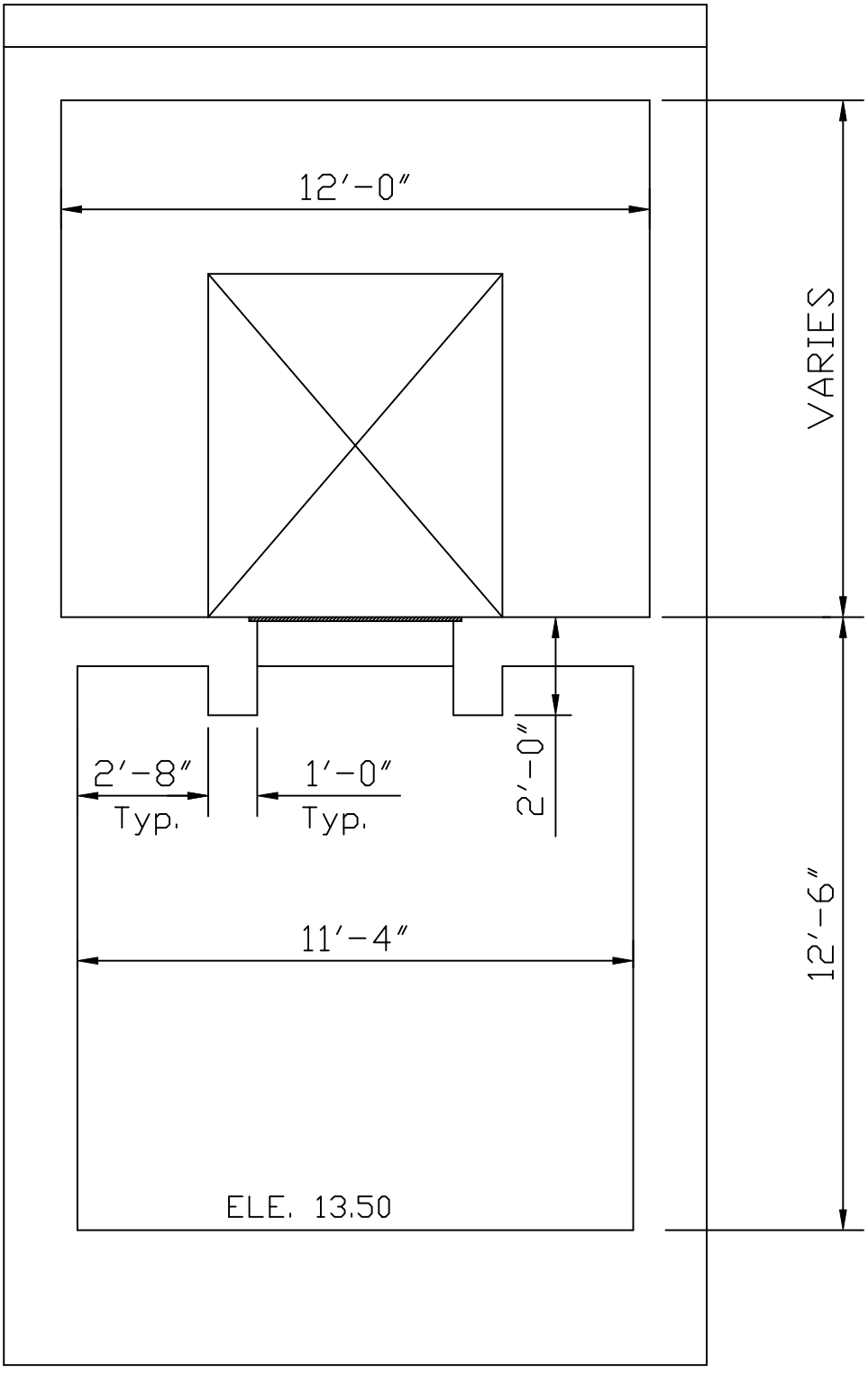
Fig. 2

Eastern Avenue N.E. Stormwater Pump Station



SECTION A-A

Fig. 3



SECTION B-B

Fig. 4

Photo No. 1- Front Door

Photo No. 2- Drainage Ditch at Front Door

Photo No. 3- 3" Hole at Bottom Slab of Drainage Ditch

Photo No. 4- Motor Room, Walls

Photo No. 5- Motor Room, Walls

Photo No. 6- Motor Room, Floor

Photo No. 7- Motor Room, Wall at top of Door Opening

Photo No. 8- Motor Room, South Wall

Photo No. 9- Pump Chamber, Crack on Wall

Photo No. 10- Pump Chamber Ceiling, Spall and Exposed Rebar under the Beam

Photo No. 11- Pump Chamber, Spall and Exposed Rebar on Ceiling

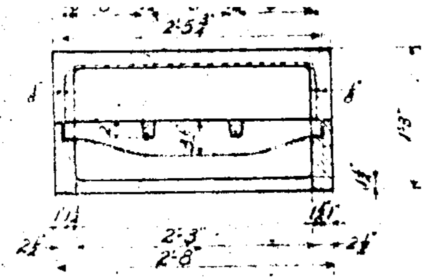
Photo No. 12- Pump Chamber Walls, Concrete Spall

Photo No. 13- Sump Room

Photo No. 14- Sump Room

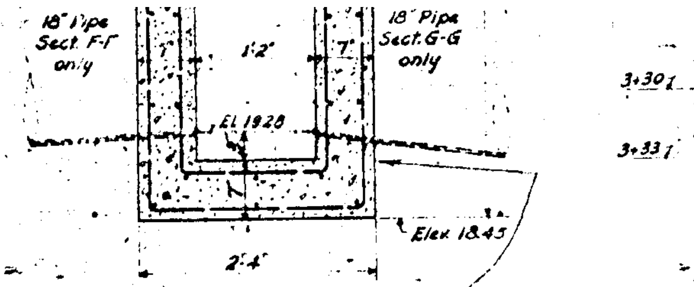
Photo No. 15- Sump Room, Ceiling at Float Pipe

Photo No. 16- Roof Slab



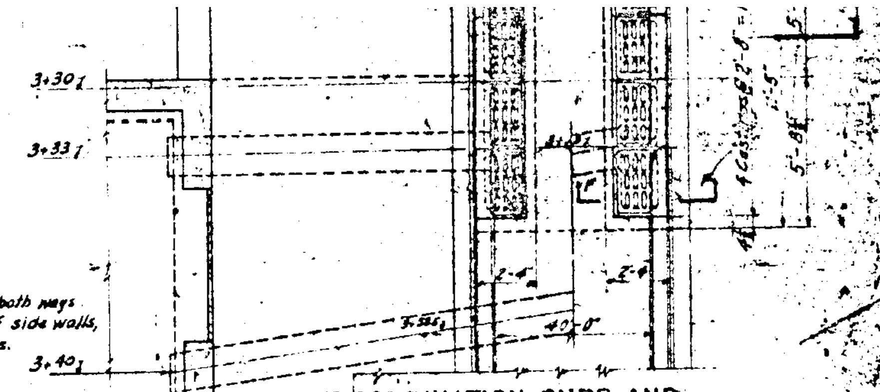
PLAN AND SECTION H-H OF COMBINATION CURB AND GUTTER DROP CASTING— 8 REQUIRED

Scale 1"-1'-0"



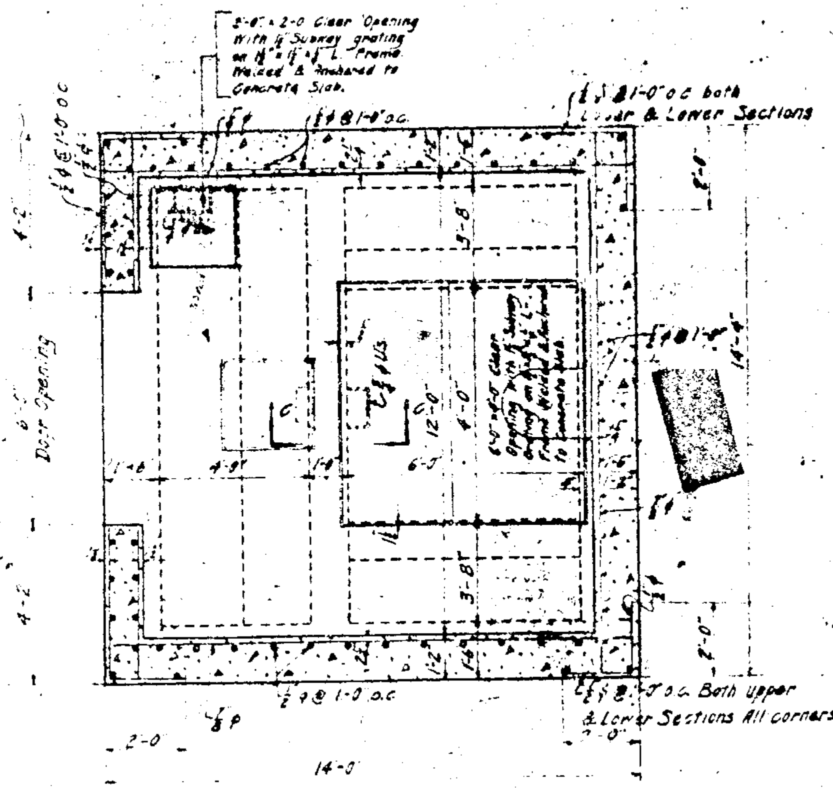
SECTION F-F—G-G

Scale 1"-1'-0"



PLAN AT COMBINATION CURB AND GUTTER DROP STORMWATER INLET SUMP

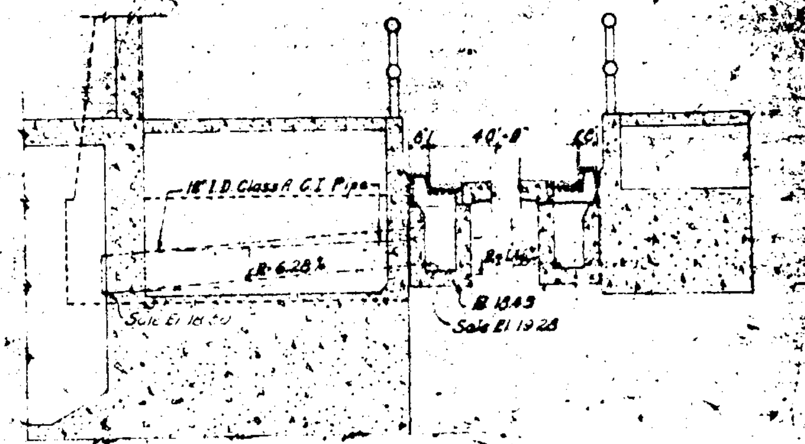
Scale ¼"-1'-0"



SECTION B-B

Scale ⅜"-1'-0"

Pump capacity—
2 — 4000 GPM pumps
w/ 39½' head



SECTION E-E

Scale ¼"-1'-0"

1. For general notes and list of drawings— See Sheet #1.
2. All cast iron castings to be gray cast iron conforming to Federal Specification QQ-I-651.
3. Motor Room Door.
   The door to be a double swing, ventilated top and bottom, Truscon stock type, or equal.
   The stiles, top rail and bottom rail shall be constructed of #14 gauge pressed steel tube 3¾" x 1⅜".
   The steel panels shall be constructed from cold rolled sheets, full pickled, reannealed, and patent leveled.

The corners shall be mitered and internally reinforced, the reinforcing extending eight and one half (8½) inches in both directions from the corner. All miter joints shall be face welded and ground smooth.
The door shall be equipped with steel panels electrically spot welded to the stiles and rails. This plate shall not be less than #18 gauge in thickness.
Doors shall be equipped with heavy steel ...

EASTERN AVE. UNDERPASS, N.E.

OFFICE OF THE ENGINEER COMMISSIONER, D.C.

ENGINEER OF BRIDGES, D.C.

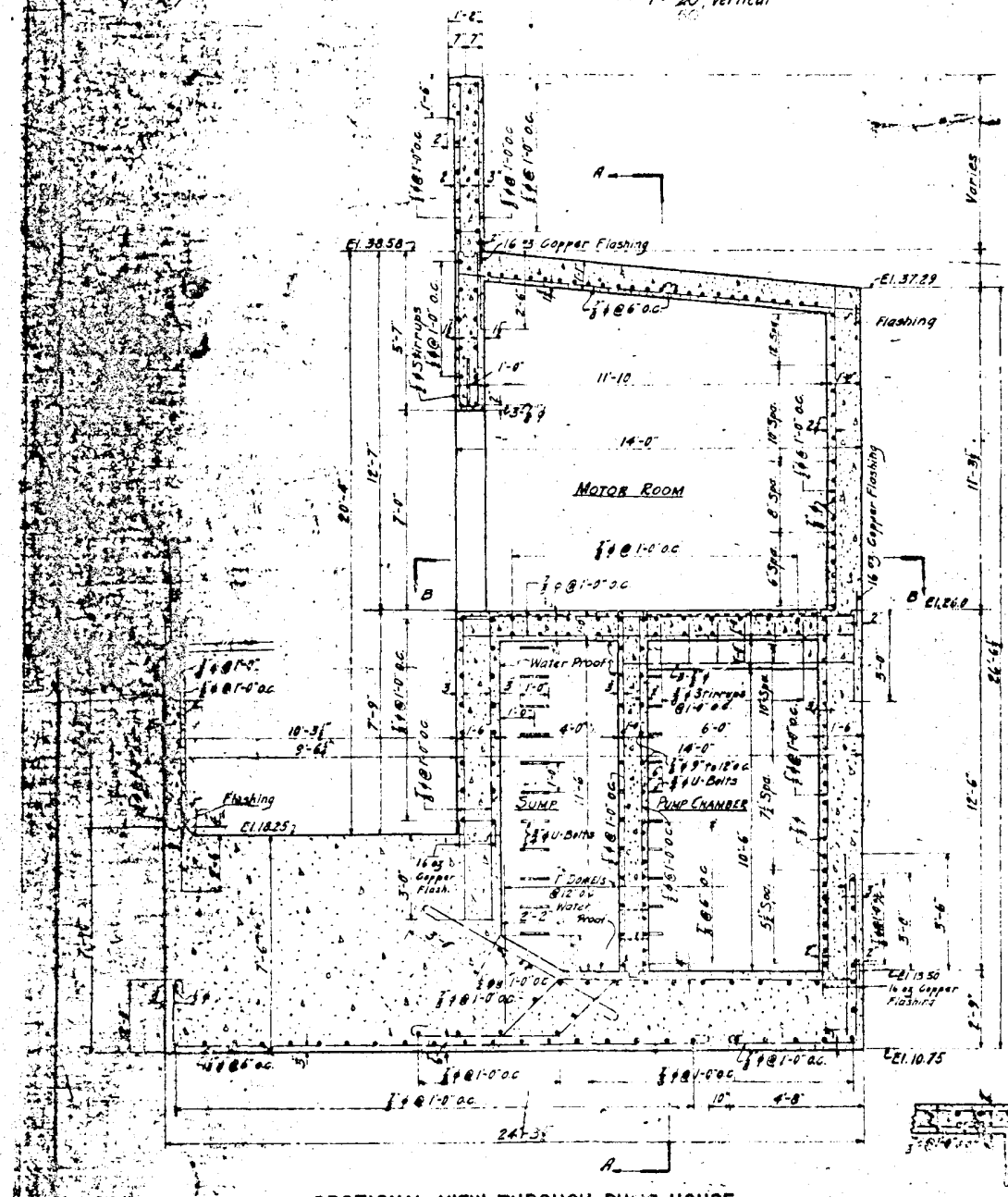
STORMWATER OUTLET SEWER SYSTEM AND PUMP HOUSE DETAILS

Designed by	R.L.M.	Drawn by	A.H.C. & H.L.V.
Traced by	L.M.J. & M.A.S.	Checked	
Revised			
Sheet 9 of			

9

PROFILE AT ℄ PROPOSED 24" STORMWATER OUTLET SEWER

Scale 1" = 100' horizontal
1" = 20' vertical



SECTIONAL VIEW THROUGH PUMP HOUSE

Scale 3/8" = 1'-0"

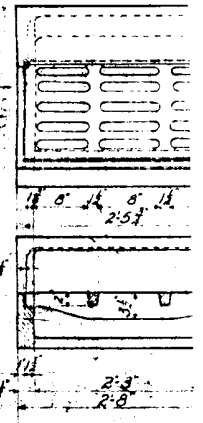
Note: Openings for 18" sump inlets not shown

SECTION C-D

Scale 3/8" = 1'-0"

ELEVATION OF STORMWATER OUTLET SEWER SUI

Scale 3/8" = 1'-0"



PLAN AND SECTION I
COMBINATION CURB
GUTTER DROP CAS
& REQUIRED

Scale 1" = 1'-0"

1 LEAD AND ASBESTOS SURVEY
FOR
THE EASTERN AVENUE PUMP STATION

Reconstruction of Eastern Avenue
Bridge over Kenilworth Avenue, N.E.

GREENHORNE & O'MARA
CONSULTING ENGINEERS

August 22, 2008

Bruce B. Beall, Program Manager
DC Water and Sewer Authority (WASA)
5000 Overlook Avenue
Washington, DC 20032

RE: Lead and Asbestos Survey for the Eastern Avenue Pump Station, Northeast, Washington, D.C.

Dear Mr. Beall:

Greenhorne and O'Mara, Inc. (G&O) recently completed a lead and asbestos survey at the above-referenced property (Figure 1, Appendix A). The purpose of the inspection was to determine if asbestos-containing materials (ACMs) and/or lead-based paint (LBP) were present within the building. Based on G&O's site visit and survey efforts, no suspect ACMs were observed at the pumping station. LBP was identified in the pumping station by G&O as well as through previously conducted surveys. Tables are presented within the text of this letter/report, but figures and other supporting documentation are presented as appendices.

PREVIOUS REPORT SUMMARY

Prior to completing the lead and asbestos inspection, G&O was provided a copy of two previously prepared reports: "*Stormwater Pumping Stations District of Columbia Water and Sewer Authority*" (September, 2001) and an excerpt from an undated report identified as "*15 Stormwater Pumping Station Asbestos and Lead Based Paint Survey Report*" (no date).

The 2001 report does not contain any sample information regarding the presence or absence of ACMs or LBP. Background information and an overview of the facility are provided. According to the 2001 report, the well capacity of the pumping station is approximately 3,465 gallon and it was constructed in 1935 under a railroad overpass.

The undated report indicated no suspect ACMs were observed during the site visit; therefore, no samples were collected. A lead inspection was performed, and 13 samples were collected for analysis via laboratory method SW 846, 7420. Of the 13 samples collected and analyzed, five were reported to have lead contents of more

6110 Frost Place ▪ Laurel, MD 20707
Phone 301 982 2800 ▪ Fax 301 220 2483
www.G-and-O.com

than 0.50% in weight (which is the U.S. Environmental Protection Agency or "EPA" standard). Table 1 depicts these materials and their lead content (in % weight).

Table 1
Previously Conducted Lead Survey Results

Surface	Color	Lead Content (% weight)
Floor	Red	1.700
Motor	Green	1.700
Door	Green	5.200
Electrical Panel	Lt. Green	1.90
Water Level Equipment	Green	2.00

ASBESTOS

No suspect ACMs were identified during the previously conducted surveys. The walls and floor of the pumping station are constructed of concrete. No pipe insulation of any kind was observed within the small facility. G&O did not observed any suspect ACMs during the visual inspection (2008) of the pumping station, which was conducted on July 24, 2008. Therefore, no samples were collected for analysis.

LEAD

In Washington, D.C., guidelines define LBP as paint that contains 1.0 milligrams per centimeter squared (mg/cm^2) of lead or more using an X-Ray Fluorescent (XRF) analyzer. The most accurate method to test for the presence of LBP is the XRF analyzer, which requires licensed operators.

LBP Methodology

The inspection to identify LBP at the site was performed by Kathy Nicholson, a DC-licensed Lead Inspector (# DC08-387). A Niton XL 309 XRF Analyzer with a Cadmium-109 source was utilized to provide in-situ analysis of painted surfaces. The instrument was calibrated before and after use in accordance with the manufacturer's specifications. The lead inspection protocol was based on current U.S. Department of Housing and Urban Development (HUD) guidelines and the instrument's Performance Characteristic Sheet (PCS).

LBP Results

A total of 12 surfaces were tested with the XRF during the inspection. The tests were conducted on exterior components and interior components. Only one surface tested with the XRF yielded a reading equal to or above 1.0 mg/cm^2. This surface was the metal door casing (dark green in color) of the entry door to the pumping station, which recorded a lead level of 43.0 mg/cm^2. Although only one surface was identified to be painted with LBP, several surfaces within the project area are lead-containing (recording lead levels below the EPA limit). Table 2 outlines LBP and lead-containing surfaces at the pumping station. Lead survey data sheets are presented as Attachment B.

Table 2
LBP and LCM at Pumping Station

Surface	Color	Lead Content (mg/cm^2)
Metal door (exterior)	Dark green	0.01
Concrete Wall B	White	0.03
Concrete floor	Burgundy	0.03
Large metal pipe	Mint green	0.05
Concrete Wall C	White	0.01
Metal pipe cover	Black	0.01
Metal pipe cover	Mint green	0.5
Metal door casing (exterior)	**Dark green**	**43.0**

Bold indicates LBP

OTHER HAZARDOUS MATERIALS

During G&O's site visit, the pumping station was inspected for the presence of hazardous materials, beyond those discussed above, which would require additional consideration and/or specialized removal efforts prior to conducting demolition or renovation activities. This section provides a brief summary of equipment identified within the on site structure that will require special attention and their quantities, where possible. Details relating to their removal are provided at the end of this report in the "Conclusions" section.

Mercury & Polychlorinated Biphenyls (PCBs)

The District Department of the Environment (DDOE) regulates universal wastes under District of Columbia Municipal Regulations (DCMR) and the Code of Federal Regulations: DCMR 4273 and 40 CFR Part 273. EPA and DDOE regulations encourage consumer recycling of materials identified as universal wastes. G&O observed one potentially mercury-containing thermostat within the pumping station on the northern interior wall. Due to the nature of motor equipment in the pumping station, it is possible that PCB-containing ballasts are located within this machinery.

CONCLUSIONS

G&O's survey confirmed the presence of LBP/LCM. Additionally, one item of universal waste was identified in the building. This section provides information regarding future actions that should be taken to remove potentially hazardous materials from the pumping station, prior to the commencement of renovation or demolition activities.

Asbestos

No suspect ACMs were observed during G&O's visual inspection of the pumping station; therefore, no samples were collected. No further action is required at this time.

Lead

Although the XRF did not confirm the results of the 2001 lead survey, the laboratory analysis of paint chips from the pumping station should not be discounted. As such, G&O maintains that in addition to the lead-based painted door casing identified by this survey, the five surfaces (floor, door, motor, electrical panel, and water level equipment box) identified in the 2001 survey should also be considered LBP. The renovation contractor should evaluate potential sources of exposure to lead, including lead in painted surfaces, prior to demolition in accordance with Occupational Safety and health Administration (OSHA) requirements. The contractor should also select demolition and/or finishing methods that minimize worker exposure to lead. Because the purpose of this project is to renovate the pumping station (and not to perform an abatement), engineering controls and personal protective equipment must be incorporated into the demolition/renovation work plans, as necessary, based on the potential exposure hazards and the OSHA Lead in Construction standard (29 CFR 1926.62). Reasonable precautions should be taken to prevent the release of fugitive dust emissions and contamination of surface soils with lead-containing debris during demolition.

Mercury & PCBs

Mercury-containing thermostats cannot be disposed at a municipal solid waste landfill. These items must be properly recycled or reused. Once the thermostat is no longer in use it becomes a waste and should be handled in accordance with the above-mentioned Federal and City regulations. The thermostat manufacture or the DDOE may be contacted to obtain recycling instructions or universal waste drop off locations within the City.

G&O is pleased to have this opportunity to be of service to DC WASA. Should you have any questions or comments regarding the above findings and recommendations, please feel free to call me at (301) 982-2852.

Sincerely,

J. Ross Voorhees, CHMM
Technical Director

Enclosure(s): Appendix A – Figures
Appendix B – Lead Survey Results
Appendix C – Site Photographs

References:

District Department of the Environment (DDOE). (n.d.). *District of Columbia Hazardous Waste Management Regulations Chapter 42 – Standards for the Management of Hazardous Waste and Used Oil.* Retrieved August 21, 2008, from http://ddoe.dc.gov/ddoe/frames.asp?doc=/ddoe/lib/ddoe/information/pdf/hwm_regs.pdf.

U.S. Environmental Protection Agency (EPA). (2003). Title 40 Protection of Environment Part 273 Standards for Universal Waste Management. Retrieved August 21, 2008, from http://edocket.access.gpo.gov/cfr_2003/julqtr/pdf/40cfr273.4.pdf.

Unknown author. (n.d.). *15 Stormwater Pumping Stations Asbestos and Lead Based Paint Survey Report* (pages 13-17 and Appendices D, E, and F).

Unknown author. (2001). *Stormwater Pumping Stations District of Columbia Water and Sewer Authority September, 2001* (one page of report and two pages of Appendix I).

Appendix A

Figures


Eastern Avenue
Pumping Station
New York Ave
201
Tuxedo Rd
50
295
Addison Rd
Eastern Ave
Quarles St NE
Kenilworth Ave NE
Ponds St NE
Douglas St NE
Polk St NE
Nash St NE
Meade St NE
Lee St NE
Kane Pl NE
Sheriff Rd NE
Just St NE
Mann St
Sheriff Rd
Zion St
Elkwood Ln
Leroy Gorham Dr
Chapelwood Ln
Nye St
Minnesota Ave NE
42nd St NE
42nd Pl NE
Lane Pl NE
44th St NE
45th Pl NE
45th St NE
46th St NE
49th St NE
49th Pl NE
50th Pl NE
50th St NE
51st Pl NE
51st St NE
52nd St NE
Doewood Ln
57th Ave
57th Pl
51st Pl
© 2008 Tele Atlas
Google
38°54'40.14" N
76°55'53.07" W
elev 42 ft
Eye alt 6471 ft

Appendix B

Lead Survey Results

XRF Survey Form

Inspector(s): Nicholson/Duggan Date: 7/24/08 Building: DC Pump Sta Eastern Ave @ Kenilworth

Reading #	Room	Component	Substrate	Pos/Neg	Reading	Notes
444		calibration			1.2	
445		"			1.1	
446		"			1.0	
447		door	metal		0.01	dark green (outside)
448		"	"		0.00	" (inside)
449	NULL	wall B	concrete		0.03	white
450		floor	"		0.03	burgandy
452		large pipe	metal		0.05	mint green
453		wall C	concrete		0.01	white
454		pipe cover	metal		0.01	black
455	NULL	pipe cover	metal		~~0.5~~	black
456		pipe cover	metal		0.5	mint green
457		door casing	metal		43.0	dark green (outside)
458		door	"		0.0	dark green (outside)
459		calibration			1.1	
460	NULL					
461		calibration			1.3	
462		"			1.1	

Appendix C

Site Photographs

Photo 1: Entry door to pumping station (LBP door casing)

Photo 2: Metal piping

Photo 3: motor and electrical panels

Photo 4: Electrical equipment

Photo 5: Metal grate

Photo 6: Thermostat

1 CSXT CONSTRUCTION REQUIREMENTS

Reconstruction of Eastern Avenue
Bridge over Kenilworth Avenue, N.E.

CONSTRUCTION REQUIREMENTS

When performing work on, over or adjacent to CSX Transportation (CSXT) right-of-way or operations, the Contractor must abide by the current CSXT Special Provisions, and the following additional requirements.

1. All construction related correspondence will be directed to AECOM acting as the Construction Monitoring Representative (CMR) on behalf of CSXT, with the following contact and address:

   Brian V. Harrison
   Manager – Construction Services
   AECOM
   260 S. Broad Street, Suite 1500
   Philadelphia, PA 19102
   (215) 966-4846

   Upon receipt of notification, the CMR will direct the Contractor to the local CSXT construction contact for the project.

2. The Contractor shall submit the following construction procedures and documents. The Contractor shall obtain written acceptance from CSXT or their representative before proceeding with construction.

   a. Means and Methods – The Contractor shall develop a detailed submission indicating the progression of work with specific times when tasks will be performed during the project. This submission will include a walkthrough at which time CSXT personnel will be present. Work will not be permitted to commence until the Contractor has provided CSXT with a satisfactory plan that the project will be undertaken without scheduling, performance or safety related issues. Provide a listing of the anticipated equipment to be used, the location of all equipment to be used and insure a contingency plan of action is in place should a primary piece of equipment malfunction. All work in the vicinity of CSXT property that has the potential of affecting CSXT train operations must be submitted and approved by CSXT prior to work being performed. This submission will also include a detailed narrative discussing the coordination of project safety issues between the sponsor, Contractor, CSXT and the CMR. The narrative shall address project level coordination and day to day, specific work operations including, but not limited to, equipment operations and temporary works.

   b. Containment System – Removed paint and debris may not be deposited on the CSXT right-of-way at any time during cleaning operations. Vacuum type systems for paint removal operations to prevent paint and debris deposits are required in lieu of a containment system over the track(s). The outside party selected contractor may submit a containment system for work over CSXT for acceptance by the railroad if the following CSXT horizontal and vertical clearance standards can be maintained. Any temporary containment system shall not encroach horizontally within eighteen feet (18') measured perpendicularly from the centerline of the nearest track. Any containment system must also maintain the existing vertical clearance over all tracks or a minimum of 23'-0" measured from top of high rail to the lowest point of structure in the clearance area which extends 6'-0" to both sides from centerline of track. If a containment system can meet these clearance standards, a construction submittal must be provided and include a written installation and removal procedure and a plan showing the details of the system. This submission is to include any work platforms with design loads and supporting calculations signed and sealed by a Professional Engineer in the State of Maryland. The design of the system shall also be in accordance with OSHA and all applicable environmental standards.

   c. Construction Schedule – Submit a detailed construction schedule for the duration of the project clearly indicating the time periods while working on and around CSXT right-of-way. As the work progresses, this schedule shall be updated and resubmitted as necessary to reflect changes in work sequence, duration and method, etc.

d. Insurance – Submit all required insurance information in accordance with the current CSXT Insurance Standards for approval. The complete original policies should be submitted to:

Donna W. Melton
Manager – Insurance
CSX Transportation, Inc.
500 Water Street - C907
Jacksonville, FL 32202
Phone: 904-359-1247
Fax: 904-245-2833

with a copy to the CMR. The insurance policies will be required to be in place and approved prior to any work commencing on or that could potentially impact CSXT right-of-way.

e. Emergency Action Plan – Submit an emergency action plan indicating the location of the site, contact numbers, access to the site, instructions for emergency response and location of the nearest hospitals. This plan should cover all items required in the event of an emergency at the site including fire suppression. Coordinate the Emergency Action Plan with the safety related discussion of the Means and Methods submission discussed above. The plan should also include a method to provide this information to each project worker for each day on site.

3. Up to thirty (30) days will be required to review all construction submissions. Up to an additional thirty (30) days will be required to review any subsequent submissions returned not approved.

4. The Contractor must not use CSXT right-of-way for storage of materials or equipment during construction. The CSXT right-of-way must remain clear at all times.

5. The Contractor will be required to abide by the provisions of the County/CSXT Construction Agreement. Periodically, throughout the project duration, the Contractor will be required to meet, discuss and, if necessary, take immediate action at the discretion of CSXT personnel and/or the CMR to comply with provisions of that agreement and these specifications.

6. This project will require extensive use of CSXT Flagmen to protect train operations from project activity in the area of the tracks. While CSXT cannot guarantee the availability of flagmen at all requested times, every accommodation will be extended to the Contractor when forces are available. Flagging requests should be made to the CSXT Roadmaster Roger Taylor at 301-874-2769 at least thirty (30) days in advance. Termination or cancellation of a flagman requires ten (10) days notice to avoid incurring costs.

7. All operations that could potentially impact CSXT right-of-way must be coordinated with the CSXT Flagman.

8. The Contractor shall execute Schedule I (Contractor's Acceptance) prior to starting work on, over, under or adjacent to CSXT right of way, which is part of the Construction Agreement to be executed between the Agency and CSXT.

9. Contractor access will be limited to the immediate project area only. The CSXT right-of-way may not be used for contractor access to the project site and no temporary at-grade crossings will be allowed.

CSXT SPECIAL PROVISIONS

I. AUTHORITY OF CSXT ENGINEER

The CSXT Representative shall have final authority in all matters affecting the safe maintenance of CSXT operations and CSXT property, and his or her approval shall be obtained by the Agency or its Contractor for methods of construction to avoid interference with CSXT operations and CSXT property and all other matters contemplated by the Agreement and these Special Provisions.

II. INTERFERENCE WITH CSXT OPERATIONS

A. Agency or its Contractor shall arrange and conduct its work so that there will be no interference with CSXT operations, including train, signal, telephone and telegraphic services, or damage to CSXT's property, or to poles, wires, and other facilities of tenants on CSXT's Property or right-of-way. Agency or its Contractor shall store materials so as to prevent trespassers from causing damage to trains, or CSXT Property. Whenever Work is likely to affect the operations or safety of trains, the method of doing such Work shall first be submitted to the CSXT Representative for approval, but such approval shall not relieve Agency or its Contractor from liability in connection with such Work.

B. If conditions arising from or in connection with the Project require that immediate and unusual provisions be made to protect train operation or CSXT's property, Agency or its Contractor shall make such provision. If the CSXT Representative determines that such provision is insufficient, CSXT may, at the expense of Agency or its Contractor, require or provide such provision as may be deemed necessary, or cause the Work to cease immediately.

III. NOTICE OF STARTING WORK

Agency or its Contractor shall not commence any work on CSXT Property or rights-of-way until it has complied with the following conditions:

A. Notify CSXT in writing of the date that it intends to commence Work on the Project. Such notice must be received by CSXT at least ten business days in advance of the date Agency or its Contractor proposes to begin Work on CSXT property. The notice must refer to this Agreement by date. If flagging service is required, such notice shall be submitted at least thirty (30) business days in advance of the date scheduled to commence the Work.

B. Obtain authorization from the CSXT Representative to begin Work on CSXT property, such authorization to include an outline of specific conditions with which it must comply.

C. Obtain from CSXT the names, addresses and telephone numbers of CSXT's personnel who must receive notice under provisions in the Agreement. Where more than one individual is designated, the area of responsibility of each shall be specified.

IV. WORK FOR THE BENEFIT OF THE CONTRACTOR

A. No temporary or permanent changes to wire lines or other facilities (other than third party fiber optic cable transmission systems) on CSXT property that are considered necessary to the Work are anticipated or shown on the Plans. If any such changes are, or become, necessary in the opinion of CSXT or Agency, such changes will be covered by appropriate revisions to the Plans and by preparation of a force account estimate. Such force account estimate may be initiated by either CSXT or Agency, but must be approved by both CSXT and Agency. Agency or Contractor shall be responsible for arranging for the relocation of the third party fiber optic cable transmission systems, at no cost or expense to CSXT.

B. Should Agency or Contractor desire any changes in addition to the above, then it shall make separate arrangements with CSXT for such changes to be accomplished at the Agency or Contractor's expense.

V. HAUL ACROSS RAILROAD

A. If Agency or Contractor desires access across CSXT property or tracks at other than an existing and open public road crossing in or incident to construction of the Project, the Agency or Contractor must first obtain the permission of CSXT and shall execute a license agreement or right of entry satisfactory to CSXT, wherein Agency or Contractor agrees to bear all costs and liabilities related to such access.

B. Agency and Contractor shall not cross CSXT's property and tracks with vehicles or equipment of any kind or character, except at such crossing or crossings as may be permitted pursuant to this section.

VI. COOPERATION AND DELAYS

A. Agency or Contractor shall arrange a schedule with CSXT for accomplishing stage construction involving work by CSXT. In arranging its schedule, Agency or Contractor shall ascertain, from CSXT, the lead time required for assembling crews and materials and shall make due allowance therefore.

B. Agency or Contractor may not charge any costs or submit any claims against CSXT for hindrance or delay caused by railroad traffic; work done by CSXT or other delay incident to or necessary for safe maintenance of railroad traffic; or for any delays due to compliance with these Special Provisions.

C. Agency and Contractor shall cooperate with others participating in the construction of the Project to the end that all work may be carried on to the best advantage.

D. Agency and Contractor understand and agree that CSXT does not assume any responsibility for work performed by others in connection the Project. Agency and Contractor further understand and agree that they shall have no claim whatsoever against CSXT for any inconvenience, delay or additional cost incurred by Agency or Contractor on account of operations by others.

VII. STORAGE OF MATERIALS AND EQUIPMENT

Agency and Contractor shall not store their materials or equipment on CSXT's property or where they may potentially interfere with CSXT's operations, unless Agency or Contractor has received CSXT Representative's prior written permission. Agency and Contractor understand and agree that CSXT will not be liable for any damage to such materials and equipment from any cause and that CSXT may move, or require Agency or Contractor to move, such material and equipment at Agency's or Contractor's sole expense. To minimize the possibility of damage to the railroad tracks resulting from the unauthorized use of equipment, all grading or other construction equipment that is left parked near the tracks unattended by watchmen shall be immobilized to the extent feasible so that it cannot be moved by unauthorized persons.

VIII. CONSTRUCTION PROCEDURES

A. General

1. Construction work on CSXT property shall be subject to CSXT's inspection and approval.

2. Construction work on CSXT property shall be in accord with CSXT's written outline of specific conditions and with these Special Provisions.

3. Contractor shall observe the terms and rules of the CSXT Safe Way manual, which Agency and Contractor shall be required to obtain from CSXT, and in accord with any other instructions furnished by CSXT or CSXT's Representative.

B. Blasting

1. Agency or Contractor shall obtain CSXT Representative's and Agency Representative's prior written approval for use of explosives on or adjacent to CSXT property. If permission for use of explosives is granted, Agency or Contractor must comply with the following:

a. Blasting shall be done with light charges under the direct supervision of a responsible officer or employee of Agency or Contractor.

b. Electric detonating fuses shall not be used because of the possibility of premature explosions resulting from operation of two-way train radios.

c. No blasting shall be done without the presence of an authorized representative of CSXT. At least 10 days' advance notice to CSXT Representative is required to arrange for the presence of an authorized CSXT representative and any flagging that CSXT may require.

d. Agency or Contractor must have at the Project site adequate equipment, labor and materials, and allow sufficient time, to (i) clean up (at Agency's expense) debris resulting from the blasting without any delay to trains; and (ii) correct (at Agency's expense) any track misalignment or other damage to CSXT's property resulting from the blasting, as directed by CSXT Representative, without delay to trains. If Agency's or Contractor's actions result in delay of any trains, including Amtrak passenger trains, Agency shall bear the entire cost thereof.

e. Agency and Contractor shall not store explosives on CSXT property.

2. CSXT Representative will:

   a. Determine the approximate location of trains and advise Agency or Contractor of the approximate amount of time available for the blasting operation and clean-up.

   b. Have the authority to order discontinuance of blasting if, in his or her opinion, blasting is too hazardous or is not in accord with these Special Provisions.

IX. MAINTENANCE OF DITCHES ADJACENT TO CSXT TRACKS

Agency or Contractor shall maintain all ditches and drainage structures free of silt or other obstructions that may result from their operations. Agency or Contractor shall provide erosion control measures during construction and use methods that accord with applicable state standard specifications for road and bridge construction, including either (1) silt fence; (2) hay or straw barrier; (3) berm or temporary ditches; (4) sediment basin; (5) aggregate checks; and (6) channel lining. All such maintenance and repair of damages due to Agency's or Contractor's operations shall be performed at Agency's expense.

X. FLAGGING / INSPECTION SERVICE

A. CSXT has sole authority to determine the need for flagging required to protect its operations and property. In general, flagging protection will be required whenever Agency or Contractor or their equipment are, or are likely to be, working within fifty (50) feet of live track or other track clearances specified by CSXT, or over tracks.

B. Agency shall reimburse CSXT directly for all costs of flagging that is required on account of construction within CSXT property shown in the Plans, or that is covered by an approved plan revision, supplemental agreement or change order.

C. Agency or Contractor shall give a minimum of 10 days' advance notice to CSXT Representative for anticipated need for flagging service. No work shall be undertaken until the flag person(s) is/are at the job site. If it is necessary for CSXT to advertise a flagging job for bid, it may take up to 90-days to obtain this service, and CSXT shall not be liable for the cost of delays attributable to obtaining such service.

D. CSXT shall have the right to assign an individual to the site of the Project to perform inspection service whenever, in the opinion of CSXT Representative, such inspection may be necessary. Agency shall reimburse CSXT for the costs incurred by CSXT for such inspection service. Inspection service shall not relieve Agency or Contractor from liability for its Work.

E. CSXT shall render invoices for, and Agency shall pay for, the actual pay rate of the flagpersons and inspectors used, plus standard additives, whether that amount is above or below the rate provided in the Estimate. If the rate of pay that is to be used for inspector or flagging service is changed before the work is started or during the progress of the work, whether by law or agreement between CSXT and its employees, or if the tax rates on labor are changed, bills will be rendered by CSXT and paid by Agency using the new rates. Agency and Contractor shall perform their operations that require flagging protection or inspection service in such a manner and sequence that the cost of such will be as economical as possible.

XI. UTILITY FACILITIES ON CSXT PROPERTY

Agency shall arrange, upon approval from CSXT, to have any utility facilities on or over CSXT Property changed as may be necessary to provide clearances for the proposed trackage.

XII. CLEAN-UP

Agency or Contractor, upon completion of the Project, shall remove from CSXT's Property any temporary grade crossings, any temporary erosion control measures used to control drainage, all machinery, equipment, surplus materials, falsework, rubbish, or temporary buildings belonging to Agency or Contractor. Agency or Contractor, upon completion of the Project, shall leave CSXT Property in neat condition, satisfactory to CSXT Representative.

XIII. FAILURE TO COMPLY

If Agency or Contractor violate or fail to comply with any of the requirements of these Special Provisions, (a) CSXT may require Agency and/or Contractor to vacate CSXT Property; and (b) CSXT may withhold monies due Agency and/or Contractor; (c) CSXT may require Agency to withhold monies due Contractor; and (d) CSXT may cure such failure and the Agency shall reimburse CSXT for the cost of curing such failure.

INSURANCE REQUIREMENTS

I. Insurance Policies:

Company and Contractor, if and to the extent that either is performing work on or about CSXT's property, shall procure and maintain the following insurance policies:

1. Commercial General Liability coverage at their sole cost and expense with limits of not less than $5,000,000 in combined single limits for bodily injury and/or property damage per occurrence, and such policies shall name CSXT as an additional named insured.

2. Statutory Worker's Compensation and Employers Liability Insurance with limits of not less than $1,000,000, which insurance must contain a waiver of subrogation against CSXT and its affiliates.

3. Commercial automobile liability insurance with limits of not less than $500,000 combined single limit for bodily injury and/or property damage per occurrence, and such policies shall name CSXT as an additional named insured.

4. Railroad protective liability insurance with limits of not less than $5,000,000 combined single limit for bodily injury and/or property damage per occurrence and an aggregate annual limit of $10,000,000, which insurance shall satisfy the following additional requirements:

   a. The insurer must be financially stable and rated B+ or better in Best's Insurance Reports.

   b. The Railroad Protective Insurance Policy must be on the ISO/RIMA Form of Railroad Protective Insurance - Insurance Services Office (ISO) Form CG 00 35.

   c. CSX Transportation must be named as the named insured on the Railroad Protective Insurance Policy.

   d. Name and Address of Contractor and Company must be shown on the Declarations page.

   e. Description of operations must appear on the Declarations page and must match the Project description, including project or contract identification numbers.

   f. Authorized endorsements must include the Pollution Exclusion Amendment - CG 28 31, unless using form CG 00 35 version 96 and later.

   g. Authorized endorsements may include:

      (i). Broad Form Nuclear Exclusion - IL 00 21
      (ii) 30-day Advance Notice of Non-renewal or cancellation
      (iii) Required State Cancellation Endorsement
      (iv) Quick Reference or Index - CL/IL 240

h. Authorized endorsements may not include:

(i) A Pollution Exclusion Endorsement except CG 28 31
(ii) A Punitive or Exemplary Damages Exclusion
(iii) A "Common Policy Conditions" Endorsement
(iv) Any endorsement that is not named in Section 4 (f) or (g) above.
(v) Policies that contain any type of deductible

5. Such additional or different insurance as CSXT may require.

II. Additional Terms

1. Contractor must submit its original insurance policies and two copies and all notices and correspondence regarding the insurance policies to:

Donna W. Melton
Manager – Insurance
CSX Transportation, Inc.
500 Water Street - C907
Jacksonville, FL 32202
Phone: 904-359-1247
Fax: 904-245-2833

2. Neither Company nor Contractor may begin work on the Project until it has received CSXT's written approval of the required insurance policies.