

# Attachment II

## AET Standard Drawings

# NORTH CAROLINA TURNPIKE AUTHORITY

## AET STANDARD DRAWINGS

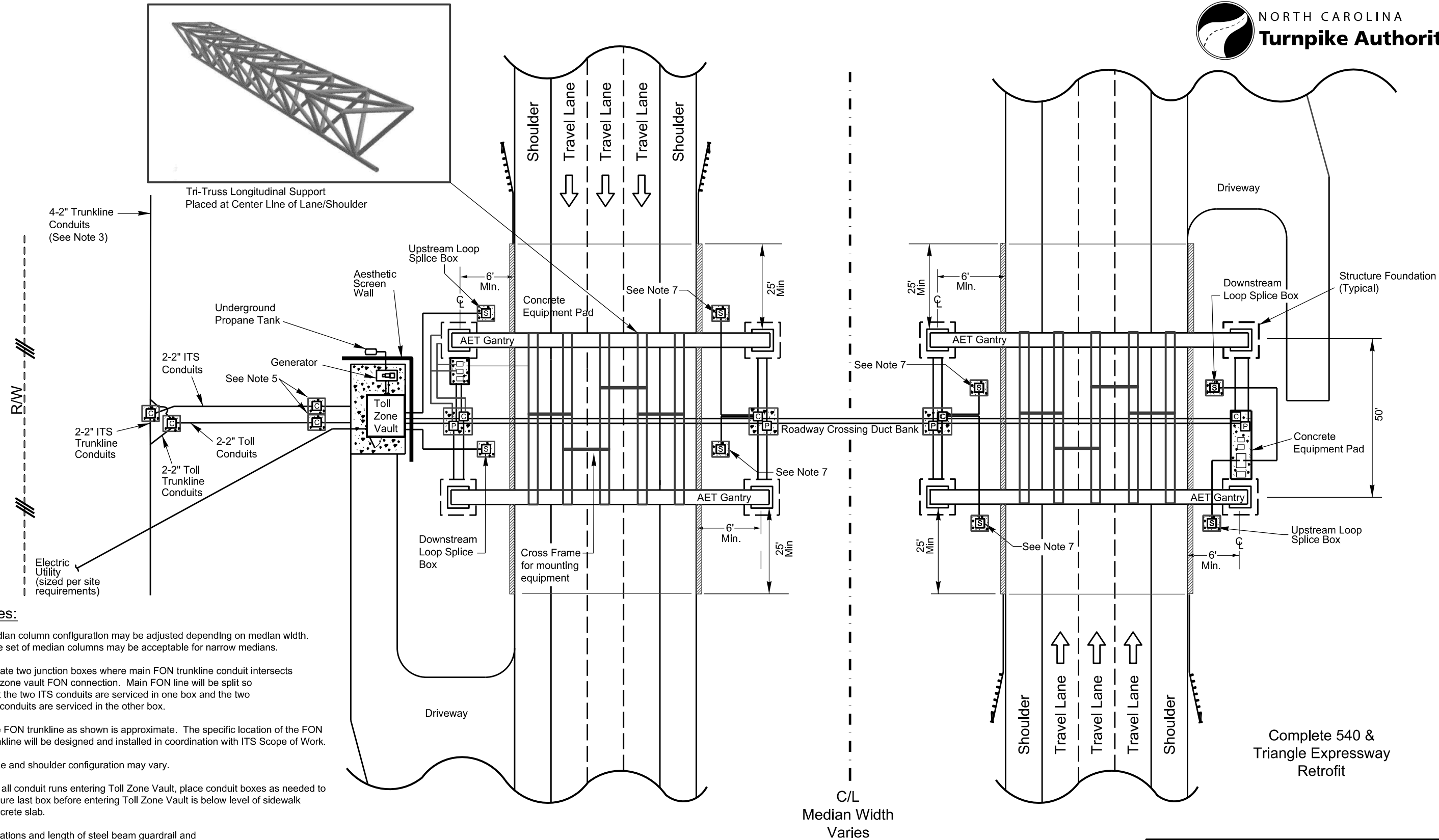
**Typical All-Electronic Tolling (AET) Toll Zone Guidelines**

- C-1 Typical Mainline AET Toll Zone Plan View
- C-2 Typical Ramp AET Toll Zone Plan View
- C-3 Typical 2-Lane, 2-Way AET Toll Zone Plan View
- C-4 AET Toll Zone Access
- C-5 Typical Mainline/Ramp Loop and Joint Locations Detail for Pavement
- C-6 Typical 2-Lane, 2-Way Loop and Joint Locations Detail for Pavement
- A-1 AET Toll Zone Vault Plan
- A-2 AET Toll Zone Vault Elevations
- A-3 Typical AET Toll Zone Gantry Elevations
- A-4 Typical AET Toll Zone Gantry Side Elevation
- A-5 Typical Express Lane Toll Zone Elevation
- E-1 Typical Mainline AET Toll Zone Conduit Detail
- E-2 Typical Ramp AET Toll Zone Conduit Detail
- E-3 Typical 2-Lane, 2-Way AET Toll Zone Conduit Detail
- E-4 AET Toll Zone Cabinets with Concrete Pads
- E-4a Express Lane Toll Zone Cabinets with Concrete Pads
- E-5 Toll Zone Vault Electrical Plan
- E-6 Toll Zone Vault Conduit Plan
- E-7 Typical Express Lane Toll Site Plan View
- R-1 Revisions

**Abbreviations**

- AET - All-Electronic Tolling
- AVC - Automatic Vehicle Classification
- AVI - Automatic Vehicle Identification
- C - Conduit
- C/L - Centerline
- DMS - Dynamic Message Sign
- EOP - Edge of Pavement
- EQ - Equal Distance
- FON - Fiber Optic Network
  - (includes conduit, fiber, boxes, etc.)
- ITS - Intelligent Transportation Systems
- LPS - Lightning Protection System
- NEC - National Electrical Code
- NFPA - National Fire Protection Association
- R/W - Right-of-Way
- SOW - Scope of Work
- SPD - Surge Protection Device
- TYP - Typical
- UL - Underwriters Laboratories
- UPS - Uninterruptable Power Supply












**Notes:**

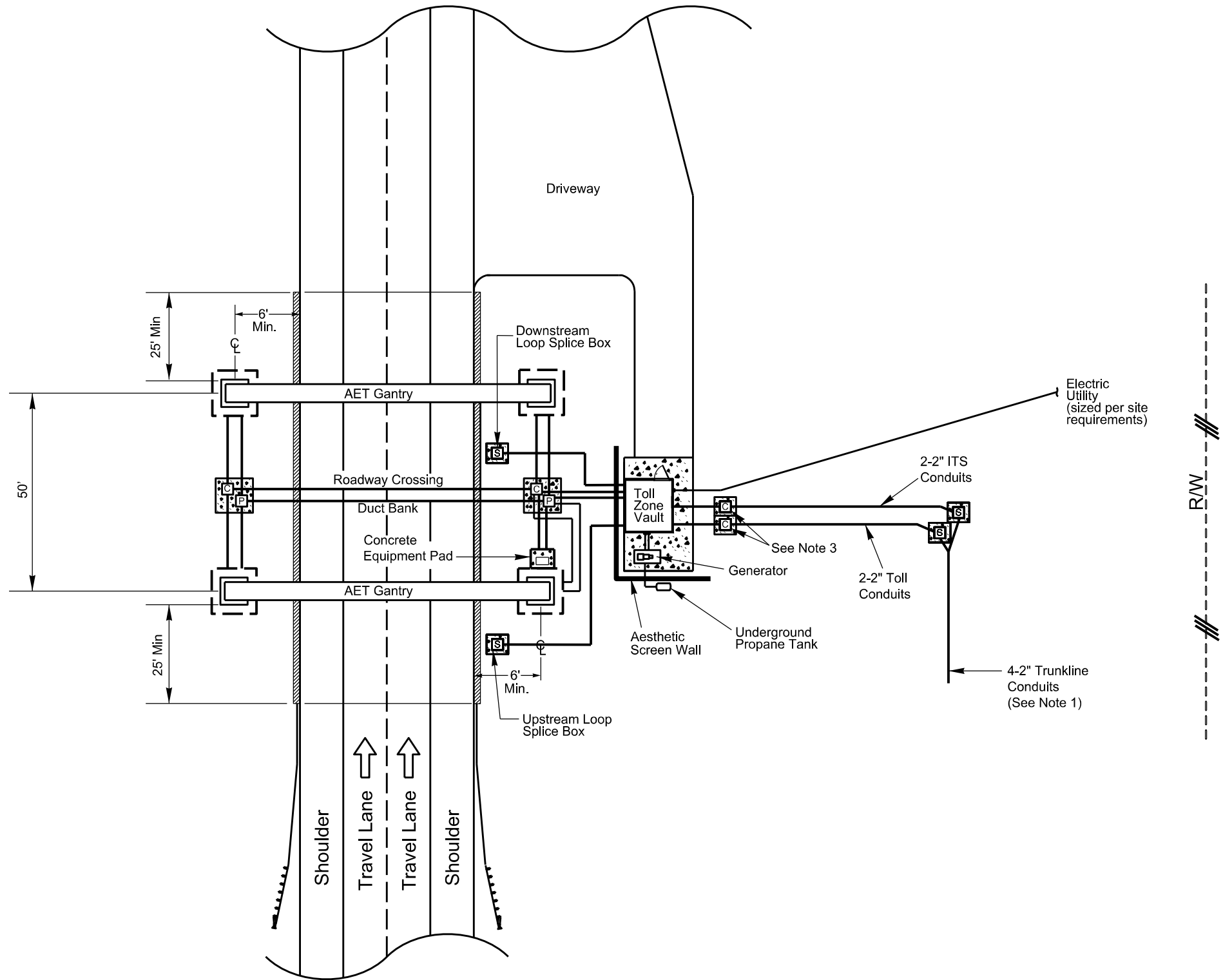
- Median column configuration may be adjusted depending on median width. One set of median columns may be acceptable for narrow medians.
- Locate two junction boxes where main FON trunkline conduit intersects toll zone vault FON connection. Main FON line will be split so that the two ITS conduits are serviced in one box and the two toll conduits are serviced in the other box.
- The FON trunkline as shown is approximate. The specific location of the FON trunkline will be designed and installed in coordination with ITS Scope of Work.
- Lane and shoulder configuration may vary.
- For all conduit runs entering Toll Zone Vault, place conduit boxes as needed to ensure last box before entering Toll Zone Vault is below level of sidewalk concrete slab.
- Locations and length of steel beam guardrail and location of end terminals shall be determined during design in accordance with AASHTO roadside safety design guidelines and NCDOT standards.
- For mainline segments with 4 or more tolled travel lanes in each direction, install additional loop splice boxes in median.
- Anchor Barrier Wall on top of pavement edge by installing dowel bars tied into every other vertical reinforcing bar of the Barrier Wall.
- Provide concrete aprons for all junction boxes as per the ITS and AET Scope of Work.

**Legend**

- |   |  |
|---|--|
|  - Communications Junction Box                 |  - Guardrail                    |
|  - Power Junction Box                          |  - Guardrail with doubled posts |
|  - Loop Splice Box                             |  - Structure Foundation         |
|  - Box with 18" concrete apron; 1" above grade |  |

Complete 540 &  
Triangle Expressway  
Retrofit

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NORTH CAROLINA TURNPIKE AUTHORITY AET STANDARD DRAWINGS Typical Mainline AET Toll Zone Plan View		
SCALE: N.T.S.	NORTH CAROLINA TURNPIKE AUTHORITY	SHEET NO. <b>C-1</b>
Rev. Sept 2017		



Notes:


1. The FON trunkline as shown is approximate. The specific location of the FON trunkline will be designed and installed in coordination with ITS Scope of Work.
2. Lane and shoulder configuration may vary.
3. For all conduit runs entering Toll Zone Vault, place conduit boxes as needed to ensure last box before entering Toll Zone Vault is below level of sidewalk concrete slab.
4. Locations and length of steel beam guardrail and location of end terminals shall be determined during design in accordance with AASHTO roadside safety design guidelines and NCDOT standards.
5. Anchor Barrier Wall on top of pavement edge by installing dowel bars tied into every other vertical reinforcing bar of the Barrier Wall.
6. Provide concrete aprons for all junction boxes as per the ITS and AET Scope of Work.


Legend


- C


- Communications Junction Box
- P

- Power Junction Box
- S

- Loop Splice Box
- 

- Box with 18" concrete apron; 1" above grade
- 

- Guardrail
- 

- Guardrail with doubled posts
- 

- Structure Foundation

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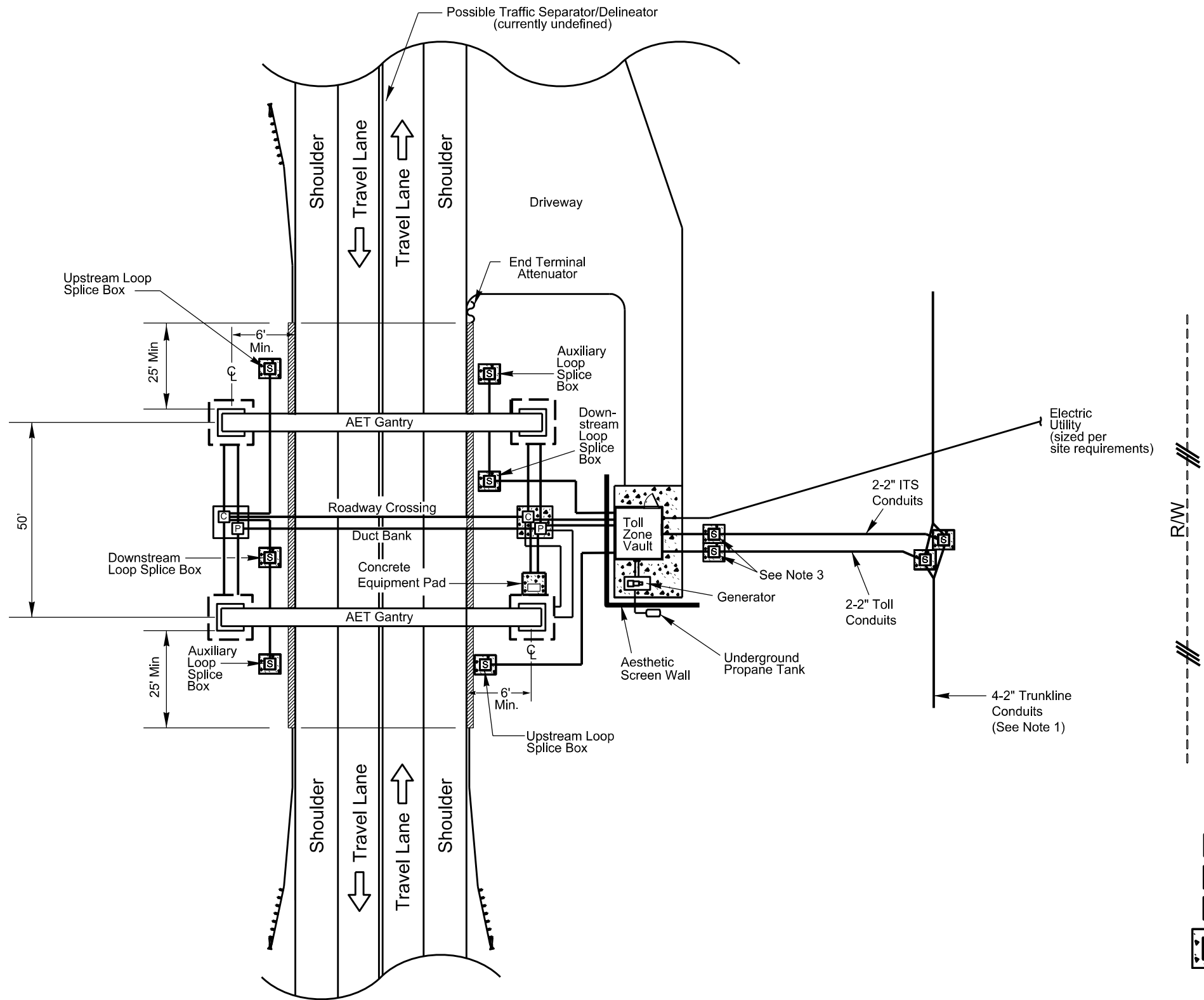
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AET STANDARD DRAWINGS

Typical Ramp AET Toll Zone Plan View

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NORTH CAROLINA  
TURNPIKE AUTHORITY

SHEET NO.  
C-2



Notes:

1. The FON trunkline as shown is approximate. The specific location of the FON trunkline will be designed and installed in coordination with ITS Scope of Work.
2. Lane and shoulder configuration may vary.
3. For all conduit runs entering Toll Zone Vault, place conduit boxes as needed to ensure last box before entering Toll Zone Vault is below level of sidewalk concrete slab.
4. Locations and length of steel beam guardrail and location of end terminals shall be determined during design in accordance with AASHTO roadside safety design guidelines and NCDOT standards.
5. Place Toll Zone Vault on side of road that allows for future expansion.
6. Anchor Barrier Wall on top of pavement edge by installing dowel bars tied into every other vertical reinforcing bar of the Barrier Wall.
7. Provide concrete aprons for all junction boxes as per the ITS and AET Scope of Work.

Legend

- C

 - Communications Junction Box
- P

 - Power Junction Box
- S

 - Loop Splice Box
- [Box with 18" concrete apron: 1" above grade]

 - Box with 18" concrete apron: 1" above grade
- [Guardrail symbol]

 - Guardrail
- [Guardrail with doubled posts symbol]

 - Guardrail with doubled posts
- [Structure Foundation symbol]

 - Structure Foundation

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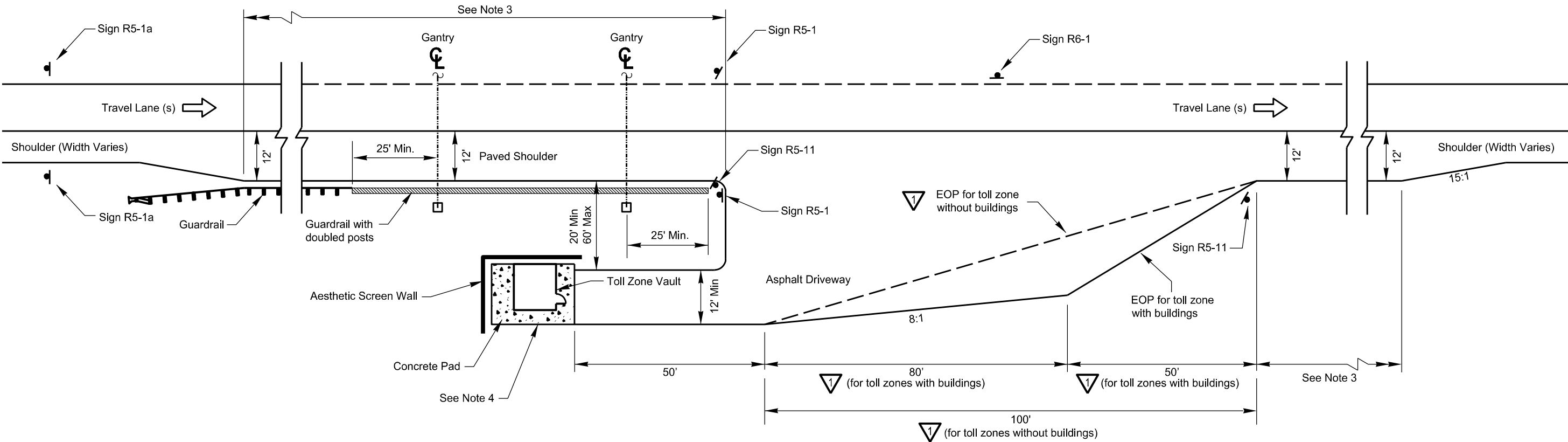
NORTH CAROLINA TURNPIKE AUTHORITY  
AET STANDARD DRAWINGS

Typical 2-Lane, 2-Way AET Toll Zone Plan View

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Signing Notes:

1. Signing applies to AET Toll Zones with and without buildings.
2. Signing applies to both mainline and ramp AET Toll Zones.
3. Sign spacing shall be in accordance with NCDOT and MUTCD standards.
4. Sign sizes shall be in accordance with MUTCD Table 2B-1.
5. U-channel support design shall be in accordance with NCDOT standards.



Access and Signing Detail for AET Facility

Sign Key

Not to Scale

Notes:

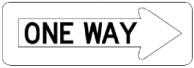
1. AET Toll Zone Vault and concrete pad may vary in size.
2. Locations and length of steel beam guardrail and location of end terminals shall be determined during design in accordance with AASHTO roadside safety design guidelines and NCDOT standards.
3. Acceleration and deceleration lengths shall be determined based on the design criteria included in the Roadway Scope of Work.
4. Center Toll Zone Vault between gantries.
5. Provide driveway whether vault is present or not.



R5 - 1



R5 - 1 a



R6 - 1



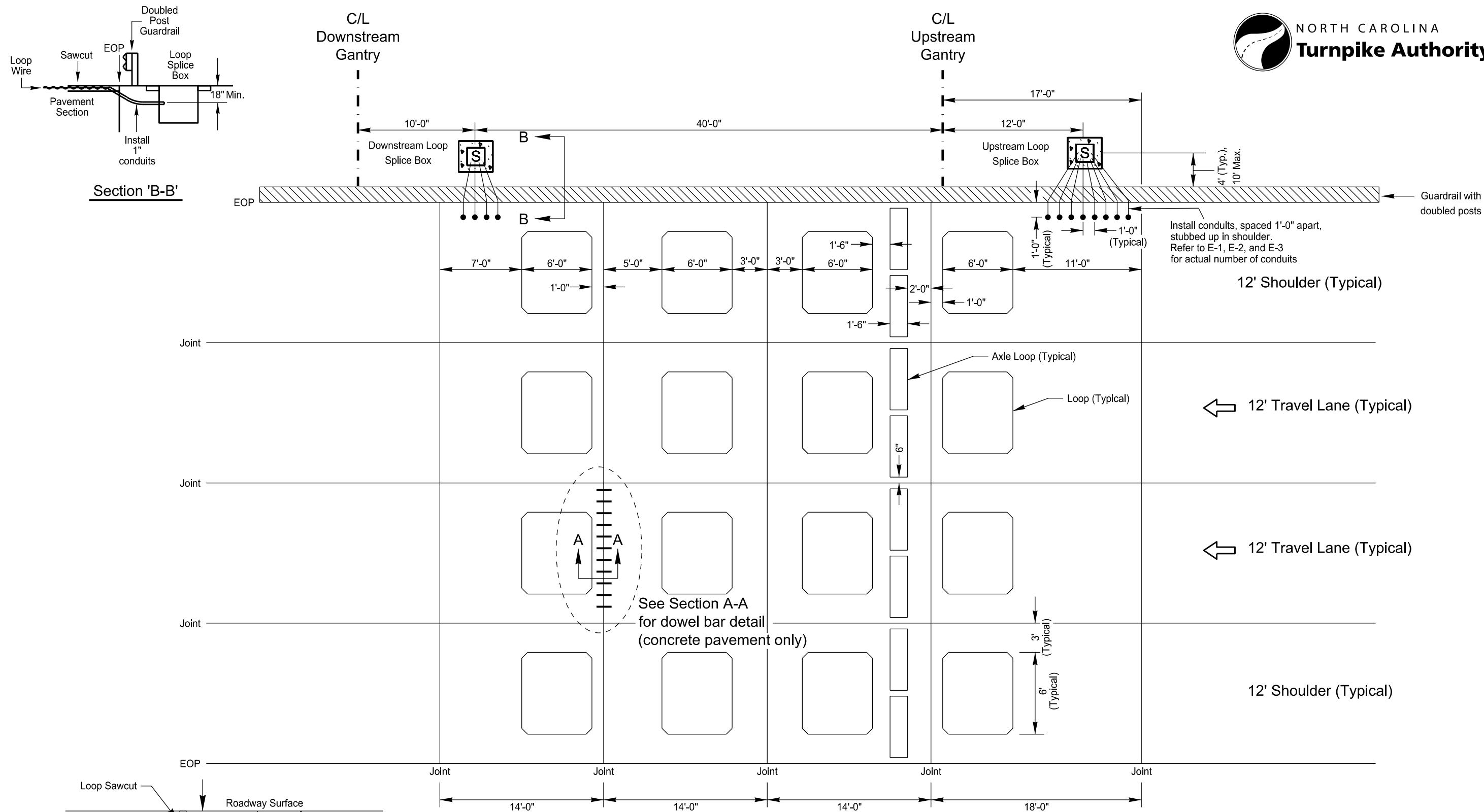
R5 - 11



Ground-mounted sign on U-channel support(s)

Revised 4/21/2015

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NORTH CAROLINA TURNPIKE AUTHORITY AET STANDARD DRAWINGS AET Toll Zone Access & Signing		
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INFORMATION NOT YET AVAILABLE

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<div>NORTH CAROLINA TURNPIKE AUTHORITY AET STANDARD DRAWINGS Typical 2-Lane, 2-Way Loop and Joint Locations Detail for Pavement</div>		
SCALE:	N.T.S.	<div>NORTH CAROLINA TURNPIKE AUTHORITY</div> <div>SHEET NO.  C-6</div>



GENERAL NOTES:

1. See Scope of Work for additional details and requirements.
2. Provide prefabricated, pre-cast or built-in-place vault with R-24 insulation, per State building codes.
3. Provide 3/4" chamfered edge on maintenance pad.
4. Field-adjust exterior cabinets/boxes as needed for local conditions, wire size, etc.

VAULT PLAN - ELECTRICAL:

1. Provide SPD on all distribution panels.
2. Locate conduit stub-ups a maximum of 12" from interior wall surface.
3. Provide integral safety disconnect on HVAC unit.

LIGHTING SYSTEM:

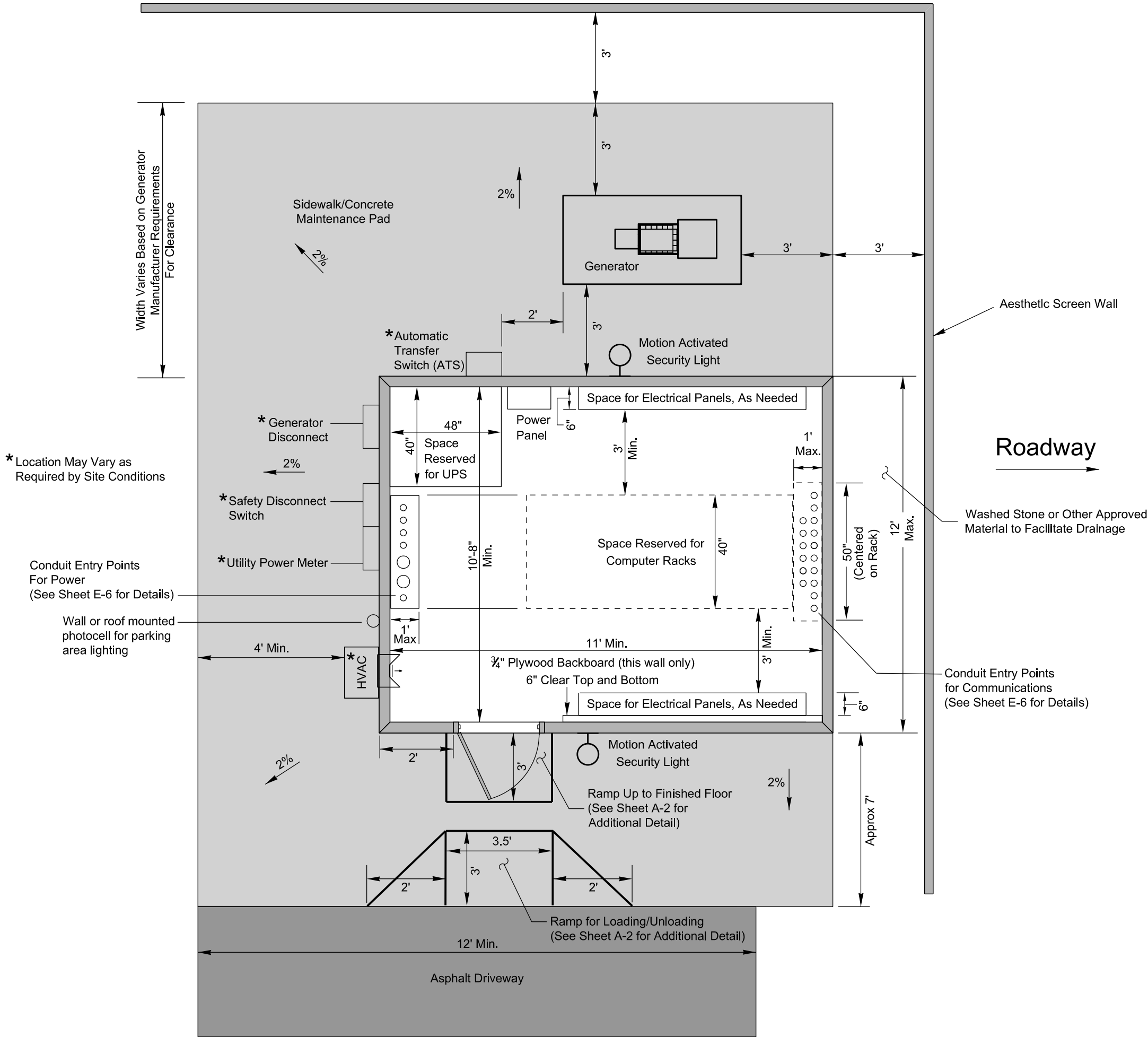
1. Provide lighting system with battery backup for power loss capable of maintaining one interior light fixture for 30 minutes minimum.

SECURITY SYSTEM:

1. Provide conduit and electrical boxes to support the electronic door security system to be installed by the Toll System Integrator.

CONDUIT SYSTEM:

1. Contractor may choose to place conduit entrances in side of building rather than up through floor.



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AET STANDARD DRAWINGS

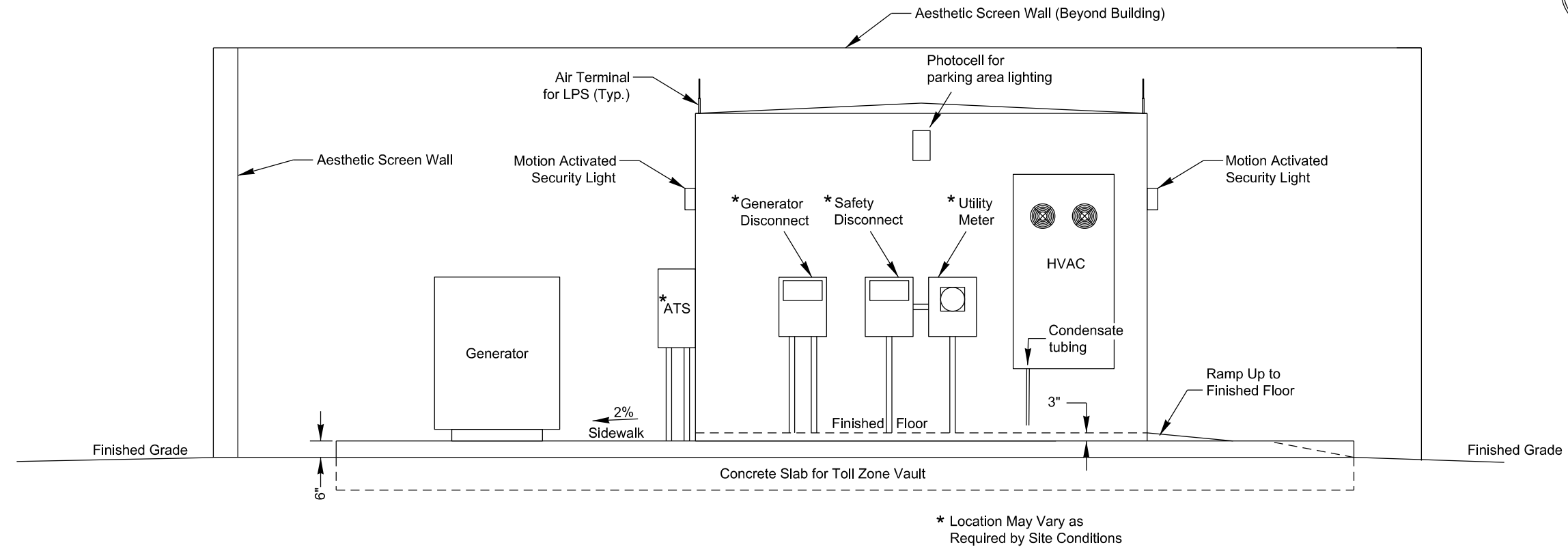
AET Toll Zone Vault Plan

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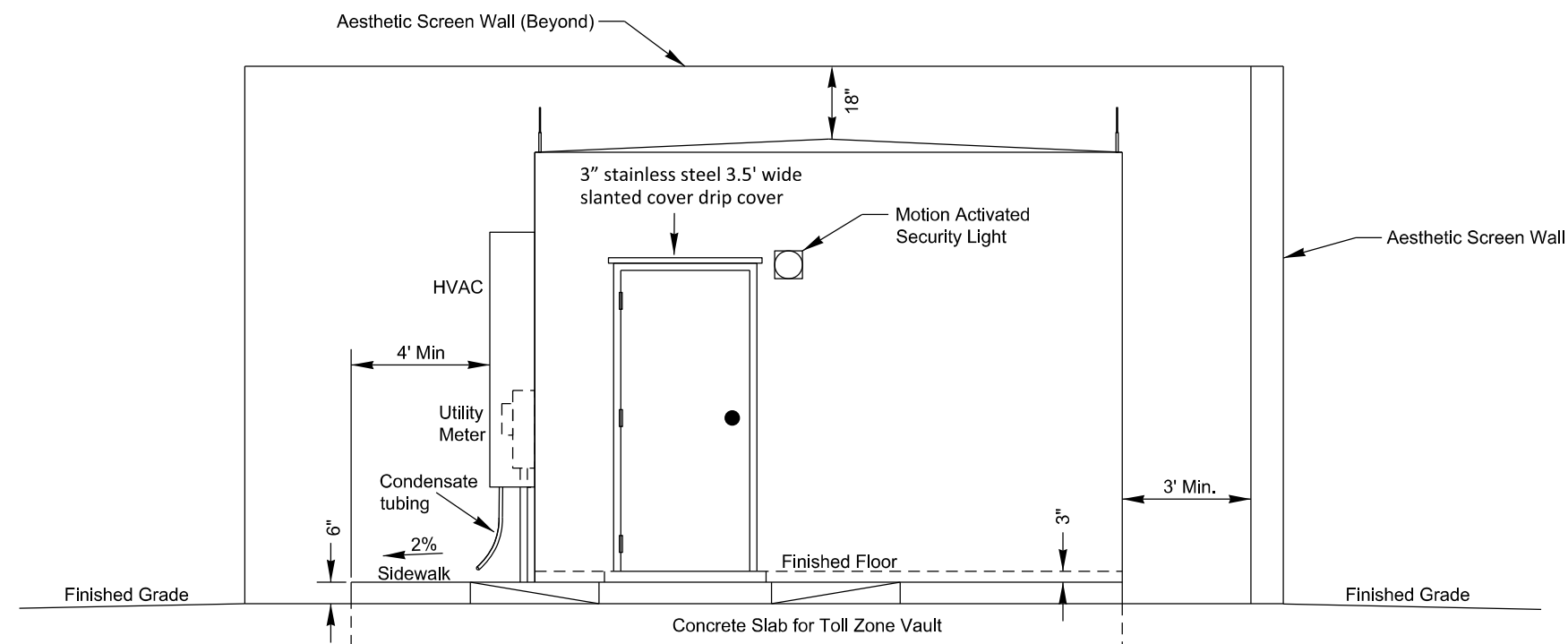
NORTH CAROLINA  
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SHEET NO.

A-1

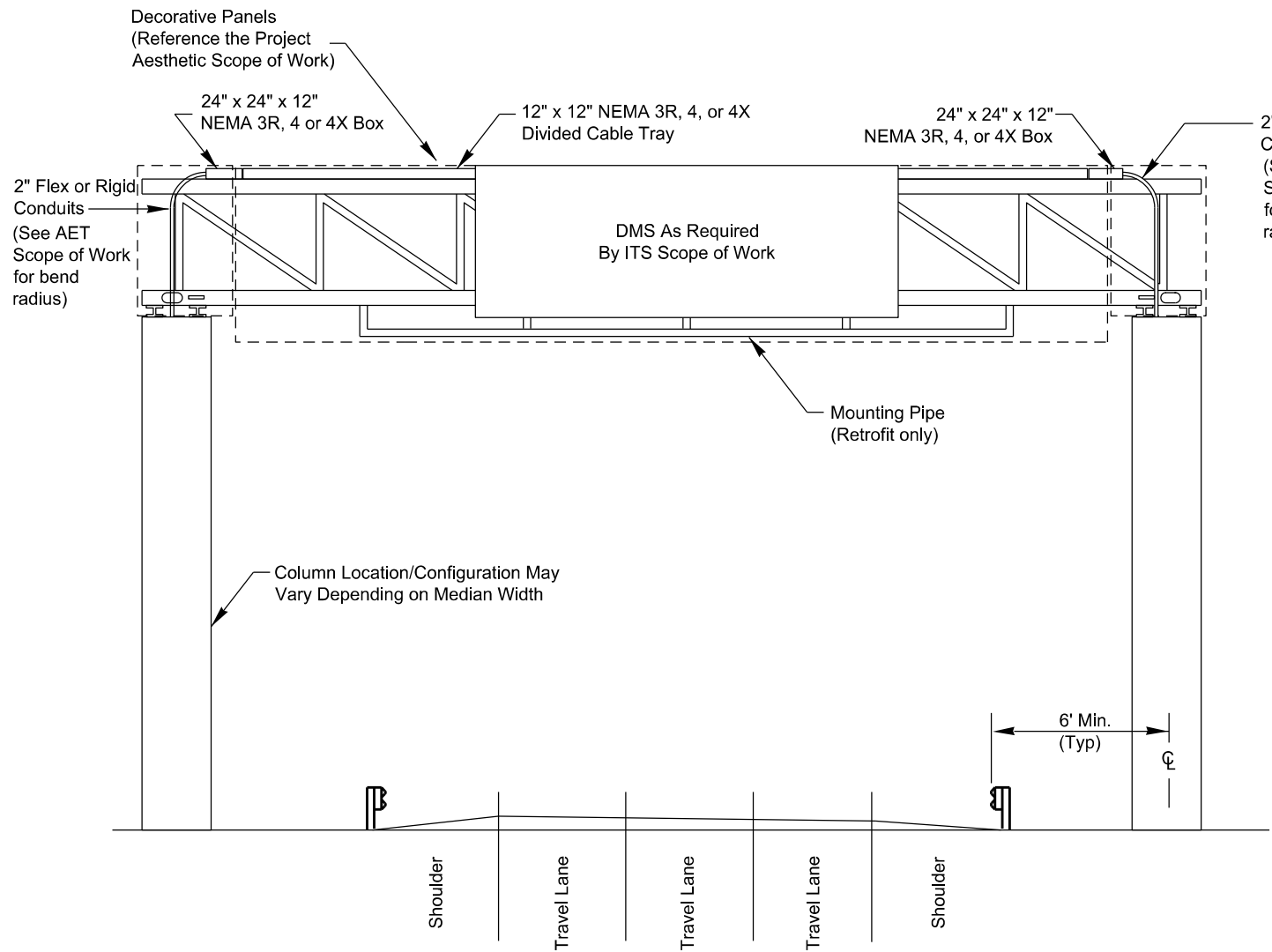


**Side Elevation**  
Not to Scale



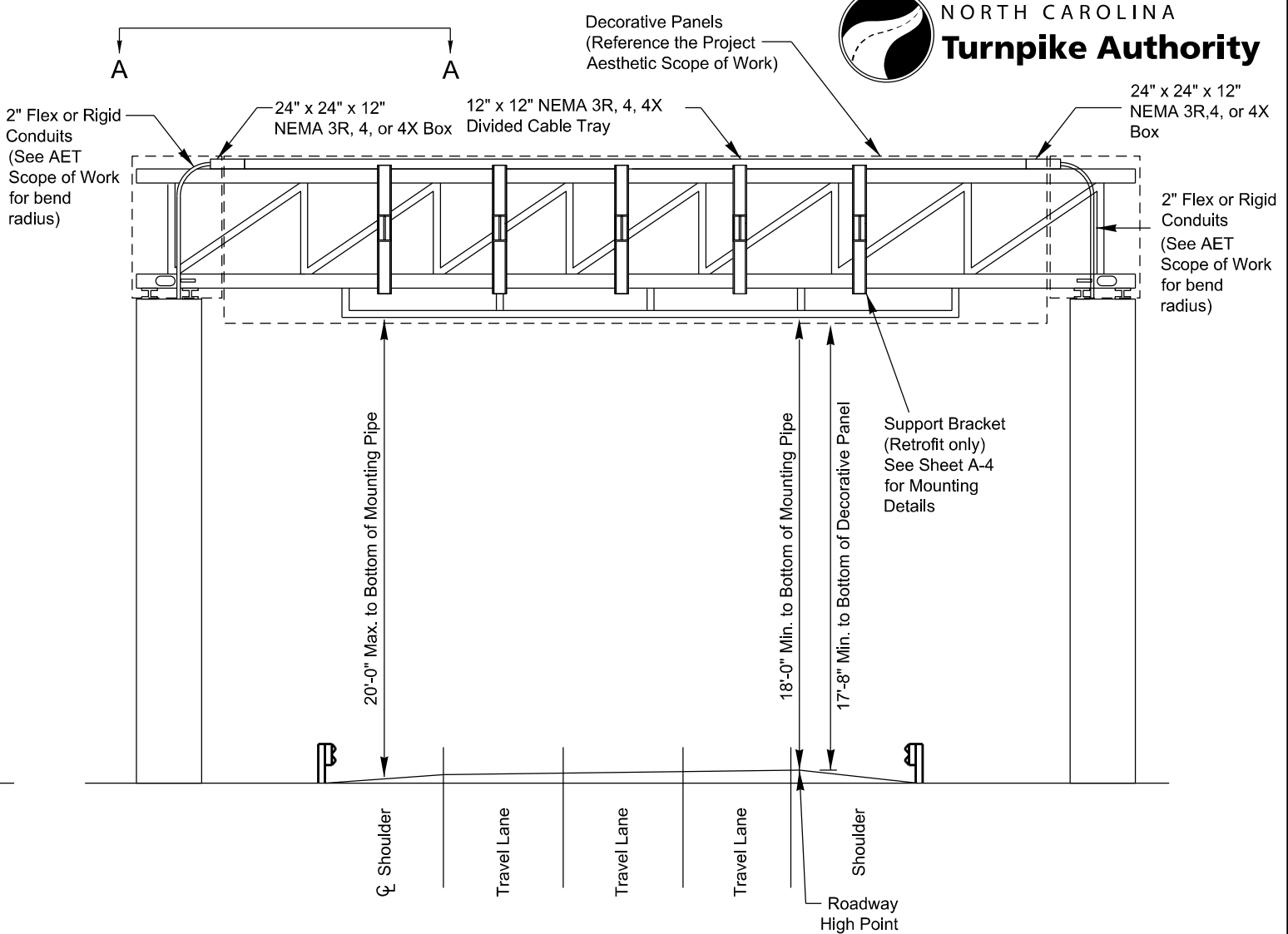
**Front Elevation**  
Not to Scale

<b>ATKINS</b> 1616 EAST MILLBROOK ROAD, SUITE 310 RALEIGH, NORTH CAROLINA 27609 (919) 876-6888 NCBEES #F-0326	<p>NORTH CAROLINA TURNPIKE AUTHORITY AET STANDARD DRAWINGS AET Toll Zone Vault Elevations</p>	
SCALE: N.T.S. Rev. Oct 2014	NORTH CAROLINA TURNPIKE AUTHORITY	SHEET NO. <b>A-2</b>



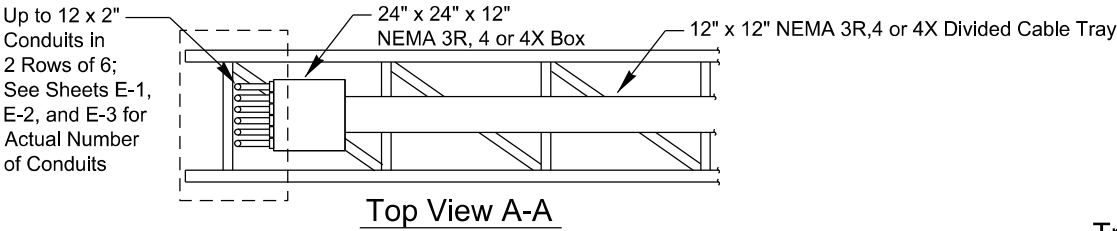
Upstream Mainline Gantry Front Elevation

Not to Scale



Upstream Mainline Gantry Rear Elevation

Not to Scale

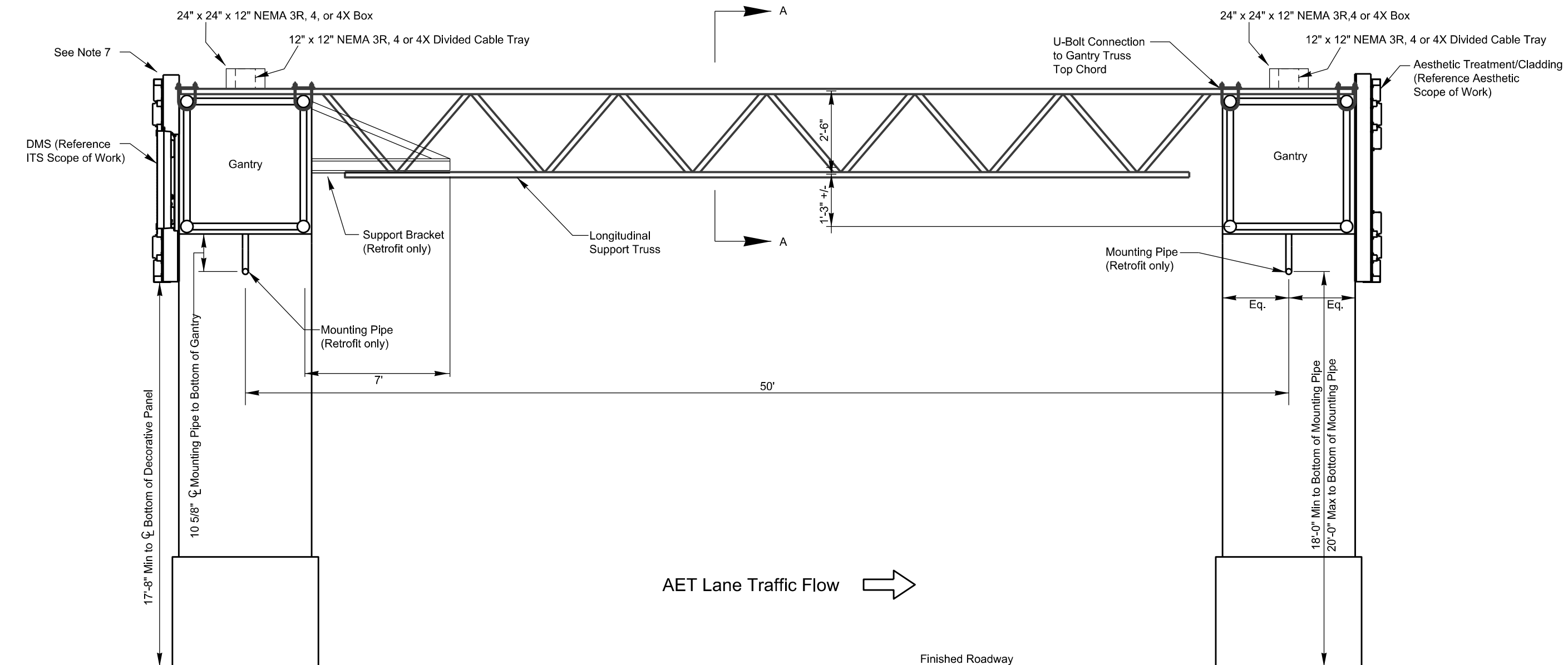


Notes:

1. Downstream gantry is similar but without DMS and Support Bracket.
2. Number of travel lanes may vary.
3. Mounting pipes are horizontal.

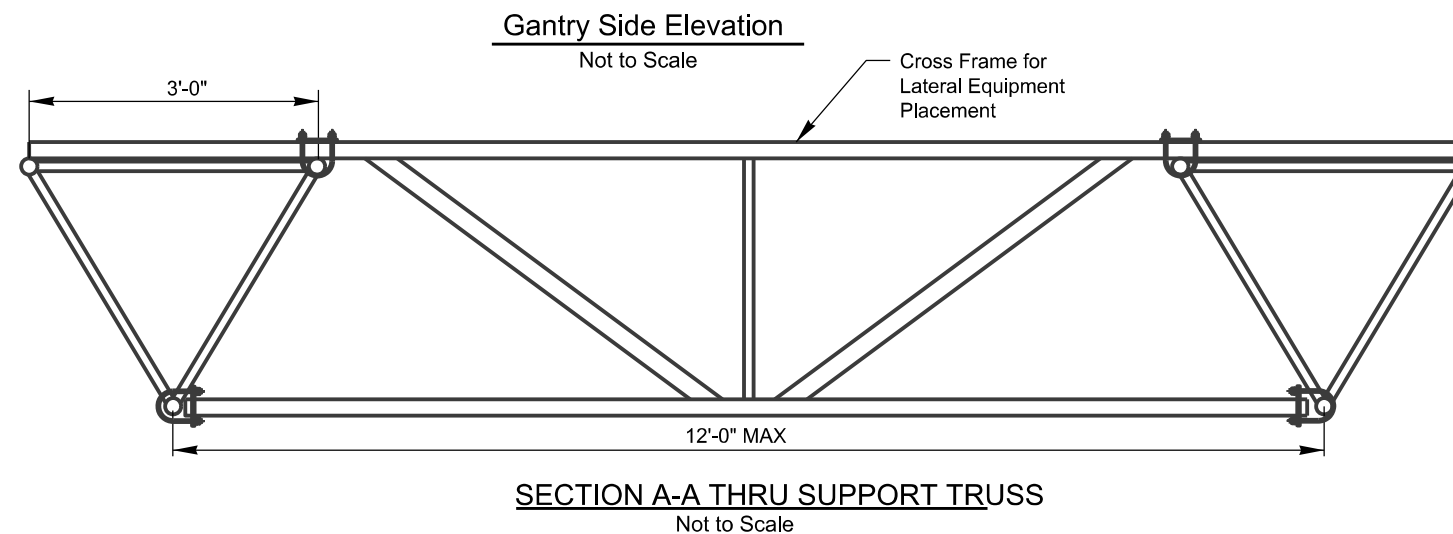
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NORTH CAROLINA TURNPIKE AUTHORITY AET STANDARD DRAWINGS Typical AET Toll Zone Gantry Elevations		
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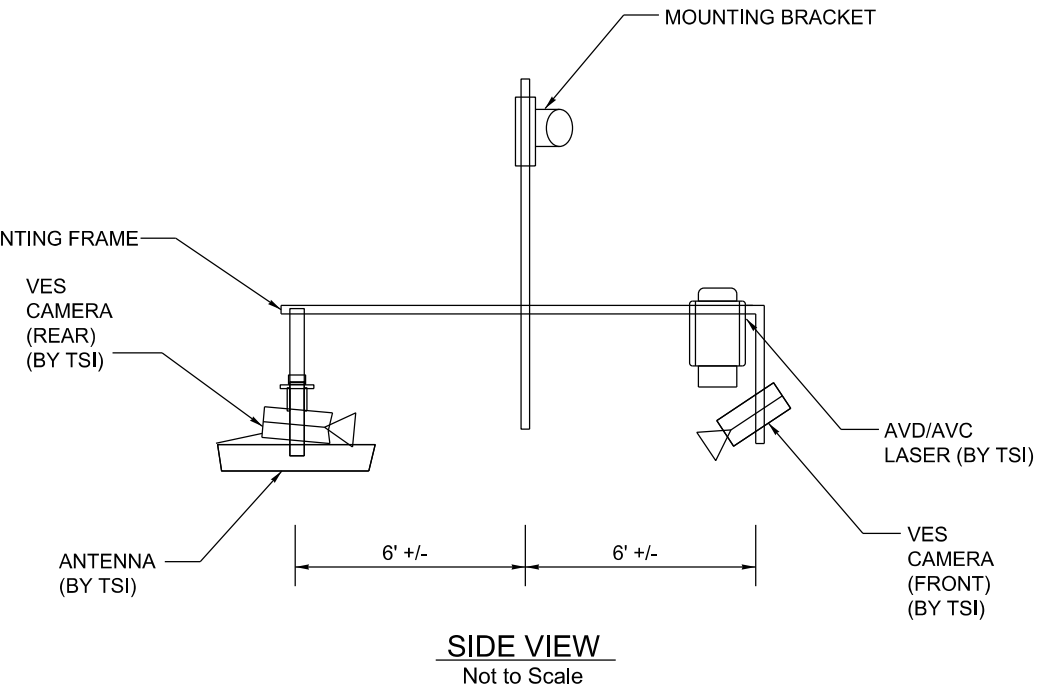
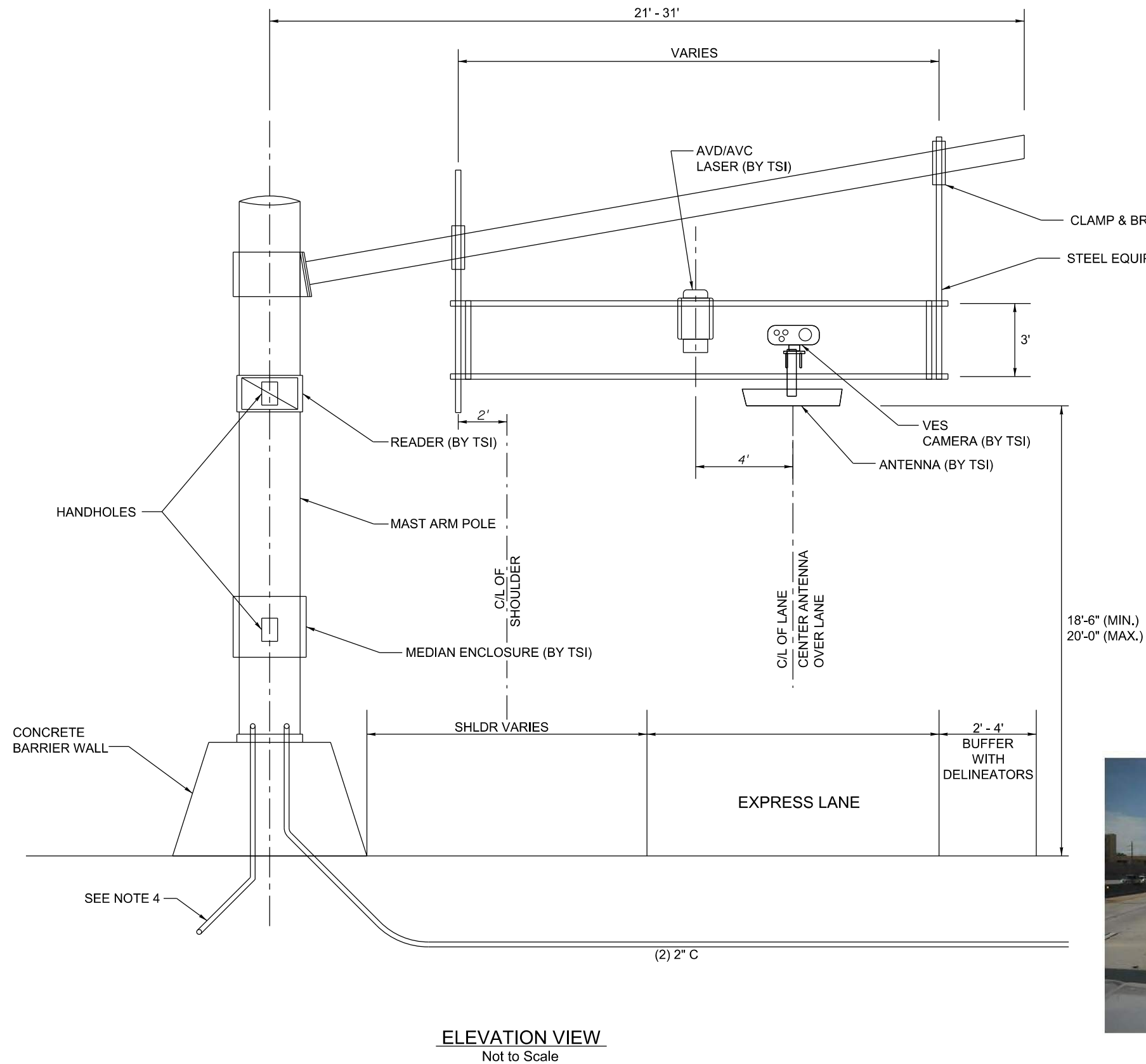
Notes:

- All mounting heights are to the centerline of the mounting pipe.
- Heights are typical for both gantries.
- Install DMS per the ITS Scope of Work.
- Mounting pipes:  
Camera/Antenna - 2" Rigid Galvanized Pipe.  
AVC/Profiler - 3" Rigid Galvanized Pipe (if mounting pipe is used)
- Divided cable tray shall be watertight (NEMA 3R) and grounded on both ends per NEC.
- All conduit from the divided cable tray to the top of the columns shall be concealed behind cladding or earwalls. (See Aesthetic Scope of Work for cladding details).
- Top of gantry aesthetic treatment shall be higher than top of cable tray and watertight box.



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<div> <div>NORTH CAROLINA TURNPIKE AUTHORITY</div> <div>AET STANDARD DRAWINGS</div> <div>Typical AET Toll Zone Gantry Side Elevation</div> </div>		
<div>SCALE: N.T.S.</div> <div>Rev. Sept. 2017</div>	<div>NORTH CAROLINA TURNPIKE AUTHORITY</div>	<div>SHEET NO.</div> <div>A-4</div>




- NOTES:**
- Equipment mounting bracket and assembly shall be fabricated with suitable corrosion resistant components.
  - Complete assembly shall be designed for equipment and wind loads and signed and sealed by a professional engineer licensed in North Carolina.
  - This is a typical Express Lane site. Width of median, median shoulder and buffer may vary. Median treatment may be different.
  - Lightning protection ground are NFPA 780.



DELINEATORS EXAMPLE

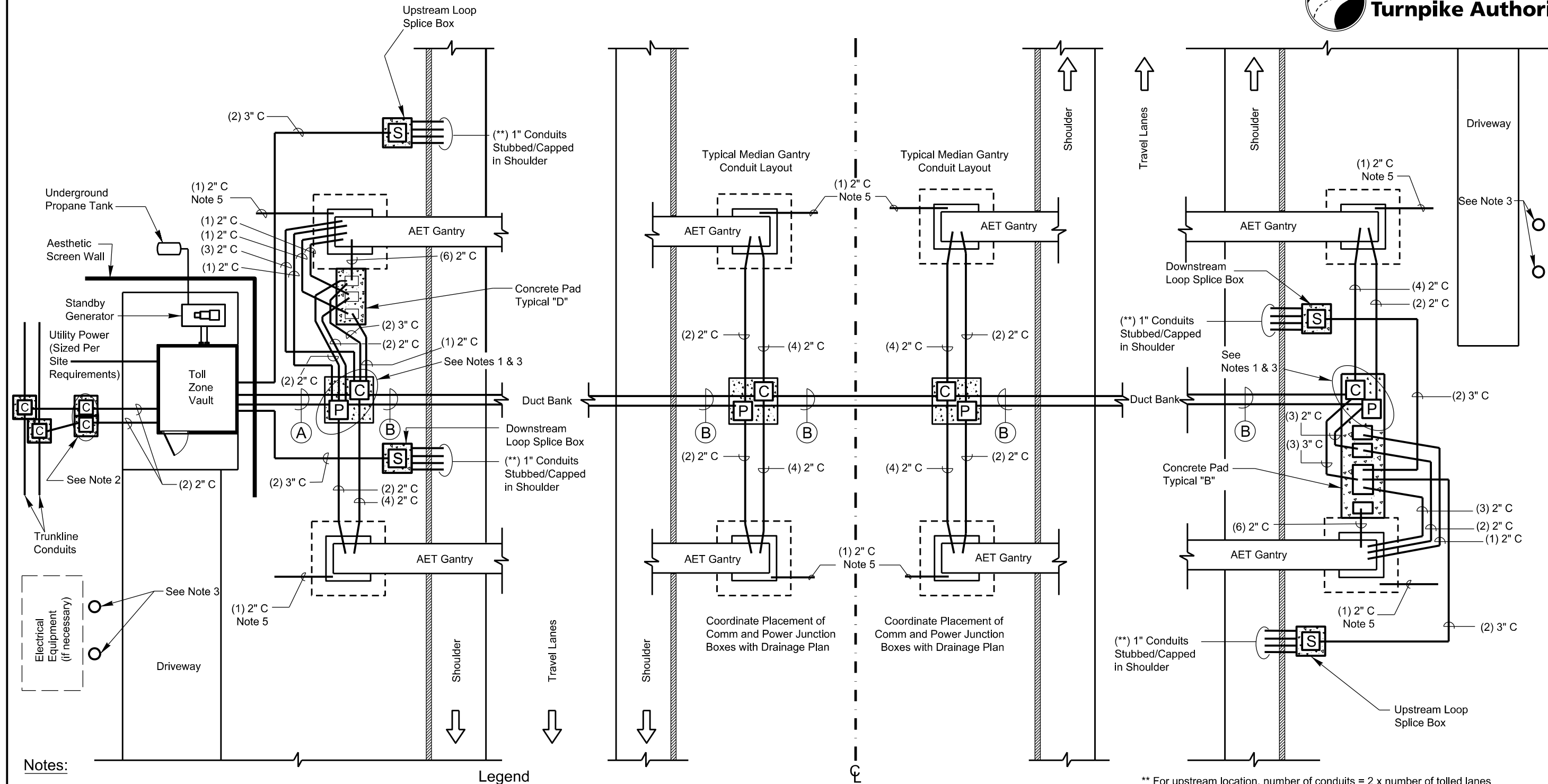
TSI: TOLL SYSTEM INTEGRATOR



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AET STANDARD DRAWINGS  
Typical Express Lanes Toll Zone Elevation




SCALE:	N.T.S.	NORTH CAROLINA TURNPIKE AUTHORITY	SHEET NO.  <b>A-5</b>



**Notes:**

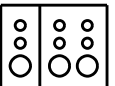
1. Size junction boxes to fit conduit needs.
2. For all conduit runs entering Toll Zone Vault, place conduit boxes as needed to ensure last box before entering Toll Zone Vault is below level of sidewalk concrete slab.
3. Protect electrical equipment installed adjacent to driveway with concrete bollards.
4. Provide concrete aprons for all junction boxes as per the ITS and AET Scope of Work.
5. Provide 2" conduit for Lightning Protection System grounding.
6. Provide drains for loop boxes as directed by the Engineer.

**Legend**

- C** - Communications Junction Box (36" x 24" x 24" Min)  
**P** - Power Junction Box (30" x 17" x 24" Min)  
**S** - Loop Splice Box (36" x 17" x 30" Min)  
 - Box with 18" concrete apron, 1" above grade  
2" C - Designates 2" Conduit  
3" C - Designates 3" Conduit  
4" C - Designates 4" Conduit  
(#) - Designates Quantity  
 - Structure Foundation  
 - Guardrail with doubled posts

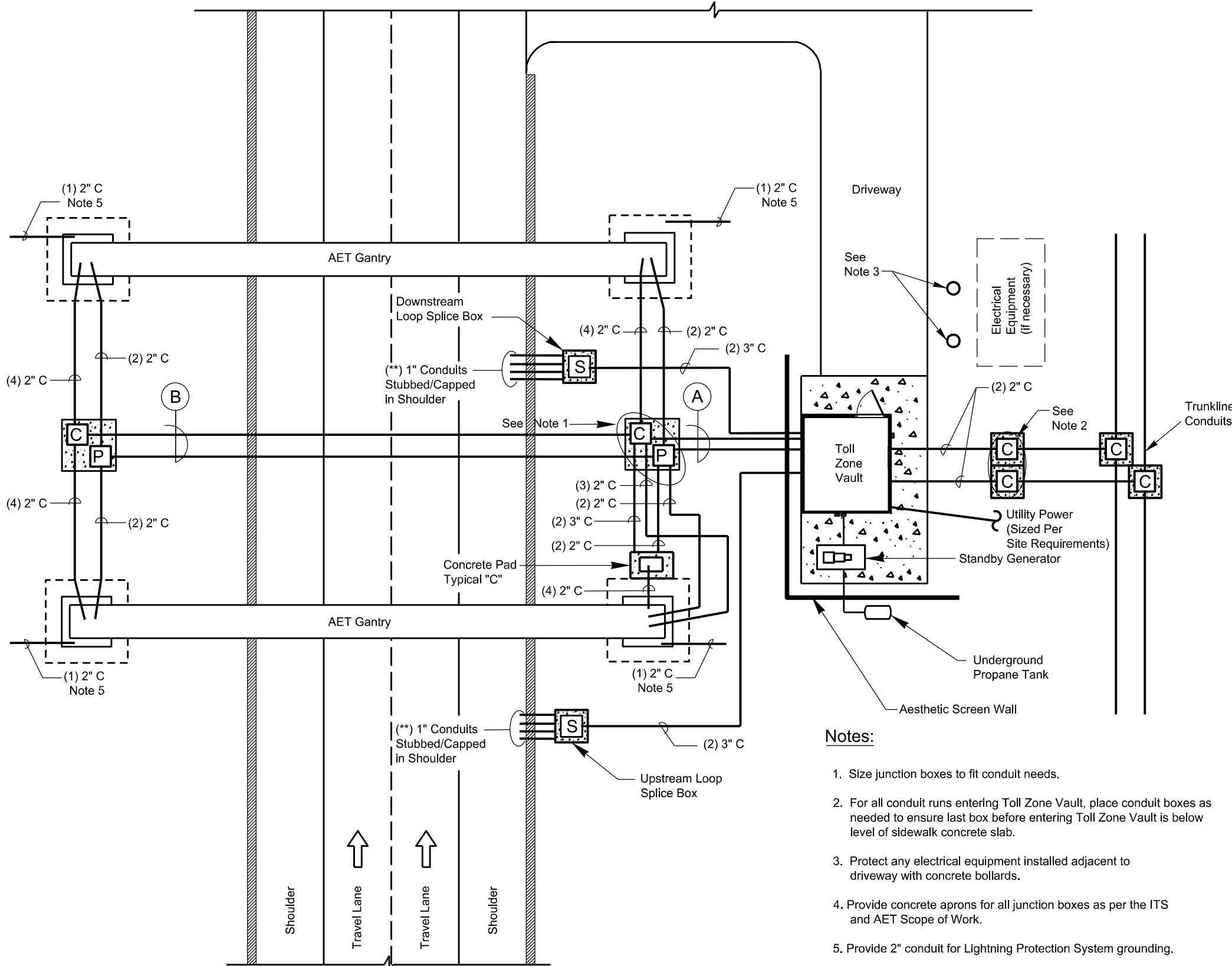
**Median Width Varies**

- (A) Conduit from Last Box to Vault**  
Communications:  
(7) - 2" Conduits  
(2) - 4" Conduits  
Power:  
(4) - 2" Conduits  
(2) - 4" Conduits




- (B) Duct Bank Detail**  
Power, Communication & FON (As Needed)  
  
Roadway Crossing Duct Bank  
6-2" Conduit, 3-4" Conduit  
Encased in Concrete  
Unless Under Existing Roadway

\*\* For upstream location, number of conduits = 2 x number of tolled lanes  
For downstream location, number of conduits = number of tolled lanes  
(shoulders greater than 4' wide count as "tolled lanes")

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Typical Mainline AET Toll Zone Conduit Detail		
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Legend

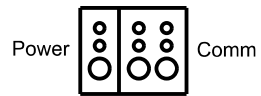
- C** - Communications Junction Box (36" x 24" x 24" Min)
- P** - Power Junction Box (30" x 17" x 24" Min)
- S** - Loop Splice Box (36" x 17" x 30" Min)
-  - Box with 18" concrete apron, 1" above grade
- 2" C - Designates 2" Conduit
- 3" C - Designates 3" Conduit
- 4" C - Designates 4" Conduit
- (#) - Designates Quantity
-  - Guardrail with doubled posts
-  - Structure Foundation

**A** Conduit from Last Box to Vault

- |                   |                   |
|-------------------|-------------------|
| Communications:   | Power:            |
| (7) - 2" Conduits | (4) - 2" Conduits |
| (2) - 4" Conduits | (2) - 4" Conduits |

**B** Duct Bank Detail

Power, Communication & FON (As Needed)



Roadway Crossing Duct Bank  
6-2" Conduit, 3-4" Conduit  
Encased in Concrete  
Unless Under Existing Roadway

Notes:

1. Size junction boxes to fit conduit needs.
2. For all conduit runs entering Toll Zone Vault, place conduit boxes as needed to ensure last box before entering Toll Zone Vault is below level of sidewalk concrete slab.
3. Protect any electrical equipment installed adjacent to driveway with concrete bollards.
4. Provide concrete aprons for all junction boxes as per the ITS and AET Scope of Work.
5. Provide 2" conduit for Lightning Protection System grounding.
6. Provide drains for loop boxes as directed by the Engineer.

\*\* For upstream location, number of conduits = 2 x number of tolled lanes  
For downstream location, number of conduits = number of tolled lanes  
(shoulders greater than 4' wide count as "tolled lanes")

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NORTH CAROLINA TURNPIKE AUTHORITY AET STANDARD DRAWINGS Typical Ramp AET Toll Zone Conduit Detail		
SCALE: N.T.S. Rev. Oct 2014	NORTH CAROLINA TURNPIKE AUTHORITY	SHEET NO. <b>E-2</b>

Legend

- C


- Communications Junction Box (36" x 24" x 24" Min)
- P

- Power Junction Box (30" x 17" x 24" Min)
- S

- Loop Splice Box (36" x 17" x 30" Min)
- Box with 18" concrete apron, 1" above grade

2" C - Designates 2" Conduit  
3" C - Designates 3" Conduit  
4" C - Designates 4" Conduit  
(#) - Designates Quantity

 - Guardrail with doubled posts

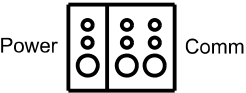
 - Structure Foundation

A Conduit from Last Box to Vault

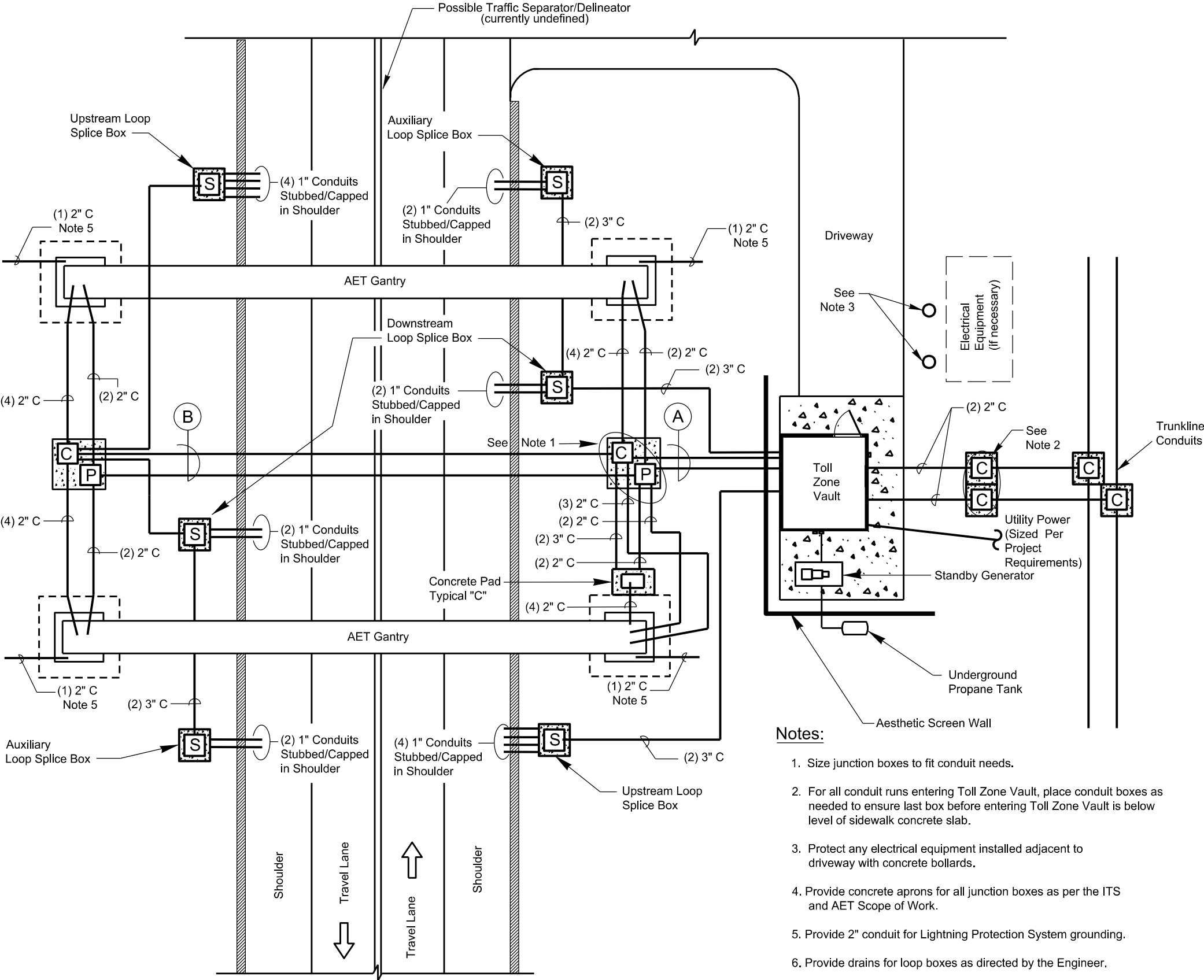
Communications:	Power:
(7) - 2" Conduits	(4) - 2" Conduits
(2) - 4" Conduits	(2) - 4" Conduits

B Duct Bank Detail

Power, Communication  
& FON (As Needed)

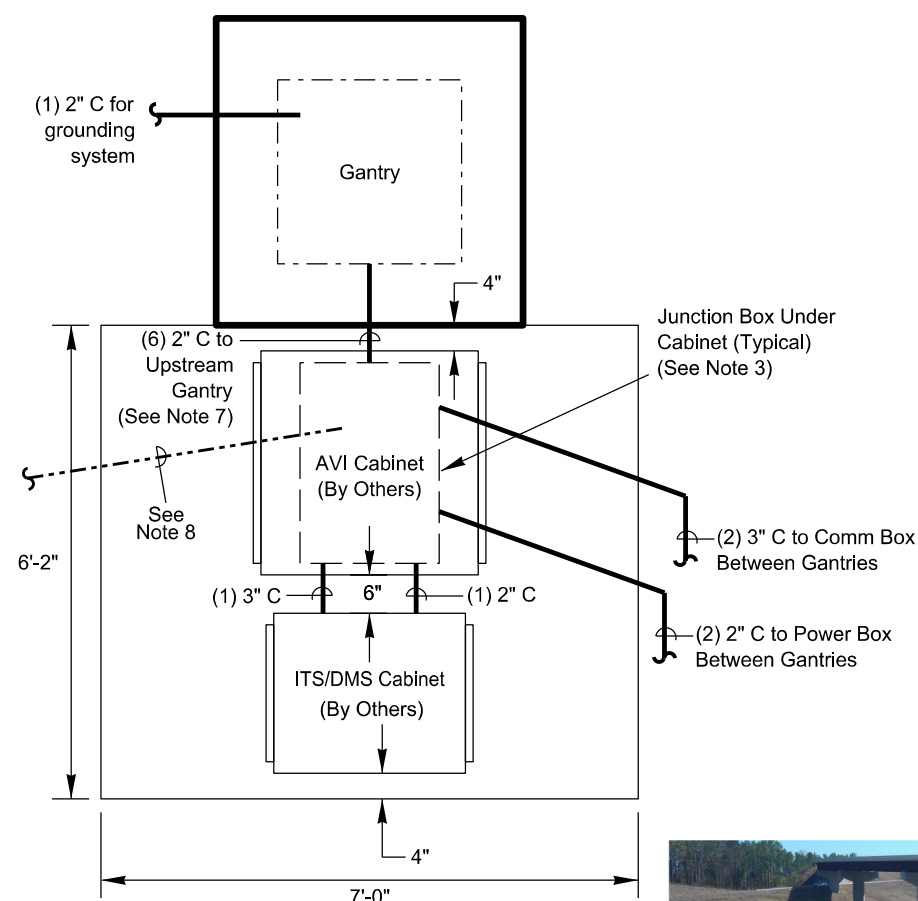


Roadway Crossing Duct Bank  
6-2" Conduit, 3-4" Conduit  
Encased in Concrete  
Unless Under Existing Roadway



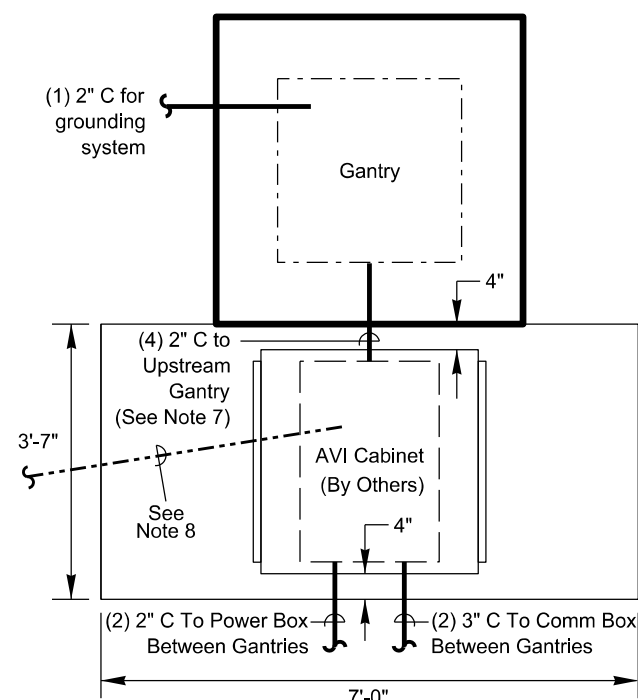
- Notes:
1. Size junction boxes to fit conduit needs.
  2. For all conduit runs entering Toll Zone Vault, place conduit boxes as needed to ensure last box before entering Toll Zone Vault is below level of sidewalk concrete slab.
  3. Protect any electrical equipment installed adjacent to driveway with concrete bollards.
  4. Provide concrete aprons for all junction boxes as per the ITS and AET Scope of Work.
  5. Provide 2" conduit for Lightning Protection System grounding.
  6. Provide drains for loop boxes as directed by the Engineer.





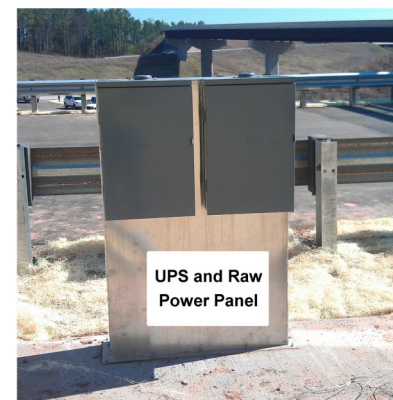
### Pad Typical "A" AVI and ITS/DMS Cabinets

N.T.S.



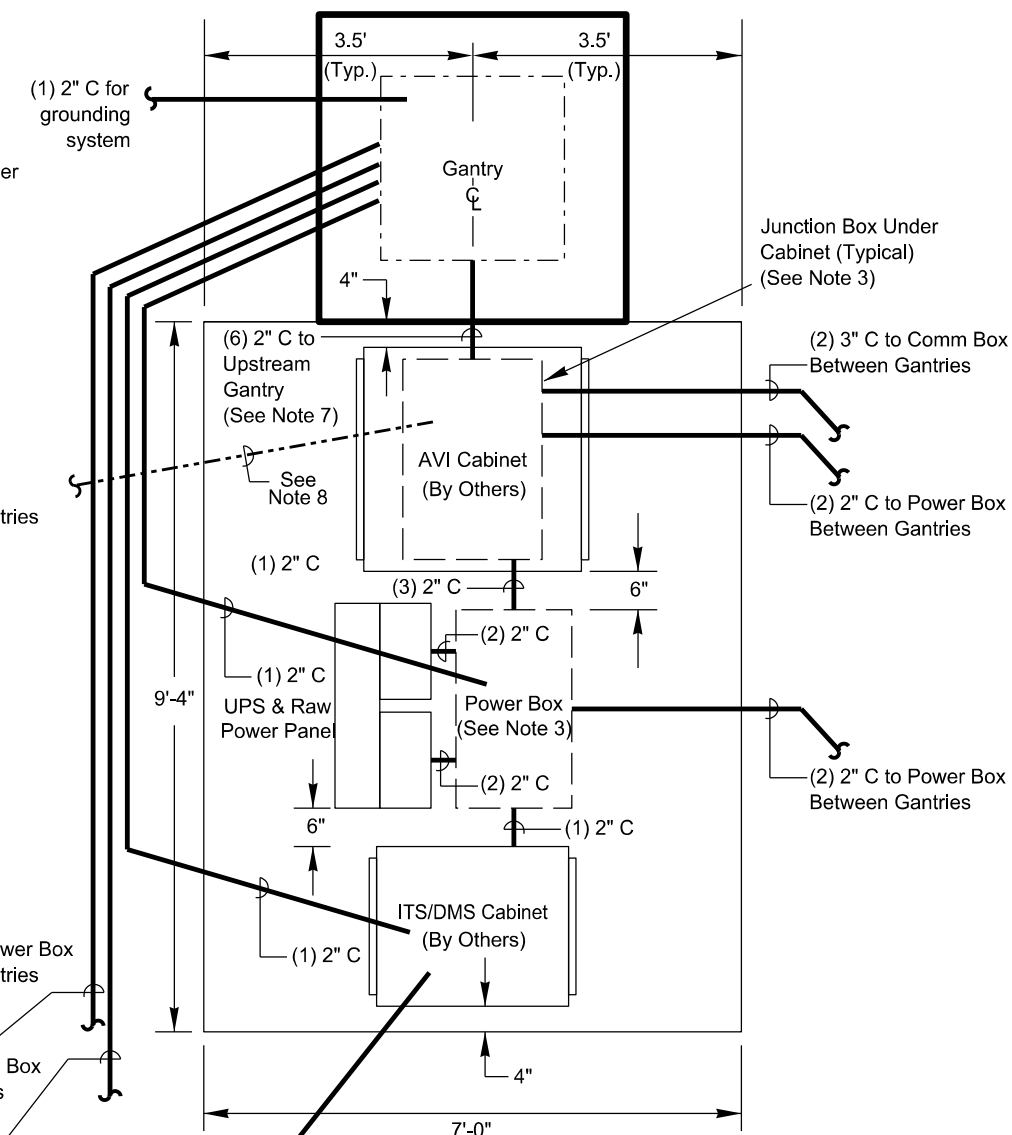
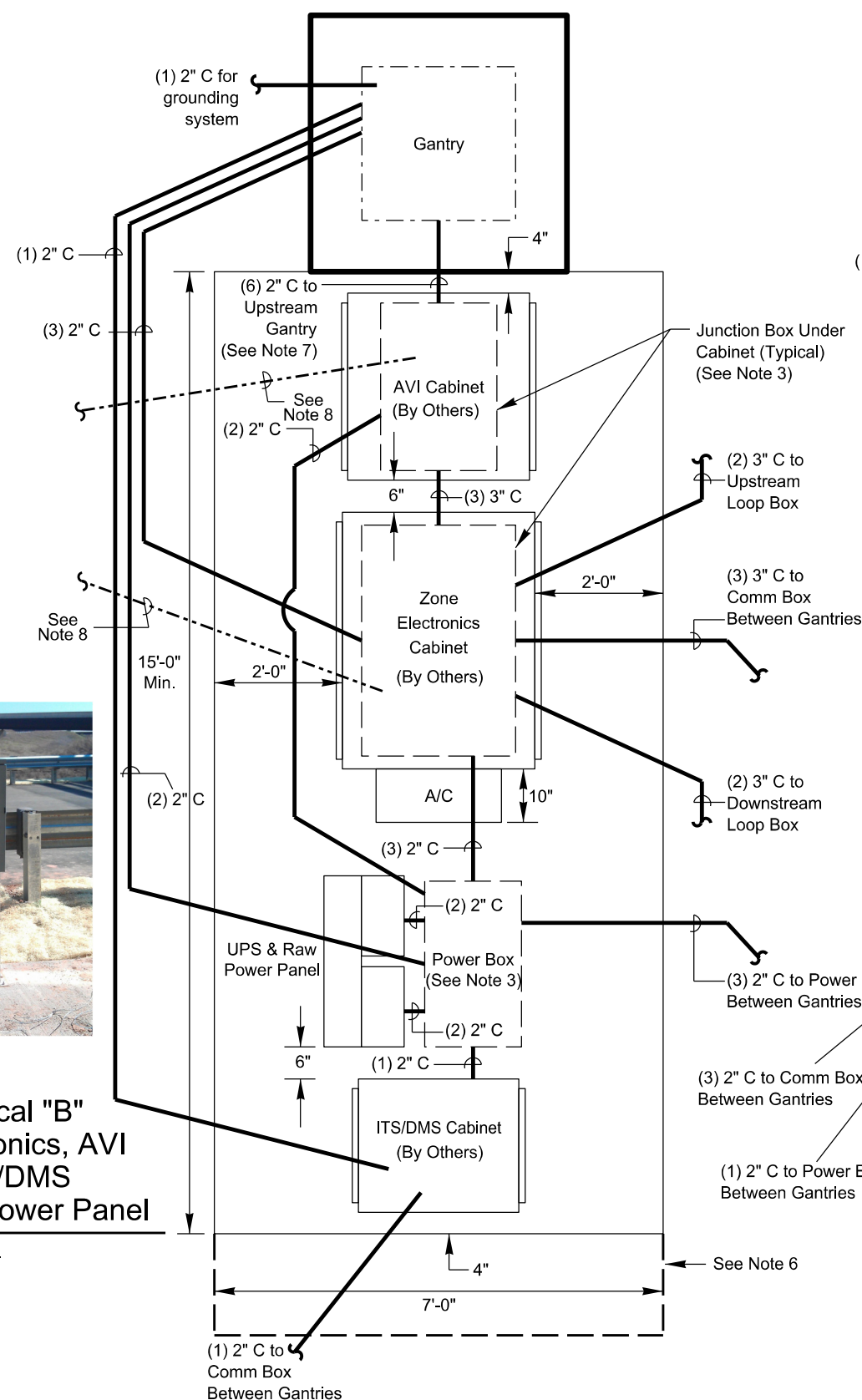
### Pad Typical "C" AVI Cabinet

N.T.S.



Pad Typical "B"  
Zone Electronics, AVI  
and ITS/DMS  
Cabinets w/ Power Panel

N.T.S.



Comm Box  
Between Gantries

Pad Typical "D"  
AVI and ITS/DMS Cabinets w/Power Panel

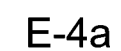
N.T.S.

- Notes:

1. Provide detailed conduit stub-up and interconnect diagrams. Coordinate conduit layout with Toll System Integrator.
2. At toll zone, where ITS/DMS cabinet is not present, stub up and cap conduit flush with surface of pad. Use rigid metallic conduit for such installations.
3. Size junction boxes as needed to fit conduit needs and cabinet sizes.
4. Coordinate pad conduit entry points with Toll System Integrator to provide proper location of stub-ups.
5. All cabinet sizes/dimensions are best information available and are subject to change.
6. Refer to Sheet E-1 for extension of concrete pad.
7. Sweep conduit into side of junction box. Coordinate conduit radius with Toll System Integrator.
8. Provide box drain for all boxes below equipment cabinets.
9. Pad shall be 8" thick (4" above and below finished grade).
10. Provide 3/4" chamfered edge on equipment pads.
11. Provide wire and conduit to ground cabinets.

## Typical Cabinet Sizes

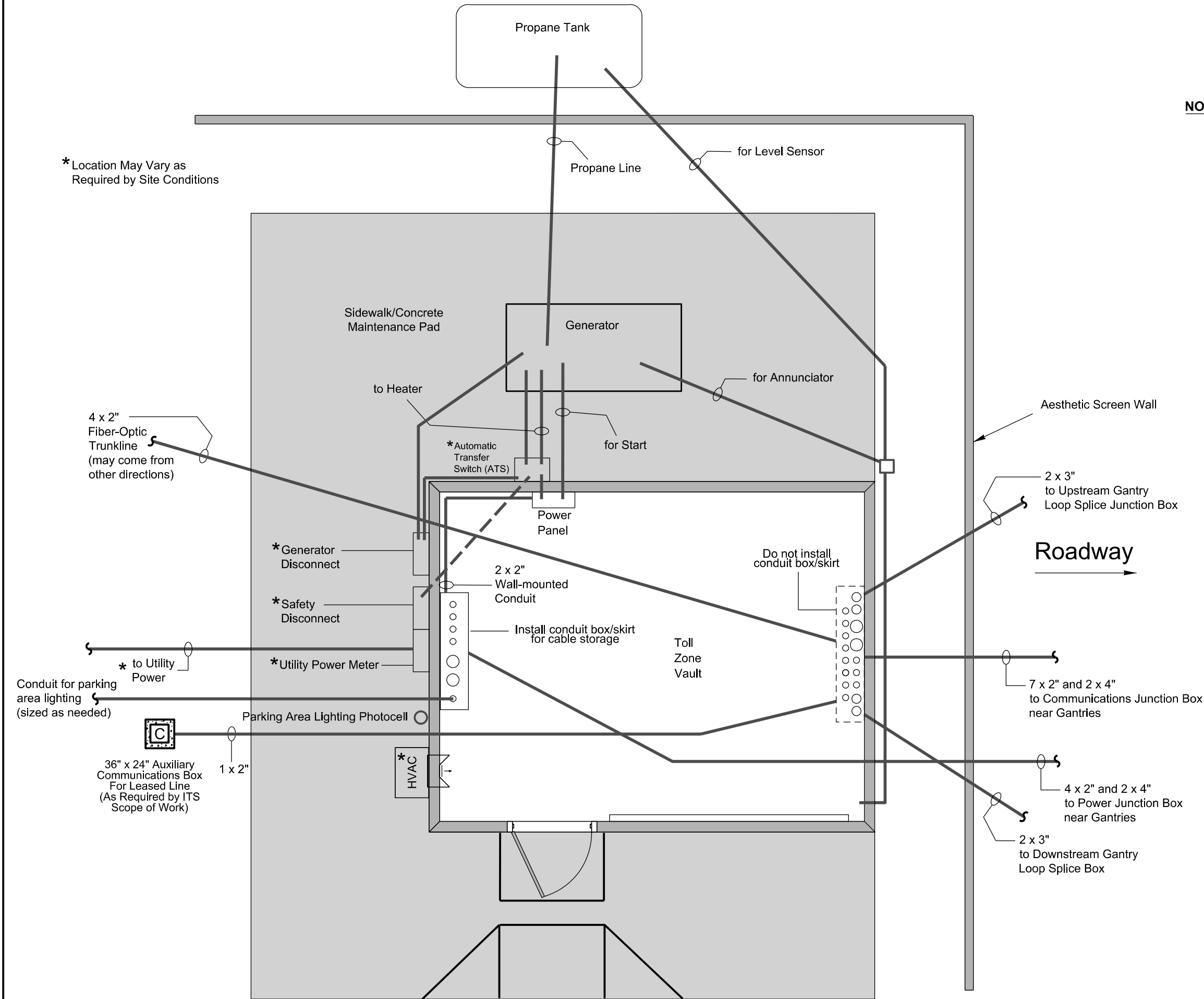
AVI Cabinet - 35"W x 34"D x 67"H  
DMS Cabinet - 25"W x 30"D x 46"H  
Zone Cabinet - 48"W x 36"D x 72"H  
UPS & Raw Power Panel - 32"W x 16"D



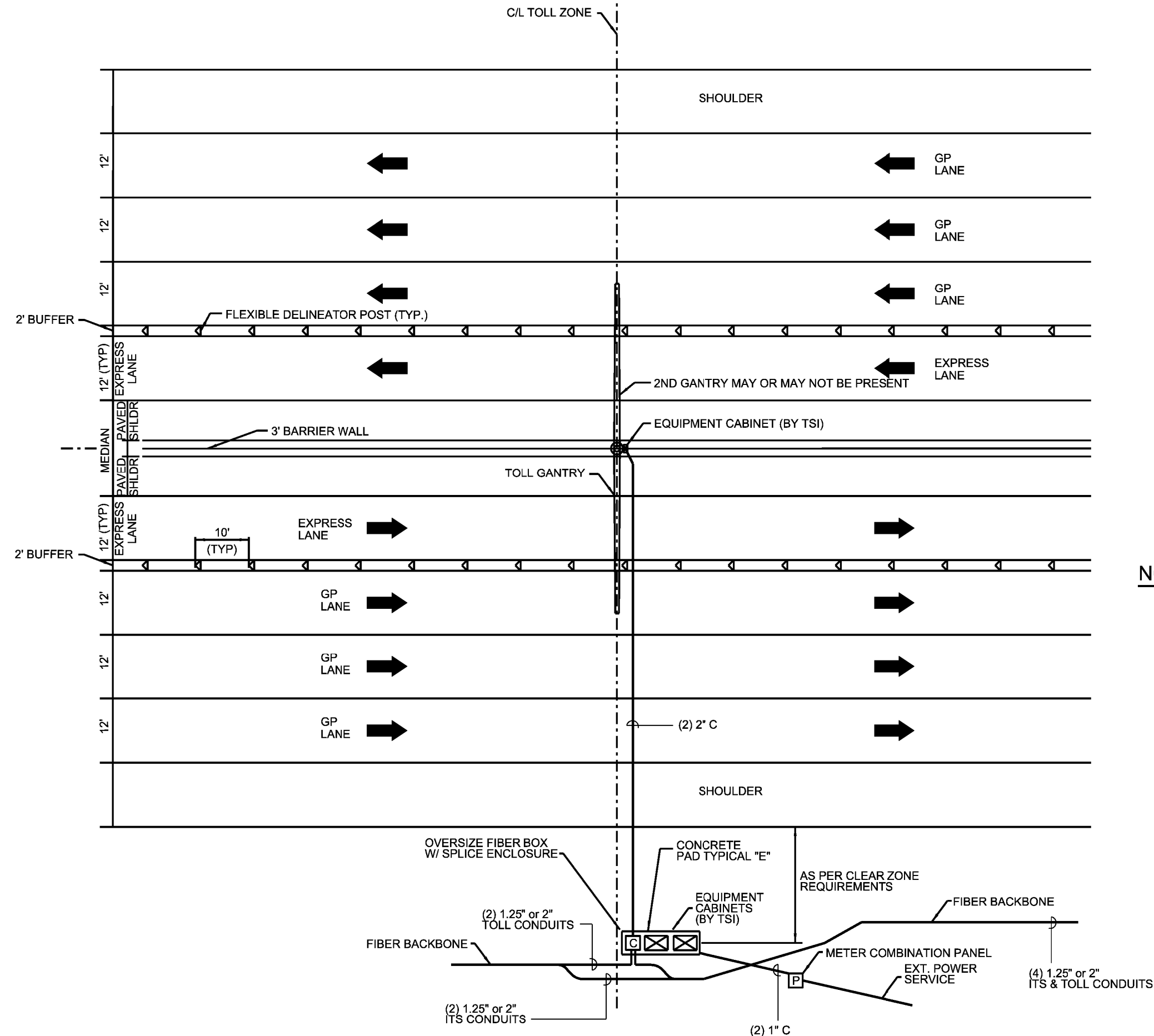


NOTES:

1. Provide UL-Listed PVC or HDPE conduit for all underground conduit runs.
2. Provide rigid galvanized conduit for all above-ground exterior conduit runs.
3. Unless otherwise labeled, provide one (1) conduit, size to be determined by Design/Build Team, for all conduit runs.
4. Contractor may choose to run conduit entrances thru the walls rather than the floor.



<div><b>ATKINS</b><div>1616 EAST MILLBROOK ROAD, SUITE 310 RALEIGH, NORTH CAROLINA 27609 (919) 876-6888 NCBEES #F-0326</div></div>		
NORTH CAROLINA TURNPIKE AUTHORITY AET STANDARD DRAWINGS AET Toll Zone Vault Conduit Plan		
SCALE: N.T.S. Rev. Oct 2014	NORTH CAROLINA TURNPIKE AUTHORITY	SHEET NO. E-6



NOTES:

1. This is a typical Express Lane site. Width of median, median shoulder and buffer may vary. Number of General Purpose Lanes and median treatment may be different.

**DATES STIMES SFILES**

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NORTH CAROLINA TURNPIKE AUTHORITY AET STANDARD DRAWINGS Typical Express Lanes Toll Site Plan View			
SCALE: N.T.S. Rev. Mar 2016		NORTH CAROLINA TURNPIKE AUTHORITY	
		SHEET NO. E-7	

# AET STANDARD DRAWINGS - REVISIONS

Date	Sheet	Revisions
10/2014	C-1,2,3; A-3	Changed offset of column from 5' min. to 6' min. behind guardrail
10/2014	C-4,5; E-1,2,3	Clarified that barrier thru toll zone shall be double-post guard rail
10/2014	A-1, E-6	Contractor conduit may enter vault thru walls as well as floor
10/2014	A-1	Changed interior long dimension from 15' min. to 11' min.
10/2014	A-2	Added drip cover over door and condensate tubing
10/2014	A-3	Changed nomenclature associated with cable tray
10/2014	E-1,2,3	Added note regarding drains for loop boxes
10/2014	E-4	Added note to provide wire and conduit for grounding
10/2014	E-5	Added note to field-adjust outlets; added note regarding wiring of outside notes
04/2015	C-4	Added details for the smaller driveway for locations without vault
03/2016	A-5,E-7,E-4a	Added new sheets for typical Express Lanes toll zones/sites