

Project Manual

SET NUMBER

Valparaiso Redevelopment Commission

Customer Owned Outside Plant Fiber Project

Project # 15-112



Planning ∩ Design ∩ Management

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October 2015

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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.
- B. In addition to other requirements indicated, all labor and materials provided under this Section shall be fully compliant with the following:
 - 1. American Association of State Highway and Transportation Officials (AASHTO)
 - 2. BICSI -Building Industry Consulting Services International publication Customer-owner Outside Plant Design Manual.
 - 3. American National Standards Institute/Telecommunications Industry Association - ANSI/TIA 758-B Standard -Customer-Owned Outside Plant Telecommunications Infrastructure Standard.
 - 4. Applicable State Codes

1.2 RELATED SECTIONS

- A. Division 0 and 1 Sections.

1.3 SUMMARY OF WORK

- A. This Section provides for the installation of a Customer Owner-Outside Plant (CO-OSP) buried pathway system and fiber optic cabling infrastructure as specified.
 - 1. Outside Plant (OSP) is defined as telecommunications spaces, pathways, cabling, cabling and termination hardware, and bonding and grounding work required to connect two or more buildings or structures and includes work through the building or structure penetration to the point of termination.
- B. The project

1.4 RELATED WORK NOT IN CONTRACT

- A. The system specified under this Section shall fully interface with future network transport equipment provided by others.

1.5 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract, Division 1 and Division 27 Specification Sections.
1. Product data and certificates of complete connectivity solution provider.
 2. Engineered drawings indicating specific placement of system and all related components.
 3. Cable Manufacturer's Certification of Quality and Performance.
 4. Pathway Manufacturer's detailed specifications.
 5. Maintenance Hole Manufacturer's detailed specifications.
 6. Complete details of Contractor's Installation Practices including a complete list of equipment to be used and detailed quality control procedures with corrective action.
 7. As detailed under "Quality Assurance" paragraph below.
- B. Maintenance Manual: Include information listed above in the Maintenance Manual in accordance with Specifications.

1.6 QUALITY ASSURANCE

- A. The Prime Contractor or his subcontractor responsible for this Section shall have a Registered Communications Distribution Designer (RCDD) on staff who will be ultimately responsible for this Project. The RCDD must have sufficient experience in this type project as to be able to lend adequate technical support to the field forces during installation, during the warranty period, and during any extended warranty periods or maintenance contracts. A resume of past projects of the responsible RCDD must be attached to the Contractor's response for evaluation by the Owner and Consultant. Provide a copy of the staff member's certificates, and resume with the Bid Response. The RCDD shall specifically be experienced in the installation of telecommunications Outside Plant (OSP) cabling infrastructure systems.
- B. The lead technician on the Project must carry a current BICSI certified technician certificate or have a minimum of five (5) years' experience in the installation of telecommunications outside plant cabling infrastructure systems of similar size and scope. A copy of the technician's certification and resume is required with the Bid response.
- C. The lead Technician(s) on the Project shall have a thorough understanding of the following:
1. American National Standards Institute/Telecommunications Industry Association/Electronics Industry Association –ANSI/TIA/EIA 590A -Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant.
 2. American National Standards Institute/Telecommunications Industry Association - ANSI/TIA 758-B Standard -Customer-Owned Outside Plant Telecommunications Infrastructure Standard.
 3. BICSI -Building Industry Consulting Services International publication Customer-owner Outside Plant Design Manual.
- D. The lead technician shall at all times during work hours:
1. Carry a mobile telephone equipped with voicemail.

2. Provide the telephone numbers of the above devices to the Consultant and Owner.

E. Documentation to be submitted with the Bid for evaluation includes:

1. A complete material list, including description, quantity of each item, the manufacturer being used, and the manufacturer's part number. Each item shall reference the Specification paragraph number and the list shall be submitted in the same numerical order as part 2 of the Section being referenced. (NOTE: Submission of this list does not constitute acceptance by the Owner or relieve the Contractor from providing approved items in the proper quantities to fulfill the Scope of this Project.)
2. Provide a minimum of five (5) reference accounts at which similar work, both in scope and design for each system specified, has been completed by the contractor within the last four (4) years. List shall include contact names and telephone numbers of each.
3. A list of test equipment proposed for use in verifying the installed integrity of fiber optic cable systems on this Project.
4. A technical resume of experience for the contractor's project manager and onsite installation supervisor who will be assigned to this Project.
5. A list of technical product training attended by the Contractor's personnel that will be working on this Project.
6. Each subcontractor on this Project must be listed with the Scope of Work for each. The above requirements also apply to each Subcontractor.
7. Engineered drawings indicating specific placement of system and all related components.
8. Manufacture Authorized and Certified. A copy of the Contractor's certificate.
9. Complete list of equipment, tools, and test equipment to be used for the Work specified under this Section.

1.7 SYSTEM DESCRIPTION

A. System shall include all Work as follows:

1. Underground optical fiber cabling housed in conduit placed in public right-of-way as indicated in the Contract Documents. The system includes maintenance holes as indicated and/or required. Include locate conductor for all pathways and pull rope in all empty conduits.
2. The cabling consists of singlemode optical fiber cable spliced, terminated, and tested complete as indicated.

PART 2 - PRODUCTS

2.1 PRODUCT STANDARDS

A. This Section is designed to provide the Contractor with a minimum standard of quality and functionality for the products used for Outside Plant (OSP). This standard will be considered in force for the original response as well as for any additions or changes to this Project. All products must be new. Any request for substitution shall be submitted in accordance with Section "Substitutions."

- B. All materials provided under this Section shall be UL-listed and meet all requirements of NEMA, NEC, local requirements, and be designed specifically for the environment in which it is installed.
- C. All materials shall be free of defects.
- D. The Consultant maintains the right to inspect and reject any and all materials provided under this Project.

2.2 PATHWAYS AND SPACES

- A. Pathways and spaces shall be fully compliant with applicable standards, local codes and regulations, common industry installation practices and manufacturer's recommended methods. All hardware and miscellaneous items required for the complete installation of pathways and spaces shall be corrosion resistant material such as stainless steel. An inert dielectric material shall separate dissimilar metals.
- B. Underground Conduit System: Specified duct sizes are Inside Diameter (ID) measurements. The system and all associated components shall be provided by a single manufacturer and include all required couplings, adaptors, fittings, brackets, hangers, and all other accessories recommended by the manufacturer and necessary for a complete and functional system as indicated. Where indicated provide system as follows:
 - 1. Bridge and culvert attachments shall include expansion joints, epoxy kits, terminators, couplings, transition adaptors, and split anchor rings, or approved equals.
 - 2. Where directional boring is performed, provide system specifically designed for directional boring.
 - 3. The system shall be specifically designed for underground direct buried applications by trenching or directional bore.
 - 4. The system shall be suitable for outdoor installations including constant immersion in water and attachment to external structures such as bridges without any degradation to the system.
 - 5. The system shall be resistant to most harsh chemicals and protected against degradation due to oxidation or general corrosion.
 - 6. The system shall provide for fixed or flexible sweeps and bends.
 - 7. The percent ovality of the system shall not exceed 5%.
 - 8. The system shall be capable of being sealed in concrete.
 - 9. Provide conduit as indicated in the Contract Documents to house all underground optical fiber cabling.
 - a. Provide (2) 2-inch conduits for pathways in these locations:
 - 1) South Loop
 - 2) North Loop
 - 3) East/West Connector
 - 4) North Route
 - b. Provide (1) 2-inch conduit for pathways in these locations:
 - 1) Leg services
 - c. Approved manufacturers are:

- 1) Opti-Com Manufacturing Network, Inc.
- 2) Dura-Line
- 3) JM Eagle
- 4) Blue Diamond Industries
- 5) Plastic Industries

C. Full Size Maintenance Holes: All Full Size Maintenance Holes and associated components shall be provided by a single manufacturer and include all required couplings, adaptors, fittings, brackets, hangers, and all other accessories recommended by the manufacturer and necessary for a complete and functional system as indicated. Where indicated provide Full Size Maintenance Holes and covers as follows:

1. Be reinforced precast concrete, 4500 psi and designed for truck loading.
2. 8'-6" long x 5'-6" wide x 7' high inside dimensions.
3. Provided with pulling irons opposite each duct bank.
 - a. Complete with bonding jumper to reinforcing steel in each section. Pre-cast maintenance holes have reinforcing steel bonded together and do not require an additional ground rod. Install a bonding ribbon horizontally around the top of the maintenance hole and attached to all cable racks, hardware and collar. Continue installation vertically between bonding clamps so both top and bottom halves are bonded together on each side. The bonding ribbon will be used to bond hardware placed within the maintenance hole.
4. Complete with cable racks for proper cable support.
5. All maintenance hole hardware shall have hot dipped galvanized finish.
6. Provide heavy-duty, cast-iron, frame and cover with nominal 30" opening with pick holes or handles.
7. Provide grade ring riser castings as required to elevate cover to approximately 1" above finished grade. Internal diameter of grade rings to be not less than internal diameter of maintenance hole cover frame. Verify with manufacturer on availability. Custom grade rings are acceptable upon prior approval of Owner's Representative.
8. Set on leveled undisturbed earth with minimum 3" granular fill under entire maintenance hole before setting. If earth is disturbed during excavation, properly compact soil and provide 3" concrete leveling pad under entire maintenance hole before setting. Backfill around maintenance holes per INDOT specifications for Maintenance hole, Inlet and Catch Basins, Section 720.
9. Maintenance hole ladders and corresponding ladder rings are required for all maintenance holes.
10. Maintenance holes shall be equipped with a 14 inch sump pit located directly under the maintenance hole lid per manufacturer specifications.
11. Maintenance hole shall be Type "J" with offset opening, duct entrances as shown on Drawings with properly placed precast knockouts, duct terminators.
12. Tinned copper bonding ribbon equivalent to .0510 x .3750 EPT shall be bonded to all cable racks within the maintenance holes.
13. Align multiple grade rings so that ladder steps line up. Do not cut these off.
14. Install gasket material between rings and frame per manufacturer's direction.

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- D. Above Ground Fiber Distribution Cabinet: Provides above ground access and modular approach to centralized fiber distribution. Enable jumper routing for efficient fiber management utilizing equal length pigtailed for the entire cabinet.
1. Dual-door entry for access to distribution and fiber management fields.
 2. Provide AFL IDEAA Exterior Distribution Cabinet in place of Full Size Maintenance Holes.
 3. Provide concrete filled bollards to protect cabinet from traffic damage.
 4. Provide Under Alternate Bid
- E. Maintenance Hand Holes: All Maintenance Hand Holes and associated components shall be provided by a single manufacturer and include all required couplings, adaptors, fittings, brackets, hangers, and all other accessories recommended by the manufacturer and necessary for a complete and functional system as indicated. Where indicated provide Maintenance Hand Holes and covers as follows:
1. Maintenance Hand Holes shall be Tier-22 rated heavy-duty enclosures and lid.
 2. Maintenance Hand Holes shall be of sufficient size to allow "Figure-8" coiling of cable slack without violating the bend radius restrictions of the cable.
 3. Maintenance Hand Holes shall be of sufficient size to accommodate splice closures as specified where indicated.
 4. Maintenance Hand Holes hardware shall be corrosion resistant stainless steel.
 5. Maintenance Hand Holes shall be manufactured of high strength polymer concrete material consisting of an aggregate mix bound together with a polymer resin.
 6. Maintenance Hand Holes materials shall be non-conductive, non-corrosive, and unaffected by moisture, freezing, sub-soil chemicals and UV light.
 7. Equip Maintenance Hand Holes with sump hole and all necessary provisions for knockouts, cable racking pulling irons, etc. for proper duct and cable installation per applicable electrical code, standards, and practice.
 8. Provide Maintenance Hand Holes with a concrete apron as indicated on the Drawings. Concrete apron shall be fully compliant with the Contract Documents including all applicable and referenced standards.
 9. Provide- Maintenance Hand Holes with a lid suitable for vehicle loading as specified. Bolt the lid to the enclosure after complete inspection by Consultant.
 10. Enclosures, boxes and covers are required to conform to all test provisions of the most current ANSI/SCTE 77 "Specification For Underground Enclosure Integrity" for Tier 22 applications.
 11. All covers are required to have the Tier level rating embossed on the surface. In no assembly can the cover design load exceed the design load of the box.
 12. All components in an assembly (box & cover) are manufactured using matched surface tooling. Independent third party verification or test reports stamped by a registered Professional Engineer certifying that all test provisions of this specification have been met are required with each submittal.
 13. Provide Maintenance Hand Holes as indicated on the Drawings. In addition, place Maintenance Hand Holes at one thousand feet intervals for pulling access.
 - a. Approved manufacturers are:
 - 1) Quazite

F. Steel Casings: All materials shall be hot-dipped galvanized steel.

1. Steel casings shall perform in an ambient temperature range of 40°C -120°C without degradation of material properties.
2. Steel casings shall be resistant to most harsh chemicals and protected against degradation due to oxidation or general corrosion.
3. Steel casings shall have a low coefficient of thermal expansion such that expansion and contraction is minimal.
4. Provide steel casings of adequate diameter to completely house the conduit system through the entire length of all railroad and paved vehicle crossings.

G. Warning Tape:

1. Warning tape shall be a detectable underground-metallized Mylar conduit marking tape. Bury above all conduit as indicated on the Drawings.

H. Above ground cable markers:

1. Provide above ground fiber optic cable markers in the apron of each maintenance hole as indicated.
 - a. Where Maintenance Holes are installed in soil and other non-pedestrian traffic areas, provide Rhino Damage Prevention Systems Tri-flex posts with Tri-flex anchor available from Repnet, Inc. or approved equal. Locate marker in the corner of the apron as indicated. Label maker as specified.
 - b. Where Maintenance Holes are installed in concrete sidewalks or other pedestrian traffic areas, provide Rhino Damage Prevention Systems A-Tag Pavement Marker available from Repnet, Inc. or approved equal. Locate marker in the corner of the apron as indicated. Label maker as specified.
 - c. In addition, in the apron of all Maintenance Holes provide Rhino Damage Prevention Systems A-Tag Pavement Marker available from Repnet, Inc. to match existing for identifying the maintenance hole number.

2.3 CABLING

A. All cabling shall be UL verified, rated for outside plant construction, and used appropriately as conditions require.

B. Fiber optic backbone cable:

1. Provide cable in continuous lengths. Each individual fiber strand shall be pulled from the same optical waveguide form and be completely void of any splices from the manufacturer.
1. Cable shall be Singlemode fiber with a Low water-peak, suitable for coarse wavelength division multiplexing specified for 1310, 1383 and 1550 nm. Colors shall remain stable during temperature cycling and not subject to fading or smearing.

2. Cable shall be a loose tube all dielectric construction designed for outdoor use, suitable for installation in an underground environment including constant immersion in water, and shall use Arid-Cor dry water blocking technology for moisture protection.
3. Each fiber and group of fibers shall be free-floating within the tubes allowing stresses placed on the cable to be de-coupled from the fiber strands.
4. The space within the tubes and around the strands shall contain a water blocking compound.
5. The cable shall employ a reverse oscillation stranding structure.
6. Cable configuration shall be in groups of up to twelve tubes surrounding a dielectric central strength member.
7. Each strand shall include a high density polymer coating of a minimum of 250 micron to prevent surface abrasion.
8. The cable performance shall have a minimum rating of the following:
 - a. Maximum Attenuation- (dB/Km) .4 over its operating range of 1310 to 1625 nm as defined in ITU-T G.652.D.
 - b. Tensile Strength — 2700 N under load conditions, 600N under static conditions, and crush resistance of 5000 N/m.
 - c. Minimum Bend Radius - 15 times its outer diameter during operation and 20 times its outer diameter during installation.
 - d. Environmental — Cable shall function without degradation under the following conditions:
 - 1) Installation: -30°C to +70°C
 - 2) Storage/Operation: -40°C to +70°C
 - 3) Humidity: 0 to 100%
9. Cable shall fully comply with all referenced and applicable standards and the following:
 - a. TIA 492CAAB/OS2 for performance
 - b. Bellcore GR-20 for crush resistance, impact resistance, flexing, and twist/bend
 - c. EIA/TIA-598 color coding for fiber optic cables
 - d. ANSI/ICEA S-83-640 for performance and physical construction
10. Provide quantity, type, and size of fiber cabling complete as indicated and as follows:
 - a. North Route - 288 strands
 - b. North Loop - 288 strands
 - c. East/West Connector - 288 strands
 - d. South Loop - 288 strands
 - e. Lateral Services - 6 strands per service location as identified on the Drawings.
11. Approved manufacturers are:
 - a. Comscope
 - b. Corning
 - c. General Cable
 - d. Hitachi
 - e. Mohawk

- f. OFS Optics
- g. Panduit
- h. Superior Essex

17.2 TERMINATION HARDWARE

- A. General: No field termination of connectors shall be allowed. All fiber terminations shall be factory manufactured pigtailed. The Contractor shall fusion splice pigtailed ends onto specified fibers and install pre-terminated pigtail ends into the specified fiber patch panels. Provide field fusion splices in Maintenance Hand Holes and above ground access points where indicated.
1. Underground fiber optic splice closures: Closures shall be fully compliant with Bellcore document GR-771-CORE.
 - a. Closure shall be specifically designed for underground installations and function without degradation in a temperature range of -45°C to $+70^{\circ}\text{C}$.
 - b. Closure shall comply with the following:
 - 1) Corrosion resistance of metal components. ASTM B 117 salt spray test for (30) days.
 - 2) Chemical resistance of nonmetallic components.
 - 3) Ultra-violet degradation of nonmetallic components. ASTM G 53 for (90 days - UVB-313 lamps) days.
 - 4) Resistance to water/moisture ingress.
 - 5) Impact resistance (vandalism).
 - 6) Effect of condensation (temperature/humidity cycle).
 - 7) Fungus resistance (ASTM 21).
 - 8) No light loss from cable clamping or cable movement.
 - c. Closure shall consist of an outer enclosure, inner enclosure, and splice trays. Outer enclosure shall be waterproof, re-enterable, and use an encapsulant between inner and outer enclosures to protect against moisture. Inner enclosure shall be re-enterable and protect the buffer tubes and splice trays.
 - d. Closure shall provide for the entry and exit of fiber optic cabling without violating the bend radius restrictions of the cable.
 - e. Closure shall be sized at each splice location appropriately to accommodate the quantity of fibers being spliced.
 - f. Splice trays shall be sized in each closure appropriately to accommodate the quantity of fibers being spliced.
 - g. Provide quantity of COYOTE→PUP closures as manufactured by Preformed Line Products necessary to complete all underground fiber splicing indicated.

17.3 HARDWARE, CABLE ASSEMBLIES, AND ACCESSORIES

- A. Identification:

1. Provide "The City of Valparaiso - Fiber Optic Cabling System - call (219) xxx-xxxx before proceeding" imprinted on the warning tape every fifteen feet.
2. Provide "The City of Valparaiso - Fiber Optic Cabling System - call (219) xxx-xxxx before proceeding" imprinted on each Tri-flex above ground cable marker.
3. Provide "Fiber Optic Cabling System - call (219) xxx-xxxx before proceeding" imprinted on the A-Tag above ground cable markers located in the apron of each maintenance hole.
4. Provide the maintenance hole number imprinted on each Tri-flex above ground cable marker located in the apron of each maintenance hole. Where no Tri-flex marker is provided (i.e. concrete sidewalks), provide maintenance hole number imprinted in the apron of each maintenance hole as specified.
5. Provide the name and trademark of the manufacturer, conduit size, date of manufacture, and "The City of Valparaiso - Fiber Optic Cabling System - call (219) xxx-xxxx before proceeding" on the underground conduit with durable identification every fifteen feet.
6. Provide the date of manufacture, manufacturer's name, and a numerical sequence at intervals no greater than 10 feet on the outer jacket of all cabling.
7. Provide "The City of Valparaiso - Fiber Optic Cabling System - call (219) xxx-xxxx before proceeding" on each maintenance hole lid.
8. Provide "The City of Valparaiso - Fiber Optic Cabling System - call (219) xxx-xxxx before proceeding" on a nylon cable tag attached on all cable ends at 6 inches from the sheath end. The cable tag shall also identify the cable number. Within each Maintenance Hole label each fiber as specified within 6-inches of ingress conduit, egress conduit, and splice enclosure.
9. Provide the manufacturer's name, and a numerical sequence at intervals no greater than 2 feet on the pull rope.
10. Provide labeling with a white background and black print on all terminations. Labeling shall be as specified. Lettering shall be bold print and 1/4 inch in height. Labels shall be as manufactured by Brady or Panduit.
11. Apply an identifying label to the sheath on each end of each fiber cable.
12. All identification shall be permanent.

B. Pull Rope

1. Provide a jacketed uni-directional Aramid Fiber custom woven flat pull rope in each innerduct. Pull rope shall be manufactured using a process that encapsulates the Aramid Fiber and bonds an exterior waterproof tape to the Aramid Fibers. Provide as manufactured by Arnco.

C. Cable Lubricant

1. Use a non-hardening, non-toxic, non-corrosive, non-sensitizing, lubricating compound during installation of cabling to reduce friction. Do not use liquid detergent. Provide Arnco Hydra-Lude Blue (B200) Cable Lubricant or approved equal.

PART 18 - EXECUTION

18.1 GENERAL REQUIREMENTS

- A. This Section is designed to provide the contractor with a standard of quality and functionality for the installation of Outside Plant (OSP). Not all procedures will be necessary for the installation of this Project. However, this standard will be considered in force for the original response as well as for any additions or changes to this Project.

18.2 INSTALLATION PRACTICES

- A. STANDARDS -The minimum criteria for proper installation may be found in the *TELECOMMUNICATIONS DISTRIBUTION METHODS MANUAL* and *CUSTOMER-OWNED OUTSIDE PLANT DESIGN MANUAL* published by the Building Industry Consulting Services International. Vendor must refer to this publication for cable installation practices.
- B. General
1. Provide all labor and materials as specified and as required for a complete and operational system as indicated whether or not specifically enumerated herein.
 2. All installation practices shall use the latest available machinery, equipment, and tools. All techniques used on this Project shall result in the ease of maintenance and ready access to all components. Methods shall be approved by the Consultant before installation.
 3. Label all cabling, spaces, pathways, closures, and terminations as indicated.
 4. Coordinate with the Owner before beginning any work.
 5. Clean up all scrap, materials, and tools each day at end of work cycle. Schedule work hours with the Consultant and Owner to determine time and length of shifts and weekend availability.
 6. Provide all cutting and patching as required.
 7. Use proper tools as recommended by the manufacturer and as defined by the applicable standard for all work performed on this Project.
 8. All installation practices shall be fully compliant with referenced and applicable standards, regulations, and codes and manufacturer's recommendations.
 9. Coordinate with existing public utilities before beginning any work.
 10. Submit proposed details of attachment to bridges and culvert structures and railroad crossings for Consultant approval before installation. Provide submittals in accordance with Construction Documents and State Department of Transportation requirements.
 11. Examine all components of the system to verify that the materials, design, construction, markings, and workmanship are fully compliant with these Specifications.
- C. Permits:
1. Contact the Authority Having Jurisdiction (AHJ) and secure all required permits for the Work specified under this Section.
- D. Right-of-way:

1. Right-of-way will be secured by the Owner. Provide all Work specified under this Section within the requirements of the right-of-way agreement.

E. Safety:

1. Provide and erect proper barriers, signage, covers, fencing, supports, and any other protection necessary to prevent harm to persons within and near the construction area at all times.
2. Provide proper electrical protection for all Work as indicated.
3. Provide proper grounding and bonding of all Work as indicated.

F. Traffic Control:

1. Provide complete traffic control including flag and security personnel, signage, barricades, routing changes, and all other requirements as specified. Submit proposed Work schedule and traffic control details to Consultant before installation.

G. Existing Utilities:

1. Locate, identify, and avoid all existing utilities (public and private) including but not limited to electric, water, sewer, gas, CATV, telecommunications, etc.
 - a. Identify underground utilities by marking on the ground with color coded paint as follows:
 - 1) Electric – Red
 - 2) Gas/Oil-Yellow
 - 3) Communications/CATV — Orange
 - 4) Water-Blue
 - 5) Sewer – Green
 - 6) Limits of Exposed Excavation – White
 - 7) Temporary Survey Marking – Pink
2. The location and routing of all underground conduits shown on the Drawings are intended as conceptual only, and are anticipated to vary depending upon actual field conditions encountered. The exact location and routing of underground conduits shall be determined by the Contractor following the intent of the Drawings as general guideline only, and shall be approved by the Owner's Field Representative. Prior to beginning the installation of underground conduits, it shall be the responsibility of the Contractor to research, locate, and mark any existing underground utilities that may interfere with the installation of new underground conduit. The Contractor shall be responsible for any damage to existing underground (or above ground) utilities or facilities. Any damage to existing underground or above ground utilities or facilities shall be replaced at the Contractor's expense, as approved by the Consultant. Contractor is to notify all utility companies no less than 48 hours prior to construction. It shall be the responsibility of the Contractor to research and identify all utility companies whose utilities and facilities may be affected by this Project.
3. Where the actual location is uncertain, identify obstacles located along the proposed construction area by means of test holes.

4. Create test holes either directly above or to the side of the assumed location of any obstacle. After obstacle is located, take exact measurements and create a profile drawing identifying the obstacles exact location.

H. Pathways and Spaces System

1. The pathways and spaces system consists primarily of underground conduit and Maintenance Hand Holes.
2. The general location of the pathway and spaces is indicated on the Drawings. Place pathway and spaces in the straightest and clearest pathway possible after location of underground utilities have been determined. Where minimum depth is unattainable, cover system with concrete as specified by the State Department of Transportation.
3. The inside radius of all bends and sweeps shall be no less than 40 inches. No single continuous conduit run shall contain more than the equivalent of two 90-degree bends (180 degrees total) between pull points. Encase all sweeps and bends in 17225 kPa (2500psi) concrete.
4. Hand-trench within five feet of each side and across all existing underground services.
5. Clearances: Provide and maintain the following clearances from the system at all times.
 - a. 12 inches of well-tamped earth or 3 inches of concrete between system and any electric power of other conduit.
 - b. 6 inches when crossing and 12 inches when parallel of well-tamped earth between system and any pips (gas, water, oil, etc.)
 - c. 50 inches below the top rail of any railroad crossing.
 - d. 36 inches below the top rail of any street railway crossing.
6. Provide end caps on each end of all empty innerducts.
7. Seal open ends to prevent the entrance of dirt and/or moisture.
8. All conduit ends shall be smooth and free from burrs and sharp edges.
9. Where duct system is placed beneath a railroad, paved street or highway, or river or stream crossing, provide galvanized steel casing as specified. After installation of underground duct system, fill casing with fine sand (blown in under pressure) and seal both ends with a 3 inch concrete wall.
10. Provide duct plugs on all duct ends at maintenance holes and building penetrations to prevent water and gas infiltration.
11. Provide underground fiber optic warning tape above duct system and below grade as indicated on the Drawings.
12. Where existing surface is removed, repair by back filling with material equal in composition and density to the surrounding areas and replace removed surface such as asphalt pavement and concrete riprap with like material to equivalent condition.
13. After complete installation of the system and before the installation of any cabling, pull completely through each innerduct a spherical template having a diameter of not less than 75% of the inside diameter of the innerduct to ensure the absence of any obstruction.
14. Provide system as specified and as indicated on the Drawings.
15. Where directional boring is performed, installation practices shall be consistent with industry standards and practices and fully compliant with applicable codes and regulations. Maximum bend radius of system for directional bores is 65 feet: For example, to obtain a 90-degree turn will require 65 feet of forward distance in any directional plane.

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16. Provide a no. 6 AWG conductor in duct system to allow detectability of the system. This conductor is strictly for the purpose of above ground location of the system.
- I. Cabling: Notify the Consultant no less than five working days before the installation of any fiber optic cabling.
 1. Provide all cabling as indicated in the Contract Documents.
 2. Install cabling in the underground pathway and spaces system as indicated.
 3. Provide innerduct as specified.
 4. Perform all Work in a manner consistent with industry practices. Extreme care shall be taken to not violate the bend radius restrictions of the cable at all times during the handling of the cable.
 5. Provide protection of the fiber optic cabling at all times during storage and installation.
 6. When the cable must be unreeled or slack provided at pull points during installation, use a "figure-8" configuration to prevent kinking or twisting of cable. Do not coil cable in a continuous direction. The bend radius restrictions of the cable shall not be violated.
 7. Use entry guide shutes and cable sheaves to guide and protect cabling during installation. When multiple cables are being installed simultaneously, use separate cable sheaves and cabling systems for each cable to reduce cable entanglement.
 8. Use cable lubricant as specified during installation of cabling to reduce friction.
 9. Continuously monitor the pulling tension of the cable and do not allow pulling tension to exceed Specifications.
 10. Use complete cabling installation system for the placement of fiber optic cable. Use Amco Tension Master pulling system or approved equal.
 11. Prior to connectorizing or splicing, remove and discard the first ten feet of fiber from the cable ends. Clean water blocking compound from fiber and keep closures and Equipment Rooms void of water blocking compound.
 12. Provide all termination hardware as indicated.
 13. Neatly dress and securely attach all cabling.
 14. Terminate all cabling on both ends using proper tools and manufacturer's instructions.
 15. All cable runs are to be continuous without splices except where specifically indicate.
 16. Provide all bonding and ground as specified.
 17. Provide proper strain relief for cabling at all connection points.
 18. Provide a minimum of twenty feet of cable slack per each cable in all enclosures, at all splices, and at all terminations taking care not to exceed bend radius restrictions of fiber optic cabling.
 19. Provide pull rope in all empty innerducts.
 20. Seal all conduits after complete installation.
 21. Provide a minimum of twenty feet of cable slack coiled in a "figure-8" configuration on each fiber cable in each maintenance hole where a fiber splice is not performed.
 22. In maintenance holes and equipment rooms, secure cabling such that it can not be pulled from another location and cause damage to the cable.
 23. Where indicated, fusion splice fiber optic cabling to route fiber strands to their assigned locations.
 24. Provide specified fiber splice closures. Locate splice closures as indicated. Install closures such that they are easily and readily accessible for maintenance.
 25. Maintain the correct polarity throughout the cabling system to support two-fiber transmit and receive applications.

26. Provide no less than six feet of pigtail slack neatly coiled in splice trays.

J. Restoration:

1. Completely restore all areas to original condition as it existed before construction or better.
2. Provide erosion control including bailed hay and sediment control fencing as specified in the referenced standards and as indicated on the Drawings.
3. Where trenching has been performed, restoration shall include return visits and additional trench fill after settlement of original fill has completely subsided and reseeded as necessary for complete restoration. Provide area safety as specified throughout restoration.

K. Identification:

1. Provide warning tape at 18 inches above pathway and spaces system.
2. Provide all labeling of systems and components as specified.

L. Other requirements:

1. Labels must be clearly type-written and must appear at all designated points for identification. Install labels on all cabling within six inches of sheath end. Labeling scheme must provide unique identifiers at all pertinent points. Provide labels as indicated.
2. Provide a thorough and complete system walk-through with the Consultant and Owner personnel for the purpose of training. Training shall include as a minimum location and explanation of the purpose of each enclosures, transition, crossing, above ground markers, and termination. Explain in detail how location of underground system is accomplished with an emphasis on life safety.

18.3 TESTING AND DOCUMENTATION

A. General:

1. Notify the Consultant no less than ten working days before performing any tests.
2. The results of tests shall be compared to the specified requirements- Failure to fully comply with specified requirements will result in the rejection of the tested item.
3. The Contractor is responsible for satisfying all testing requirements. The Contract period will not be extended due to delays resulting from testing requirements.
4. Complete and certify all test results before submission to the Consultant for acceptance.
5. Failure to comply with performance requirements shall be deemed a defect and test equipment is subject to rejection. Installation practices shall also be subject to rejection. Rejected equipment may be re-submitted after evidence of recalibration and non-compliance corrections has been approved by the Consultant. Evidence that rejected installation practices have been corrected shall also be submitted to the Consultant for approval.

B. Fiber Optic Cabling: Test all fiber optic cabling completely in accordance with referenced standards.

1. All fibers shall be proof tested by the manufacturer are a minimum load of 6000 kPa. All fibers shall be 100% attenuation tested by the manufacturer for compliance with the specified performance requirements. Provide manufacturer's test results and performance certification before installation.
2. Perform 100% attenuation test all fiber optic cabling on the reel after receipt and before installation and submit results to Consultant for comparison against manufacturer's certified test results.
3. If any test results fail to meet the manufacturer's certified test results or are non-compliant with this Section, the cable shall be rejected.
4. Test and document all fiber optic cables form both ends on each terminated strand with a properly calibrated Optical Time Domain Reflectometer (OTDR) as manufactured by Siecior or approved equal. Documentation shall include OTDR catalog number, serial number, manufacturer, strand identifier, meter readings, test date, calibration information and operator responsible for test. All OTDR testing shall be fully compliant with ANSI/EIA/TIA 455-8.
5. Provide 100 meters of like fiber to project OTDR cable examination beyond the "dead zone."
6. Test and record all fiber losses with an approved light source and meter and submit to Consultant for approval. Provide all test information on printouts and on electronic files. Perform test as segments of the fiber installation are completed and as directed by the Consultant.
7. NOTE: Owner reserves the right to have present a representative during any or all testing procedures. Verification testing will be performed at or near Project completion by a third party specified by the Owner.

18.4 PROJECT RECORD DOCUMENTS

- A. Provide all items required in Section "Project Record Documents" and the following printed and on CD-ROM. Electronic format shall be the same as the Contract Documents.
 1. A complete operation and maintenance manual that will include the following:
 - a. Provide a master list of all materials used on the Project and "clean" and "approved" product cut sheets including catalog information, sizing, and technical data on each item.
 - b. A complete and accurate diagram indicating all cables, cable types, cable sizes, and the connectivity provided. Provide 3 copies of full-size color plot that shows the fiber routing throughout the entire city on one drawing. The fiber runs shall be color-coded based on which core site they originate from. The core ring shall be a separate color. Coordinate color scheme with Owner prior to submitting.
 - c. A complete and accurate drawing of each cabinet/rack layout (to scale) showing space used by each installed component.
 - d. A complete and accurate diagram of the labeling scheme used on the Project.
 - e. Complete and accurate records of all performance data and test results as specified.
 - f. A complete detail of installation, splicing, terminating, and testing procedures used on the Project.

31 23 00.00 - EARTHWORK

PART 1 GENERAL

1.1 DESCRIPTION

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. Work Included: Work in this section includes, but is not necessarily limited to:
 - 1. Excavation, filling, backfilling, berming and compacting as required for Work indicated on the Drawings, including underground services
 - 2. Trenching and trench backfilling
 - 3. Boring
- C. In the case of an inconsistency between Divisions 27, and this section, the requirements for Divisions 27, shall supersede.

1.2 JOB CONDITIONS

- A. Protection: Where existing structures, facilities, lawns, drives, trees, irrigation lines and other existing items are indicated to remain, provide protection to prevent damage from construction activities. Methods for protection, such as barricades, tarpaulins, board covers and lighting, shall be subject to approval of Architect; but adequacy of such devices shall be the responsibility of the Contractor. Any damage or destruction to items intended to remain intact shall be professionally repaired or replaced to the satisfaction of the Architect at no additional cost to the Owner.
- B. Utilities: Locate existing utilities in areas of excavation work. Contact the owner of the utility for exact location. Examine the Drawings to determine the location of new service and utility lines and to the extent to which they may affect earthwork operations. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations. Where service and utility lines are essential to the operation of the present buildings or other facilities owned by the Owner or others, provide protection to prevent damage or disruption of services.

1.3 QUALITY ASSURANCE

- A. Contractor shall obtain written approval from Architect/Engineer for source and quality of borrowed fill material.
- B. Qualifications of workmen:
 - 1. Provide at least one experienced person who shall be present at all times during execution of this portion of the work and who shall be thoroughly trained in the work specified and who shall direct all work performed under this section.
- C. Use equipment adequate in size, capacity, and number to accomplish the work of this section in a timely manner.
- D. Testing and inspection service: Contractor shall employ and pay for a qualified independent geotechnical testing agency to perform soil testing and inspection service during earthwork operations. Tests required will be specified herein.

1.4 SUBMITTALS

- A. Test Reports: Testing service shall submit the following reports with their recommendations directly to the Architect/Engineer.
 - 1. Test reports on borrow materials.
 - 2. Verification of each footing's subgrade.
 - 3. Field density test reports on subgrades of roads, parking areas, sidewalks and utility slabs.
- B. The reports should include, but not be limited to, the following information:
 - 1. Project name and location.
 - 2. Type of test performed.
 - 3. Date of test.
 - 4. Location of test.
 - 5. Results of test.
 - 6. Statement as to whether this data complies with the specifications.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Fill Materials:
 - 1. Suitable materials for fill shall be on site materials from excavation and/or structural excavation and/or off site borrow that is free of debris, roots, organic or frozen materials, stones having a maximum dimension of one inch in the upper twelve inches and six inches in the remainder of fill.
 - 2. Unsuitable materials for fill include all materials that contain debris, roots, organic or frozen materials, stones having a maximum dimension larger than one inch in the upper twelve inches of fill or larger than six inches for the remainder of fill and materials that are determined by the Architect as unsuitable for providing a stable slope, fill, subgrade or foundation for structures. Otherwise suitable material which is unsuitable due to excess moisture content will not be classified as unsuitable material unless it cannot be dried to optimum moisture content specified hereinafter, by manipulation, aeration, or blending with other materials satisfactorily as approved by the Architect.
- B. Existing topsoil shall be stockpiled as designated on the Drawings and redistributed evenly over site during final grading operations. Provide topsoil consisting of friable, fertile soil of loamy character capable of sustaining healthy plant life and free of subsoil, roots, heavy or stiff clay, stone or other materials larger than 1" in greatest dimension, noxious weeds, sticks, brush, litter, and other deleterious matter. Where additional topsoil is needed provide imported topsoil obtained from sources outside the project limits which conforms to the above standards.
- C. Topsoil stockpile shall be stabilized with an erosion control fabric such as:
 - 1. Hold Gro manufactured by Gulf States Paper Corporation.
 - 2. Enkamat manufactured by American Enka Company.
 - 3. Approved Equal.

2.2 DRAINAGE

- A. Slabs: Drainage fill beneath interior and exterior slabs-on-grade shall be a clean, washed, free-draining granular material, such as fill sand or pea gravel.

2.3 OTHER MATERIALS

- A. All other materials, not specifically described but required for a complete and proper installation, shall be as selected by the Contractor, subject to the approval of the Architect.

PART 3 EXECUTION

3.1 GENERAL

- A. Familiarization: Prior to all bidding and work of this section, the Contractor shall become thoroughly familiar with the site, site conditions, Subsurface Investigation Report as found in Volume II of the Specifications and all portions of the work falling within this section.
- B. Backfilling Prior to Approvals:
 - 1. Do not allow or cause any of the work performed or installed to be covered up or enclosed by work of this section prior to all required inspections, tests, and approvals, including trenching and other required excavation in connection with the construction of utilities.
 - 2. Should any of the work be so enclosed or covered up before it has been approved, uncover all such work at no additional cost to the Owner.
 - 3. After the work has been completely inspected, tested, and approved, make all repairs and replacements necessary to restore the work to the condition in which it was found at the time of uncovering, all at no additional cost to the Owner.
- C. Dewatering:
 - 1. Remove all water, including rain water, encountered during trench and sub-structure work to an approved location by pumps, drains, and other approved methods.
 - 2. Keep excavations and site construction area free from water.
- D. Use means necessary to prevent dust from becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.
- E. Maintain access to adjacent areas at all times.
- F. Do not use explosives on this project.

3.2 EXCAVATION

- A. General: It is anticipated that all existing materials can be satisfactorily excavated with a power shovel. Should obstacles or objects be encountered which cannot be so removed, notify the Architect/Engineer and do not proceed in areas in question until so instructed by the Architect/Engineer.
- B. Excavate up to 10 feet beyond the perimeter of the building and elevations as indicated on the Drawings and recommended in the Subsurface Investigation Report, as specified hereinafter or as required for work indicated on the Drawings. Include sufficient space to allow for forming, concreting, testing, and other subsequent work. See notes on Drawings and VOLUME II Subsurface Investigation Report for description of existing soils. Refer to Sheet A202 of the Drawings for additional information regarding the location of the building which formerly occupied this site.
- C. Subgrade: Unless otherwise indicated, excavate to following subgrades:
 - 1. Slabs-on-grade: Subgrade at bottom of drainage fill.
 - 2. Footings: Subgrade at indicated bottom of footing or as described on plans.

- D. Conform to elevations and dimensions shown within a tolerance of + 0.1'. In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.
- E. When footings and foundations have been prepared, prior to reinforcement placement, the testing agency shall perform hand auger probe tests as follows:
 - 1. For footings: 1 test every 50 linear feet, but not less than 1.
 - 2. For piers and other foundation points: 1 test for every 10 square feet but not less than 1 per pier or foundation point. Fill auger hole as approved by the testing agency.
- F. Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
 - 1. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

3.3 SURPLUS EARTH MATERIAL

- A. Remove and legally dispose of all surplus earth not needed to complete filling and grading.

3.4 TRENCHING

- A. General:
 - 1. Perform all trenching required for the installation of items where the trenching is not specifically described in other sections of these specifications.
 - 2. Contractor shall verify all existing grades, inverts, utilities, obstacles, and topographical conditions prior to any trenching, excavation, or underground installation. In the event existing conditions are such as to prevent installations in accordance with the Contract Documents, Contractor shall immediately notify Architect for a decision. Architect's decision will be final and binding upon the Contractor and installations shall be in accordance with same.
 - 3. Where rock is encountered, carry excavation 6 inches below required elevation and backfill with a 6 inch layer of crushed stone fully compacted.
- B. Width:
 - 1. Excavate trench to a uniform width. Trenches for piping shall be not less than 12" wide or more than 16" wider than the outside diameter of the pipe to be laid therein, and shall be excavated true-to-line, so that a clear space not less than 6" or more than 8" in width is provided on each side of the pipe. The width of the trench above that level may be made as wide as necessary for sheeting and bracing, and the proper installation of the work.
 - 2. Trenches shall be open vertical construction.
- C. Depth:
 - 1. Trench as required to provide the elevations shown on the Drawings.
 - 2. Where trench excavation is inadvertently carried below proper elevations, backfill with approved material and then compact to provide a firm and unyielding subgrade and/or foundation to the approval of the Architect and at no additional cost to the Owner.
- D. Trench Bracing:
 - 1. Properly support all trenches in strict accordance with all pertinent rules and regulations.

- a) Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.
- b) Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.
2. Brace, sheet, and support trench walls in such a manner that they will be safe and that the ground alongside the excavation will not slide or settle, and that all existing improvements of every kind, whether on public or private property, will be fully protected from damage.
3. In the event of damage to such improvements, immediately make all repairs and replacements necessary to the approval of the Architect and at no cost to the Owner.
4. Arrange all bracing, sheeting, and shoring so as to not place stress on any portion of the completed work until the general construction thereof has proceeded far enough to provide sufficient strength.
5. All shoring and sheeting required to perform and protect the excavation and as required for the safety of employees and abutting structures shall be performed and shall be the responsibility of the Contractor.
- E. Removal of Trench Bracing: Exercise care in the installing and removal of sheeting, shoring, bracing and timbering to prevent collapse or caving of the excavation faces being supported.
- F. Grading and Stockpiling Trenched Material:
 1. Control the stockpiling of trenched material in a manner to prevent water running into the excavations.
 2. Any water accumulated in the trenches shall be removed by pumping or by other approved method. During excavation, material shall be stacked in an orderly manner, a sufficient distance back from edges of trenches to avoid overloading and prevent slides or cave-ins. Materials unsuitable for backfilling shall be removed from the site and legally disposed of by the Contractor.
- G. Foundation for Trenches
 1. General: Grade the trench bottoms to provide a smooth, firm, and stable foundation free from rock points throughout the length of the pipe.
 2. Place a minimum of six inches of the specified backfill, free of stones, in the bottom of the trench to the required elevation.
 3. Subsurface Conditions:
 - a) In areas where soft, unstable, unsuitable, or cinder type materials are encountered at the surface upon which non-expansive material is to be placed, remove the unstable material and make sufficient depth to develop a firm foundation for the items being installed.
 - b) Piping or sewer lines installed on rock shall be laid on 6" deep layer of clean sand extended to the center line of the pipe.
 - c) If the need for over-excavation has been occasioned by an act or failure to act on the part of the Contractor, make the over-excavation and replacement at no additional cost to the Owner.
 4. Trench Shaping:
 - a) Shape all pipe subgrade and fit the bottom of the trench to the pipe shape.
- H. Bedding for Trenches

1. General: Place the specified backfill material in the trench, simultaneously on each side of the pipe, for the full width of the trench to a maximum depth of three feet and a minimum depth of one foot above the outside diameter of the pipe barrel.
2. Densification:
 - a) Densify the bedding material after placing by thoroughly compacting with mechanical tampers after bringing to required moisture content.
 - b) Take special care to provide firm bearing support on the underside of the pipe and fitting for the full length of the pipe.

3.5 BACKFILL AND COMPACTION

- A. Compaction shall be accomplished by means specified herein and to the following densities for various parts of the work. Deficiencies in construction shall be corrected by the Contractor at no additional cost to the Owner.
- B. Backfill excavations as promptly as progress of the Work permits, but not until completion of the following.
 1. Acceptance of construction below finish grade including, where applicable, dampproofing and waterproofing.
 2. Inspecting, testing, approving, and recording locations of underground utilities.
 3. Removing concrete formwork.
 4. Removing shoring and bracing, and backfilling of voids with satisfactory materials.
 5. Removing trash and debris.
 6. All soil tests
- C. Backfill for Trenches
 1. Carefully backfill using materials as specified, placed in 8" loose lifts and fully compacted, until the pipe has a cover of not less than 12" for electric conduit and 24" for gas, water piping, and sewers or the recommended cover by the applicable codes and standards, whichever is most stringent. Backfill in trenches that contain pipe or conduit shall be reasonably free of stones.
- D. Placing and compacting:
 1. Place backfill and fill materials in layers not more than 8" loose fill.
 2. Before compacting, moisten or aerate each layer as necessary to provide the optimum moisture content.
 3. Compact each layer to required percentage of maximum density for area.
 4. Do not place backfill or fill material on surfaces that are muddy, frozen, or containing frost or ice.
 5. Place backfill and fill materials evenly adjacent to structures, to required elevations.
 6. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around the structure to approximately the same elevation in each lift.
 7. Where the construction includes basement or other underground walls having structural floors over them, do not backfill such walls until the structural floors are in place and have attained sufficient strength to support the walls.
- E. Equipment:

1. Fill areas shall be compacted using equipment capable of compacting each lift to its full depth. Moisture during compaction operations shall be maintained at optimum content.
 2. Compacting equipment shall be approved equipment of such design, weight and quantity to obtain the required density in accordance with Soils Report and Drawings.
 3. Any areas inaccessible to a roller shall be consolidated and compacted by mechanical tampers.
- F. Density requirements for specific locations are as follows and are based on a modified proctor ASTM D1557:

Area	Compaction
1. Utility Trenches	95% Modified Proctor
2. Roads, Drives, Walks Parking Areas, Access Drives	95% Modified Proctor
3. Structural Slabs, Piers, Footings, Foundations	97% Modified Proctor
4. Backfill around Structure	95% Modified Proctor
5. Lawn or Unpaved Areas	75% Modified Proctor

G. Density Testing: A sand cone density test, ASTM D1556, shall be performed by the testing agency as follows: (but not less than 1 per lift)

Area Tests Required

- | | |
|--|--|
| 1. Utility Trenches | 1 per every 40 linear feet per lift |
| 2. Roads, Drives, Walks, Parking Areas | 1 per every 2,500 square feet per lift |
| 3. Structural Slabs, Foundations | 1 per every 2,500 square feet per lift |
| 4. Backfill Around Structure | 1 per every 2,500 square feet per lift |
- H. A nuclear density test, ASTM D2922, shall be performed in areas where the sand cone method is not applicable such as #53 stone.
- I. If areas do not meet the requirements specified herein as determined by any tests the Contractor shall make corrections as directed by the Architect with the recommendations from the testing agency.

3.6 TOPSOIL PLACEMENT

- A. Prior to placing topsoil, vegetation on the areas to be top soiled shall be removed from the areas and the subgrade cleared of all other materials that would hinder proper grading, tillage or subsequent maintenance operations. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to proper grading of the proposed planting.
- B. Previously constructed subgrades shall be repaired if necessary so that the areas to be top soiled shall conform to the grade indicated on the Drawings upon completion of topsoil placement.
- C. Subgrade surface shall be approved by the Architect before placing of any topsoil.
- D. Subsequent to the above grading, the areas to be top soiled shall be thoroughly scarified to a depth of at least three inches by approved means. The work shall be performed only during

- periods when beneficial results are likely to be obtained. When conditions are such, by reason of drought, excessive moisture, or other factors, that satisfactory results are not likely to be obtained, the work will be stopped by the Architect and shall be resumed only when directed. Undulations or irregularities in the surface that would interfere with further construction operations or maintenance shall be leveled before the next specified operation.
- E. Suitable topsoil shall be uniformly distributed on the designated areas and evenly spread to give a minimum thickness of eight inches after settlement. The Contractor shall supplement on-site topsoil with off-site topsoil as necessary to provide minimum depth specified. The spreading shall be performed in such a manner that planting can proceed with little additional soil preparation or tillage.
 - F. After placement and spreading of topsoil, all such areas shall be protected from heavy machinery. All topsoil compacted by heavy machinery shall be removed and replaced at no additional cost to the Owner.
 - G. Topsoiling of utility trenches is included in the work of this section.
- 3.7 FINISHED EXCAVATION, FILLS AND EMBANKMENTS
- A. All areas covered by the Project, including excavated and filled sections and adjacent transition areas, shall be uniformly smooth graded. The finished surface shall be reasonably smooth, compacted, and free from irregular surface changes. The finished surface shall be not more than 0.15 foot above or below the established grade or approved cross section and shall be free of depressed areas where water would pond. The subgrade surface of fills or excavated areas to be paved on which a pavement structure is to be placed shall not vary more than 0.05 foot from the established grade and approved cross section.
- 3.8 CLEAN UP
- A. Upon completion of the work of this section, remove all rubbish, trash, and debris resulting from operations. Remove surplus materials, equipment, and tools. Leave the site in a neat and orderly condition acceptable to the Architect.

END OF SECTION 31 23 00.00