



STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

PAT MCCRORY
GOVERNOR

NICHOLAS J. TENNYSON
SECRETARY

ADDENDUM NO. 3

September 22, 2015

RE: **NCDOT Ferry Division – Cherry Branch Ferry Facility, Havelock, NC**
SCO ID No. 11-09079-01A

PREPARED BY: Facilities Design, NCDOT

The following clarifications, changes, additions and/or deducts shall be made to the Working Drawings and Specifications of the above-referenced project. These changes shall be included in the Contract Amount for the Construction Work as indicated below:

General:

<u>Item</u>	<u>Sheet No.</u>	<u>Description:</u>
1.		208 volt, single phase electrical power is available for pumps at Contractor's discretion. However, Contractor shall coordinate all equipment provided by electrical subcontractor for appropriate electrical service. No consideration shall be given to additional project costs to provide 208 volt, single phase equipment after receipt of bids.
2.		Although there are some restricted areas on-site, the Coast Guard will not require the Contractor to obtain Transportation Worker Identification Cards (TWIC) for workers inside the construction area. However, work inside the Generator Building may require escorts at no cost to the Contractor.

Drawings:

<u>Item</u>	<u>Sheet No.</u>	<u>Description:</u>
1.	C2.1, C3.2	Refer to Drawings C2.1 "DEMOLITION NORTH AREA" and C3.2 "SITE PLAN CENTRAL AREA". Demolish existing flag pole. Provide new flag pole per Specification Section 10 7500 and flag pole foundation per Attachment 'A' .
2.	C2.1, C2.2	Refer to notes "Relocate Ex. Trees". Relocate 8' high Holly variant and 8' high Wisteria to places within the construction area to be determined by Ferry personnel. Maintain trees in viable condition until replanting.

3. C2.2 Drawing C2.2 "DEMOLITION PLAN CENTRAL AREA" indicates extent of existing chain link fencing to remain and to be removed as well as temporary construction fencing. Contractor may relocate any or all existing chain link fencing as part of the temporary fencing at his discretion. No existing fencing to be removed may be re-used as part of new permanent fencing.
4. C2.2 Refer to Drawing C2.2 "DEMOLITION PLAN CENTRAL AREA". See note referring to the existing propane tank being rotated N-S. This work will be done by the propane vendor and is for the Contractor's information only for the purpose of coordination.
5. C3.2 Refer to Drawing C3.2 "SITE PLAN CENTRAL AREA" and note "Rework Ex. Handrails". Cut existing handrails where indicated, except provide 12" horizontal rail extensions and end caps at last posts, and repaint. No other guards or rails on this accessible route are required except as shown in Details 9, 11, and 12/A1.1 and "Floor Plan" 1/A1.0.
6. C3.2 Refer to Drawing C3.2 "SITE PLAN CENTRAL AREA". The asphalt driveway directly south of the staff parking lot in front of the building shall be widened to 20' in width for an approximate addition of 540 square feet of asphalt paving. Widening shall extend from the main road to the new electric gate and then taper into the existing pavement edge approximately 55 feet east of the new gate.
7. C3.2 Refer to Drawing C3.2 "SITE PLAN CENTRAL AREA". The temporary restrooms located just south of the driveway entrance shall be provided by NCDOT. Contractor shall provide the temporary concrete pad for the restrooms per Detail 14/C7.1.
8. C3.2 Refer to Drawing C3.2 "SITE PLAN CENTRAL AREA". See note referring to new flag pole and relocated monument. Delete reference to Note 13. Provide new pedestal for granite monument per details in **Attachment 'B'**.
9. C6.1 & C7.3 Refer to Drawings C6.1 and C7.3. There is no planting plan except Drawing C6.1 "Mulching Plan Central Area". Detail 9/C7.3 indicates requirements for re-planting two (2) trees to be relocated. Otherwise, the Ferry personnel will landscape the site.
10. All 'C' Drawings See Legend on Civil plan drawings. General Notes #5

and #6 are located on Drawing C0.1 in “GENERAL NOTES” box.

11. C5.2, C5.3 Replace Drawings C5.2 and C5.3 in their entirety with Drawings C5.2 and C5.3 per **Attachment ‘C’**.
12. C7.3 Refer to Detail 8/C7.3. Delete paragraph entitled “Cutters” in its entirety. The pumps shall all be effluent pumps.
13. C7.4, C7.8 Replace Drawings C7.4 to C7.8 in their entirety with Drawings C7.4 to C7.8 per **Attachment ‘D’**.
14. S1, S2 Refer to “Foundation Plan” 1/S1 and “Roof Framing Plan” 1/S2. Exterior walls designated as shear walls shall be constructed with wood structural panels per Note 1 on Drawing S2. All other exterior sheathing shall also conform to requirements of Note 1 on Drawings S2 except for nailing patterns. Gypsum sheathing shall not be used for wall sheathing.
15. A3.1 & A3.4 Refer to Drawings A3.1 and A3.4. The finish wood frieze assembly shown in Detail 10/A3.4 is continuous around Lobby 101. See Building Sections 1, 2, and 3/A3.1.
16. A3.2-A3.6 Refer to Wall Sections. Exterior building trim shall be PVC or fiber cement at Contractor’s discretion and depending upon the availability of shapes indicated. Contractor shall provide the trim profiles indicated.
17. A3.2-A3.6 Refer to Wall Sections. Eave soffits shall be pre-finished fiber cement panels.
18. A3.5 Refer to Detail 4/A3.5. Vertical leg of continuous metal flashing shall be 2 inches minimum.
19. A3.5 Refer to Detail 5/A3.5. PVC column cover shall be shop or field fabricated of stock materials as per Specification Section 06 6000. Prefabricated components may be used if available in the size(s) indicated.
20. A4.2 Refer to Details 13 and 14/A4.2. In Room 140, provide ceramic wall tile full wall height per Detail 14/A4.2.
21. A4.3 Refer to Details 6 and 7/A4.3. Detail 6/A.3 is applicable to Lobby 101. Detail 7/A4.3 is applicable to Rooms 111 and 112. Provide finished and painted moisture-resistant gypsum wall board only at walls of Room 116.
22. A1.0, A4.3 Refer to Rooms 119, 137, 139, 140, and 141. Provide ceramic wall tile assembly per Detail TCNA No. W244F-12 for full height ceramic wall tile. Organic adhesive shall not

be used, unless specifically approved by manufacturer for wall tiles greater than 8"x8". Waterproof membrane is not required. Provide the following materials:

- a. Ceramic wall tile – ANSI A137.1;
- b. Glass wall tile;
- c. Cementitious grout – ANSI A118.6 or better;
- d. Epoxy grout – ANSI A118.3;
- e. Cementitious bond coat – ANSI A118.1 or better;
- f. Epoxy bond coat, when used – ANSI A118.3;
- g. Latex-portland cement mortar for porcelain tiles – ANSI A118.4 or better;
- h. Non-corrosive, non-oxidizing fasteners;
- i. 2" alkali-resistant glass fiber mesh tape.

23. S1.0, A1.0, A4.3 Refer to Rooms 111, 112, 137, 139, and 141. Concrete floor slab recesses shall be 2". Provide floor tile assembly per Detail TCNA No. F112-12 for thick-set ceramic floor tile. Waterproof membrane is not required. Provide the following materials:
- a. Ceramic tile – ANSI A137.1;
 - b. Cementitious grout – ANSI A118.6 or better;
 - c. Cementitious bond coat – Portland cement paste on mortar bed that is still workable - ANSI A118.1 or better;
 - d. Mortar bed – ANSI A108.1A;
 - e. Mortar bed bond coat – Portland cement slurry;
 - f. Concrete slab shall have steel trowel and fine broom finish with no curing compounds used.
24. A5.1 Refer to Room Finish Schedule. Ceilings of Porches 113, 142, and 143 shall be glass mat gypsum panels and shall be taped and finished for a Level 5 finish. All other gypsum board ceilings and bulkheads shall receive Level 5 finishes.
25. A1.0 & A5.1 Refer to Glass Schedule. Glass Type G1 shall be 1 5/16" laminated glass units.
26. A1.0 & A5.2 Refer to Window Type 'A' in "Window Elevations" 8/A5.2. Window Type 'A' shall be hurricane-resistant aluminum framed storefront per Specification Section 08 4313.
27. A1.0 & A5.2 Refer to "Window Elevations" 8/A5.2. Provide Glass Type G1 in hurricane-resistant Window Type 'B' in Room 102. Window Types 'C', 'D', 'E', and 'H' shall also be hurricane-resistant frames with Glass Type G1. Provide Glass Type G5 in standard aluminum framed Window Types 'B' in Room 110, 'F', and 'G'.
28. P1.0 Refer to 1/P1.0 "Waste & Vent – Plumbing" plan,

Keynotes A, B, C, and D. Contractor shall cap piping indicated by keynotes under concrete floor slab for future plumbing fixtures. Future fixture installation will require cutting of concrete slab.

- 29. E0.2 Refer to Detail 1/E0.2 “Fire Alarm Riser”. Delete requirement for printer. Project shall comply with State Construction Office “Fire Alarm Guidelines and Policies 2011”.
- 30. E1.0 Refer to “Electrical Floor Plan – Lighting” 1/E1.0. The WS4 located at Door 106A indicates a four way switch which provides an alternate location to turn on lights that are controlled by the three way switches in Galley 106 and Training Room 107. This is a pushbutton controller and does not contain an occupancy sensor.
- 31. E2.1 Refer to “Floor Plan-Mechanical Equipment-Connections and Fire Alarm System” 1/E2.1. In Training Room 107, delete wall-mounted horn/strobe. In Corridor 132, provide ceiling-mounted horn/strobe device.

Specifications:

<u>Item</u>	<u>Section No.</u>	<u>Description:</u>
1.	Table of Contents	Refer to “Table of Contents”. Delete reference to Specification Section 08 4413 “Glazed Aluminum Curtain Walls”.
2.	07 2100	Refer to Specification Section 07 2100 “Thermal Insulation”, Paragraph 3.05.E. Continuous batt insulation retaining straps shall be 1” wide minimum 28 gauge galvanized at 36” on center per Wall Section 4/A3.3 ff. Delete reference to wire mesh in Paragraph G.
3.	072100	Refer to Specification Section 07 2100 “Thermal Insulation”, paragraph 2.03.A.3. Thermal Resistance of batt insulation at roof trusses shall be R-19.
4.	07 2100	Refer to Specification Section 07 2100 “Thermal Insulation”, paragraph 2.03. Add the following Subparagraph for sound attenuation batts: B. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84. <ul style="list-style-type: none"> 1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84. 2. Thickness: Acoustic at interior walls 3-1/2 inch, to achieve STC rating of 38. 3. Manufacturers:

- a. Johns Manville; MinWool Sound Attenuation Fire Batts: www.jm.com.
- b. CertainTeed Corporation: www.certainteed.com
- c. Owens Corning Corporation: www.owenscorning.com.

5. 07 2500 Refer to Specification Section 07 2500 "Weather Barriers". Delete Paragraph 3.02.C "Coatings". Refer to Paragraph 3.02.D. Seal all weather barrier joints. All vapor impermeable air barriers and vapor retarders (kraft and FSK) shall be sealed at joints. Seals to extend as far as possible around veneer anchors and all other penetrations.

6. 07 4113 Refer to Specification Section 07 4113 "Metal Roofing". Roofing panels may have pencil ribs or stress ribs to add strength and prevent oil-canning. See Paragraph 2.01 "Manufacturers", subparagraph B. Subject to all other requirements of this specification, the following manufacturer may provide products to be incorporated into the work:

Construction Metal Products, Telephone: 704-871-8704; Fax: 704-871-1381; website: www.cmpmetalsystems.com.

7. 074113 Refer to Specification Section 07 4113, Paragraph 2.05, subparagraphs C and D. Metal Gutters, Downspouts, and associated trim shall match the substrate and finish of the standing seam metal roofing panels.

8. 07 6200 Add Specification Section 07 6200 "Sheet Metal Flashing and Trim to the Project Manual. See **Attachment 'E'** below.

9. 08 7100 Add the following to Section 087100:

2.16 KEY CONTROLS

- A. Facility Manager's Key Cabinet: Sheet steel construction, piano hinged door with key lock.
 - 1. Mounting: Wall-mounted.
 - 2. Capacity: Actual quantity of keys, plus 25 percent additional capacity.
 - 3. Size key hooks to hold 6 keys each.
 - 4. Finish: Baked enamel, manufacturer's standard color.
 - 5. Key cabinet lock to building keying system.
 - 6. Location per Owner's direction.

10. 08 8000 Refer to Specification Section 08 8000.2.01.A. Glass Type G1 shall be 1 5/16" laminated glass units. The intent is to protect essential personnel in the Operations Offices 102 and 103 from wind-borne debris under hurricane conditions.
11. 09 2116 Refer to Specification Section 09 2116 "Gypsum Board Assemblies", Paragraph 2.02.B. Add subparagraph B.3 for standard gypsum wall board per **Attachment 'F'** below. Provide gypsum wall board types as follows:
a.) Moisture-resistant for walls and ceilings: Rooms 111, 112, and 116; and for ceilings in Rooms 119, 137, 139, 140, 141, and as otherwise shown in Room Finish Schedule on Drawing A5.1.
b.) Cement-Based Backing Board for Walls Behind Full Height Ceramic Tile: Rooms 119, 137, 139, 140, and 141.
12. 10 2113.19 Refer to Specification Section 10 2113.19 "Plastic Toilet Partitions", paragraph 2.01.A. Basis of Design shall be Scranton Products, texture: "EX"; color: Bronze.
13. 10 2800 Refer to Specification Section 10 2800, paragraph 2.04.B. Provide cold plasma hand dryers with automatic sensors in satin stainless steel finish. Basis of Design is Excel Dryer "Xlerator"; American Dryer Model "Extremear CPC9-C" and World Dryer "Smart dri" acceptable products.
14. 10 4400 Refer to Specification Section 10 4400 "Fire Protection Specialties, Paragraph 2.01. Manufacturers listed as acceptable for fire extinguishers are also acceptable for fire extinguisher cabinets subject to meeting all other specified requirements. The following is also an acceptable manufacturer for fire extinguishers and cabinets subject to meeting all other specified requirements: JL Industries, PH: 800-554-6077; FAX: 952-835-2218; EMAIL: www.sales@activarcpg.com, www.activarcpg.com.
15. 12 2113 Refer to Specification Section 12 2113 "Horizontal Louver Blinds", Paragraph 2.02.E. Bottom rails shall be prefinished aluminum with top surface shaped to match slat curvature.
16. Div. 27 Refer to Division 27 – COMMUNICATIONS. Add the following specification sections to the Project Manual per **Attachment 'G'**:
27 0000 Communications Basic Requirements;
27 0526 Grounding and Bonding for Communications Systems;

27 0528 Pathways for Communications Systems;
27 1116 Communications Cabinets, Racks, and Enclosures;
27 1119 Communications Termination Blocks and Patch
Panels;
27 1123 Communications Cable Management and Ladder
Rack;
27 1300 Communications Backbone Cabling;
27 1513 Communications Copper Horizontal Cabling;
27 1533 Communications Coaxial Horizontal Cabling;
27 1543 Communications Faceplates and Connectors;
27 1619 Communications Patch Cords and Workstation
Cords.

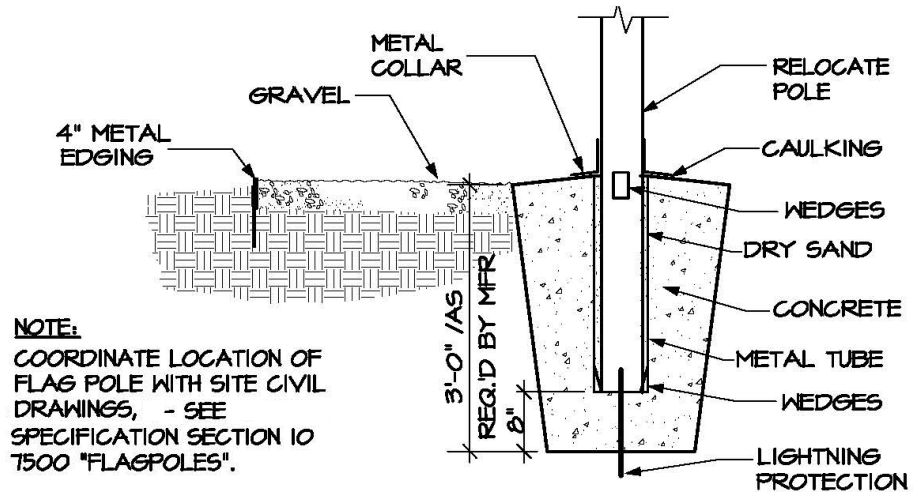
17. 33 1113 Refer to General Conditions Article 40 "Utilities, Structures, and Signs" and Specification Section 33 1113 "Water Distribution Piping". There are no tap fees or impact fees for the water utility.
18. 33 3350 Refer to Specification Section 33 3350 "Septic Field". The septic system installer shall be a North Carolina Onsite Wastewater Contractor Grade III installer as certified through the North Carolina Onsite Wastewater Contractor Inspector Certification Board (NCOWCICB).

END ADDENDUM NO. 3

APPROVED BY: Mark D. Gibson AIA, NCDOT Facilities Design

cc: Email to all Bidders, Plan Rooms, SCO;
Priscilla T. Williams, PE, Director Facilities Management Division, NCDOT;
Amber Farrelly, PE, B & F Consulting;
Kim Reitterer PE, Elm Engineering, Inc.

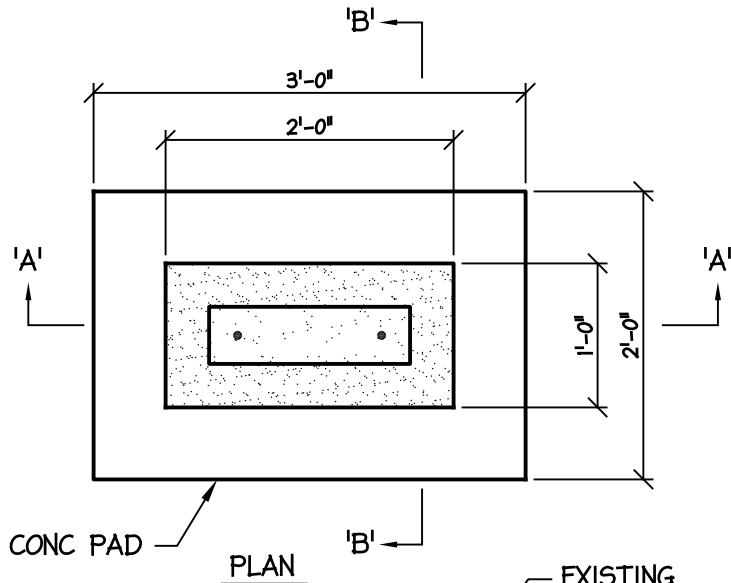
Attachment "A"



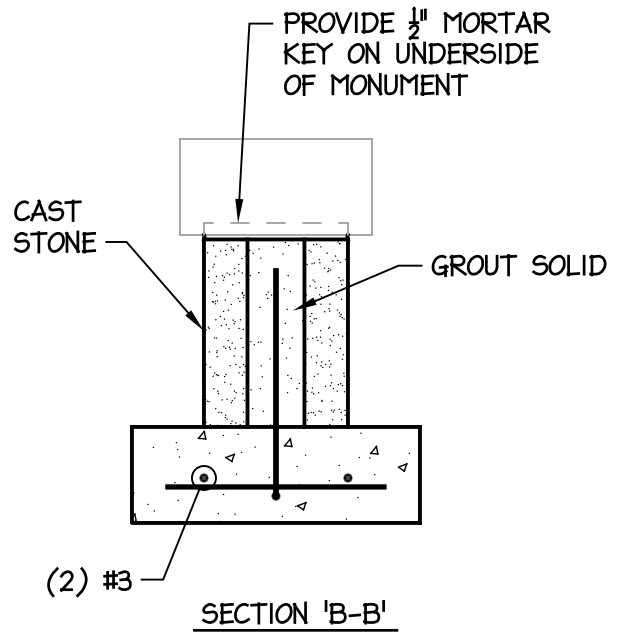
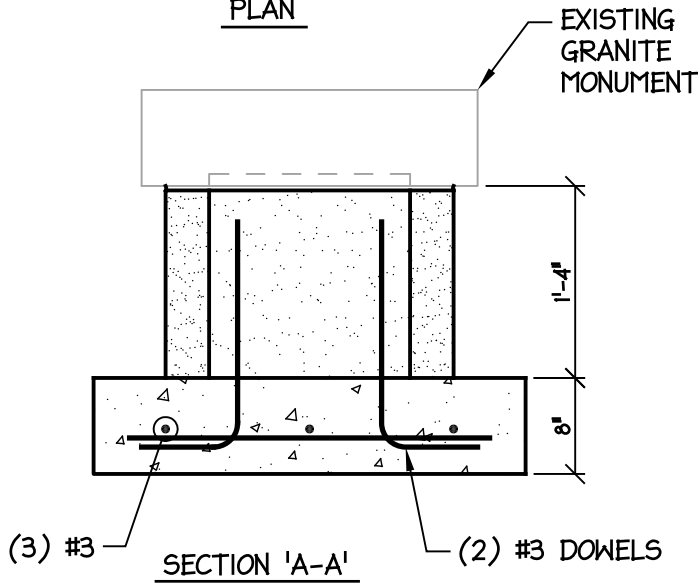
FLAG POLE FOUNDATION DETAIL

SCALE: 3/4" = 1'-0"

ATTACHMENT 'B'

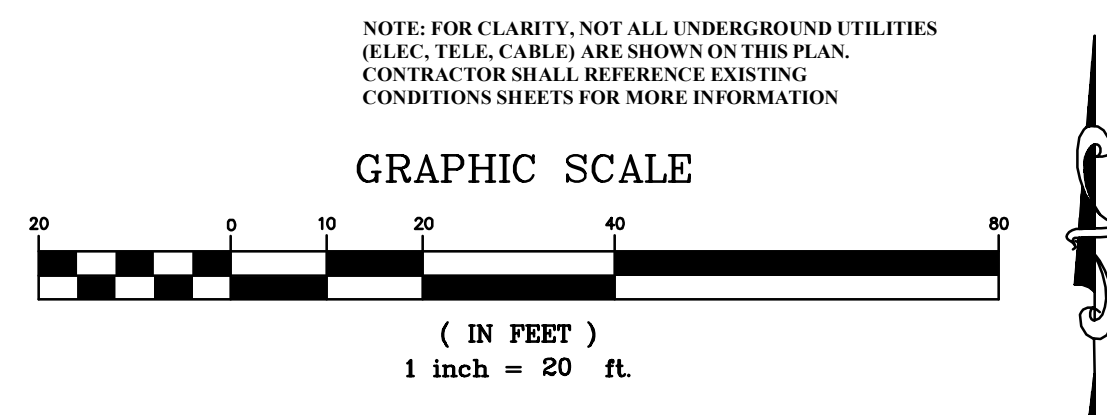
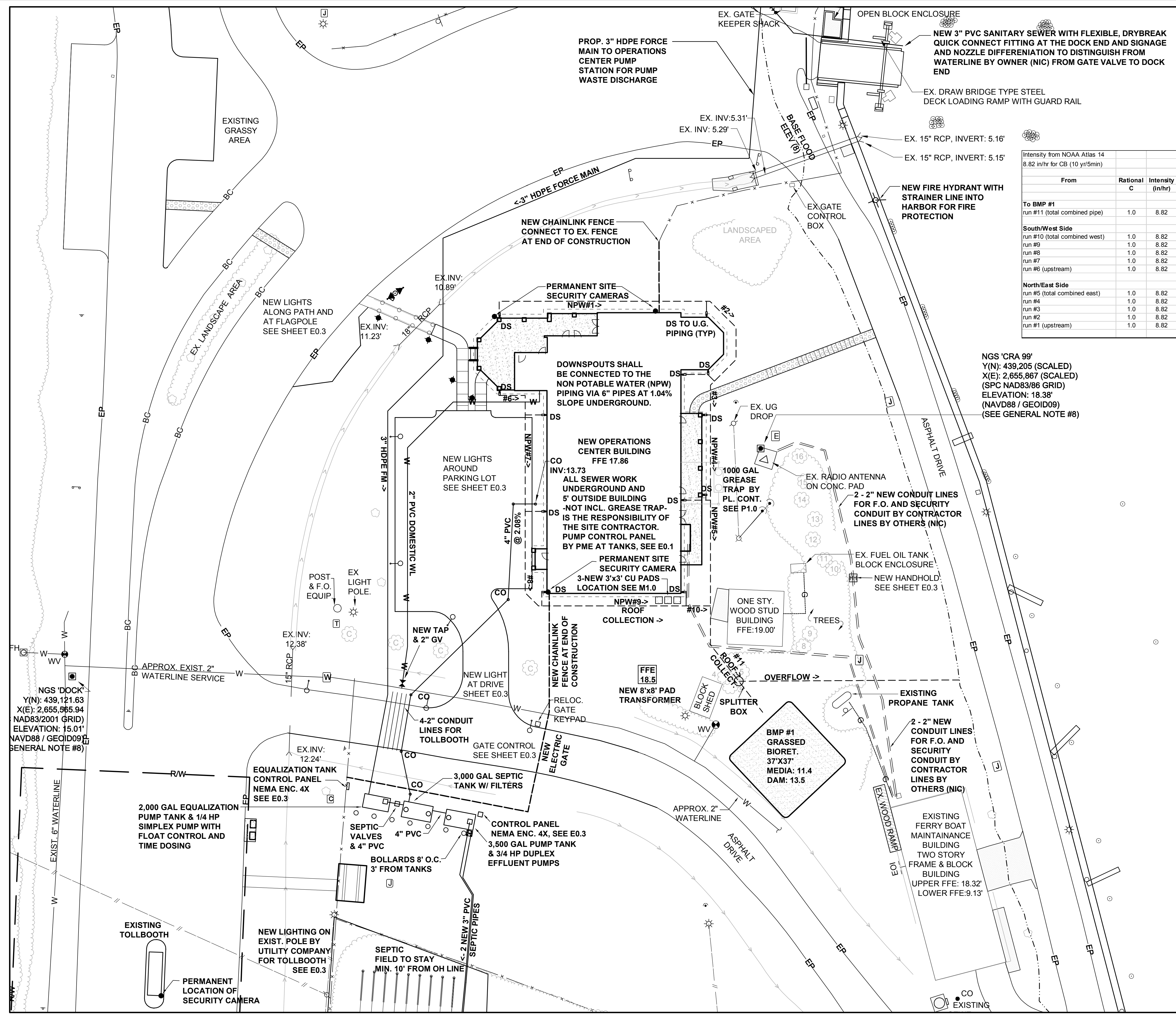


COORD MONUMENT MOUNTING
ANGLE & HEIGHT W/ OWNER



MONUMENT PEDESTAL DETAILS

SCALE: 3/4" = 1'-0"



Intensity from NOAA Atlas 14
8.82 in/hr for CB (10 yr/5min)

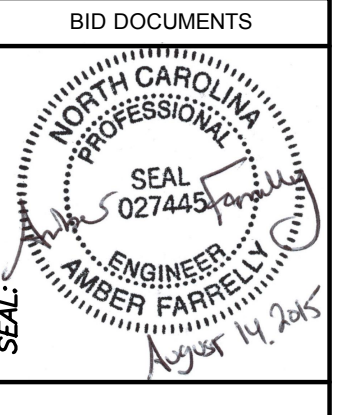
Roof Stormwater Routing - Cherry Branch Operations Center											
Summary of Pipes - 2/16/2015											
From	Rational C	Intensity (in/hr)	Area (sf)	Q ₁₀ (cfs)	Length (ft)	Diameter (inches)	Material	calculated DIA. (inches)	Slope (%)	Invert (From)	Invert (To)
To BMP #1											
run #11 (total combined pipe)	1.0	8.82	9,694	2.0	52	10	PVC	10.0	0.80%	12.43	12.84
South/West Side											
run #10 (total combined west)	1.0	8.82	4,495	0.9	11	6	PVC	5.8	3.00%	12.86	13.19
run #9	1.0	8.82	3,825	0.8	63	6	PVC	6.0	1.90%	13.19	14.39
run #8	1.0	8.82	3,285	0.7	45	6	PVC	6.0	1.40%	14.39	15.02
run #7	1.0	8.82	2,135	0.4	42	6	PVC	5.4	1.04%	15.02	15.45
run #6 (upstream)	1.0	8.82	1,022	0.2	20	6	PVC	4.1	1.04%	15.45	15.66
North/East Side											
run #5 (total combined east)	1.0	8.82	5,199	1.1	47	8	PVC	7.6	1.00%	12.84	13.31
run #4	1.0	8.82	3,769	0.8	37	6	PVC	6.0	1.80%	13.31	13.98
run #3	1.0	8.82	3,009	0.6	16	6	PVC	6.0	1.20%	13.98	14.17
run #2	1.0	8.82	1,818	0.4	45	6	PVC	5.1	1.04%	14.17	14.64
run #1 (upstream)	1.0	8.82	1,090	0.2	98	6	PVC	4.2	1.04%	14.64	15.66

STANDARD NOTES
 1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH ALL NCDOT/NC DENR/DWQ APPLICABLE STANDARDS AND SPECIFICATIONS.
 2. REFERENCE SHEET C0.1 FOR ALL APPLICABLE NOTES AND LEGEND INFORMATION.

NGS 'CRA 99'
 Y(N): 439,205 (SCALED)
 X(E): 2,655,867 (SCALED)
 (SPC NAD83/86 GRID)
 ELEVATION: 18.38'
 (NAVD88 / GEOID09)
 (SEE GENERAL NOTE #8)

LEGEND

— ELEVATION 8	APPROXIMATE FLOODPLAIN BOUNDARY (SEE GENERAL NOTE #5)
BC	BACK OF CURB
○	BUSH
○	CABLE / FIBER OPTIC PEDESTAL
□	CONCRETE
○	CONIFEROUS TREE
○	DECIDUOUS TREE
EP	EDGE OF PAVEMENT
ED	EDGE OF UNPAVED PARKING / DRIVES
—	ELECTRIC LINE (PAINT MARKS)
—	END OF INFORMATION (SIGNAL STOPS)
—	ESTIMATED CONTOURS (SEE GENERAL NOTE)
—	ESTIMATED SPOT ELEVATION
—	FENCE LINE (CHAIN LINK)
—	FIBER OPTIC LINE
FH	FIRE HYDRANT
FP	FLAG POLE
G	GAS LINE
—	GATE SENSOR LINE
NGS 'NAME'	GEODETTIC SURVEY MARKER
G	GUY WIRE
○	LARGE CREPE MYRTLE
○	LIGHT POLE
○	LIGHT POLE w CCTV
○	MANHOLE / ACCESS COVER
○	MAILBOX
△	MARSH / SWAMP
—	METAL HANDRAIL
MW	MONITOR WELL
—	OVERHEAD UTILITY LINES
○	POST / BOLLARD
—	PROPERTY LINE (SEE GENERAL NOTE #6)
—	RIGHT-OF-WAY (SEE GENERAL NOTE #6)
—	RIP RAP
—	ROPE OR WIRE / POST BARRIER
CO	SANITARY SEWER CLEANOUT
SS	SANITARY SEWER LINE (PAINT MARKS)
—	SHRUB LINE
4	SIGN (ONE POST)
1	SIGN (TWO POST)
—	SPOT ELEVATION
—	STORAGE AREA
—	STORM SEWER LINE
—	TELECOMMUNICATION LINE (PAINT MARKS)
—	TELEPHONE PEDESTAL
○	TREE (SEE TREE TABLE)
—	TREE LINE / LANDSCAPED LIMIT
UEB	UNDERGROUND ELECTRIC BOX
—	UNDERGROUND JUNCTION BOX
—	UNKNOWN UTILITY LINE (PAINT MARKS)
—	UTILITY POLE
—	VENT PIPE
—	WATER LINE (PAINT MARKS)
W	WATER METER
WV	WATER VALVE
—	WOOD PRIVACY FENCE



DESIGNED BY:
FACILITIES DESIGN ARCHITECTS & ENGINEERS
 FACILITIES MANAGEMENT DIVISION NCDOT
 1 SOUTH WILKINSON STREET
 RALEIGH, NORTH CAROLINA 27601
 PHONE: 919/707-5540 FAX: 919/715-0399

CONSULTANT:
B&F CONSULTING
 2808 FOREBROOK LANE
 RALEIGH, NORTH CAROLINA 27606
 PHONE: 919/989-9102
 NC LICENSE C2149

DRAWING TITLE / DESCRIPTION:
UTILITIES PLAN CENTRAL AREA

PROJECT TITLE:
CHERRY BRANCH FERRY FACILITY NORTH CAROLINA DOT

2300 FERRY ROAD, HAVELOCK, NC 28632
 CRAVEN COUNTY, NORTH CAROLINA

STATE CONSTRUCTION ID.# 11-09079-01A

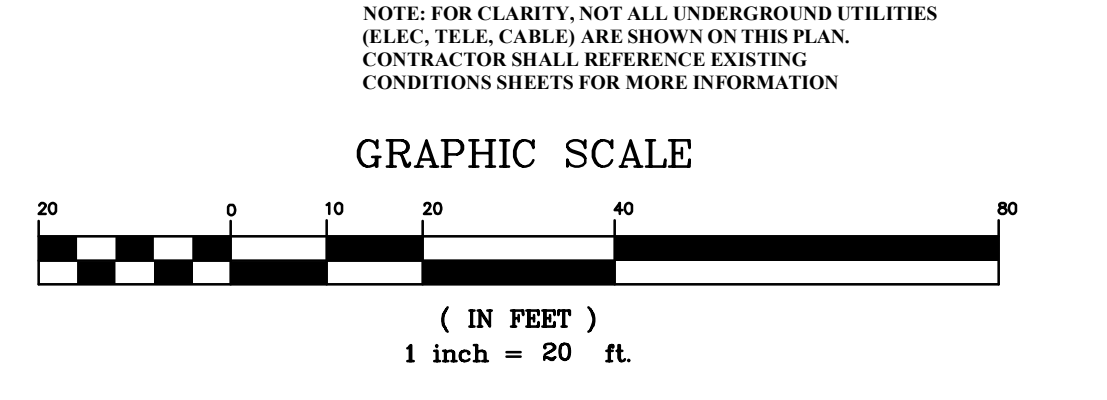
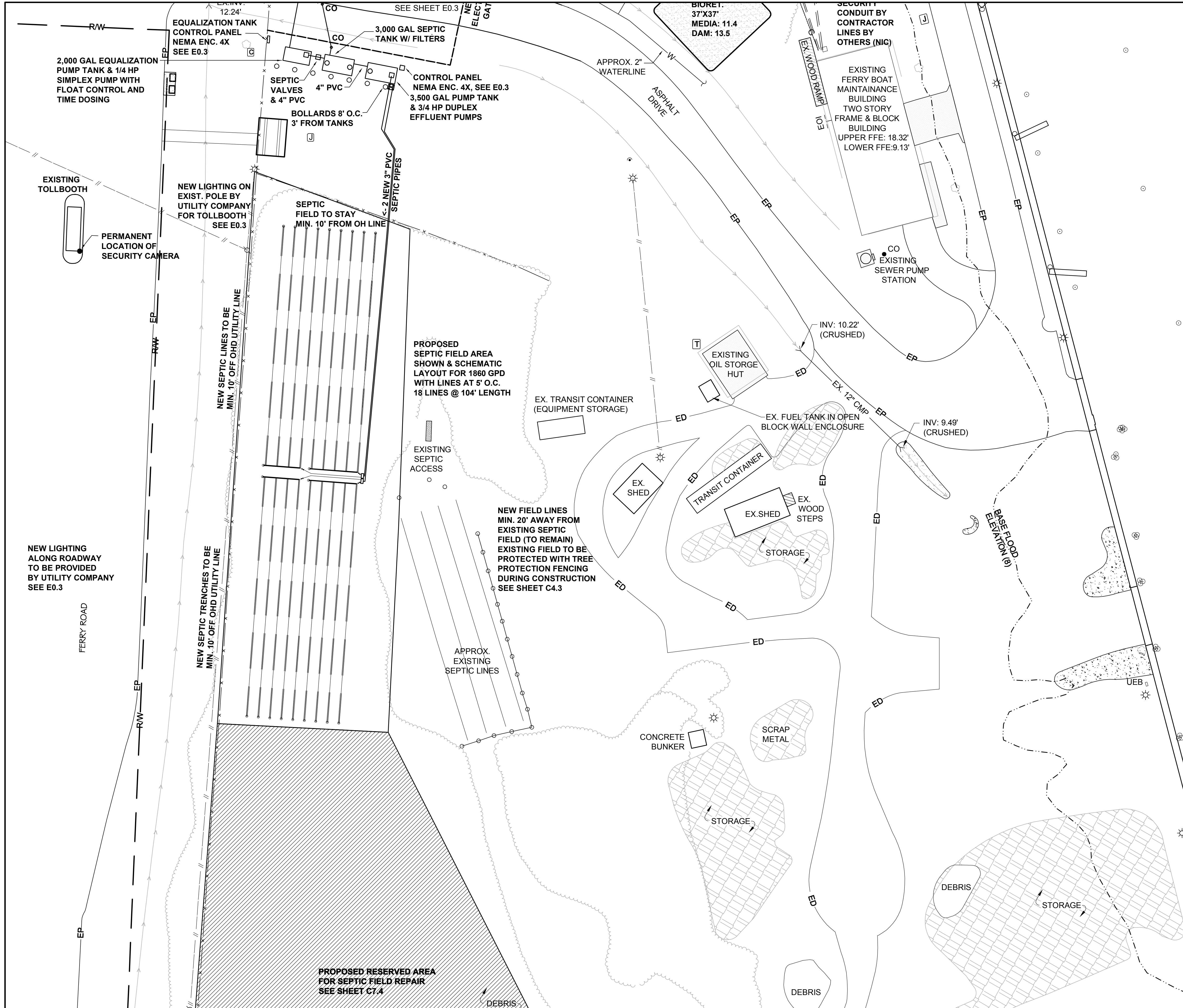
ASSET NUMBER:
 CO. SITE # BLDG #
 48

REVISIONS

NO.	DATE
1	ADDENDUM 3 9-16-2015

DATE ISSUED: 8-14-15
 DRAWN BY: AF
 CHECKED BY: RJB
 SHEET NO.

C5.2



STANDARD NOTES
 1. ALL CONSTRUCTION TO BE IN ACCORDANCE WITH ALL NCDOT/NCENR/DWQ APPLICABLE STANDARDS AND SPECIFICATIONS.
 2. REFERENCE SHEET C0.1 FOR ALL APPLICABLE NOTES AND LEGEND INFORMATION.

LEGEND

— ELEVATION 8	APPROXIMATE FLOODPLAIN BOUNDARY (SEE GENERAL NOTE #5)
BC	BACK OF CURB
○	BUSH
□	CABLE / FIBER OPTIC PEDESTAL
■	CONCRETE
⊛	CONIFEROUS TREE
⊙	DECIDUOUS TREE
EP	EDGE OF PAVEMENT
ED	EDGE OF UNPAVED PARKING / DRIVES
—	ELECTRIC LINE (PAINT MARKS)
—	END OF INFORMATION (SIGNAL STOPS)
12.5	ESTIMATED SPOT ELEVATION
3.7	ESTIMATED CONTOURS (SEE GENERAL NOTE)
— x —	FENCE LINE (CHAIN LINK)
—	FIBER OPTIC LINE
FH	FIRE HYDRANT
FP	FLAG POLE
G	GAS LINE
—	GATE SENSOR LINE
NGS "NAME"	GEODETIC SURVEY MARKER
G	GUY WIRE
⊙	LARGE CREPE MYRTLE
○	LIGHT POLE
○	LIGHT POLE w/ CCTV
○	MANHOLE / ACCESS COVER
⊙	MAILBOX
⊙	MARSH / SWAMP
—	METAL HANDRAIL
MW	MONITOR WELL
—	OVERHEAD UTILITY LINES
○	POST / BOLLARD
—	PROPERTY LINE (SEE GENERAL NOTE #6)
—	RIGHT-OF-WAY (SEE GENERAL NOTE #6)
—	RIP RAP
—	ROPE OR WIRE / POST BARRIER
CO	SANITARY SEWER CLEANOUT
SS	SANITARY SEWER LINE (PAINT MARKS)
—	SHRUB LINE
4	SIGN (ONE POST)
1	SIGN (TWO POST)
13.2	SPOT ELEVATION
XX RCP	STORAGE AREA
—	STORM SEWER LINE
—	TELECOMMUNICATION LINE (PAINT MARKS)
○	TELEPHONE PEDESTAL
○	TREE (SEE TREE TABLE)
—	TREE LINE / LANDSCAPED LIMIT
UEB	UNDERGROUND ELECTRIC BOX
□	UNDERGROUND JUNCTION BOX
—	UNKNOWN UTILITY LINE (PAINT MARKS)
○	UTILITY POLE
—	VENT PIPE
—	WATER LINE (PAINT MARKS)
W	WATER METER
WV	WATER VALVE
—	WOOD PRIVACY FENCE

BID DOCUMENTS

NOTARY SEAL: AMBER FARRELLY, ENGINEER, 027445

DESIGNED BY: FACILITIES DESIGN ARCHITECTS & ENGINEERS, FACILITIES MANAGEMENT DIVISION NCDOT
 1 SOUTH WILKINSON STREET, RALEIGH, NORTH CAROLINA 27601
 PHONE: 919/707-6540 FAX: 919/775-0399

CONSULTANT: B&F CONSULTING, 2808 TORENOURY LANE, RALEIGH, NORTH CAROLINA 27606
 PHONE: 919/889-9102 FAX: 919/889-9102
 NC LICENSE C2149

DRAWING TITLE / DESCRIPTION: UTILITIES PLAN SOUTH AREA

PROJECT TITLE: CHERRY BRANCH FERRY FACILITY NORTH CAROLINA DOT
 2300 FERRY ROAD, HAVELOCK, NC 28632
 CRAVEN COUNTY, NORTH CAROLINA

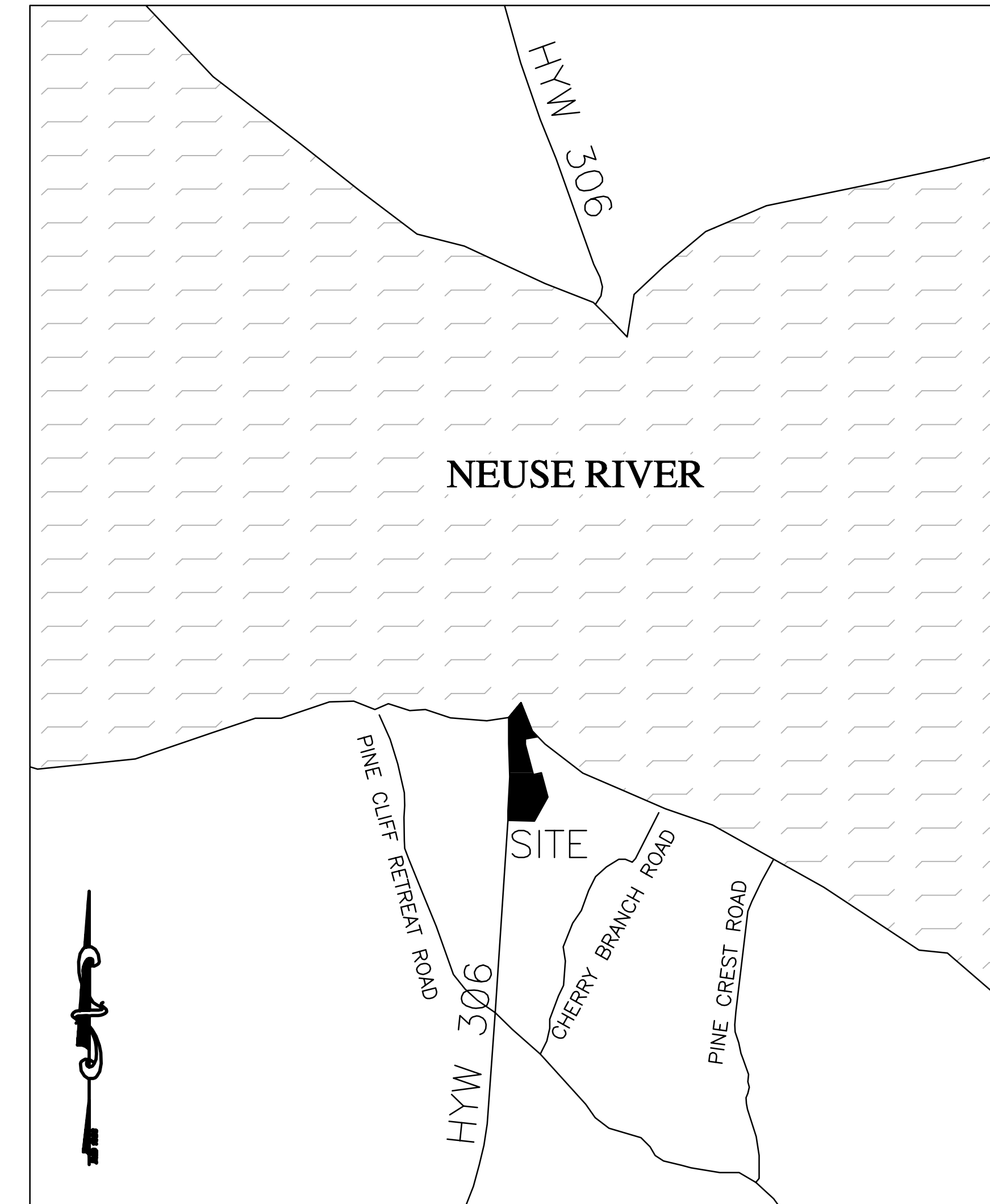
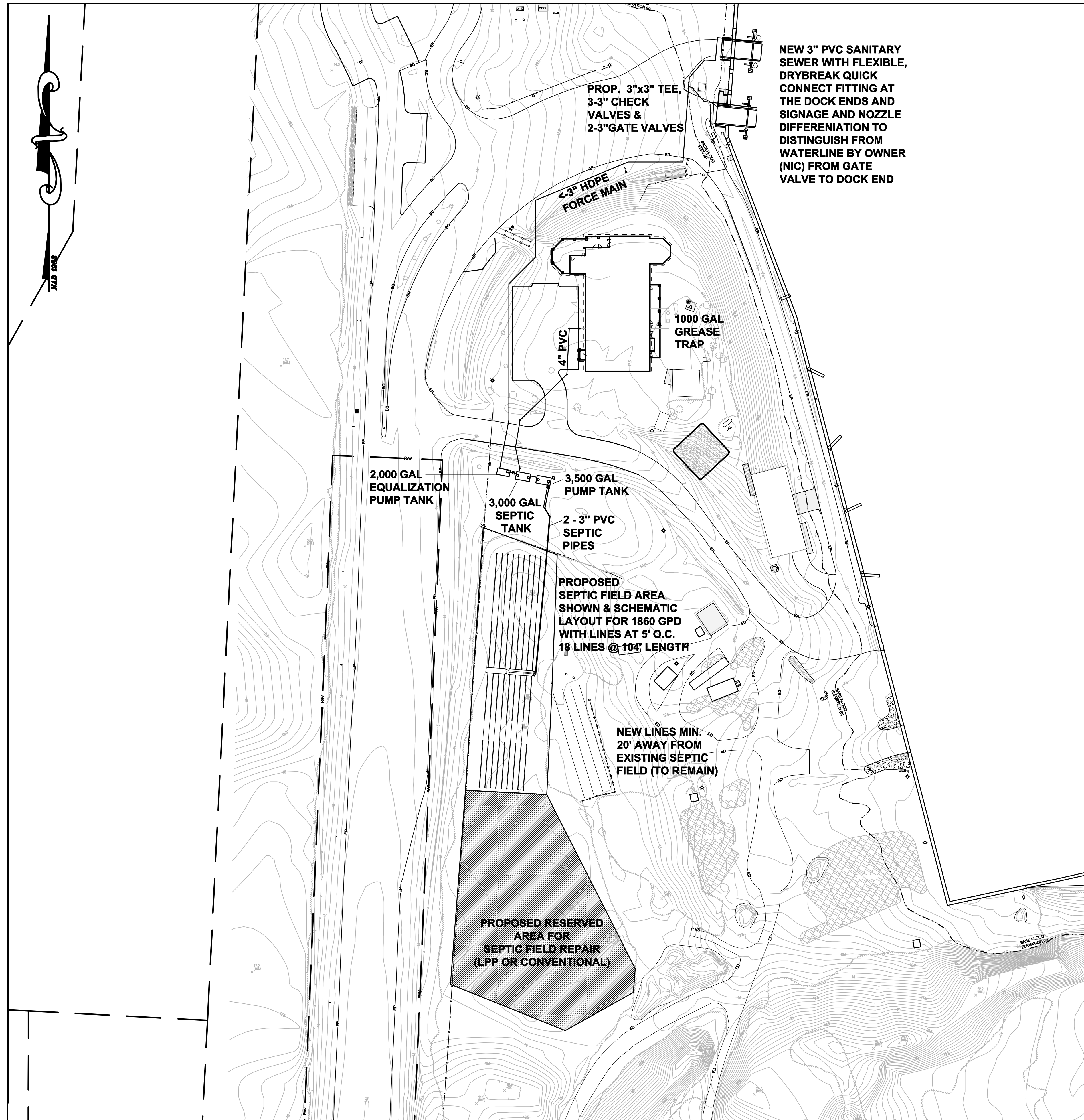
STATE CONSTRUCTION ID.# 11-09079-01A

ASSET NUMBER: 48

REVISIONS
 NO. DATE
 1 ADDENDUM 3 9-16-2015

DATE ISSUED: 8-14-15
 DRAWN BY: AF
 CHECKED BY: RJB
 SHEET NO. C5.3

BID DOCUMENTS

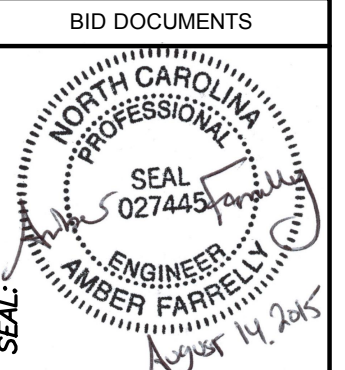


THE PROPOSED WASTEWATER SYSTEM WILL HANDLE WASTE FROM THE PROPOSED FACILITY AS WELL AS WASTE FROM TWO FERRY BOAT STORAGE TANKS FOR A TOTAL OF 1860 GALLONS PER DAY.

WASTE FROM THE BOATS WILL BE PUMPED TO A 2000 GALLON EQUALIZATION TANK. THE WASTE WILL THEN BE PUMPED IN SMALL TIMED DOSES TO THE SEPTIC TANK FOR FINAL PROCESSING AND TREATMENT BEFORE BEING HELD IN THE EQUALIZATION TANK FOR FINAL DOSING TO THE SEPTIC FIELD.

NOTE THIS PAGE IS FOR OVERALL GRAPHICAL UNDERSTANDING OF THE SITE ONLY. UTILITY PIPING AND NOTE DETAILS ARE SHOWN ON SHEETS C5.1 TO C5.3.

SEE SHEET C7.5 FOR LARGE SCALE DETAIL AREAS OF SEPTIC FIELDS.



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B&F CONSULTING
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PHONE: 919/889-8102
NC LICENSE C2149

DRAWING TITLE / DESCRIPTION:
**SEPTIC DETAILS
SITE PLAN**

PROJECT TITLE:
**CHERRY BRANCH FERRY FACILITY
NORTH CAROLINA DOT**
2300 FERRY ROAD, HAVELOCK, NC 28532
CRAVEN COUNTY, NORTH CAROLINA

STATE CONSTRUCTION
ID.# 11-09079-01A

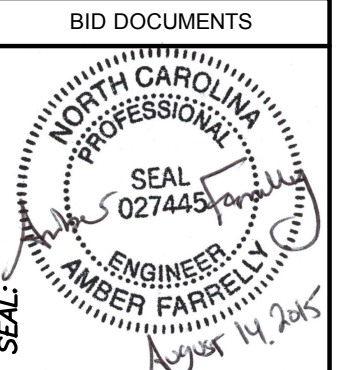
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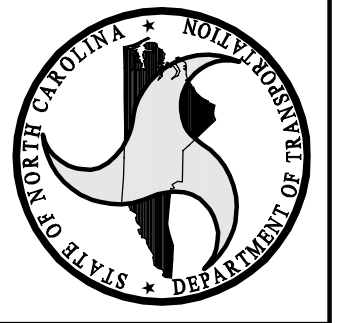
DATE ISSUED: 8-14-15
DRAWN BY: AF
CHECKED BY: RJB

SHEET NO.
C7.4

NOTES:
 1. LAND DISTURBING AND EROSION CONTROL DETAILS SHALL ADHERE TO ALL APPLICABLE STATE CONSTRUCTION STANDARDS.
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 3. SEWERLINE UTILITIES ARE MANAGED BY NCDOT ONSITE BY SEPTIC SYSTEMS AND ARE TO ADHERE TO THE STATE STANDARDS AND APPROVALS AS SET BY NCDENR AND/OR CRAVEN COUNTY HEALTH DEPARTMENT.
 4. ALL ROADWAY AND SITE WORK IS OWNED AND MAINTAINED BY NCDOT. ALL CONSTRUCTION FOR PUBLIC ACCESSES ARE TO ADHERE TO NCDOT STANDARDS AND SPECIFICATIONS



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DRAWING TITLE / DESCRIPTION:
SEPTIC SYSTEM SYSTEM DETAIL

PROJECT TITLE:
CHERRY BRANCH FERRY FACILITY
 NORTH CAROLINA DOT
 2300 FERRY ROAD, HAVELOCK, NC 28632
 CRAVEN COUNTY, NORTH CAROLINA

STATE CONSTRUCTION ID.# 11-09079-01A

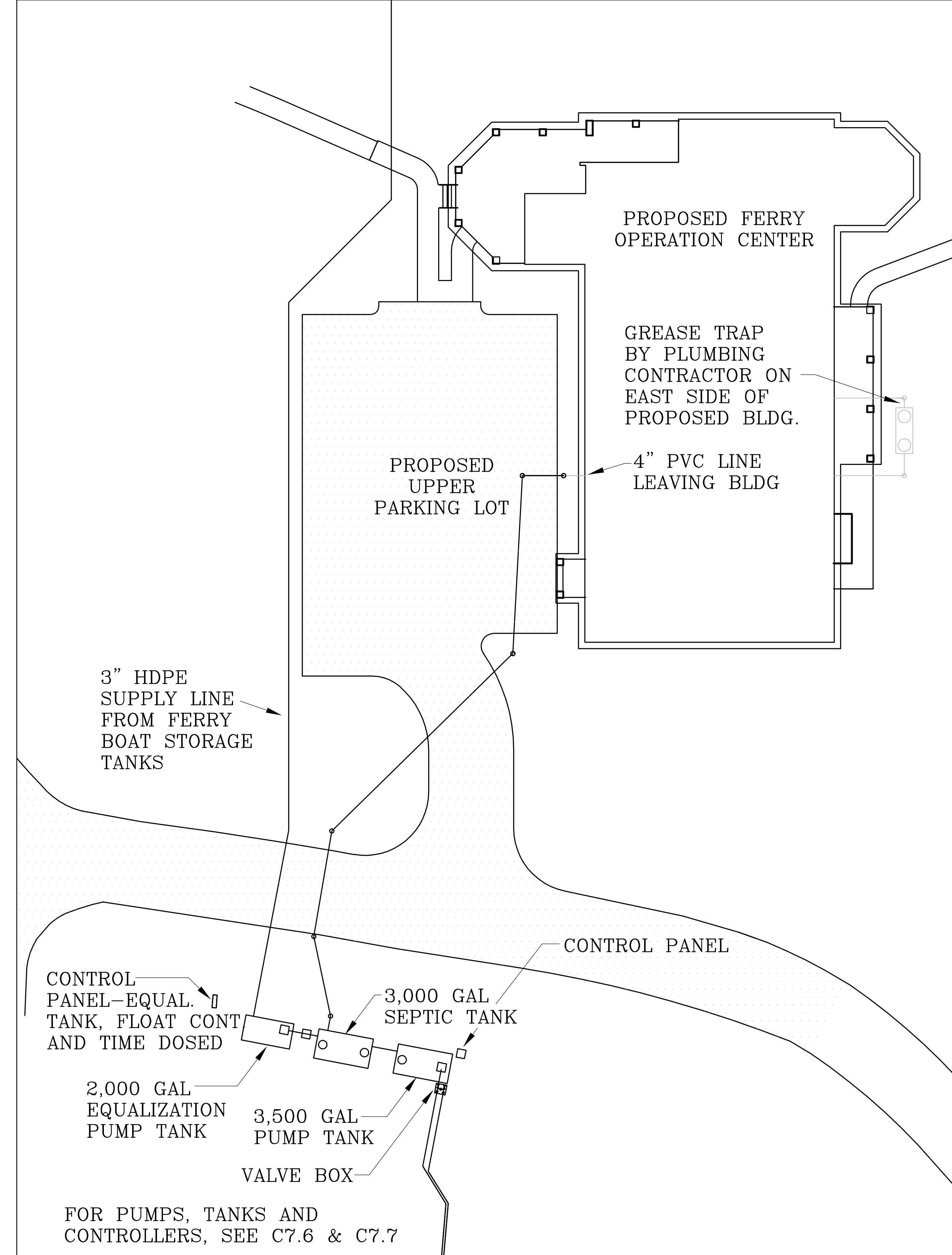
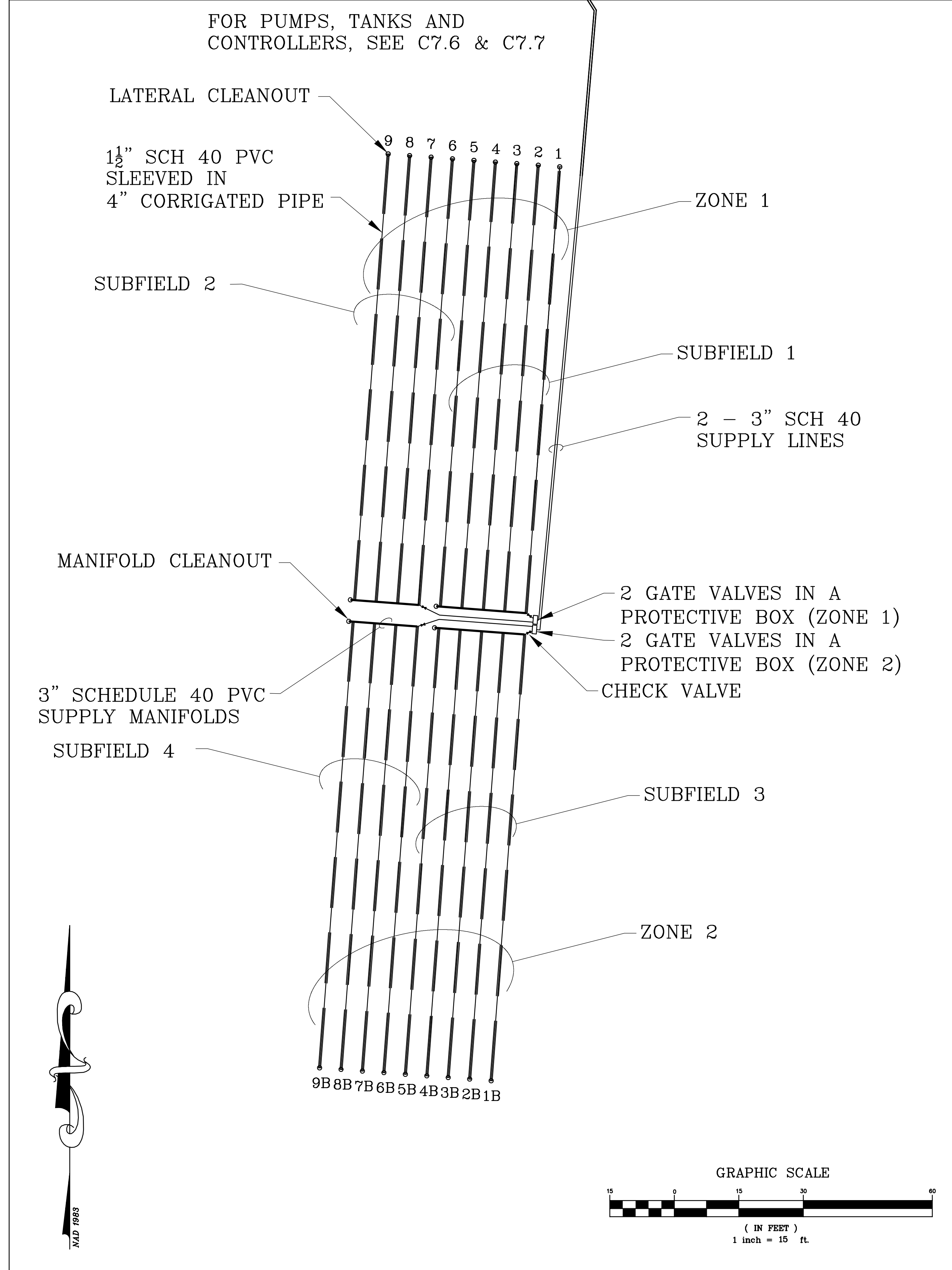
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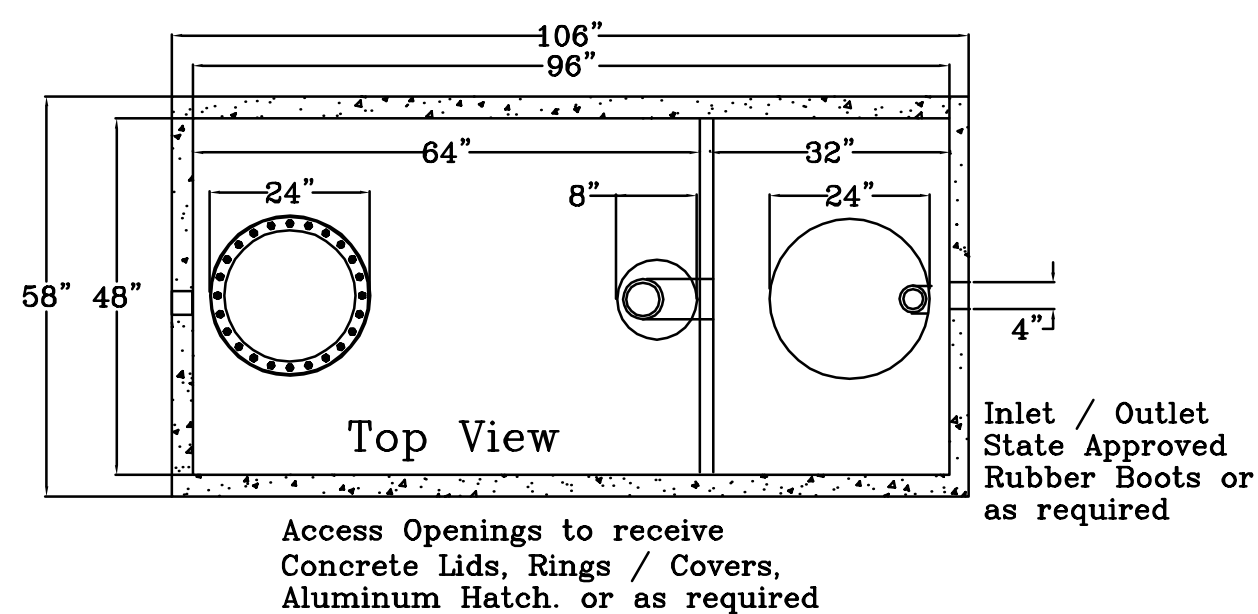
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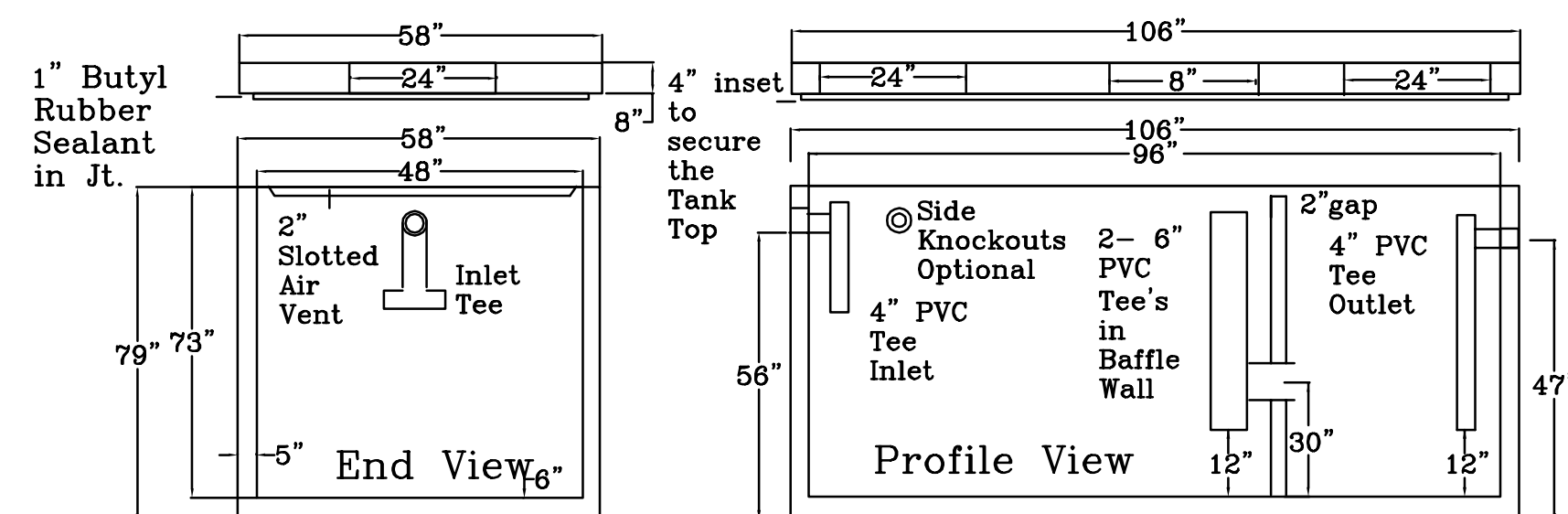
C7.5

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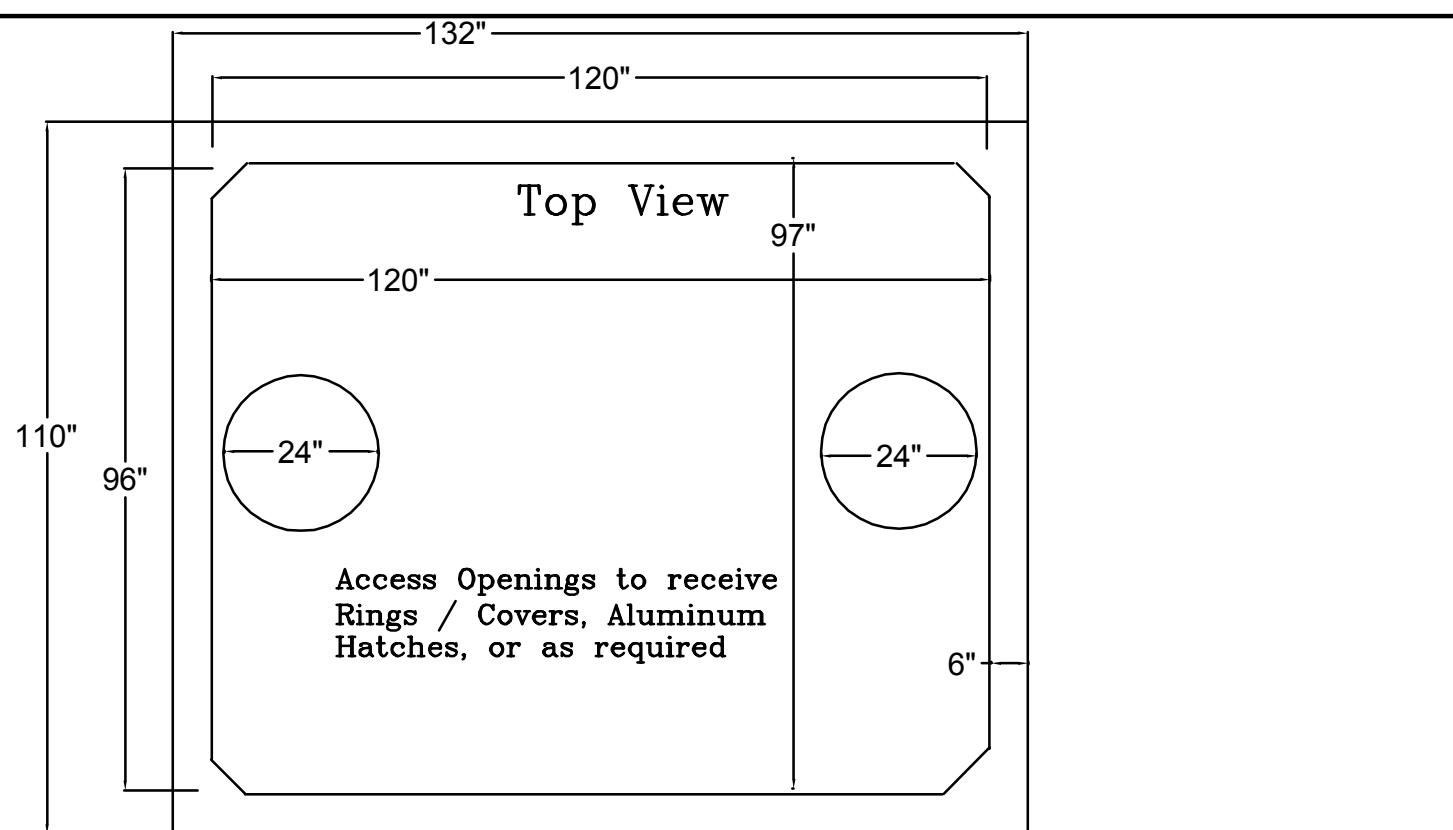


Specifications
 Grease Trap Tank: 1000 Gallon
 Liquid Capacity: 1000 Gallons
 Non Traffic Rated
 Reinforcement Schedule #3 Grade 60 Rebar
 4500 PSI Concrete w/ State Approved Structural Fiber
 2.75 Yds. Est. Weight 11,000 lbs.
 Blackwelder Tank Service STB-345
 or Engineer approved State equal
 Other Acceptable Manufacturers:
 Northeastern Ready Mix
 Stalling Septic Tank Company
 Coastal Ready Mix Concrete Co.



Grease Trap Notes:
 Grease Trap is to be provided and installed by plumbing contractor according to approved plumbing plan sheets. This plan is for approval of the overall septic system.

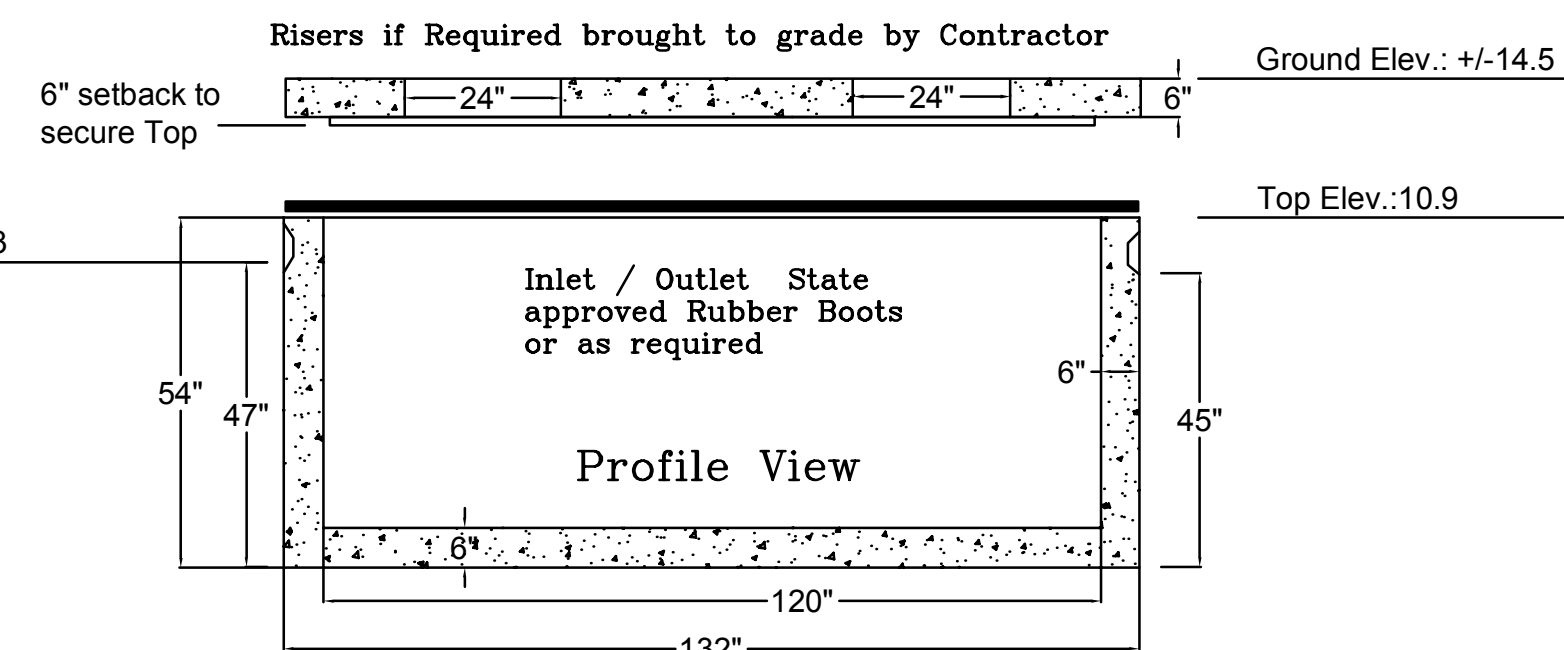
1000 GALLON GREASE TRAP
 NOT TO SCALE



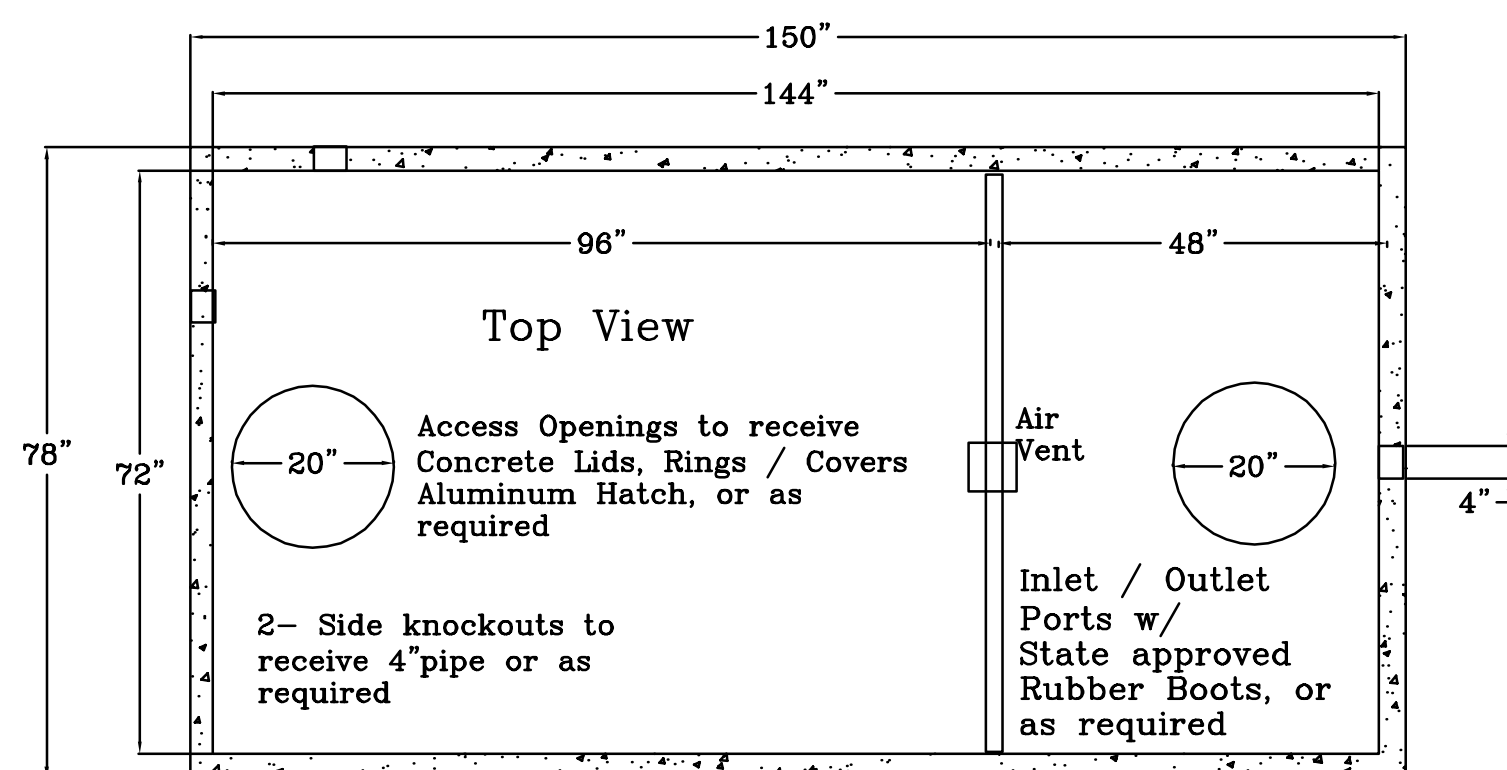
Specifications
 Single Phase Simplex Control Panel
 SJE Rhombus Installer Friendly Series - IFS In-Site control panel
 or Engineer approved State equivalent
 Other Acceptable Manufacturers:
 American Control Panel
 CSI Control Panel
 Quality Controls

Pump (1)
 Meyers Model ME50
 or Engineer approved State Equivalent
 Other Acceptable Manufacturers:
 Sulzer/ABS Brand
 Liberty Brand

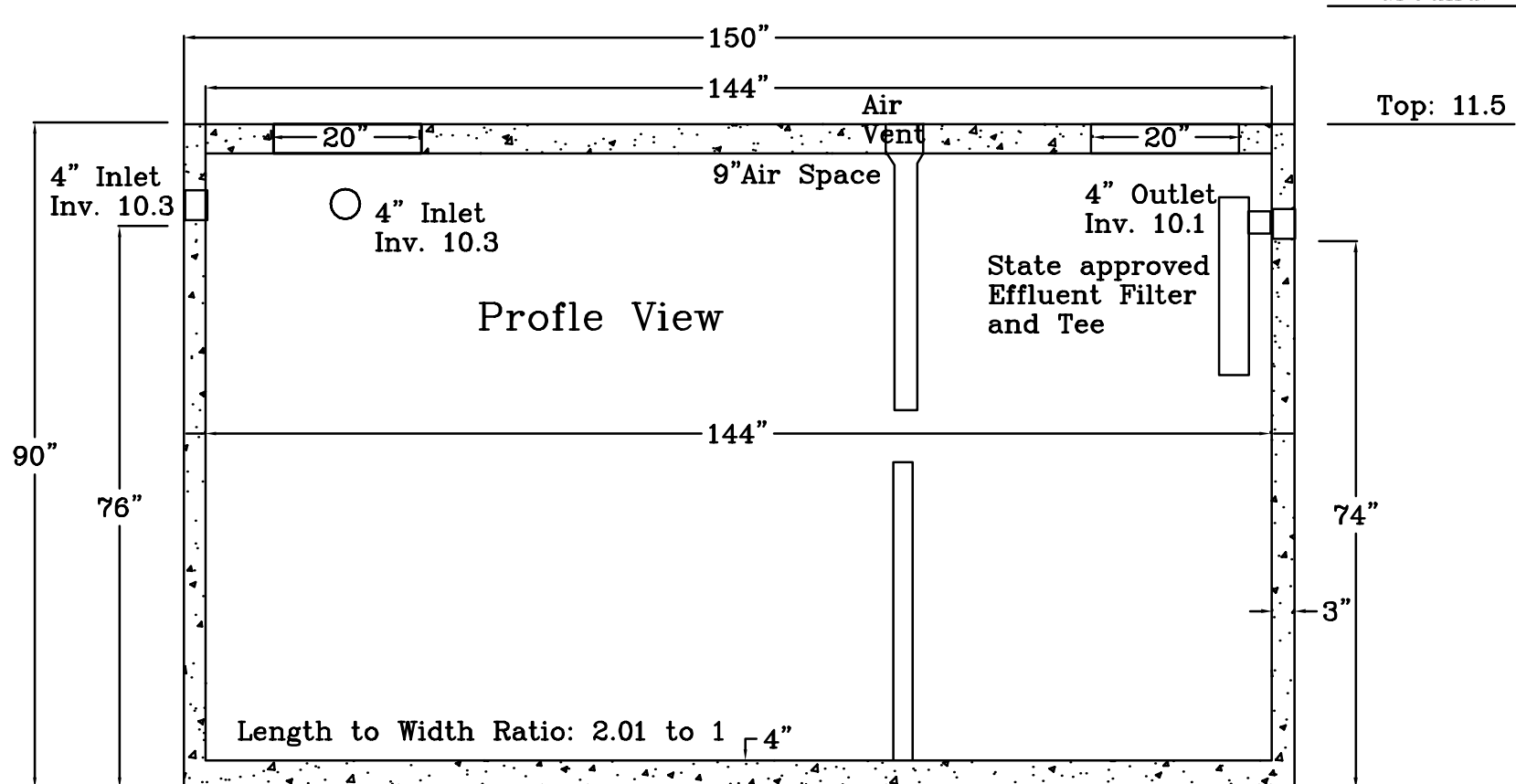
Tank: 2000 Gallon Pump Tank
 Liquid Capacity: 2400 Gallons - 50 gals/inch
 Non Traffic Rated
 Reinforcement Schedule #3 Grade 60 Rebar
 4500 PSI Concrete w/ State Approved Structural Fiber
 Est. Weight 28,000 lbs.
 MC Precast Concrete PT-539 (approval 9/29/2006)
 or Engineer approved State equal
 Other Acceptable Manufacturers:
 Page Septic Tank
 Futrell Precast
 Stalling Septic Tank Company
 Coastal Ready Mix Concrete Co.



2000 GALLON EQUALIZATION PUMP TANK
 NOT TO SCALE



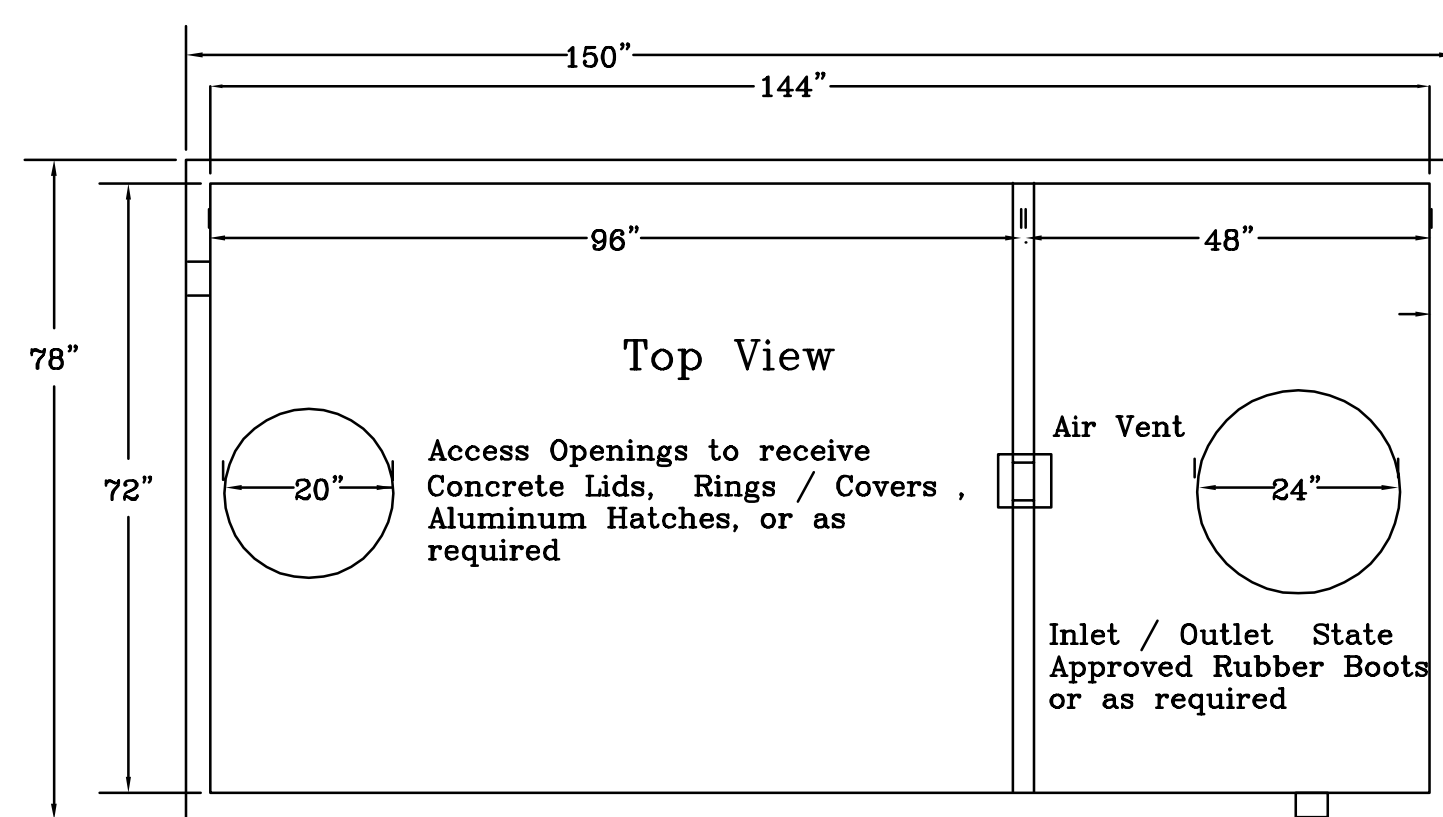
Ground: +/-14.5



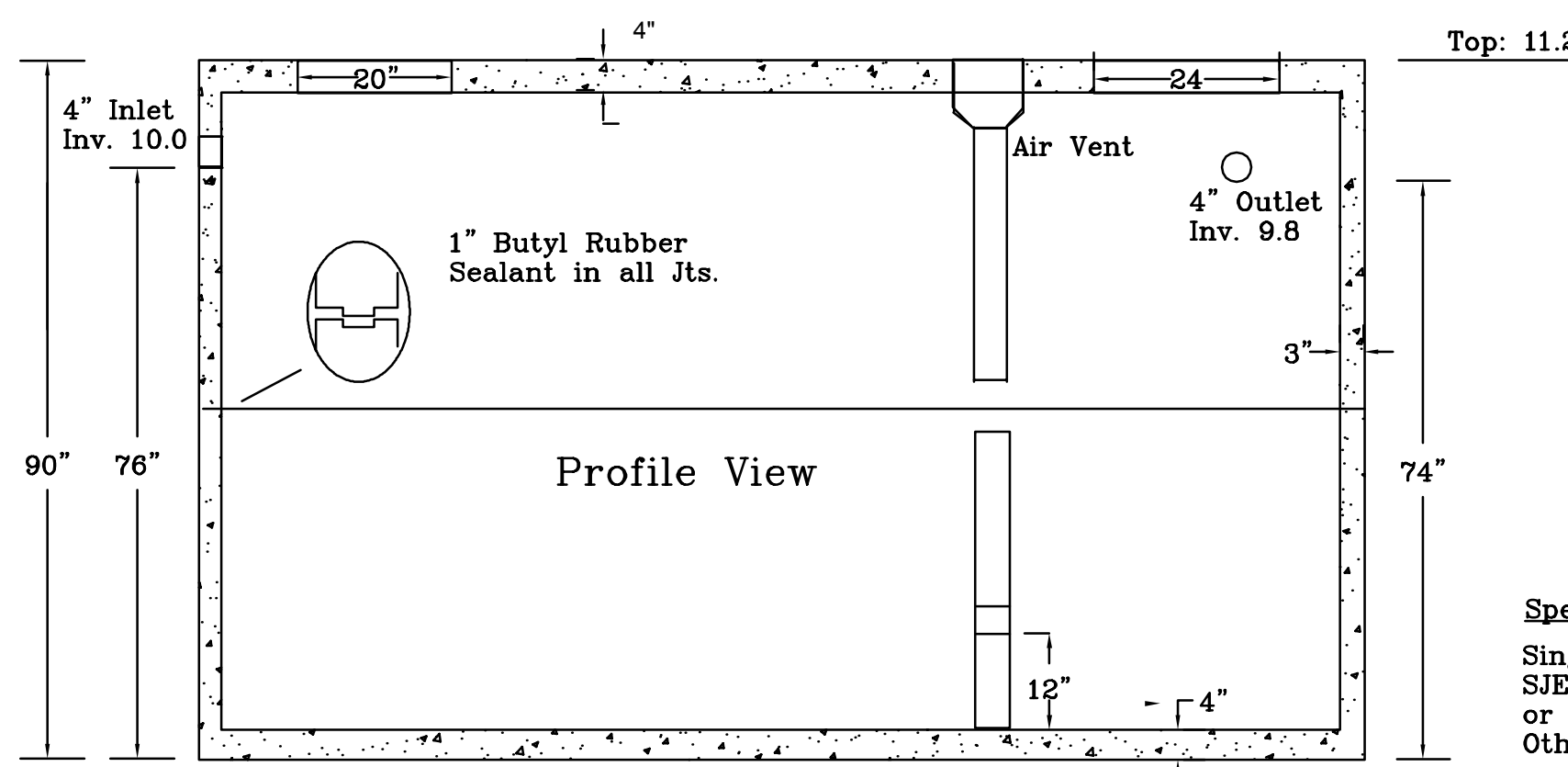
Specifications
 Septic Tank Filter
 Zoeller 170-0144 Residential Effluent Filter
 or Engineer approved State equivalent
 Other Acceptable Manufacturers:
 Orenco Effluent Filter
 GAG Sim/Tec Filters

Tank: 3000 Gallon Pump Tank
 Liquid Capacity: 3141 Gallons
 Non Traffic Rated
 Reinforcement Schedule #3 Grade 60 Rebar
 4500 PSI Concrete w/ State Approved Structural Fiber
 4.7 Yds. Est. Weight 18,880 lbs.
 Blackwelder Tank Service STB-349 Mid Seam (approval 8/14/1997)
 or Engineer approved State equal
 Other Acceptable Manufacturers:
 Northeastern Ready Mix
 Stalling Septic Tank Company
 Coastal Ready Mix Concrete Co.

3000 GALLON SEPTIC TANK
 NOT TO SCALE



Ground: +/-14.5



Specifications
 Single Phase Duplex Timed Dose Pump Control Panel
 SJE Rhombus Model DTD control panel
 or Engineer approved State equivalent
 Other Acceptable Manufacturers:
 American Duplex Control Panel
 CSI Duplex Control Panel
 Quality Controls Panel

Pumps (2)
 Meyers Model ME75
 or Engineer approved State Equivalent
 Other Acceptable Manufacturers:
 Sulzer/ABS Brand
 Liberty Brand

Tank: 3500 Gallon Pump Tank
 Liquid Capacity: 3528 Gallons - 44 gals/inch
 Non Traffic Rated
 Reinforcement Schedule #3 Grade 60 Rebar
 4500 PSI Concrete w/ State Approved Structural Fiber
 4.7 Yds. Est. Weight 18,880 lbs. 43.02 gals. per in.
 Blackwelder Tank Service PT-307 (approval 1/6/2000)
 or Engineer approved State equal
 Other Acceptable Manufacturers:
 Northeastern Ready Mix
 Stalling Septic Tank Company
 Coastal Ready Mix Concrete Co.

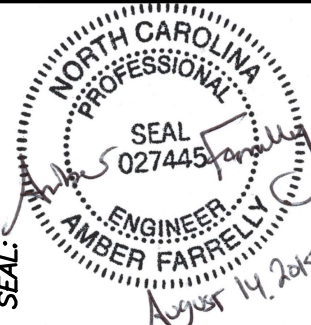
3500 GALLON PUMP TANK (FIELD DOSING)
 NOT TO SCALE

NOTES:
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 4. ALL ROADWAY AND SITE WORK IS OWNED AND MAINTAINED BY NCDOT. ALL CONSTRUCTION FOR PUBLIC ACCESSES ARE TO ADHERE TO NCDOT STANDARDS AND SPECIFICATIONS

NOTES
 1. THE TANKS WILL NOT BE INSTALLED IN THE WATER TABLE.
 2. ALL TANKS SHALL BE LEAK TESTED SUCH THAT EXFILTRATION OCCURS AT A RATE WHICH DOES NOT EXCEED TEN GALLONS PER TWENTY-FOUR HOURS PER 1,000 GALLONS OF TANK CAPACITY.
 3. ALL TANKS SHALL REST ON A BED OF #57 WASHED GRAVEL. THE MINIMUM THICKNESS OF THE GRAVEL BED IS 6 INCHES.
 4. ALL TANKS MUST BE APPROVED FOR USE BY THE NORTH CAROLINA DEPARTMENT OF ENVIRONMENTAL HEALTH (DEH).
 5. THE SOIL BEARING CAPACITY OF THE SOIL BENEATH THE PUMP TANK SHALL BE CHECKED PRIOR TO TANK INSTALLATION AND SHALL HAVE A SOIL BEARING CAPACITY OF AT LEAST 3000 PSF.
 6. PIPE PENETRATIONS IN THE PUMP TANK AND SEPTIC TANK ARE TO BE SEALED WITH PRESS-BOOT TYPE SEALS.
 7. ALL HARDWARE INSTALLED INSIDE OF TANKS SHALL BE OF STAINLESS STEEL

OPERATION AND MAINTENANCE

- ONCE PER MONTH
- RECORD CYCLE COUNTERS AND RUN TIMER
 - CHECK SLUDGE LEVELS IN BOTH PUMP TANK AND SEPTIC TANK. SLUDGE TO BE REMOVED AS NECESSARY.
 - CHECK MANHOLES. CLEAN AS NECESSARY.
 - CHECK EFFLUENT FILTERS. CLEAN AS NECESSARY.
- BI-ANNUALLY
- FLUSH GRAVITY SEWER.
 - PUMP SLUDGE FROM SEPTIC TANK AND PUMP TANK.
 - EXERCISE ALL VALVES.
 - CLEAN MANIFOLD TAPS.
 - CHECK MANIFOLD HEAD PRESSURE. RESET AS NECESSARY.
 - CHECK PUMP TANK DRAW DOWN.
 - FLUSH MANIFOLDS AND LATERALS



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 NC LICENSE C2149

DRAWING TITLE / DESCRIPTION:
**SEPTIC DETAILS
 TANK DETAILS**

PROJECT TITLE:
**CHERRY BRANCH FERRY FACILITY
 NORTH CAROLINA DOT**
 2300 FERRY ROAD, HAVELOCK, NC 28632
 CRAVEN COUNTY, NORTH CAROLINA

STATE CONSTRUCTION
 ID.# 11-09079-01A

ASSET NUMBER:
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C7.6

EQUALIZATION TANK NOTES

- TANK DIMENSIONS VARY BY MANUFACTURER.
- DRAWDOWN WILL VARY WITH TANK DIMENSIONS. DRAWDOWN SHOWN BASED ON 1000 GALLONS AT 90 GALLONS PER INCH
- NO ELECTRICAL SPLICES SHALL BE MADE INSIDE THE PUMP TANK.
- ALL HARDWARE INSIDE THE PUMP TANK SHALL BE OF STAINLESS STEEL.
- FLOW SHALL BE TIMER DOSED TO SEPTIC TANK. (SEE FLOW EQUALIZATION WORKSHEET)
- DUPLEX PUMPS TO BE MYERS MODEL ME50 OR APPROVED EQUIVALENT, SEE SHEET C7.6.
- CONTROL PANEL TO BE INSTALLER FRIENDLY SERIES IFS IN-SITE SINGLE PHASE SIMPLEX OR APPROVED EQUIVALENT, SEE SHEET C7.6.

CONTROL PANEL NOTES

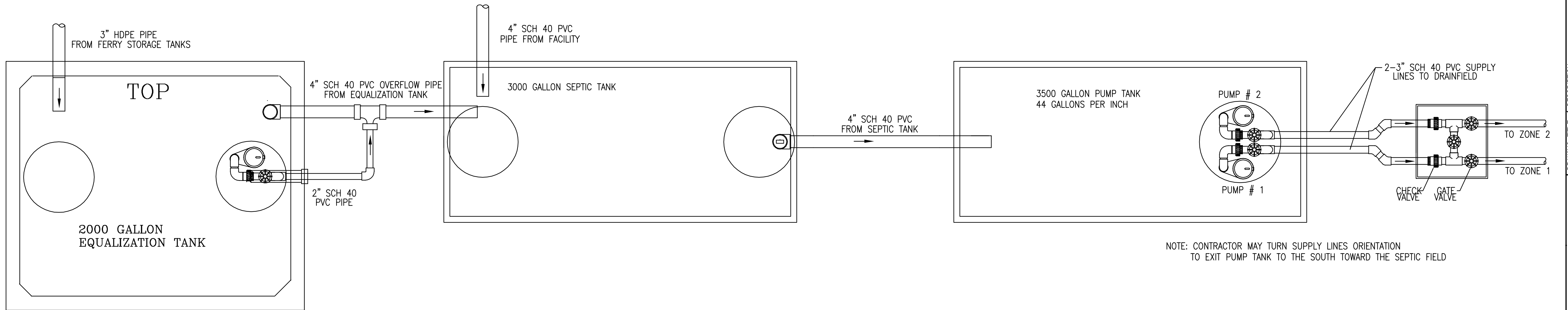
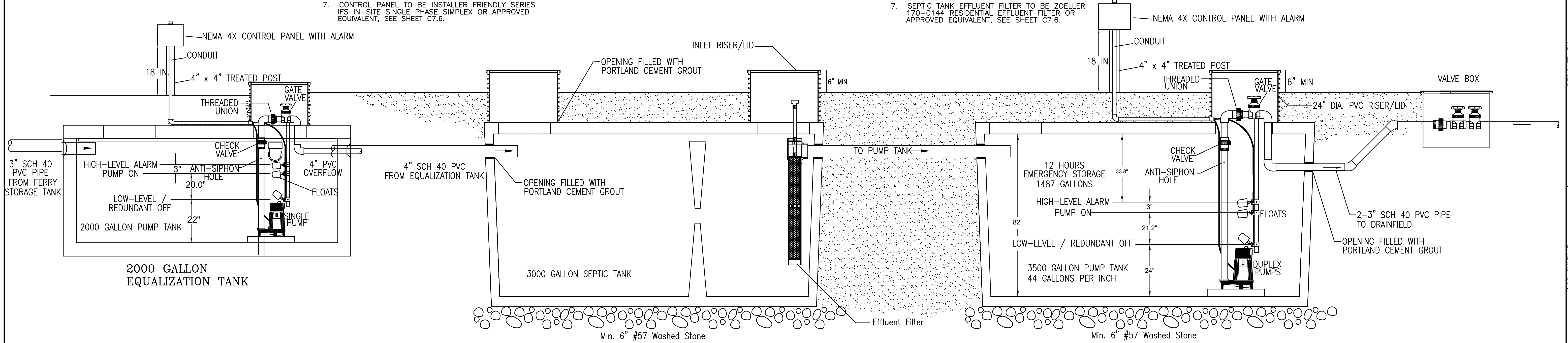
- CONTROL PANELS TO BE ENCLOSED IN NEMA 4X ENCLOSURE PER STATE REQUIREMENTS.
- CONTROL PANELS SHALL HAVE INTEGRAL MAIN DISCONNECT, SINGLE POINT CONNECTION, ALL STARTERS AND CONTROL WIRING INCLUDED
- SEE ELECTRICAL SITE PLANS FOR ELECTRICAL SERVICE TO CONTROL PANELS.

PUMP TANK/SEPTIC TANK NOTES

- TANK DIMENSIONS VARY BY MANUFACTURER.
- DRAWDOWN WILL VARY WITH TANK DIMENSIONS. DRAWDOWN SHOWN BASED ON 1860 GALLONS AT 44 GALLONS PER INCH
- NO ELECTRICAL SPLICES SHALL BE MADE INSIDE THE PUMP TANK.
- ALL HARDWARE INSIDE THE PUMP TANK SHALL BE OF STAINLESS STEEL.
- DUPLEX PUMPS TO BE MYERS MODEL ME75 OR APPROVED EQUIVALENT, SEE SHEET C7.6.
- CONTROL PANEL TO BE SJE RHOMBUS MODEL DTD OR APPROVED EQUIVALENT, SEE SHEET C7.6.
- SEPTIC TANK EFFLUENT FILTER TO BE ZOELLER 170-0144 RESIDENTIAL EFFLUENT FILTER OR APPROVED EQUIVALENT, SEE SHEET C7.6.

NOTES:

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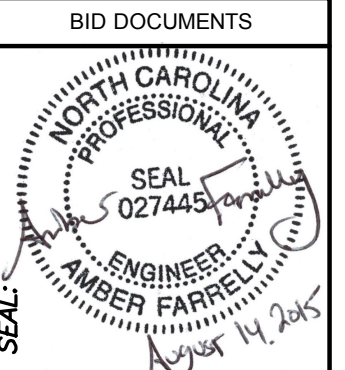
NOTE: CONTRACTOR MAY TURN SUPPLY LINES ORIENTATION TO EXIT PUMP TANK TO THE SOUTH TOWARD THE SEPTIC FIELD

Cherry Branch Buoyancy Calculations

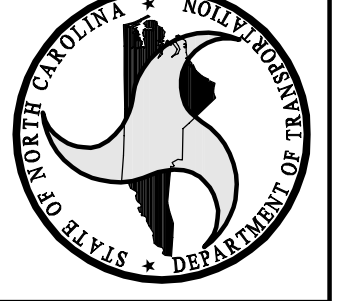
Date: 1/23/2015		Unit Weight of Water: 62.4 lb/cf		Unit weight of Concrete: 144 lb/cf		Unit weight of soil: 100 lb/cf																										
top elevation	bottom elev	length	width	height	water @10	area (cf)	force of buoyancy (lbs)	factor of safety	force of buoyancy (lbs)	elevation of ground (ft)	length of base (ft)	width of base (ft)	depth (ft)	area of ground (cf)	soil weight (lbs)	slab thickness (ft)	concrete box weight (lbs)	total weight (lbs)														
10.9	6.4	10	8.1	4.0	3.1	250.6	15636.4	1.5	23454.6	14.5	11	9.1667	3.6	363	36300	0.5	17956.4	54256.4	OK													
																			Deadmen Calculations													
																			length of block (ft)	width of block (ft)	height of block (ft)	area of each deadmen (cf)	weight for each (lbs)						No. of Deadmen		total weight (lbs)	
																			0	0	0	0	0						0		37547.9	
																			No. of Deadmen		total weight (lbs)							0		39675		

top elevation	bottom elev	length	width	height	water @10	area (cf)	force of buoyancy (lbs)	factor of safety	force of buoyancy (lbs)	elevation of ground (ft)	length of base (ft)	width of base (ft)	depth (ft)	area of ground (cf)	weight (lbs)	slab thickness (ft)	concrete box weight (lbs)	total weight (lbs)														
11.5	4	12	6.0	6.8	5.3	384.0	23961.6	1.5	35942	14.5	12.5	6.5	3	243.75	24375	0.3	13172.9	37547.9	OK													
																			Deadmen Calculations													
																			length of block (ft)	width of block (ft)	height of block (ft)	area of each deadmen (cf)	weight for each (lbs)						No. of Deadmen		total weight (lbs)	
																			0	0	0	0	0						0		37547.9	
																			No. of Deadmen		total weight (lbs)							0		39675		

TANK SHALL BE INSTALLED AND TESTED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS, INCLUDING PRE-INSTALLATION AIR PRESSURE TESTING OF EACH TANK AND POST-INSTALLATION TESTING (INCLUDING TESTING THE INTEGRITY OF THE TANK INTERCONNECTIONS) BY AIR TESTING AND LEAKAGE TESTS AS SPECIFIED IN THE MANUFACTURER'S INSTALLATION REQUIREMENTS. INSTALLATION AND TESTING SHALL BE VERIFIED BY A MANUFACTURER'S REPRESENTATIVE, THE ENGINEER AND THE HEALTH DEPARTMENT.



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 NC LICENSE C2149

DRAWING TITLE / DESCRIPTION:
SEPTIC DETAILS
TANK DETAILS

PROJECT TITLE:
CHERRY BRANCH FERRY FACILITY
NORTH CAROLINA DOT
 2300 FERRY ROAD, HAYLOCK, NC 28632
 CRAVEN COUNTY, NORTH CAROLINA

STATE CONSTRUCTION ID# 11-09079-01A
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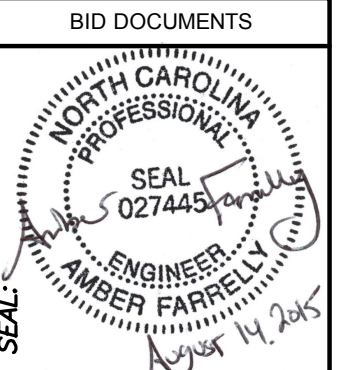
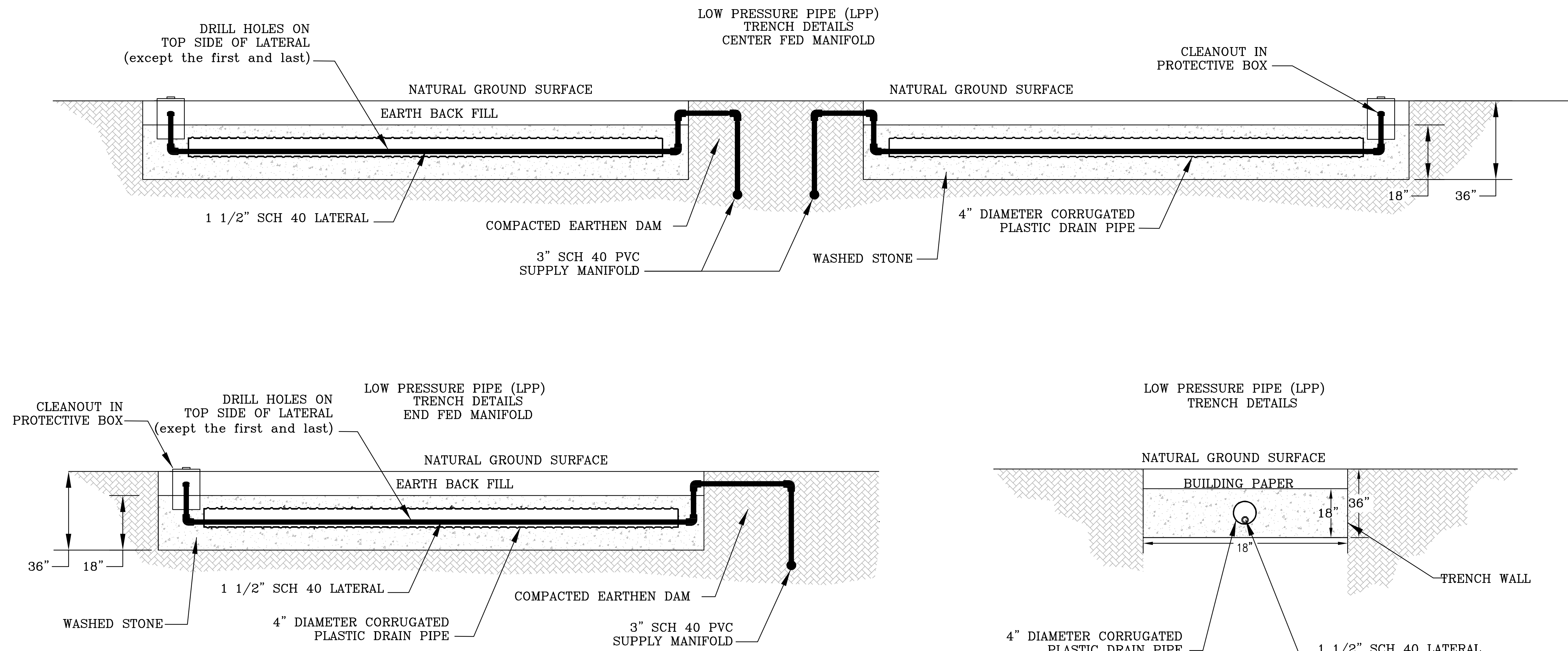
DATE ISSUED: 8-14-15
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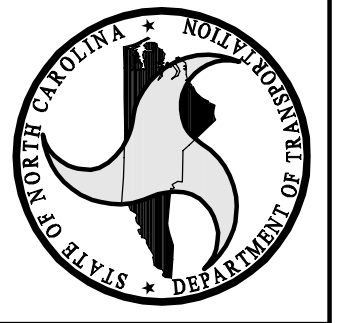
LOW PRESSURE PIPE (LPP) TRENCH DETAILS

NOTES:
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SEPTIC SYSTEM INSTALLATION NOTE:
 1. SEPTIC SYSTEM INSTALLER MUST BE A NORTH CAROLINA ONSITE WASTEWATER CONTRACTOR GRADE III INSTALLER - CERTIFIED THROUGH THE NORTH CAROLINA ONSITE WASTEWATER CONTRACTOR INSPECTOR CERTIFICATION BOARD (NCOWCIB)



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 CONSULTING**
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 PHONE: 919/889-0102
 FAX: 919/889-0102
 NC LICENSE C2149

DRAWING TITLE / DESCRIPTION:
**SEPTIC DETAILS
 TRENCH DETAILS**

PROJECT TITLE:
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 NORTH CAROLINA DOT**
 2300 FERRY ROAD, HAVELOCK, NC 28632
 CRAVEN COUNTY, NORTH CAROLINA

STATE CONSTRUCTION
 ID.# 11-09079-01A

ASSET NUMBER:
 C.C.# SITE# BLDG.#
 48

NO.	DATE
1	ADDENDUM 3 9-16-2015

DATE ISSUED: 8-14-15
 DRAWN BY: AF
 CHECKED BY: RJB

SHEET NO.
C7.8

ATTACHMENT 'E'

SECTION 07 6200 SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, counterflashings, reglets, cleats, and other accessories.
- B. Sealants for joints within sheet metal fabrications.

1.02 RELATED REQUIREMENTS

- A. Section 04 2000 - Unit Masonry: Metal flashings embedded in masonry.
- B. Section 06 1000 - Rough Carpentry: Wood nailers for sheet metal work.
- C. Section 07 7123 - Manufactured Gutters and Downspouts.
- D. Section 07 9200 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.

1.03 REFERENCE STANDARDS

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 2012.
- B. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels; 2013.
- C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- D. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- F. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2012)e1.
- G. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
- B. Maintain one copy of each document on site.
- C. Fabricator and Installer Qualifications: Company specializing in sheet metal work with three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

- A. Pre-Finished Aluminum: ASTM B209 (ASTM B209M); 20 gage (0.032 inch) thick; plain finish shop pre-coated with modified silicone coating.

1. Modified Silicone Polyester Coating: Pigmented Organic Coating System, AAMA 2603; baked enamel finish system.
 2. Color: As selected by NCDOT from manufacturer's standard colors.
 - a. Roof flashing to match roof panels color.
- B. Cleats: Continuous cleats, unless otherwise indicated, for attachment of flashings. Same material and finish as flashing. Attached securely to substrate with approved fasteners.

2.02 ACCESSORIES

- A. Fasteners: Galvanized steel, with soft neoprene washers. Conceal fasteners wherever possible.
- B. Primer: Zinc chromate type.
- C. Protective Backing Paint: Zinc molybdate alkyd.
- D. Sealant to be Concealed in Completed Work: Non-curing butyl sealant.
- E. Sealant to be Exposed in Completed Work: ASTM C920; elastomeric sealant, 100 percent silicone with minimum movement capability of plus/minus 25 percent and recommended by manufacturer for substrates to be sealed; clear.
- F. Plastic Cement: ASTM D4586, Type I.

2.03 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
- F. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.03 INSTALLATION

- A. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.
- B. Apply plastic cement compound between metal flashings and felt flashings.
- C. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Provide expansion joints per SMACNA recommendations or as recommended by manufacturer.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Assurance, for field inspection requirements.

- B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

ATTACHMENT 'F'

B. Gypsum Wallboard:

3. Standard Gypsum Board - Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - a. Application: Use for vertical surfaces, unless otherwise indicated.
 - 1) Thickness:
 - (a) Vertical Surfaces: 5/8 inch, unless otherwise indicated.
 - 2) Standard Gypsum Board Paper Faced Products:
 - (a) American Gypsum Company; LIGHTROC® Lightweight Gypsum Board
 - (b) Continental Building Products; General Purpose Drywall
 - (c) Georgia-Pacific Gypsum; ToughRock Gypsum Board.
 - (d) National Gypsum Company; Gold Bond Gypsum Board .
 - (e) Substitutions: See Section 01 6000 - Product Requirements.
 - b. Application: Use for horizontal surfaces, unless otherwise indicated.
 - 1) Thickness: 1/2" may be used at Contractor's discretion.

ATTACHMENT 'G'

SECTION 270000 - COMMUNICATIONS BASIC REQUIREMENTS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Applicable requirements of General Requirements/Provisions shall be considered a part of this section and shall have the same force as if printed herein full. In addition, all information related to communications infrastructure that is documented in the architectural, structural, mechanical, and electrical drawings/documents shall be included as part of the Communications documents.

1.02 QUALITY ASSURANCE

- A. Specifications, Standards and Codes: All work shall be in accordance with the following:

1. The 2011 edition of the National Electrical Code (NFPA 70)
2. American National Standards Institute (ANSI)
3. National Electrical Manufacturers Association (NEMA)
4. Telecommunications Industries Association (TIA)
5. Electronic Industries Association (EIA)
6. Institute of Electrical & Electronics Engineers (IEEE)
7. Underwriters Laboratories (UL)
8. American Standards Association (ASA)
9. Federal Communications Commission (FCC)
10. Occupational Safety and Health Administration (OSHA)
11. American Society of Testing Material (ASTM)
12. Americans with Disabilities Act (ADA)
13. Local city and county ordinances governing electrical work
14. In the event of conflicts, the more stringent provisions shall apply.

1.03 SCOPE

- A. The work to be done under this section of the Specifications shall include the furnishing of labor, material, equipment and tools required for the complete installation of the work indicated on the Drawings or as specified herein.
- B. All materials, obviously a part of the Communications Infrastructure and necessary to its proper operation, but not specifically mentioned or shown on the Drawings, shall be furnished and installed without additional charge.
- C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the engineer shall be notified of the discrepancy.

1.04 WORK INCLUDED

- A. The Communications Infrastructure installed and work performed under this Division of the Specifications shall include but not necessarily be limited to the following:
 - 1. Voice/Data Cabling Infrastructure
 - 2. CATV Cabling Infrastructure System
 - 3. CATV Cabling Distribution System
 - 4. Audio-Visual Systems
 - 5. Satellite Distribution System
 - 6. Overhead Paging System
 - 7. Wireless Access System
 - 8. Emergency Call System
 - 9. Communications conduits, raceways, cable tray, racks, cabinets and equipment mounting boards
 - 10. Grounding and Bonding
 - 11. Underground raceway excavation, backfill, and compaction
 - 12. Concrete work for duct banks, maintenance holes, handholes, vaults and restoration (where applicable)

1.05 DEFINITIONS

- A. Terms: The following definitions of terms supplement those of the General Requirements and are applicable to Division 27 - Communications:
- B. Provide: As used herein shall mean "furnish, install and test (if applicable) complete."
- C. Infrastructure: As used herein shall mean cable, conduit, raceway, cable tray or j-hooks with all required boxes, fittings, connectors, and accessories; completely installed.
- D. Work: As used herein shall be understood to mean the materials completely installed, including the labor involved.
- E. Owner: NCDOT
- F. Project Manager: Mark Gibson
- G. Engineer: Elm Engineering, Inc.

1.06 DRAWINGS

- A. Drawings are generally diagrammatic and show the arrangement and location of pathways, outlets, support structures and equipment. The Contractor shall carefully investigate the structural and finish conditions affecting his work and arrange his work accordingly. Should conditions on the job make it necessary to make adjustments to pathways or materials, the Contractor shall so advise the Engineer and secure approval before proceeding with such work.
- B. Where exact locations are required by equipment for stubbing-up and terminating conduit concealed in floor slabs, the Contractor shall request shop drawings, equipment location drawings, foundation drawings, and any other data required by him to locate the concealed conduit before the floor slab is poured.

- C. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.
- D. The right is reserved to make reasonable changes in locations of equipment indicated on Drawings prior to rough in without increase in contract cost.
- E. The Contractor shall not reduce the size or number of conduit runs indicated on the Drawings without the written approval of the Engineer.
- F. Any work installed contrary to Contract Drawings shall be subject to change as directed by the Engineer, and no extra compensation will be allowed for making these changes.
- G. The location of equipment, support structures, outlets, and similar devices shown on the Drawings are approximate only. Do not scale Drawings. Obtain layout dimensions for equipment from Architectural plans unless indicated on Communications plans.
- H. Schematic diagrams shown on the Drawings indicate the required functions only. The technology of a particular manufacturer may be used to accomplish the functions indicated without exact adherence to the schematic Drawings shown. Additional labor and materials required for such deviations shall be furnished at the Contractor's expense.
- I. Verify the ceiling type, ceiling suspension systems, and clearance above hung ceilings prior to ordering cabling and associated hardware. Notify the Engineer of any discrepancies.
- J. Review all architectural drawings for modular furniture.
- K. Portions of these Drawings and Specifications are abbreviated and may include incomplete sentences. Omissions of words or phrases such as "the Contractor shall," "shall be," "as indicated on the Drawings," "In accordance with," "a," "the" and "all are intended" shall be supplied by inference.

1.07 SUBMITTALS

- A. Submit for approval, details of all materials, equipment and systems to be furnished. Work shall not proceed without the Owner and/or the Project Manager's approval of the submitted items. Three (3) copies of the following shall be submitted:
 - 1. Submittals for individual systems and equipment assemblies that consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered, reviewed or stored, and such submittals will not be returned except at the request and expense of the Contractor.
 - 2. Contractor shall generate shop drawings. Modify reviewed and accepted shop drawings to include revisions based upon completion of work. Submit shop drawings with record drawings on hard copy.
 - 3. Shop drawings shall include equipment racks, patch panels, termination blocks, connection details, rack mounting details and any other details not included in the construction drawings.

- B. Any materials and equipment listed that are not in accordance with Specification requirements may be rejected.
- C. The approval of material, equipment, systems and shop drawings is a general approval subject to the Drawings, Specifications and verification of all measurements at the job. Approval does not relieve the Contractor from the responsibility of shop drawing errors. The Contractor shall carefully check and correct all shop drawings prior to submission for approval.
- D. NOTE: Manufacturer must provide qualifying letter to ensure compliance with the Federal Transit Administration's (FTA) Buy-America Requirements found in 49 CFR Part 661.

1.08 QUALITY ASSURANCE

- A. Equipment and materials required for installation under these Specifications shall be the current model and new (less than one [1] year from the date of manufacture), unused and without blemish or defect.
- B. Equipment shall bear labels attesting to Underwriters Laboratories, where subject to label service. Manufacturers of equipment and materials pertinent to these items shall have been engaged in the manufacture of said equipment a minimum of three (3) years and, if so directed by the Owner, be able to furnish proof of their ability by submitting affidavits and descriptive data about their product including size and magnitude comparable to requirements specified herein.

1.09 CONTRACTOR QUALIFICATIONS

- A. The Contractor shall have total responsibility for the coordination and installation of the work shown and described in the Drawings and Specifications. The Contractor shall be a company specializing in the design, fabrication and installation of integrated communications systems.
- B. Communications Systems specified shall be installed under the direction of a qualified Contractor. Qualification requirements shall include submittal by the Contractor to the Architect of the following:
 - 1. List of previous projects of this scope, size and nature; including names and sizes of projects, description of work, time of completion and names of contact persons for reference.
 - 2. Shall certify that they are manufacturer-authorized for work to be performed and able to offer a minimum of a 25-year system warranty for work performed.
 - 3. Contractor must employ at least one (1) full-time Registered Communications Distribution Designer (RCDD). The RCDD shall be a W2 employee and not a subcontractor.

1.10 COORDINATION WITH OTHER TRADES

- A. The Contractor shall coordinate communications work with that of other sections as required to ensure that the entire communications work will be carried out in an orderly, complete and coordinated fashion.

1.11 SITE INVESTIGATION

- A. Prior to submitting bids of the project, visit the site of the work to become aware of existing conditions that may affect the cost of the project. Where work under this project requires extension, relocation, reconnections or modifications to existing equipment or systems, the existing equipment or systems, shall be restored to their original condition before the completion of this project.

1.12 PERMITS

- A. Obtain all permits and inspections for the installation of this work and pay all charges incident thereto. Deliver to the Owner all certificates of said inspection issued by authorities having jurisdiction.

1.13 RENOVATIONS AND ADDITIONS

- A. All work that would adversely affect the normal operation of the other portions of the Owner's property shall be done at a time other than normal working hours. Normal working hours shall be considered 8 a.m. to 5 p.m. Monday through Friday.
- B. Prior to submitting bids on the project, visit the site of the work to become aware of existing conditions that may affect the cost of the project.
- C. Where work under this project requires extension, relocation, reconnections or modifications to existing equipment or systems, the existing equipment or systems shall be restored to their original and operating condition. Remove all equipment indicated to be demolished, including outlets, devices, raceways and support structures.
- D. Care shall be exercised in the removal and storage of equipment indicated to be relocated or removed and reused. Prior to placing back into service, equipment shall be cleaned, and marred or chipped paint surfaces touched-up.
- E. Provide all coring, cutting and patching to existing walls, floors, etc., required for the removal of existing work or the installation of new work.

PART 2 - PRODUCTS

2.01 SUBSTITUTIONS

- A. Where equipment is identified by manufacturer and catalog number, it shall be as the base of requirements for quality and performance. Where manufacturers for equipment are identified by name, the Contractor may submit for approval, similar equipment of other manufacturers as substitution. The Engineer's decision as to whether the submitted equipment is acceptable shall be final and binding.
- B. All changes necessary to accommodate the substituted equipment shall be made at the Contractor's expense, and shall be as approved by the Engineer. Detailed drawings indicating the required changes shall be submitted for approval at the time the substitution is requested.
- C. If substitutions are made in lieu of device specified; form, dimension, design and profile shall be submitted to the Engineer for approval.

- D. Submit request for approval of substitute materials in writing to the Architect at least ten days prior to bid opening.

2.02 MATERIALS

- A. All materials used in this work shall be new and shall bear the inspection label of Underwriters' Laboratories Inc. or certification by other recognized laboratory.
- B. The published standards and requirements of the Telecommunications Industries Association (TIA), National Electrical Manufacturers Association (NEMA), the American National Standard Institute (ANSI), the Institute of Electrical and Electronic Engineers (IEEE), and the American Society of Testing Materials (ASTM), are made a part of these Specifications and shall apply wherever applicable.
- C. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts are available.
- D. When more than one unit of the same class of equipment or material is required, such units shall be the products of a single manufacturer or partner manufacturers that offer a certified solution.
- E. Components of an assembled unit need not be products of the same manufacturer, but must offer a certified end-to-end solution.
- F. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
- G. Components shall be compatible with each other and with the total assembly for the intended service.

PART 3 - EXECUTION

3.01 EXAMINATION OF CONDITIONS

- A. Prior to the start of work, the Contractor shall carefully inspect the installed work of other trades and verify that such work is complete to the point where installation may properly commence. Start of work indicates acceptance of conditions.
- B. Install equipment in accordance with applicable codes and regulations, the original design and the referenced standards.
- C. In the event of a discrepancy, immediately notify the Project Manager.
- D. Do not proceed with installation until unsatisfactory conditions and discrepancies have been fully resolved.

3.02 PROTECTION OF SYSTEMS AND EQUIPMENT

- A. Protect materials and equipment from damage during storage at the site and throughout the construction period. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, theft, moisture, extreme temperature and rain.
- B. Damage from rain, dirt, sun and ground water shall be prevented by storing the equipment on elevated supports and covering the sides with securely fastened protective rigid or flexible waterproof coverings.
- C. During installation, equipment shall be protected against entry of foreign matter on the inside and be vacuum cleaned both inside and outside before testing, operating or painting.
- D. As determined by the Project Manager, damaged equipment shall be fully repaired or shall be removed and replaced with new equipment to fully comply with requirements of the Contract Documents. Decision of the Project Manager shall be final.
- E. Damaged paint on equipment and materials shall be repainted with painting equipment and finished with the same quality of paint and workmanship as used by the manufacturer.

3.03 ACCESS TO EQUIPMENT

- A. Equipment shall be installed in location and manner that will allow convenient access for maintenance and inspection.
- B. Working spaces shall be not less than specified in the National Electrical Code (NEC) for voltages specified.
- C. Where the Project Manager determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled, one time only, as directed by the Project Manager, at no additional cost to the Owner. "Conveniently accessible" is defined as being capable of being reached without the use of ladders or without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping and duct work.

3.04 CLEANING

- A. During construction, and prior to Owner acceptance of the building, remove from the premises and dispose of packing material and debris caused by communications work.
- B. Remove dust and debris from interiors and exteriors of electrical equipment. Clean accessible current carrying elements prior to being energized.

3.05 COMPLETION

- A. General: Upon completion of the work, remove excess debris, materials, equipment, apparatus, tools and similar items. Leave the premises clean, neat and orderly.
- B. Results Expected: Systems shall be complete and operational and controls shall be set and calibrated. Testing, start-up and cleaning work shall be complete.

- C. Maintenance Materials: Special tools for proper operation and maintenance of the equipment provided under this Specification shall be delivered to the Owner.

3.06 TESTING AND VERIFICATION

- A. See specific Division 27 sections for testing parameters of sub-systems.
- B. The Contractor shall verify that requirements of this Specification are met. Verification shall be through a combination of analyses, inspections, demonstrations and tests, as described below.
- C. Verification by inspection includes examination of items and comparison of pertinent characteristics against the qualitative or quantitative standard set forth in the Specifications. Inspection may require moving or partially disassembling the item to accomplish the verification, included as part of the work at no additional cost to the Owner.
- D. The Contractor shall verify by formal demonstrations or tests that the requirements of this Specification have been met. The Contractor shall demonstrate that the communications systems, components and subsystems meet Specification requirements in the "as-installed" operating environment during the "System Operation Test." Even though no formal environmental testing is required, the Contractor shall measure and record temperature, humidity and other environmental parameters and the environmental conditions, which were encountered during the "System Operation Test."
- E. The Contractor shall carefully plan and coordinate the final acceptance tests so that tests can be satisfactorily completed. The Contractor shall provide necessary instruments, labor and materials required for tests, including the equipment manufacturer's technical representative and qualified technicians in sufficient numbers to perform the tests within a reasonable time period.
- F. The Contractor shall satisfy all items detailed in the final acceptance check-off list (punch list). The list shall be a complete representation of specified installation requirements. At the time of final acceptance punch list items shall be corrected until the system is found to be acceptable to the Owner and the Project Manager.
- G. After the Contractor systems have been installed and tested, the completed test plan shall be signed by the Communications Contractor Project Manager and submitted for approval.

END OF SECTION 270000

SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Grounding conductors.
 - 2. Grounding connectors.
 - 3. Grounding busbars.
 - 4. Grounding rods.
 - 5. Grounding labeling.

1.3 DEFINITIONS

- A. BCT: Bonding conductor for telecommunications.
- B. EMT: Electrical metallic tubing.
- C. TGB: Telecommunications grounding busbar.
- D. TMGB: Telecommunications main grounding busbar.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. NOTE: Manufacturer must provide qualifying letter to ensure compliance with the Federal Transit Administration's (FTA) Buy-America Requirements found in 49 CFR Part 661.
- C. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
 - 1. Ground rods.

2. Ground and roof rings.
 3. BCT, TMGB, TGBs, and routing of their bonding conductors.
- B. Qualification Data: For installer and installation supervisor, and field inspector.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Result of the ground-resistance test, measured at the point of BCT connection.
 - b. Result of the bonding-resistance test at each TGB and its nearest grounding electrode.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
1. Installation Supervision: Installation shall be under the direct supervision of ITS Installer 2, who shall be present at all times when Work of this Section is performed at Project site.
 2. Field Inspector: Currently registered by BICSI as a registered communications distribution designer to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 SYSTEM COMPONENTS

- A. Comply with J-STD-607-A.

2.2 CONDUCTORS

- A. Manufacturers:
1. Harger Lightning and Grounding.
 2. Panduit Corp.
 3. Tyco Electronics Corp
 4. Or equivalent.
- B. Comply with UL 486A-486B.

- C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
 - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
 - 2. Cable Tray Equipment Grounding Wire: [No. 8] [No. 6] AWG.
- D. Cable Tray Grounding Jumper:
 - 1. Not smaller than No. 6 AWG and not longer than 12 inches (300 mm). If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
 - 2. Not smaller than No. 10 AWG and not longer than 12 inches (300 mm). If jumper is a wire, it shall have a crimped grounding lug with one hole and standard barrel for one crimp. If jumper is a flexible braid, it shall have a one- or two-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
- E. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmils (14.2 sq. mm), 14 strands of No. 17 AWG conductor, and 1/4 inch (6.3 mm) in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.3 CONNECTORS

- A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- B. Manufacturers:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. Chatsworth Products, Inc.
 - 3. Harger Lightning and Grounding.
 - 4. Panduit Corp.
 - 5. Tyco Electronics Corp.
 - 6. Or Equivalent.
- C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
 - 1. Electroplated tinned copper, C and H shaped.

- D. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.
- E. Busbar Connectors: Cast silicon bronze, solderless [compression] [or] [exothermic]-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8- or 25.4-mm) centers for a two-bolt connection to the busbar.
- F. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

- A. Manufacturers:
 - 1. Chatsworth Products, Inc.
 - 2. Harger Lightning and Grounding.
 - 3. Panduit Corp.
 - 4. Or equivalent
- B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with J-STD-607-A.
 - 1. Predrilling shall be with holes for use with lugs specified in this Section.
 - 2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
 - 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- C. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with J-STD-607-A.
 - 1. Predrilling shall be with holes for use with lugs specified in this Section.
 - 2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch (50-mm clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.)
 - 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- D. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with J-STD-607-A. Predrilling shall be with holes for use with lugs specified in this Section.
 - 1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
 - 2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch (483- or 584-mm) equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.

3. Rack-Mounted Vertical Busbar: 72 or 36 inches long, with stainless-steel or copper-plated hardware for attachment to the rack.

2.5 GROUND RODS

- A. Manufacturers:
 1. Harger Lightning and Grounding.
 2. Tyco Electronics Corp.
 3. Or equivalent.
- B. Ground Rods: Copper-clad steel 3/4 inch by 10 feet (19 mm by 3 m) [5/8 by 96 inches (16 by 2400 mm) in diameter.

2.6 LABELING

- A. Manufacturers:
 1. Brother International Corporation.
 2. HellermannTyton.
 3. Panduit Corp.
 4. Or equivalent
- B. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with J-STD-607-A.

3.3 APPLICATION

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
 - 1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
 - 2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2 AWG minimum.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.
- D. Conductor Support:
 - 1. Secure grounding and bonding conductors at intervals of not less than 36 inches (900 mm.)
- E. Grounding and Bonding Conductors:
 - 1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
 - 2. Install without splices.
 - 3. Support at not more than 36-inch (900-mm) intervals.
 - 4. Install grounding and bonding conductors in 3/4-inch (21-mm) PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
 - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

- A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 3/0 AWG.

3.5 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 12 inches (300 mm) above finished floor unless otherwise indicated.
- B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.6 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
 - 1. Use crimping tool and the die specific to the connector.
 - 2. Pretwist the conductor.
 - 3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
- E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kmils/linear foot (1 sq. mm/linear meter) of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.
- F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-mounted mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.
- G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.
- H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.
- I. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA/EIA-568-B.1 and TIA/EIA-568-B.2 when grounding screened, balanced, twisted-pair cables.

- J. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
- K. Access Floors: Bond all metal parts of access floors to the TGB.
- L. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using No. 6 AWG bonding conductors.
 - 1. Install the conductors in grid pattern on 4-foot (1200-mm) centers, allowing bonding of one pedestal from each access floor tile.
 - 2. Bond the TGB of the equipment room to the reference grid at two or more locations.
 - 3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.
- M. Towers and Antennas:
 - 1. Ground Ring: Buried at least 30 inches (760 mm) below grade and at least 24 inches (610 mm) from the base of the tower or mounting.
 - 2. Bond each tower base and metallic frame of a dish to the ground ring, buried at least 18 inches (460 mm) below grade.
 - 3. Bond the ground ring and antenna grounds to the equipment room TMGB or TGB, buried at least 30 inches (760 mm) below grade.
 - 4. Bond metallic fences within 6 feet (1.8 m) of towers and antennas to the ground ring, buried at least 18 inches (460 mm) below grade.
 - 5. Special Requirements for Roof-Mounted Towers:
 - a. Roof Ring: Meet requirements for the ground ring except the conductors shall comply with requirements in Section 264113 "Lightning Protection for Structures."
 - b. Bond tower base footings steel, the TGB in the equipment room, and antenna support guys to the roof ring.
 - c. Connect roof ring to the perimeter conductors of the lightning protection system.
 - 6. Waveguides and Coaxial Cable:
 - a. Bond cable shields at the point of entry into the building to the TGB and to the cable entrance plate, using No. 2 AWG bonding conductors.
 - b. Bond coaxial cable surge arrester to the ground or roof ring using bonding conductor size recommended by surge-arrester manufacturer.

3.7 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- B. Comply with IEEE C2 grounding requirements.

- C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) extends above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.
- D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect grounding conductors to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.8 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
 - 1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
 - 2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
 - 3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
 - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.

3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
 - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB[and in each TGB]. Maximum acceptable ac current level is 1 A.
- D. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 270526

SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Optical-fiber-cable pathways and fittings.
4. Metal wireways and auxiliary gutters.
5. Nonmetallic wireways and auxiliary gutters.
6. Surface pathways.
7. Boxes, enclosures, and cabinets.
8. Handholes and boxes for exterior underground cabling.

- B. Related Requirements:

1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Section 260533 "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.
3. Section 280528 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

- B. NOTE: Manufacturer must provide qualifying letter to ensure compliance with the Federal Transit Administration's (FTA) Buy-America Requirements found in 49 CFR Part 661.
- C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
- D. Samples: For [wireways] [nonmetallic wireways] [and] [surface pathways] and for each color and texture specified, [12 inches (300 mm)] <Insert dimension> long.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of pathway groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Certificates: For pathway racks, enclosures, cabinets, equipment racks and their mounting provisions, including those for internal 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 certification is based and their installation requirements.
 - 4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.
- D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [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. AFC Cable Systems, Inc.
 - 2. Allied Tube & Conduit.
 - 3. Alpha Wire Company.
 - 4. Anamet Electrical, Inc.
 - 5. Electri-Flex Company.
 - 6. O-Z/Gedney.
 - 7. Picoma Industries.

8. Republic Conduit.
9. Robroy Industries.
10. Southwire Company.
11. Thomas & Betts Corporation.
12. Western Tube and Conduit Corporation.
13. Wheatland Tube Company.
14. Or equivalent.

B. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

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: Comply with ANSI C80.3 and UL 797.

H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:
 - a. Material: Steel
 - b. Type: compression
3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [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. AFC Cable Systems, Inc.
2. Allied Tube & Conduit.
3. Anamet Electrical, Inc.
4. Arnco Corporation.
5. CANTEX Inc.
6. CertainTeed Corporation.
7. Condux International, Inc.
8. Electri-Flex Company.
9. Kraloy.
10. Lamson & Sessions; Carlon Electrical Products.
11. Niedax-Kleinhuis USA, Inc.
12. RACO; Hubbell.
13. Thomas & Betts Corporation.
14. Or equivalent.

B. General Requirements for Nonmetallic Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

C. RNC: Type EPC-40-PVC complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. Rigid HDPE: Comply with UL 651A.

E. Continuous HDPE: Comply with UL 651B.

F. RTRC: Comply with UL 1684A and NEMA TC 14.

G. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

H. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

I. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

A. Manufacturers:

1. Alpha Wire Company.
2. Arnco Corporation.
3. Endot Industries Inc.
4. IPEX.
5. Lamson & Sessions; Carlon Electrical Products.
6. Or equivalent

- B. Description: Comply with UL 2024; flexible-type pathway, approved for plenum, riser, or general-use installation unless otherwise indicated.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-B.

2.4 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [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 B-Line, Inc.
 - 2. Hoffman.
 - 3. Mono-Systems, Inc.
 - 4. Square D.
 - 5. Or equivalent
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, UL listed as suitable for location, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with TIA-569-B.
- C. Fittings and Accessories: Include covers, 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.
- D. Wireway Covers: Hinged type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [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. Allied Moulded Products, Inc.
 - 2. Hoffman.
 - 3. Lamson & Sessions; Carlon Electrical Products.
 - 4. Niedax-Kleinhuis USA, Inc.
 - 5. Or equivalent
- B. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Comply with TIA-569-B.
- C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- F. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 SURFACE PATHWAYS

- A. General Requirements for Surface Pathways:
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with TIA-569-B.
- B. Surface Metal Pathways: Use aluminum with clear anodized finish in finished areas such as offices, conferences rooms, workstations, etc, with snap-on covers complying with UL 5. Manufacturer's standard enamel finish
 1. Manufacturers:
 - a. Mono-Systems, Inc.
 - b. Niedax-Kleinhuis USA, Inc.
 - c. Panduit Corp.
 - d. Wiremold / Legrand.
 - e. Or equivalent
- C. Tele-Power Poles:
 1. Manufacturers:
 - a. Mono-Systems, Inc.
 - b. Panduit Corp.
 - c. Wiremold / Legrand.
 - d. Or equivalent
 2. Material: Aluminum with clear anodized finish.

3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.7 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers:

1. Adalet.
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. Hoffman.
6. Lamson & Sessions; Carlon Electrical Products.
7. Milbank Manufacturing Co.
8. Molex; Woodhead Brand.
9. Mono-Systems, Inc.
10. O-Z/Gedney.
11. Quazite:Hubbell Power Systems, Inc.
12. RACO; Hubbell.
13. Robroy Industries.
14. Spring City Electrical Manufacturing Company.
15. Stahlin Non-Metallic Enclosures.
16. Thomas & Betts Corporation.
17. Wiremold / Legrand.
18. Or equivalent.

B. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-B.
2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

F. Metal Floor Boxes:

1. Material: Cast metal
2. Type: Fully adjustable
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

- H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep)
- J. Gangable boxes are prohibited.
- K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, 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:
 - a. Material: Plastic or Fiberglass
 - b. Finished inside with radio-frequency-resistant paint.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- L. Cabinets:
 - 1. NEMA 250, 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.
 - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.8 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND CABLING

- A. General Requirements for Handholes and Boxes:
 - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 3. Comply with TIA-569-B.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
 - 1. Manufacturers:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. NewBasis.
 - d. Oldcastle Precast, Inc; Christy Concrete Products.
 - e. Quazite: Hubbell Power System, Inc; Hubbell Power Systems.

- f. Synertech Moulded Products.
 - g. Or equivalent
2. Standard: Comply with SCTE 77.
 3. Configuration: Designed for flush burial with [open] [closed] [integral closed] bottom unless otherwise indicated.
 4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 6. Cover Legend: Molded lettering, ["COMMUNICATIONS."] <Insert legend>.
 7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

2.9 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 an 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 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
 1. Exposed Conduit: Coated GRC or IMC
 2. Concealed Conduit, Aboveground: GRC or IMC
 3. Underground Conduit: RNC, Type EPC-80-PVC concrete encased
 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
 1. Exposed, Not Subject to Physical Damage: EMT
 2. Exposed, Not Subject to Severe Physical Damage: EMT
 3. Exposed and Subject to Severe Physical Damage: GRC or IMC. Pathway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Warehouse

- e. Truck bays and Maintenance of Way areas other than offices, breakrooms, and conference/training rooms.
- 4. Concealed in Ceilings and Interior Walls and Partitions: EMT
- 5. Damp or Wet Locations: GRC or IMC.
- 6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: EMT
- 7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: EMT
- 8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: EMT
- 9. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 stainless steel in damp or wet locations.
- C. Minimum Pathway Size: 3/4-inch (21-mm) trade size. Minimum size for optical-fiber and data cables is 1 inch (27 mm).
- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - 3. EMT: Use steel compression fittings. Comply with NEMA FB 2.10.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface pathways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C)

3.2 INSTALLATION

- A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- B. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- C. Complete pathway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

- F. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- I. Pathways 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. Secure pathways to reinforcement at maximum 10-foot (3-m) intervals.
 - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange pathways to keep a minimum of [1 inch (25 mm)] [2 inches (50 mm)] <Insert dimension> of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from ENT to GRC or IRC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for pathways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- N. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- P. Cut conduit perpendicular to the length. For conduits of 2-inch (53-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- Q. Install pull wires in empty pathways. 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. Cap underground pathways designated as spare above grade alongside pathways in use.
- R. Surface Pathways:

1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
 2. Install surface pathway with a minimum 2-inch (50-mm) radius control at bend points.
 3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- S. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
1. 3/4-Inch (21-mm) Trade Size and Smaller: Install pathways in maximum lengths of 50 feet (15 m).
 2. 1-Inch (27-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).
 3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway 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.
- T. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, 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 pathway sealing fittings according to NFPA 70.
- U. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service pathway enters a building or structure.
 3. Where otherwise required by NFPA 70.
- V. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- W. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC 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). Install in each run of aboveground RMC[and EMT] conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - 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 Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
 - d. Attics: 135 deg F (75 deg C) temperature change.
3. 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 for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated. Match receptacle outlets on same wall so that all are at same height.
 - Y. 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. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
 - Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
 - AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
 - BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
 - CC. Set metal floor boxes level and 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 Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
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 Section 312000 "Earth Moving."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits, but a minimum of 6 inches (150 mm) below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

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 with bottom below frost line, <Insert depth of frost line below grade at Project site> 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 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 AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 270528

SECTION 271116 - COMMUNICATIONS CABINETS, RACKS AND ENCLOSURES

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Communications Cabinets, Racks and Enclosures.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

- A. Provide product data from manufacturer's specifications.
- B. NOTE: Manufacturer must provide qualifying letter to ensure compliance with the Federal Transit Administration's (FTA) Buy-America Requirements found in 49 CFR Part 661.

1.03 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

- A. Approved Equipment Rack/Cabinet/Shelf Manufacturer(s)
 - 1. ADC.
 - 2. Belden Inc.
 - 3. Cooper B-Line.
 - 4. Emerson Network Power Connectivity Solutions.
 - 5. Hubbell Premise Wiring.
 - 6. Leviton Commercial Networks Division.
 - 7. Middle Atlantic Products, Inc.
 - 8. Ortronics, Inc.
 - 9. Panduit Corp.

10. Siemon Co. (The).
11. Tyco Electronics Corporation; AMP Products.

2.02 EQUIPMENT RACKS/CABINETS/SHELVES

A. Equipment Racks

1. The equipment rack shall be constructed of high strength, lightweight aluminum.
2. The vertical rails of the equipment rack shall be equipped with the EIA hole pattern, four post style.
3. Rack shall be: 7'H x 19"W floor mounted, four post.
4. Rack color shall be black.

B. Equipment Cabinets

1. The frame of the equipment cabinet shall be constructed of high strength, lightweight aluminum or high strength steel.
2. Front and rear doors of the equipment cabinet shall be lockable.
3. The vertical rails of the equipment cabinet shall be equipped with the EIA hole pattern.
4. The equipment cabinet shall be equipped with a fan unit.
5. Cabinet shall be: 7'H x 19"W x 32"D floor mounted.
6. Cabinet shall be: 36"H x 24"D x 19"W wall mounted. WC1838 - 36"H x 21"W x 24"D wall-mount cabinet, black
7. Cabinet color shall be black.

C. Single-Sided Equipment Shelves

1. The single-sided equipment shelf shall be constructed of high strength, lightweight aluminum.
2. The single-sided equipment shelf shall be a minimum depth of 14".
3. The single-sided equipment shelf shall support a minimum of 50lbs.
4. Single-Sided Equipment Shelf color shall be black.

D. Double-Sided Equipment Shelves

1. The double-sided equipment shelf shall be constructed of high strength, lightweight aluminum.
2. The double-sided equipment shelf shall be a minimum depth of 25".
3. The double-sided equipment shelf shall support a minimum of 85lbs.
4. Double-Sided Equipment Shelf color shall be black.

PART 3 - EXECUTION

3.01 EQUIPMENT RACKS/CABINETS/SHELVES

- A. Equipment racks shall be securely attached to the concrete floor using minimum 3/8" hardware or as required by local codes.

- B. Equipment cabinets shall be installed as per the requirements specified by the manufacturer's installation guidelines.
- C. Equipment racks/cabinets shall be placed with a minimum of 40-inch clearance from the walls from the front and rear of the rack or as indicated on Drawings.
- D. All equipment racks/cabinets shall be grounded to the telecommunications ground bus bar.
- E. Mounting screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.

3.02 BACKBOARDS

- A. Backboards shall be 3/4" void free plywood. Size of backboard shall be 4' x full height unless noted differently on Drawings. Backboards shall be painted with two (2) coats of gray fire-retardant paint.

3.03 IDENTIFICATION

- A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION 271116

SECTION 271119 - COMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Communications Termination Blocks and Patch Panels.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

- A. Provide product data from manufacturer's specifications.
- B. NOTE: Manufacturer must provide qualifying letter to ensure compliance with the Federal Transit Administration's (FTA) Buy-America Requirements found in 49 CFR Part 661.

1.03 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

- A. Approved Manufacturer(s)
 - 1. ADC.
 - 2. Belden Inc.
 - 3. Cooper B-Line.
 - 4. Emerson Network Power Connectivity Solutions.
 - 5. Hubbell Premise Wiring.
 - 6. Leviton Commercial Networks Division.
 - 7. Middle Atlantic Products, Inc.
 - 8. Ortronics, Inc.
 - 9. Panduit Corp.

10. Sistemax
11. Commscope
12. Siemon Co. (The).
13. Tyco Electronics Corporation; AMP Products.

2.02 PATCH PANELS

A. Category 6 Patch Panel

1. The Category 6 patch panel shall be compatible with 19" equipment racks, cabinets or wall mount brackets and shall be constructed of all steel. Straight and Angled patch panel versions are acceptable.
2. The Category 6 patch panel shall be equipped with 8-position modular ports with Power Safe Pins and shall allow for termination using universal T568A/B wiring configurations.
3. The Category 6 patch panel shall be equipped with front labeling space to facilitate port identification.
4. The connector module shall meet or exceed the Category 6 performance criteria per ANSI/TIA-568-C.2 and ISO/IEC 60603-7 requirements.
5. 48-port Cat 6 patch panel

2.03 OPTICAL FIBER PANELS/ENCLOSURES

A. Rack Mount Optical Fiber Panel/Enclosure

1. The rack mount optical fiber panel/enclosure shall be constructed of all steel and equipped with either removable front and rear access to fibers or a sliding drawer to access fibers
2. The rack mount optical fiber panel/enclosures shall be available with locking capabilities for security.
3. The rack mount optical fiber panel/enclosure shall be capable of terminating tight-buffered or loose tube optical fiber cable.
4. The rack mount optical fiber panel/enclosure shall provide for bend radius control throughout the panel as well as storage space for slack cabling.
5. The rack mount optical fiber panel/enclosure shall provide labeling space to facilitate port identification.
6. The panel/enclosure shall meet or exceed the performance criteria per ANSI/TIA-568-C.3.
7. The rack mount optical fiber panel/enclosure shall be equipped with optical fiber adapter panels.
 - a. The optical fiber adapter panels shall accommodate Not Applicable terminated optical fiber.
 - b. The optical fiber adapter panels shall be compatible with Not Applicable connectors.

B. Wall Mount Optical Fiber Panel/Enclosure

1. The wall mount optical fiber panel/enclosure shall be constructed of all steel and have a hinged door for access, with locking available for security.
2. The wall mount optical fiber panel/enclosure shall be capable of terminating tight-buffered or loose tube optical fiber cables and all popular connector types.

3. The wall mount optical fiber panel/enclosure shall provide for bend radius control throughout the panel as well as storage space for slack cabling.
4. The wall mount optical fiber panel/enclosure shall provide labeling space to facilitate port identification.
5. The panel/enclosure shall meet or exceed the performance criteria per ANSI/TIA-568-C.3.
6. The wall mount optical fiber panel/enclosure shall be equipped with optical fiber adapter panels.
 - a. The optical fiber adapter panels shall accommodate Not Applicable terminated optical fiber.
 - b. The optical fiber adapter panels shall be compatible with Not Applicable connectors.

2.04 TERMINATION BLOCKS

A. 110 Type Wiring Blocks/Cross-Connect Kits:

1. The 110-type wiring block shall be Not Applicable.
2. The 110-type wiring blocks shall be available in Not Applicable configurations.
3. The cross-connect kits shall include all the components required to complete a wall-mounted 110 cross-connect installation and be available in both 100- and/or 300-pair configuration. (Includes 110-blocks, connecting blocks and designation strips).
4. The termination block shall meet or exceed the performance criteria per ANSI/TIA-568-C.2.
5. Backbone blocks shall use 5-pair connecting blocks on each 25-pair row.
6. Horizontal blocks shall use 4-pair connecting blocks on each 25-pair row.

PART 3 - EXECUTION

3.01 PATCH PANELS

- A. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practice.
- B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).
- C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.
- D. Cables shall be neatly bundled and dressed to their respective patch panel. Each patch panel shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- E. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.02 OPTICAL FIBER PANELS/ENCLOSURES

- A. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practices.
- B. Each cable shall be individually attached to the respective splice enclosure by mechanical means. The cables strength member shall be securely attached the cable strain relief bracket in the enclosure.
- C. Bend radius of the optic fiber cable in the panel/enclosure shall not exceed 10 times the outside diameter of the cable.
- D. Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.
- E. Each cable shall be clearly labeled at the entrance to the splice enclosure. Cables labeled within the bundle shall not be acceptable.
- F. A maximum of 12 strands of fiber shall be spliced in each tray
- G. All spare strands shall be installed into spare splice trays.
- H. Fiber slack shall be neatly coiled within the fiber splice tray or enclosure. No slack loops shall be allowed external to the fiber panel.

3.03 TERMINATION BLOCKS

- A. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practice.
- B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).
- C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.
- D. Cables shall be neatly bundled and dressed to their respective termination block. Each termination block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- E. Each cable shall be clearly labeled on the cable jacket within 12" of the termination block at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.
- F. Wall mounted termination block fields shall be mounted on communications backboard.
- G. Wall mounted termination block fields shall be installed as per the requirements specified by the manufacturer's installation guidelines.

3.04 IDENTIFICATION

A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION 271119

SECTION 271123 - COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Communications Cable Management and Ladder Rack.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

- A. Provide product data from manufacturer's specifications.
- B. NOTE: Manufacturer must provide qualifying letter to ensure compliance with the Federal Transit Administration's (FTA) Buy-America Requirements found in 49 CFR Part 661.

1.03 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

- A. Approved Cable Management Manufacturer(s)
 - 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. Sistemax
11. SYSTIMAX Solutions; a CommScope Inc. brand.
12. 3M.
13. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

2.02 CABLE MANAGEMENT - HORIZONTAL

A. Horizontal Cable Management

1. The horizontal wire manager shall be compatible with 19" equipment racks, cabinets or wall mount brackets.
2. The horizontal cable manager shall be single-sided and provide support for patch cords at the front of the panel.
3. The horizontal cable manager shall be 2 rack-units in height when matched with a 2 rack-units patch panel or switch.
4. The horizontal cable manager shall be 1 rack-unit in height when matched with a 1 rack-unit patch panel or switch.
5. The horizontal cable manager color shall be black and have removable covers.
6. Horizontal cable manager, high-capacity, single-sided, 2RU with hinged cover

2.03 CABLE MANAGEMENT - VERTICAL

A. Vertical Cable Management

1. The vertical cable manger shall be double-sided.
2. The vertical cable manager shall provide support for patch cords at the front of the rack and wire management at the rear of the rack.
3. The vertical cable manager shall be a minimum width of 6" and should try to match the height of the equipment rack it is attached.
4. Vertical cable manager color shall be black and have removable covers.
- 5.

2.04 LADDER RACKS

A. Ladder Rack System

1. See Drawings for ladder rack system details.
2. The ladder rack system shall be securely mounted with hardware designed for use in ladder rack systems.
3. End caps shall be installed on the exposed ends of the ladder racks, channel supports and bolts. Protective covers shall be installed on threaded rods that come in contact with cabling plant.
4. Ladder Rack System color shall be black.

2.05 TIE WRAPS AND VELCRO STRAPS

A. Tie Wraps and Velcro Straps

1. Backbone cables shall be fastened to support structures with tie wraps/Velcro straps.
2. Horizontal cables shall be fastened to support structures with Velcro straps.
 - a. Tie Wrap color shall be black.
 - b. Velcro Strap color shall be black.

2.06 C-RINGS/D-Rings

A. C-Rings/D-rings

1. C-rings/D-rings shall be used on backboards to support cables, patch cords and cross-connect wire.
2. C-rings/D-rings shall be made of high-strength, fire-retardant material with rounded edges to prevent damage to cable and wire insulation.

PART 3 - EXECUTION

3.01 CABLE MANAGEMENT - HORIZONTAL

- A. Horizontal cable managers shall be installed below patch panels in a 1:1 ratio (one horizontal cable manager per patch panel) or as indicated on Drawings.

3.02 CABLE MANAGEMENT - VERTICAL

- A. Vertical cable managers shall be installed on both sides of a single equipment rack. Where two (2) or more racks are positioned in a row, vertical cable managers shall be installed between each rack and each end of the row.

3.03 LADDER RACKS

- A. Ladder rack system shall be installed straight, level and perpendicular to walls and ceiling slabs.
- B. Ladder racks shall be supported at 5' intervals maximum.
- C. Provide all hardware, accessories, fasteners, anchors, threaded rods and support channels required to provide a complete ladder rack system.
- D. See Drawings for ladder rack system details.

3.04 TIE WRAPS AND VELCRO STRAPS

- A. Tie wraps/Velcro straps shall be installed around cables at intervals of 12" minimum.
- B. Tie wraps shall secure cables to ladder racks using an "X" pattern.
- C. Do not over-cinch cables.

3.05 C-RINGS/D-RINGS

- A. C-ring/D-rings shall be installed on 3/4" backboard, straight and level.

3.06 IDENTIFICATION

- A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION 271123

SECTION 271300 - COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Pathways.
2. UTP cable.
3. 62.5/125-micrometer, optical fiber cabling.
4. Coaxial cable.
5. Cable connecting hardware, patch panels, and cross-connects.
6. Cabling identification products.

- B. Related Sections:

1. Section 280513 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. RCDD: Registered Communications Distribution Designer.
- G. UTP: Unshielded twisted pair.

1.4 BACKBONE CABLING DESCRIPTION

- A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system

structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- 1. For coaxial cable, include the following installation data for each type used:

- a. Nominal OD.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.

- B. NOTE: Manufacturer must provide qualifying letter to ensure compliance with the Federal Transit Administration's (FTA) Buy-America Requirements found in 49 CFR Part 661.

- C. Shop Drawings:

- 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 - 3. Cabling administration drawings and printouts.
 - 4. Wiring diagrams to show typical wiring schematics including the following:

- a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.

- 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 - 6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.
- D. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.8 CLOSEOUT SUBMITTALS

- A. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Patch-Panel Units: One of each type.
 - 2. Connecting Blocks: One of each type.

1.10 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
 - 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: An NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. 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 or less.
- 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. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- F. Grounding: Comply with ANSI-J-STD-607-A.

1.11 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. optical loss test set.
 - 2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including 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.

1.12 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install 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.

1.13 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.14 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled for support of 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.
- C. Cable Trays:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of 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 Material: Metal, suitable for indoors, and protected against corrosion by hot-dip galvanizing, complying with ASTM A 123/A 123M, Grade 0.55, not less than 0.002165 inches (0.055 mm) thick.
 - a. Ladder Cable Trays: Nominally 18 inches (455 mm) wide, and a rung spacing of 12 inches (305 mm).
 - b. Solid-Bottom Cable Trays: One-piece construction, nominally 18 inches (455 mm) wide. Provide with solid covers. Use for all exposed installations where cable tray cannot be installed above ceilings.
- D. Conduit and Boxes: Comply with requirements in Section 260533 "Raceway and Boxes for Electrical Systems." 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 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work as long as they meet the requirements of ARRA include, but are not limited to, the following:
 - 1. Belden CDT Inc.; Electronics Division.
 - 2. CommScope, Inc.
 - 3. Genesis Cable Products; Honeywell International, Inc.
 - 4. Optical Cable Corp.

5. SYSTIMAX Solutions; a CommScope Inc. brand.
 6. 3M.
 7. Or equivalent.
- B. Description: 100-ohm, 100-pair UTP, formed into 25-pair binder groups covered with a gray thermoplastic jacket and overall metallic shield.
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 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 CMG.
 - b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
 - c. Communications, Riser Rated: Type CMR, complying with UL 1666.
 - d. Communications, Limited Purpose: Type CMX.
 - e. Multipurpose: Type MP or MPG.
 - f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
 - g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.3 UTP CABLE HARDWARE

- A. 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:
1. American Technology Systems Industries, Inc.
 2. Dynacom Corporation.
 3. Hubbell Premise Wiring.
 4. Leviton Voice & Data Division.
 5. Optical Cable Corp.
 6. Panduit Corp.
 7. Siemon Co. (The).
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC for Category 6. 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.
- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
1. Number of Terminals per Field: One for each conductor in assigned cables.
- E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.
- F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- G. Patch Cords: Factory-made, 4-pair cables in 48-inch/1200-mm lengths; terminated with 8-position modular plug at each end.
1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
 2. Patch cords shall have color-coded boots for circuit identification.

2.4 OPTICAL FIBER CABLE

- A. Manufacturers:
1. Systemax, Corning, or Commscope, or equivalent
- B. Jacket:
1. Jacket Color: 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).

2.5 GROUNDING

- A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

2.6 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.7 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test 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 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Section 260533 "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where 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 when entering room from overhead.
 4. Extend conduits 3 inches (76 mm) above finished floor.
 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- G. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF 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. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. 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.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. 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. Use lacing bars and distribution spools.
8. 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.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
11. 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. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.

2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
3. All fiber optic terminations shall be accomplished by fusion or no epoxy/no-polish field terminations.
4. Terminated strands shall be secured within fiber optic enclosures. Fiber slack shall be neatly coiled within fiber splice tray or enclosure.
5. Provide appropriate number of fiber coupler panel blanks for each fiber enclosure where fiber optic terminations are made.
6. Cable strength member shall be securely attached to the cable strain relief bracket in the enclosure.
7. When terminated with field installable connectors, no epoxy/no-polish LC connectors shall be used. Connector installation shall not require the use of epoxies, adhesives, or ovens. Connectors shall be compliant with industry standard ANSI/TIA/EIA 568-B-3.

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Outdoor Coaxial Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

G. Group connecting hardware for cables into separate logical fields.

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 (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 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 (300 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 (76 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.5 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Administration Class: 2.

2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration including optional identification requirements of this standard.
- D. Comply with requirements in Section 271500 "Communications Horizontal Cabling" for cable and asset management software.
- E. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- G. Cable and Wire Identification:
1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:
1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: 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 jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for 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 copper 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 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) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
 - 2) Attenuation test results for backbone 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. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- F. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

END OF SECTION 271300

SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Communications Copper Horizontal Cabling.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

- A. Provide product data from manufacturer's specifications.
- B. NOTE: Manufacturer must provide qualifying letter to ensure compliance with the Federal Transit Administration's (FTA) Buy-America Requirements found in 49 CFR Part 661.

1.03 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

- A. Approved Copper Cable Manufacturer(s)
 - 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.

2.02 HORIZONTAL COPPER CABLE

A. 100 OHM Category 6 Balanced Twisted Pair Cable

1. The horizontal balanced twisted pair cable shall meet or exceed the Category 6 transmission characteristics per issue of ANSI/TIA/EIA-568-C.2.
2. Cable jacket shall be CMR or CMP rated (according to the space it occupies).
3. Cabling construction shall consist of four twisted pairs cabled around a cross-talk reduction separator with a left-hand lay.
4. Sheath color shall be blue for both primary and secondary connections.
5. Refer to drawings for jack and outlet colors.

PART 3 - EXECUTION

3.01 HORIZONTAL CABLES

- A. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.
- B. A plastic or nylon pull cord with a minimum test rating of 90 Kg (200 lb.) shall be co-installed with all cable installed in any conduit.
- C. Cable raceways shall not be filled greater than the ANSI/TIA/EIA-569-C maximum fill for the particular raceway type, no more than 40%.
- D. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.
- E. Riser rated cable shall be installed in metallic conduit when installed in a plenum space.
- F. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.
- G. The cable's minimum bend radius and maximum pulling tension shall not be exceeded. Refer to manufacturer's requirements.
- H. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 48 to 60 inch (1.2 to 1.5 meter) intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels. Cables shall be at least 3 inches above top of ceiling in all locations.
- I. Horizontal distribution cables shall be bundled in groups of no more than 40 cables. Cable bundle quantities in excess of 40 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.

- J. Cable shall be installed above fire-sprinkler systems and shall not be attached to system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, outlet boxes, or other control devices. Do not route cabling near sources of EMI such as lighting fixture ballasts or transformers.
- K. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the Contractor shall install appropriate carriers to support the cabling.
- L. Any cable damaged or exceeding recommended installation parameters during installation should be replaced by the Contractor prior to final acceptance at no cost to the Owner.
- M. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/EIA-568-C.2 document, manufacturer's recommendations and best industry practices.
- N. Leave a minimum of 12" of slack for twisted pair cables at the outlet. Cables shall be coiled in the in-wall box, surface-mount box or modular furniture raceway if adequate space is present to house the cable coil without exceeding the manufacturers bend radius. In hollow-wall installations where box-eliminators are used, excess wire can be stored in the wall. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.
- O. Cables shall be neatly bundled and dressed to their respective termination device. Each terminating device shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- P. Each cable shall be clearly labeled on the cable jacket behind the termination device at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.
- Q. Voice cables shall be terminated on 110 blocks in communications/wiring rooms.
- R. Sheath color shall be white for all voice cabling.
- S. Sheath color shall be blue for all data cabling.
- T. Jacks for voice shall be white (upper left, primary voice), and gray (upper right, secondary voice).
- U. Jacks for data shall be yellow (primary data, lower left) and green (secondary data, lower right).
- V. All outlets shall be labeled with a polyester film label per EIA/TIA 606 Standards.
- W. Horizontal cabling shall be installed in a star topology.
- X. Bridge taps and splices shall not be permitted.
- Y. No horizontal cable links shall exceed 90 meters.
- Z. UTP cable shall be installed so that no bends are smaller than 4 times the cable's outside diameter at any point in the cabling run and the termination area. All kinked or damaged cable shall be removed and replaced at the contractor's expense.
- AA. Pulling tension shall not exceed 25 lb-f for a four pair UTP cable.

- BB. Cables and supports shall not be connected to conduits, on top of I beams, fire sprinkler or HVAC piping.
- CC. Provide 10 feet of slack in communications rooms for all UTP cables, and 20 feet minimum slack for all fiber cables, not including the 15 feet of workable fiber wound inside the fiber cabinet.
- DD. Provide 12 inches of slack at each work area outlet and 20 feet minimum for UTP access point locations.

3.02 IDENTIFICATION

- A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION 271513

SECTION 271533 - COMMUNICATIONS COAXIAL HORIZONTAL CABLING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Communications Coaxial Horizontal Cabling.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

- A. Provide product data from manufacturer's specifications.
- B. NOTE: Manufacturer must provide qualifying letter to ensure compliance with the Federal Transit Administration's (FTA) Buy-America Requirements found in 49 CFR Part 661.

1.03 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

- A. Approved Horizontal Coaxial Cable Manufacturer(s)
 - 1. Belden, Commscope, General
 - 2. Or Approved Equal

2.02 HORIZONTAL COAXIAL CABLE

- A. Series 6 Coax

1. Series-6 coaxial cable shall be used for horizontal runs less than 200'.
2. Series-6 coaxial cable shall be 75-Ohm impedance with a nominal attenuation value of less than 29dB/100m at 3 GHz for CMP rated jacket and less than 22dB/100M at 3 GHz for CMR rated jacket.
3. Cable construction shall be 18 AWG solid-copper or copper-clad steel center-conductor and foam FEP dielectric. Cables shall be provided with 60% / 40% quad shields with braid constructed of aluminum or tinned copper wire.
4. Cable jacket shall be CMR or CMP rated (according to the space it occupies).

B. Series 11 Coax

1. Series-11 coaxial cable shall be used for horizontal runs that exceed 200'.
2. Series-11 coaxial cable shall be 75-Ohm impedance with a nominal attenuation value of less than 21dB/100m at 3 GHz for CMP rated jacket and less than 15dB/100M at 3 GHz for CM rated jacket.
3. Cable construction shall be 14 AWG solid-copper or copper-clad steel center-conductor and foam FEP dielectric. Cables shall be provided with 60%/40% quad shields with braid constructed of aluminum or tinned copper wire.
4. Cable jacket shall be CMR or CMP rated (according to the space it occupies).

PART 3 - EXECUTION

3.01 HORIZONTAL CABLES

- A. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.
- B. A plastic or nylon pull cord with a minimum test rating of 90 Kg (200 lb.) shall be co-installed with all cable installed in any conduit.
- C. Cable raceways shall not be filled greater than the ANSI/TIA-569-B maximum fill for the particular raceway type.
- D. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.
- E. Riser rated cable shall be installed in metallic conduit when installed in a plenum space.
- F. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.
- G. The cable's minimum bend radius and maximum pulling tension shall not be exceeded. Refer to manufacturer's requirements.
- H. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 48 to 60 inch (1.2 to 1.5 meter) intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.

- I. Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.
- J. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
- K. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the Contractor shall install appropriate carriers to support the cabling.
- L. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the Contractor prior to final acceptance at no cost to the Owner.
- M. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practices.
- N. Leave a minimum of 12" of slack for coax cables at the outlet. Cables shall be coiled in the in-wall box, surface-mount box or modular furniture raceway if adequate space is present to house the cable coil without exceeding the manufacturers bend radius. In hollow-wall installations where box-eliminators are used, excess wire can be stored in the wall. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.
- O. Cables shall be neatly bundled and dressed to their respective termination device. Each terminating device shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- P. Each cable shall be clearly labeled on the cable jacket behind the termination device at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.02 IDENTIFICATION

- A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION 271533

SECTION 271543 - COMMUNICATIONS FACEPLATES AND CONNECTORS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Communications Faceplates and Connectors.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

- A. Provide product data from manufacturer's specifications.
- B. NOTE: Manufacturer must provide qualifying letter to ensure compliance with the Federal Transit Administration's (FTA) Buy-America Requirements found in 49 CFR Part 661.

1.03 WORK INCLUDED

- A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

- A. Approved Cable Connectivity Manufacturer(s)
 - 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. F-Connectors (Rated at 3GHz)

1. Shall match cable manufacturer.

C. Approved Faceplate Manufacturer(s)

1. Shall match cable manufacturer.

D. Approved Surface Mount Box manufacturer(s)

1. Shall match cable manufacturer.

2.02 COPPER CONNECTIVITY

A. Voice/Data Jacks

1. Category 6, 8-Position, 8-Contact (8P8C) Modular Jack

- a. The connector module shall meet or exceed the Category 5e performance criteria per ANSI/TIA-568-C.2 and meet IEC 60603-7 requirements.
- b. The eight-position connector module shall accommodate six-position modular plug modular cords without damage to either the cord or the module.
- c. The connector module shall be designed for use at the work area (WA), communications room (TR) and/or equipment room (ER) without modification.
- d. The connector module shall be available in universal T568A/B wiring configurations within the same module.
- e. The connector module shall have an insulation displacement connection featuring insulation slicing of 22 to 24 AWG plastic-insulated solid copper conductors forming a gas-tight connection.
- f. The connector module must be compliant with Power over Ethernet requirements.
- g. Bezels shall be used if offered from the manufacturer.
- h. Jack/Bezel colors shall be:
 - i. White
 - ii. Grey
 - iii. Yellow
 - iv. Green
 - v. Refer to specifications and drawings for jack details and color assignments.

2.03 FIBER CONNECTIVITY

2.04 COAXIAL CONNECTIVITY

- A. Connectors shall be solderless, 75-Ohm impedance and be designed for the specific type of cable used.

- B. Series-6 connectors shall be one piece. Series-11 connectors shall use the cable's center conductor as the connector's center pin.
- C. All Series-6 and Series-11 connections shall be made with compression-type connectors.
- D. Screw-on connectors are not acceptable.
- E. The coaxial adapter module that occupies the faceplate shall be a 75-ohm, F-type connector and rated to pass band at 3GHz.
 - 1. Systemax or equivalent - F-Connector

2.05 FACEPLATES

A. Faceplates

- 1. The faceplate housing the connector modules shall have no visible mounting screws.
- 2. It shall be possible to install the connector modules in wall-mounted single- and dual-gang electrical boxes, utility poles and modular furniture (cubicle) access points using manufacturer-supplied faceplates and/or adapters.
- 3. The faceplate housing the connector modules shall have the option of being mounted on adapter boxes for surface mount installation.
- 4. The faceplate housing the connector modules shall have a labeling capability using built-in labeling windows, to facilitate outlet identification and ease network management.
- 5. The faceplate housing the connector modules shall provide flexibility in configuring multimedia workstation outlets that respond to present or future network needs such as audio, video, coaxial and optical fiber applications.
- 6. Color shall be same as electrical faceplates.
- 7. Systemax or equivalent - 4-port commercial single-gang faceplate, electrical white

2.06 SURFACE MOUNT BOXES

- A. The surface mount box shall accommodate connections of any type, UTP, optical fiber or coax.
- B. The surface mount box shall have internal storage space for slack cabling and a built-in spool for controlling cable bend radius.
- C. Color shall be same as electrical faceplates.
- D. Systemax or equivalent - 4-port commercial surface mount box, bright white

PART 3 - EXECUTION

3.01 COPPER CONNECTIVITY

- A. 8-position, 8-contact (8P8C) modular jacks shall be installed in accordance with manufacturer's recommendations and installation guides, and best industry practices.

- B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).
- C. Data jacks, unless otherwise noted in Drawings or fiber adapter modules are present, shall be located in the bottom position(s) of each faceplate. Data jacks in horizontally oriented faceplates shall occupy the right-most position(s).
- D. Voice jacks, unless otherwise noted in Drawings, shall occupy the top position(s) on the faceplate. Voice jacks in horizontally oriented faceplates shall occupy the left-most position(s).

3.02 OPTICAL FIBER CONNECTIVITY

- A. Optical fiber connectors shall be installed in accordance with manufacturer's recommendations and installation guides, and best industry practices.
- B. Fiber adapter modules, unless otherwise noted in Drawings, shall be located in the bottom position(s) of each faceplate. Fiber adapter modules in horizontally oriented faceplates shall occupy the right-most position(s).

3.03 COAXIAL CONNECTIVITY

- A. F-connectors shall be installed in accordance with manufacturer's recommendations and installation guides, and best industry practices.
- B. Cable preparation and connector application shall be done only with tools approved for use with the connector.

3.04 FACEPLATES

- A. Blank inserts shall be installed where ports are not used.
- B. The same orientation and positioning of jacks and connectors shall be utilized through out the installation.
- C. Faceplates shall be installed straight and level.
- D. Faceplates shall be installed at the same heights as electrical faceplates.

3.05 SURFACE MOUNT BOXES

- A. Blank inserts shall be installed where ports are not used.
- B. The same orientation and positioning of jacks and connectors shall be utilized through out the installation.
- C. Surface mount boxes shall be installed straight and level.
- D. Surface mount shall be installed at heights as electrical receptacles.

3.06 IDENTIFICATION

- A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION 271543

SECTION 271619 - COMMUNICATIONS PATCH CORDS AND WORKSTATION CORDS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Applicable requirements of Division 27 - Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Communications Patch Cords and Workstation Cords.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. The successful vendor shall meet or exceed all requirements described in this document and on the drawings.

1.02 SUBMITTALS

- A. Provide product data from manufacturer's specifications.
- B. NOTE: Manufacturer must provide qualifying letter to ensure compliance with the Federal Transit Administration's (FTA) Buy-America Requirements found in 49 CFR Part 661.

1.03 WORK INCLUDED

- A. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

PART 2 - PRODUCTS

2.01 APPROVED PRODUCTS

- A. Approved Copper Patch Cord/Workstation Cord Manufacturer(s)
 - 1. Shall match cable manufacturer.
- B. Approved Fiber Patch Cord/Workstation Cord Manufacturer(s)
 - 1. Shall match cable manufacturer.

2.02 COPPER PATCH CORDS/WORKSTATION CORDS

A. Category 6 Patch Cords/Workstation Cords

1. The Category 6 patch cord/workstation cord shall be 4-pair, with 24 AWG solid or stranded copper conductors and 8-position modular plug.
2. The Category 6 modular cord cable shall be UL Listed as Type CMR.
3. The Category 6 patch cord/workstation cord shall meet or exceed the requirements of ANSI/TIA-568-C.2.
 - a. The Category 6 patch cord/workstation cord color for voice shall be: White
 - b. The Category 6 patch cord/workstation cord color for data shall be: Blue
4. Cat 6 white patch cord, with boot, PCSIXxxB05 - Cat 6 blue patch cord, with boot xx is length in feet (03, 05, 07, 10, 14, 20)

2.03 FIBER PATCH CORDS / WORKSTATION CORDS

A. Single mode Fiber Patch Cords

1. 8.3/125-micron single-mode fiber patch cord:
 - a. The 8.3/125-micron fiber used in the single-mode fiber patch cord shall have a maximum attenuation of 1.0 dB/km @ 1310 nm and 1.0 dB/km @ 1550 nm.
 - b. The optical fiber cord connector shall have a maximum insertion loss of 0.5 dB and a reflectance of -30 dB.
 - c. The 8.3/125-micron single-mode fiber patch cord/station cord shall meet or exceed the requirements of ANSI/TIA-568-C.3.
 - d. The optical fiber cord connector shall be Not Applicable.
 - e. The single-mode fiber patch cord assembly shall be dual zip jacketed.
 - f. Angle polish connectors shall be used for video distribution.

PART 3 - EXECUTION

3.01 COPPER PATCH CORDS/WORKSTATION CORDS

- A. Copper patch cords/workstation cords shall be installed as per the requirements specified by the manufacturer's installation guidelines.

3.02 FIBER PATCH CORDS/WORKSTATION CORDS

- A. Fiber patch cords/workstation cords shall be installed as per the requirements specified by the manufacturer's installation guidelines.

3.03 IDENTIFICATION

- A. Refer to Section 27 05 53 - Identification for Communications Systems for labeling details.

END OF SECTION 271619