1 General
1.1 Scope of Work
1.1.1 The work required under this Section consists of providing all primary, secondary, telecommunications/data underground ducts and raceways, including maintenance holes and handholes, for the project as shown on Drawings and/or as specified herein.
1.1.2 The contractor installing the underground telecommunications structures shall have 10yrs experience in the installation of telecommunications underground structures. The contractor shall provide a list of recent installations (similar size and scope) along with Owner contact information of those systems as references.
1.2 Intent of the drawings and specifications
1.2.1 These Specifications, together with the Drawings accompanying them, are intended to depict the installation requirements necessary to support this Project.
1.2.2 Contractor shall furnish materials shown and/or called for on the Drawings but not mentioned in the Specifications, or vice versa, that are necessary for the installation and support of the described work, whether or not specifically called for in both.
1.2.3 Contractor shall provide incidental equipment and materials required for the completion of systems included in this contract whether or not specified or shown on the Drawings.
1.3 Communication
1.3.1 It is Purdue’s expectation that the A/E of Record will work jointly with Purdue’s Telecommunication representatives to address specific technical issues and Owner requirements.
1.3.2 All questions, deviations, comments concerning guideline(s) interpretation, content, and/or use must be submitted in writing to the Project Manager for approval.
1.3.3 No deviations from these guidelines shall be incorporated into the project without written approval from the Project Manager and Purdue Telecommunications representative.
1.4 Related Purdue Policies
1.4.1 Purdue Confined Space Program

2 Products
2.1 All ducts
2.1.1 The number, size, raceway duct material and arrangement shall be as indicated on Drawings and/or as specified herein.
2.1.2 May be non-metallic PVC (minimum of schedule 40), heavy wall, galvanized rigid conduit (GRC) as outlined in items B and C below, or HDPE and indicated on Drawings and/or as specified herein.
2.1.3 Shall be capped with manufactured caps (Duct Plugs) when installation is temporarily discontinued or installed for future use.
2.1.4 Shall be 4" nominal trade size, unless specifically noted otherwise.
2.2 Non-metallic Raceways
2.2.1 PVC Conduits Encased in Concrete
2.2.1.1 AD Technologies PVC Type DB with concrete encasement.
2.2.1.2 Plastic duct to meet NEMA TC-6 standards.
2.2.1.3 Used for all non-metallic conduits except where rigid conduit is required.
2.2.1.4 Complete with threaded adapter when attached to rigid conduit.
2.2.1.5 Perfectly circular in shape. Other configurations will not be permitted.
2.2.1.6 Have joints made with materials provided and installed per manufacturer’s directions. Comply with manufacturers requirements for bending and cutting.
2.2.2 HDPE Conduits
2.2.2.1 Conduit shall be a nonmetallic flexible raceway manufactured from High Density Polyethylene (HDPE) for use in underground applications. It shall be a ribbed-walled interior and smooth exterior configuration with wall construction of SDR 13.5.

Note: Directional drilling installations shall utilize SDR 11
2.2.2.2 Each conduit shall be black with (3) unique colored stripes, to be specified in the part number to
replace the “XX” or as specified on the drawings.

For example: 3D=3 buff stripes, 3E=3 gray stripes, 3F=3 green strips, 3G=3 lilac stripes

2.3 Rigid Heavy Wall Conduit
2.3.1 Used within excavated portion of building, including any areas where building excavation has been backfilled.
2.3.2 Extended 10’ minimum from building into undisturbed earth.
2.3.3 Used in areas of extended backfill, requiring maximum strength against shear.
2.3.4 Used where crossing under roads, tunnels, or intersections.

2.4 Concrete Encasement
2.4.1 Soil sub-grade shall have minimum gross-bearing pressure of 1500 psf.
2.4.2 Mud slab for duct bank shall be 3000 psi with a minimum 3” thickness.
2.4.3 Duct bank shall be 3000 psi, class 2, concrete ready mix per ASTM-94.
2.5 Backfill to be per section covering earthwork
2.6 Locate Wire
2.6.1 Locate wire to be stranded #10 AWG wire with overall green insulation. Locatable pulling tape can be installed as a substitution for #10 AWG locatable wire.
2.7 Pulling Tape
2.7.1 Each conduit shall have a one-half inch, woven, 1250lb. minimum polyester tape made from low friction, high abrasion resistant yarns placed within the conduit and secured at each end.
2.7.2 Tape shall be printed with sequential footage markings for accurate measurements.
2.7.3 Locatable pulling tape can be installed as a substitution for the stranded #10 AWG locatable wire as described above.
2.8 Telecommunications Maintenance Holes
2.8.1 Holes shall be provided by Electrical or Telecommunications Contractor as described in the drawings and as specified herein
2.8.2 Holes shall be reinforced precast concrete, 4500 psi and designed for truck loading
2.8.3 Unless otherwise specified on the drawings and/or as specified herein maintenance hole shall have one of the following inside dimensions:

- 10’ long x 5’ wide x 7’ high
- 8’-6” long x 5’-6” wide x 7’ high
- 8’ long x 4’ wide x 7’ high

2.8.4 Holes shall be provided with pulling irons opposite each duct bank.
2.8.5 Holes shall be complete with cable racks for proper cable support.
2.8.6 All maintenance hole hardware shall have hot dipped galvanized finish.
2.8.7 Provide heavy-duty, cast-iron frame with nominal 38” opening.
2.8.8 Provide EJ COM380206 lid to match opening. Lid to be lettered “Communication” if opening varies from 38”, coordinate part number with Purdue ITIS Representative.
2.8.9 Maintenance hole ladders and corresponding ladder rings are required for all maintenance holes.
2.8.10 Maintenance holes shall be equipped with a 14 inch sump pit located directly under the maintenance hole lid per manufacturer specifications.
2.8.11 Maintenance hole shall be Type “J” with offset opening, duct entrances as shown on Drawings with properly placed precast knockouts, duct terminators.

2.9 Cable Supports (maintenance holes)
2.9.1 Supports for Communications maintenance holes shall be equipped with appropriate cable racks to support cabling and splice cases.

2.10 Conduit couplers
2.10.1 Aluminum threaded conduit couplers to be used to join two segments of smooth-walled
conduit together.

2.10.2 Non-metallic couplers are not acceptable.

2.11 Duct plugs/Conduit-sealing plugs

2.11.1 Conduit-sealing plugs to be used to seal unused conduit.

2.12 Telecommunications Handholes

2.12.1 Handhole enclosures shall be 30"W x 48"L x 24"D PG style (Stackable) assembly with no base or as specified on drawings.

2.12.2 Installation to be per the manufacturer’s specifications.

2.12.3 Handhole cover shall be Owner-approved heavy duty pre-cast polymer concrete complete with (2) bolts and “Communications” labeling on the lid.

2.13 Telecommunications Pedestals

2.13.1 Pedestals shall be purchased and installed per the construction documents in coordination with telecommunications representative.

2.14 Duct Adhesive

2.14.1 Duct adhesive used to connect PVC conduit to HDPE conduit.

- Polywater “BonDuit®” High Strength Sealant

3 Execution

3.1 General

3.1.1 All installations mentioned below require a Purdue IT Infrastructure Services Representative to be present.

3.1.2 It is the contractor’s responsibility to notify Purdue Information Technology Infrastructure Services personnel to inspect the underground infrastructure prior to backfill. Failure to do so may result in the contractor re-excavating the site for inspection at the contractor’s cost.

3.1.3 Upon completion of manhole installation, cables shall be appropriately racked and tied in an orderly fashion. Entry ladders shall be installed and manholes shall be cleaned and free of dirt and debris.

3.2 Ducts

3.2.1 All ducts shall be checked by pulling a round wood or steel test mandrel, sized for each duct from both directions to remove obstructions.

3.2.1.1 Mandrel for 4” SDR 13.5 duct shall be a minimum of 3.75” outside diameter.

3.2.1.2 Mandrel for 4” SDR 11 duct shall be a minimum of 3.25” outside diameter.

3.2.1.3 Mandrel for 3” SDR 13.5 duct shall be a minimum of 2.75” outside diameter.

3.2.1.4 Mandrel for 3” SDR 11 duct shall be a minimum of 2.25” outside diameter.

3.2.1.5 Mandrel for 2” SDR 13.5 duct shall be a minimum of 1.75” outside diameter.

3.2.1.6 Mandrel for 2” SDR 11 duct shall be a minimum of 1.25” outside diameter.

3.2.2 All ducts shall be cleaned by passing a wire brush mandrel and/or rubber duct swab (or approved alternative) of appropriate size back and forth until all foreign materials and water are removed.

3.2.3 All ducts shall be installed using long radius sweeps, unless otherwise noted on Drawings and/or specified herein. Use no more than 180 degrees of total bends in continuous sections of conduit to reduce cable installation friction.

3.2.4 All ducts shall be installed with minimum of 3” fall per 100’ run toward maintenance holes and away from buildings.

3.2.5 All ducts shall be provided with continuous conduit measuring tape in each duct. One duct in the group shall contain locatable measuring tape or a combination of measuring tape and AWG #10 wire or Locatable Pulling Tape as described herein.

3.2.6 All ducts shall be approved for correct orientation and support before securing to prevent ducts from floating when concrete is poured.

3.2.7 Provide a minimum of 12” separation between electric power and telecommunications/data ducts.

3.2.8 A minimum of 2'-6” bury depth (measured from concrete encasement to finished grade) is required. Exceptions may be granted to avoid interference with prior approval from Purdue’s IT Infrastructure Services Representative.

3.3 Non-metallic Raceways

3.3.1 PVC Conduits Encased in Concrete

3.3.1.1 Plastic duct with straight
3.3.1.2 Couplings are to be staggered horizontally and vertically.

3.3.1.3 Protected from deformation during stockpiling.

3.3.1.4 Have joints covered with Scotch #88 tape as temporary concrete seal.

3.3.1.5 Provide with end bells flush with inside wall of maintenance hole or vault.

3.4 Concrete Encasement

3.4.1 Size where shown on drawings, with raceways receiving not less than 3" concrete cover all around and 1-1/2" between raceways.

3.4.2 Provided with support piers to undisturbed soil where necessary for permanent bearing.

3.4.3 Provided with fine sand cover for initial curing.

3.4.4 Rebar reinforcement is required where duct banks will cross roadways.

3.4.5 Conduits entering or leaving maintenance holes shall be encased in concrete (or flowable fill) 5ft beyond maintenance holes. The concrete shall be pinned to the side of the maintenance holes to keep the ducts from shearing.

3.4.6 Protected against freezing, etc., as required in General Construction Specification.

3.4.7 Installed so no honeycombing occurs and be properly vibrated with small vibrator. Do not vibrate between ducts.

3.4.8 Concrete for the duct bank shall be placed in such a way that the duct bank will not be disturbed and that the sides of the trench do not crumble using splash boards, proper placement, etc. The vertical drop of concrete from chute shall not exceed 30”.

3.4.9 Concrete shall be poured continuous from maintenance hole to maintenance hole.

3.4.10 Interval between base or intermediate spacers shall not exceed 8 feet with a minimum of two supports per length of duct.

3.4.11 Make provisions, such as nylon ties, to prevent the ducts from floating when concrete is poured.

3.4.12 Color top layer of concrete encasement by using “ORANGE” (for telecommunications) chalk dust (i.e. Strait-Line marking chalk) while still wet.

3.5 Flowable Fill

3.5.1 Flowable fill shall be utilized within 5’ of any maintenance hole when concrete encasement is not required.

3.6 Cable Supports

3.6.1 In general, all cables in maintenance holes shall be supported on 4’-0” maximum centers for straight runs, within 6” on each side of splices, and within 2’-0” of cable entrances to duct or termination.

3.7 Excavation

3.7.1 Coordinated with other trades.

3.7.2 Have elevations and arrangements verified on job.

3.7.3 If soil conditions are such that because of the depth or any other reasons the trench/excavation cannot conform to the size of the duct bank, provide forms and bracing as required.

3.7.4 Have grade stakes at 5’ intervals in trench bottom.

3.7.5 Have trench bottom filled to exact elevation with a 3” concrete grade pad prior to installation of ducts. Ducts are to be installed using 3” chairs and 1-1/2” separation to provide required cover. At Purdue IT Infrastructure Services Representative’s discretion or as directed on Drawings the 3” grade pad may be deleted.

3.7.6 Contractor shall open entire length of trench and establish proper grades before beginning installation of any portion of connecting duct runs.

3.7.7 Provide per Section 310000 - Earthwork and Section 020000 - Excavation, Backfill, Concrete, Asphalt Repairs and Related Work.

3.7.8 Depth of excavation shall be such that the required bury depths (top of concrete encasement) are met. Any deviation from required depths shall be identified and approved by a Purdue IT Infrastructure Services Representative prior to installation.

3.7.9 When utilizing an open trench (excluding concrete-encased ductbanks) warning tape shall be installed 12” above the top of the underground infrastructure.

3.8 Maintenance Holes

3.8.1 Align multiple grade rings so that ladder steps line up. Do not cut these off. Be sure to install gasket material between rings and frame. Install per manufacturer’s recommendations.
3.8.2 Maintenance Holes shall be aligned per instruction on owner-provided drawings.

3.8.3 Maintenance Holes shall be cleaned and free of dirt and debris upon completion of installation.

3.8.4 Maintenance Hole ladders, corresponding ladder rings, and racking shall be installed per manufacturer recommendations for all maintenance holes.

3.9 Reinforcing

3.9.1 Reinforcing shall be installed where noted on drawings and/or as specified herein.

3.9.2 Reinforcing shall be installed where crossing trenches for other work.

3.9.3 Reinforcing shall be installed where connected to buildings and maintenance hole walls, anchored thereto with projecting re-bars provided by this Contractor.

3.9.4 Reinforcing shall be installed at joints between pours of concrete envelope.

3.9.5 Reinforcing shall be installed if continuous pour is impractical, provide (4) #4 reinforcing bars extending six feet (6') into first and second pour.

3.9.6 Reinforcing shall be installed where trenches cross roadways.

3.9.7 Reinforcing shall be supported from bottom of trench at least one inch.

3.10 Maintenance Hole Termination

3.10.1 HDPE conduit shall be bonded to PVC conduit within 5ft of maintenance hole with a standard PVC schedule 40 end bell using Polywater “BonDuit” High Strength Sealant. Refer to Manufacturer’s instructions on the installation of the sealant.

3.10.2 Seal maintenance hole penetration around PVC using bentonite.

3.10.3 Conduits entering or leaving maintenance holes shall be incased in concrete (or flowable fill) 5ft beyond maintenance holes as described herein.

3.10.4 Installation crews shall utilize knockouts provided by the manufacturer. Any deviation shall be approved by Purdue’s IT Infrastructure Services Representative.

3.11 Building Terminations

3.11.1 Conduits entering building walls shall be sealed using a wall penetration seal system.

3.12 Backfill

3.12.1 Shall not be installed until after concrete has reached initial set.

3.12.2 Per Section Earthwork (excavation, backfill, compaction, etc.).

3.12.3 The Owner will do all re-seeding, unless specifically indicated on Drawings and/or as specified herein.

3.12.4 Backfill around maintenance holes with select granular material free of broken pavement, rocks, frozen material, etc. Backfill in 6” layers and tamp each layer to ensure complete compaction, especially under pipes and conduit. Place backfill evenly on all sides of maintenance hole to prevent racking or cracking. Backfilling should be completed on the same day the maintenance hole is placed.

3.12.5 In unpaved areas, the ground should be sloped away from the maintenance hole frame and cover to provide proper drainage.

3.12.6 Where the maintenance hole is to be installed under a paved area, such as a parking lot, the surface of the paving should be graded slightly away from the maintenance hole frame and cover.

3.12.7 Where the maintenance hole is to be installed under a concrete sidewalk, slab or pavement, expansion joint material shall be placed between the panel vault frame and concrete. A 2” minimum sand cushion shall be provided between the top surface of the maintenance hole and the bottom of the concrete sidewalk, slab or pavement to prevent stress on the casting during freeze and thaw conditions.

3.12.8 Restoration of the area where the maintenance hole structure is installed shall meet the requirements of the Purdue IT Infrastructure Services Representative.

3.13 As Built Drawings

3.13.1 Contractor shall provide as-built information to Purdue’s IT Infrastructure Services Department prior to final payment for this work.

3.13.2 Provide telecommunications underground pathway as-builts within 30 days of pathway being installed in the ground, regardless of the substantial completion date.

3.13.3 As-built information shall be in red-lined format on a copy of construction drawings. Indicate location of all underground routes, if different than original drawing.

3.13.4 If construction drawings are not utilized, Contractor shall provide all telecommunications location information on an accurate scaled site plan.

3.13.5 All as-builts will be marked with the
proper XYZ (northing, easting, elevation) coordinates and underground infrastructure depth at a minimum of every 20ft. These coordinates shall be tied to the nearest Purdue University benchmark and other permanent landmarks.

3.13.6 Contact Purdue University for the exact location of the benchmarks at least 48 hours prior to starting work.

3.13.7 A Registered Land Surveyor is required for producing as-built information.