09

Attachments

Appendix A-1 – Landscape Applications for Pedestrian Traffic Control

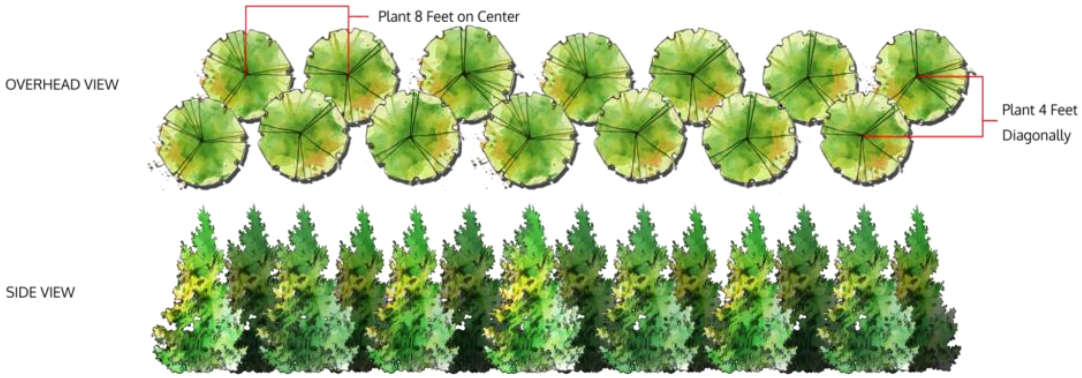
One of the methods researched in this study is to use landscape options to control of unauthorized access (trespass) to the railroad right-of-way. The Pilot Program was limited to Central Florida on the SunRail Commuter Rail line. It should be noted however that the use of plant materials in Florida will be governed by geographic location and specific site conditions which include sunlight, precipitation, soil characteristics and most importantly, UDSA climate zones.

The use of landscape for pedestrian traffic control and trespass has been implemented for centuries. Options include walls, fencing, grade separation, hedges, thicket, water and stone barriers. The effectiveness of each option is largely dependent on the context of the site, reason for unauthorized trespass or intent of the user, and site variables which would limit implementation. In circumstances where trespassers generally follow prescribed routes; subtle landscape elements will suffice in directing traffic. The opposite is true when strong origin/destination causes are present, people have a predetermined destination and route in mind, or if realistic alternative routes are not present. In these circumstances' trespassers will disregard or in many instances, vandalize, disable or overcome any device other than the most robust deterrent. The following are potential landscaping options with discussion regarding their applicability to this project.

Plant Materials

Plant materials can provide effective deterrence if installed and maintained correctly. They have the advantage of relatively low initial cost, but lifetime costs can be high due to maintenance. They also come in a variety of colors and textures.

Perceived or actual density of the planting along with the selection of plant varieties will largely dictate the success of plant barriers. With single rows, if trespassers perceive a gap they will exploit it and over time, the gap will enlarge. Planting shrubs with tight spacing, depth of planting (multiple rows), hedge laying or weaving and/or using varieties with thorns greatly increases the probability of success.



Hedge Barrier

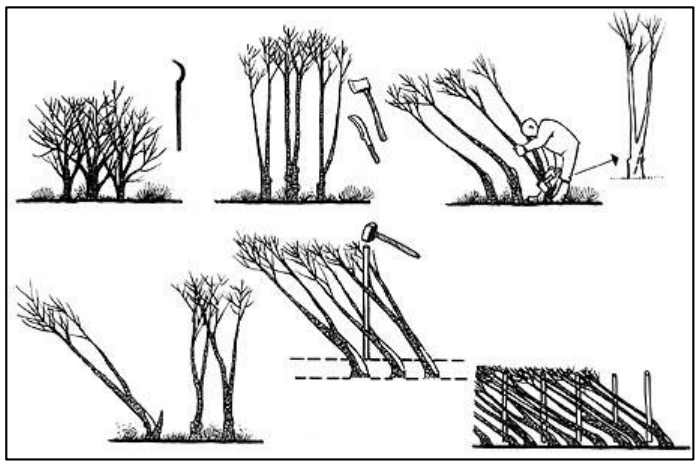
Hedge barriers have been used for centuries to articulate pedestrian traffic. Used in formal or informal applications they are an effective means for directing pedestrians. Lifetime costs for formal hedges can be high due to the need for extensive maintenance

Defensive Plant Materials

The use of defensive plant materials, or plants with thorns or sharp tips such as Spanish Bayonet and bougainvillea greatly reduces the incidences of breaching however, there are liability concerns if injury results .

Hedge Laying

Hedge laying or weaving of plant materials greatly increases the impermeability of single row hedges however, this is a labor-intensive method and is not widely practiced in the United States and takes a significant amount of time to become established



Walls and Fences

Mechanical control of pedestrian movement by walls and fences is the most reliable source of traffic articulation in landscaping.

Stone Walls

Stone walls can provide excellent deterrence if constructed properly and are resistant to vandalism. They can be constructed with a large variety of styles, colors and patterns however, they tend to be relatively expensive. Indigenous stone has been used to construct walls in Florida for centuries.

Gabion Baskets

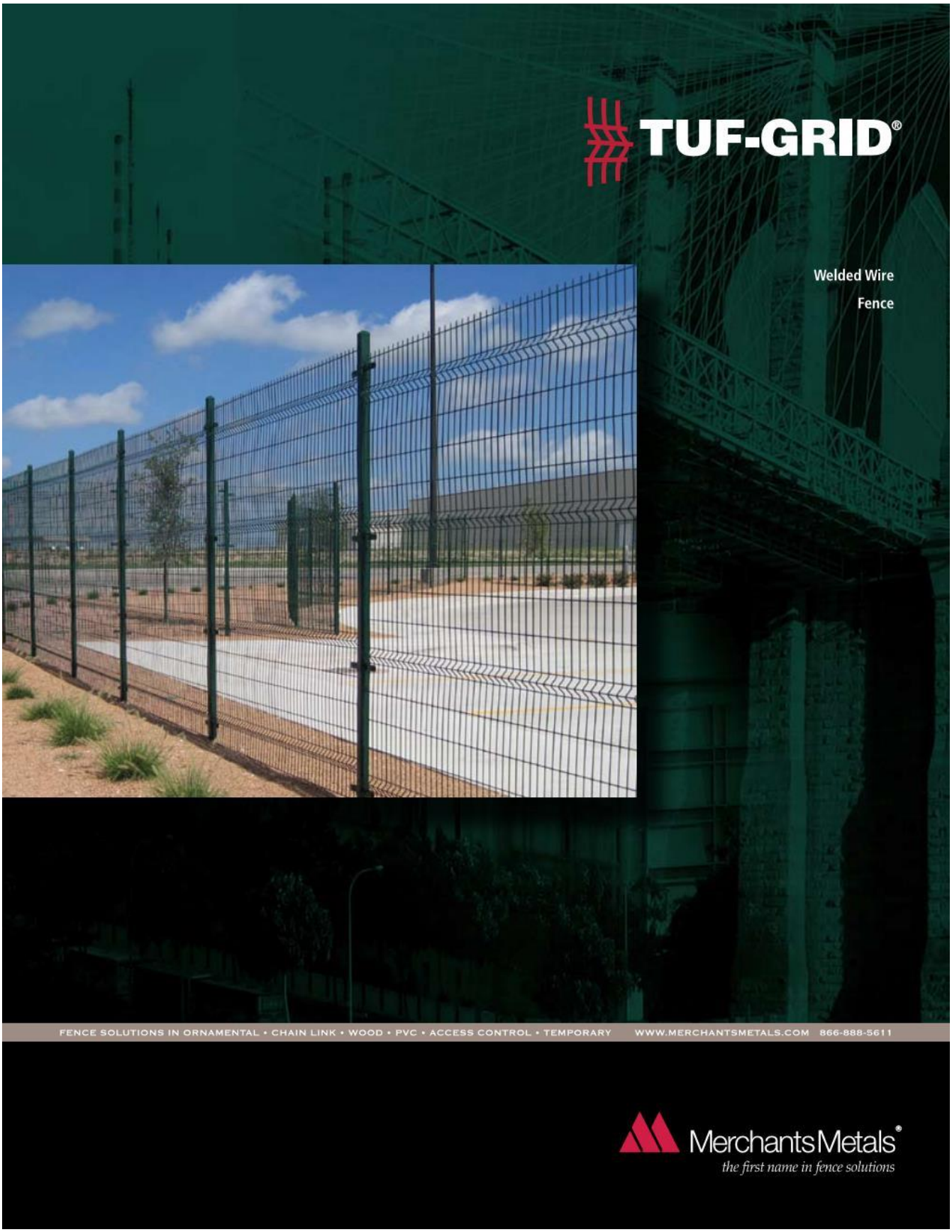
Gabion Basket Walls provide a less expensive alternative to natural stone masonry construction.

Concrete Unit Masonry

Concrete Unit Masonry walls are also a less expensive alternative to natural stone walls.

Hardened Fencing

Hardened fencing is a good alternative to chain link due to its anti-climb characteristics and resistance to cutting. The Tuf-Grid fencing by Merchants Metals was selected for cost evaluation of the Trespassing Concept Plans. This product is shown below right and has been installed on the South Florida Rail Corridor. On the following pages the official product brochure and specifications are provided.


TUF-GRID®
Welded Wire
Fence
FENCE SOLUTIONS IN ORNAMENTAL • CHAIN LINK • WOOD • PVC • ACCESS CONTROL • TEMPORARY
WWW.MERCHANTSMETALS.COM 866-888-5611
MerchantsMetals®
the first name in fence solutions

TUF-GRID® WELDED WIRE FENCE

Tuf-Grid® welded wire fence combines the strength and durability of powder coated steel, the clean lines of welded wire and the convenience of a simple, trouble-free installation. These fundamental qualities make Tuf-Grid® the ideal choice for both contractors and consumers alike.

Tuf-Grid® is manufactured using pre-galvanized steel which provides an added layer of protective coating. The galvanized wire is then welded into panels incorporating a V-Brace design for additional rigidity.

Panels and posts are then sent through our state-of-the-art powder coating line where the galvanized material is coated with a zinc rich primer and a TGIC polyester top coat. This process produces long lasting strength, beauty and maintenance-free enjoyment for years to come.

FEATURES

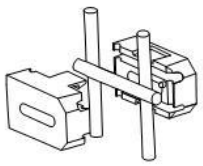
- High Security, Low Profile
- Panels mount inside posts or on the face of the posts
- Galvanized steel components
- Durable powder coat finish
- 6 ga. horizontal and vertical wire
- 2 in. x 6 in. openings
- Climb resistant

8 ft. Tuf-Grid® Welded Wire, Green

Patented Bracket Insert Makes Installation a "Snap"

Our patented bracket insert makes installing the welded wire panels a quick and easy job. The insert "snaps" securely on both sides of the wire panel and allows the panel to be easily connected to the post using standard Merchants Metals band or universal brackets.

1. Attach bracket to post
2. Snap insert onto wire panel
3. Attach insert to bracket
   You're Done!



Snap Bracket Options

Band Bracket

Universal Bracket

Swivel Bracket

Economy Bracket Options

Economy Bracket

Economy Brackets

Tuf-Grid's economy bracket allows the panels to be installed on the "face" of the post, reducing the number of brackets needed for installation. The wrap around design securely joins two panels to the post for a quick and easy installation. Economy brackets are available for 2 in., 2¼ in. and 3 in. post applications only.

WWW.MERCHANTSMETALS.COM

TUF-GRID® WELDED WIRE FENCE

SPECIFICATIONS

Vertical Wire Size	6 gauge
Horizontal Wire Size	6 gauge
Wire Spacing	2 in. verticals x 6 in. horizontals
Panel Length	95 in.
Post Size Recommended Minimum	2 in. 14 gauge for 4 ft., 5 ft., and 6 ft.
	2 ½ in. 14 gauge for 8 ft.
Panel Heights	4 ft., 5 ft., 6 ft., and 8 ft.

Additional mesh sizes available; however, they may not attach with the patented snap-fit bracket insert.

MERCHANTS METALS SPECIFIED PRODUCT

SPECS & DRAWINGS @ MERCHANTSMETALS.COM

Gates

A large selection of gates, posts and accessories are available to coordinate with your Tuf-Grid® fencing solution. All are intricately fashioned by skilled craftsmen and then completed at the Merchants Metals factory with the same high-quality powder coat finishing.

Secure-Trac® Cantilever Gate

Secure-Trac® internal roller cantilever slide gates are produced using the highest quality materials and workmanship. The fully enclosed rollers eliminate safety issues commonly associated with external rollers and the gates are available to match each style of Tuf-Grid® fence.

High Security / Low Profile

The low profile design of Tuf-Grid® provides a high security fence that doesn't hide your property. With clean lines and environmentally blending color coating, Tuf-Grid® blends beautifully with the surrounding area while providing the security and protection you need.

RESIDENTIAL/COMMERCIAL

- Parks and Recreation
- High Security Applications
- Highways & Bridges
- State & Federal Agencies

WWW.MERCHANTSMETALS.COM

TUF-GRID® WELDED WIRE FENCE

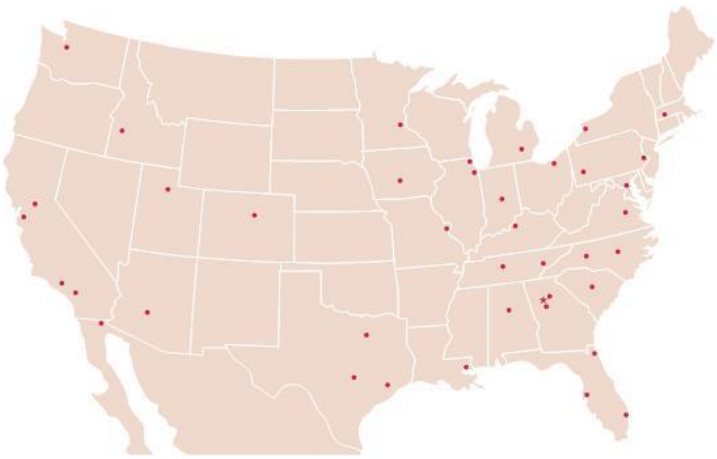
Additional Fence Solutions

Merchants Metals is one of the largest manufacturers and distributors of fence systems in the nation. The company's complete line of fencing solutions for residential, commercial and industrial applications includes:

- Hot Dipped Galvanized Chain Link
- Color Coated Chain Link
- Steel Ornamental in Both Component and Fully-Welded Systems
- Aluminum Ornamental Systems
- Wood Fence
- PVC Fence
- Temporary Fence
- Aluminum Track Gates
- Access Control Products
- Guardrail
- Pre-hung Security Gates
- Welded Wire

All Merchants Metals products are available through professional fence contractors nationwide.

To find out more about Merchants Metals and the fencing solutions we offer, please call 866.888.5611 or visit www.merchantsmetals.com.



AIA Continuing Education

ORNAMENTAL

CHAIN LINK

WOOD

PVC

ACCESS CONTROL

Merchants Metals®
the first name in fence solutions

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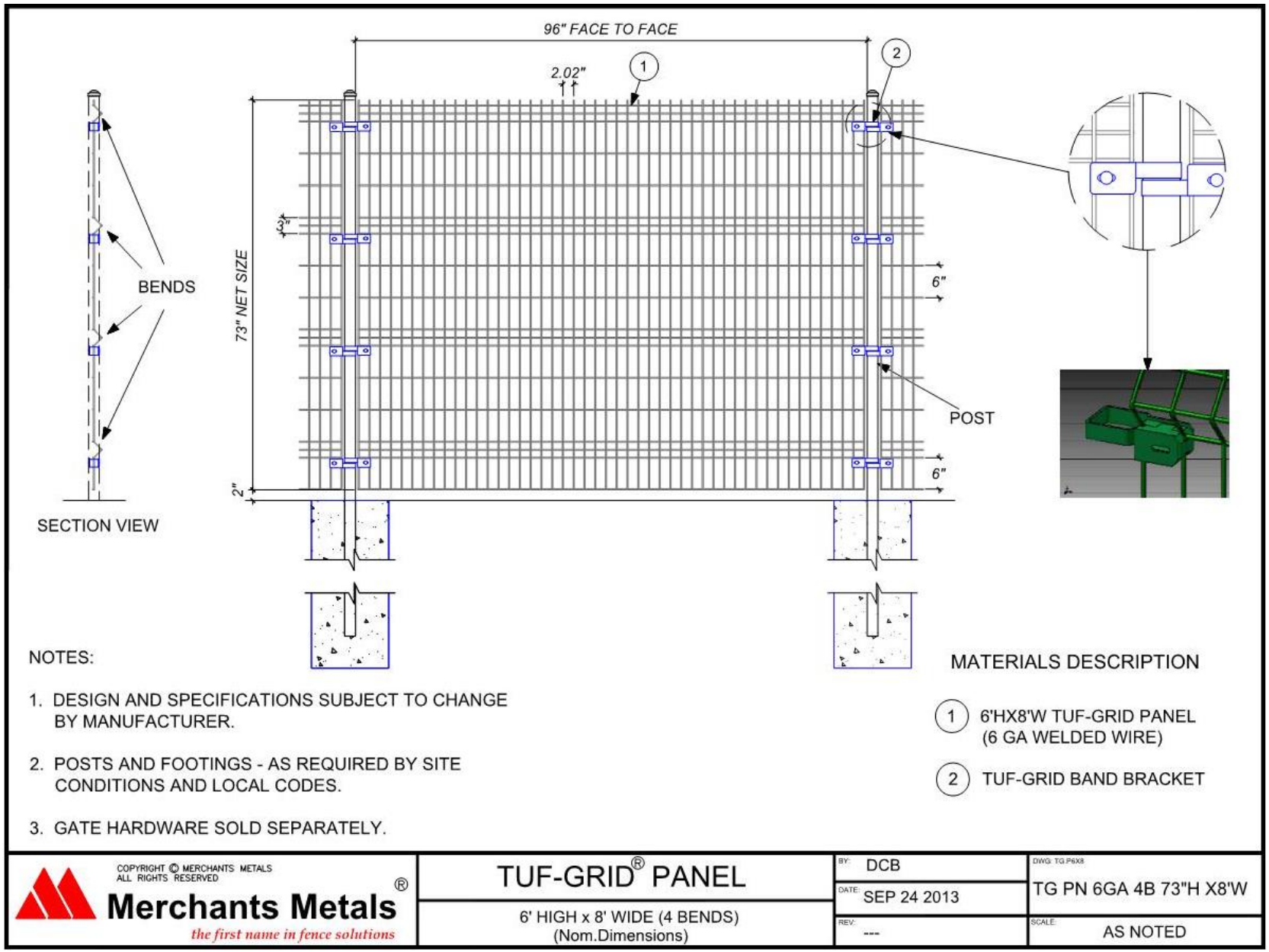
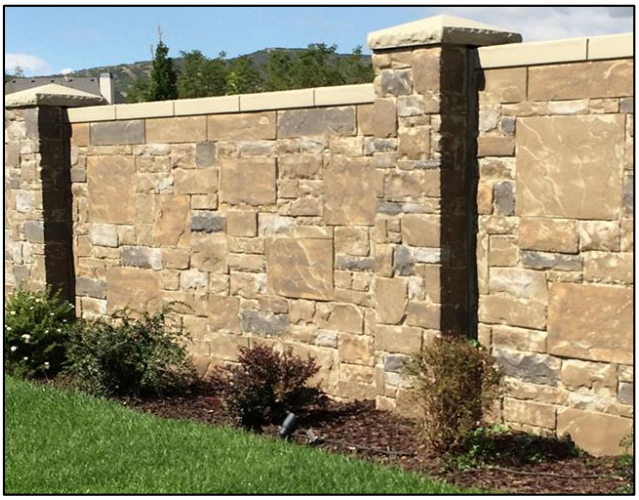

96" FACE TO FACE
2.02"
1
2
BENDS
73" NET SIZE
3"
6"
6"
2"
POST
SECTION VIEW
NOTES:
1. DESIGN AND SPECIFICATIONS SUBJECT TO CHANGE BY MANUFACTURER.
2. POSTS AND FOOTINGS - AS REQUIRED BY SITE CONDITIONS AND LOCAL CODES.
3. GATE HARDWARE SOLD SEPARATELY.
MATERIALS DESCRIPTION
1 6'HX8'W TUF-GRID PANEL (6 GA WELDED WIRE)
2 TUF-GRID BAND BRACKET
COPYRIGHT © MERCHANTS METALS ALL RIGHTS RESERVED
Merchants Metals®
the first name in fence solutions
TUF-GRID® PANEL
6' HIGH x 8' WIDE (4 BENDS) (Nom.Dimensions)
BY: DCB
DATE: SEP 24 2013
REV: ---
DWG: TG.P6X8
TG PN 6GA 4B 73"H X8'W
SCALE: AS NOTED

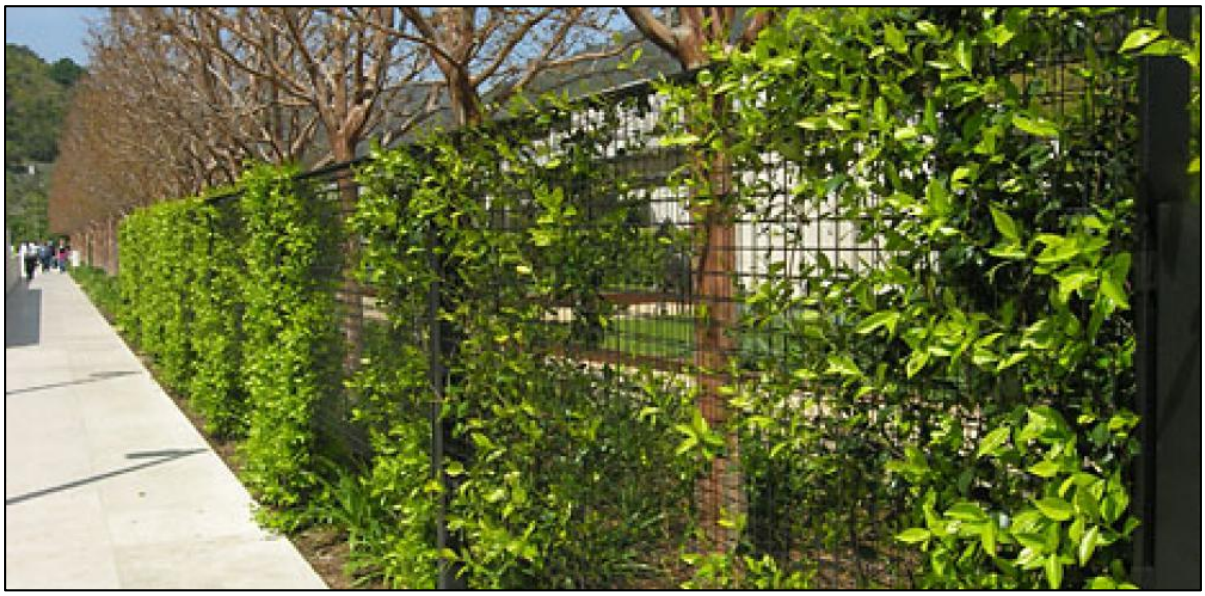
Freestanding Concrete and Metal

Freestanding Concrete and Metal Walls are relatively easier to construct than concrete unit masonry or natural stone walls



Greenscreen Fencing

Greenscreen Fencing serves as a 3-dimensional matrix on which plants are grown creating a combination fence/plant barrier.



Laser Cut Corten Steel

Laser cut CORTEN Steel panels are relatively easy to construct, are vandal resistant and require little lifetime maintenance.

Grade Separation

Grade separation has been utilized for centuries to prohibit unwanted access however, traditional methods such as the ha-ha wall require large areas to be effective. This can be used in combination with other methods including walls and plant materials.

Stone Barriers

Stone barriers can be effective traffic articulators and are relatively easy to position. However, in order to provide effective pedestrian control must be very large or placed in a manner that deters pedestrians.

Water Barriers

Water barriers (moats) can be an effective deterrent to trespass however they can be very expensive, require large areas and are expensive to maintain.

Appendix A-2 – Conceptual Plans

STATE OF FLORIDA

DEPARTMENT OF TRANSPORTATION

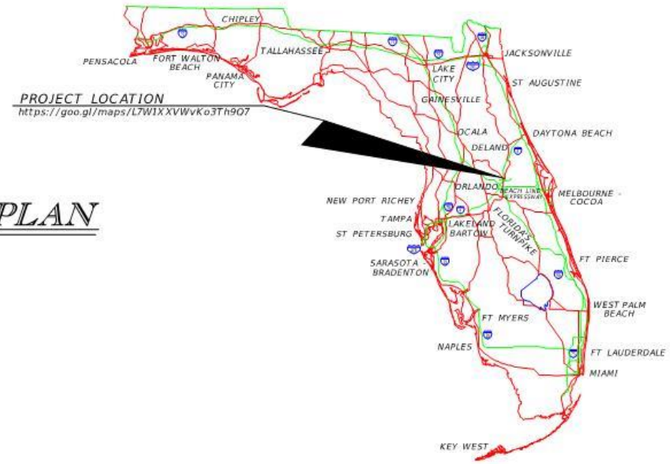
CONCEPT PLANS

FINANCIAL PROJECT ID 439036-1-12-04

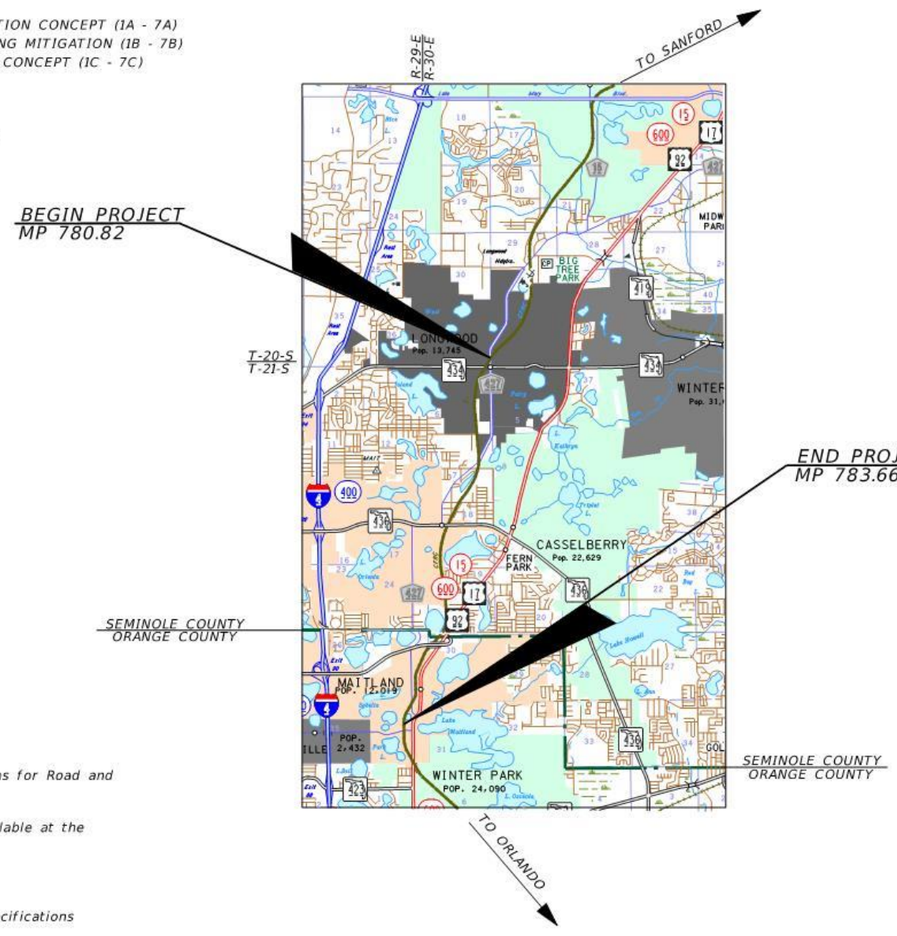
ORANGE AND SEMINOLE COUNTIES

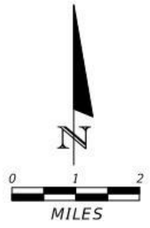
CFRC (SUNRAIL)

TRESPASSING MITIGATION CONCEPT PLAN



INDEX OF CONCEPT PLANS





GOVERNING STANDARD PLANS:

Florida Department of Transportation, FY 2020-2021 Standard Plans for Road and Bridge Construction and applicable Interim Revisions (IRs).

Standard Plans for Road Construction and associated IRs are available at the following website: http://www.fdot.gov/design/standardplans

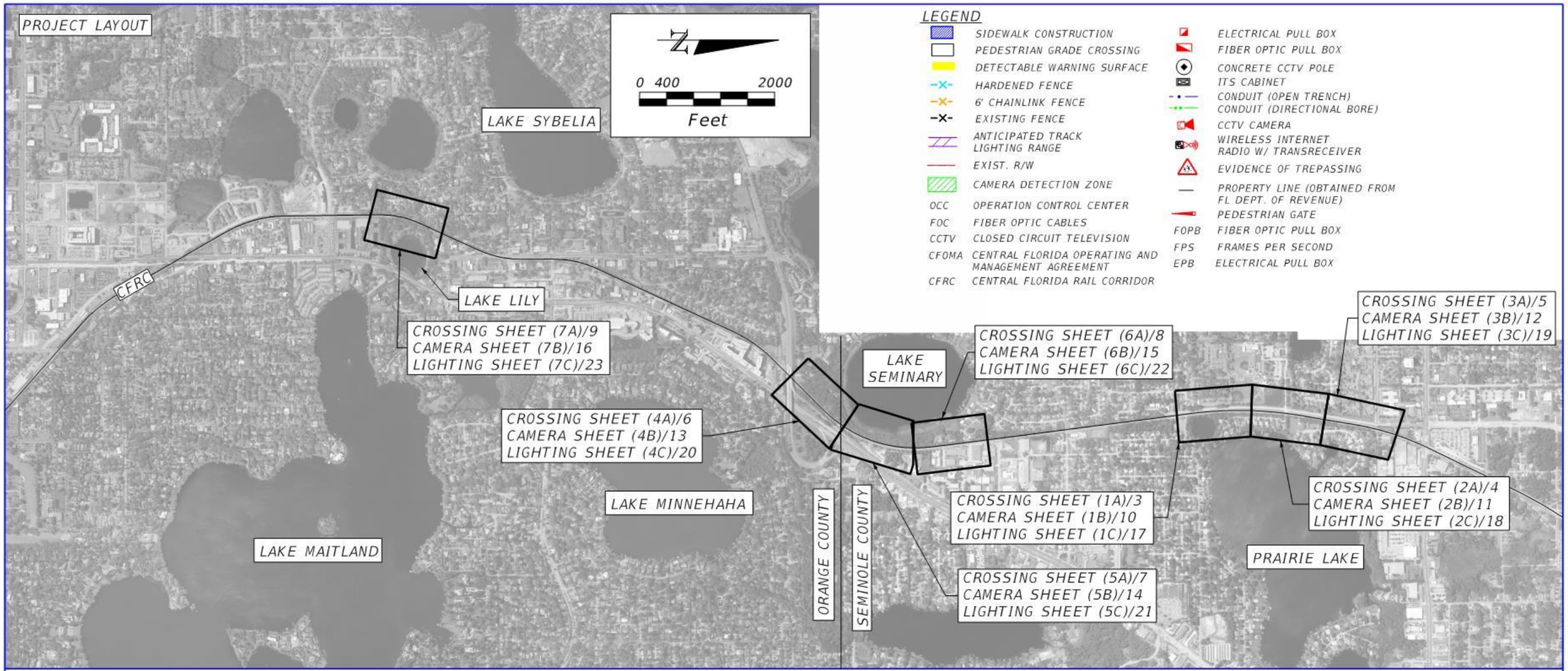
GOVERNING STANDARD SPECIFICATIONS:

Florida Department of Transportation, January 2020 Standard Specifications for Road and Bridge Construction at the following website: http://www.fdot.gov/programmanagement/Implemented/SpecBooks

CONCEPT PLANS
HNTB CORPORARTION
610 CRESCENT EXECUTIVE COURT
SUITE 400
LAKE MARY, FL 32876
CONTRACT NO: CXXXX
VENDER NO: F-431623092
CERTIFICATE OF AUTHORIZATION NO.: CA6500

FDOT PROJECT MANAGER:
RICKEY FITZGERALD
FREIGHT AND MULTIMODAL OPERATION MANAGER

FISCAL YEAR	SHEET NO.
20	1



PROJECT NOTES

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
CFRC	ORANGE/SEMINOLE	439036-1-12-04

PROJECT LAYOUT

SHEET NO. 2

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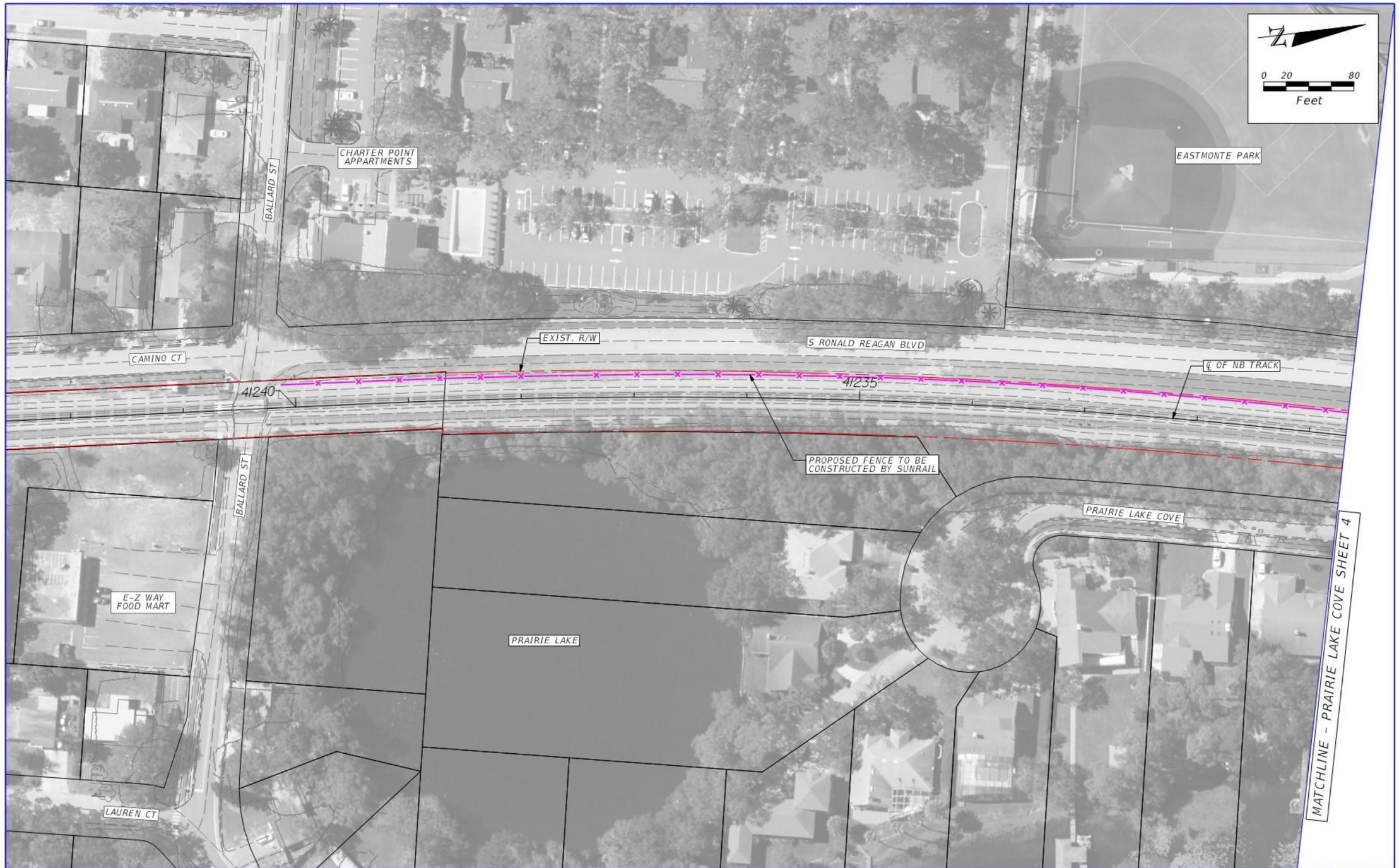

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
CFRC	SEMINOLE	439036-1-12-04

PRAIRIE LAKE COVE
R/W CHANNELIZATION & FENCING
MITIGATION CONCEPT (1A)

SHEET NO. 3

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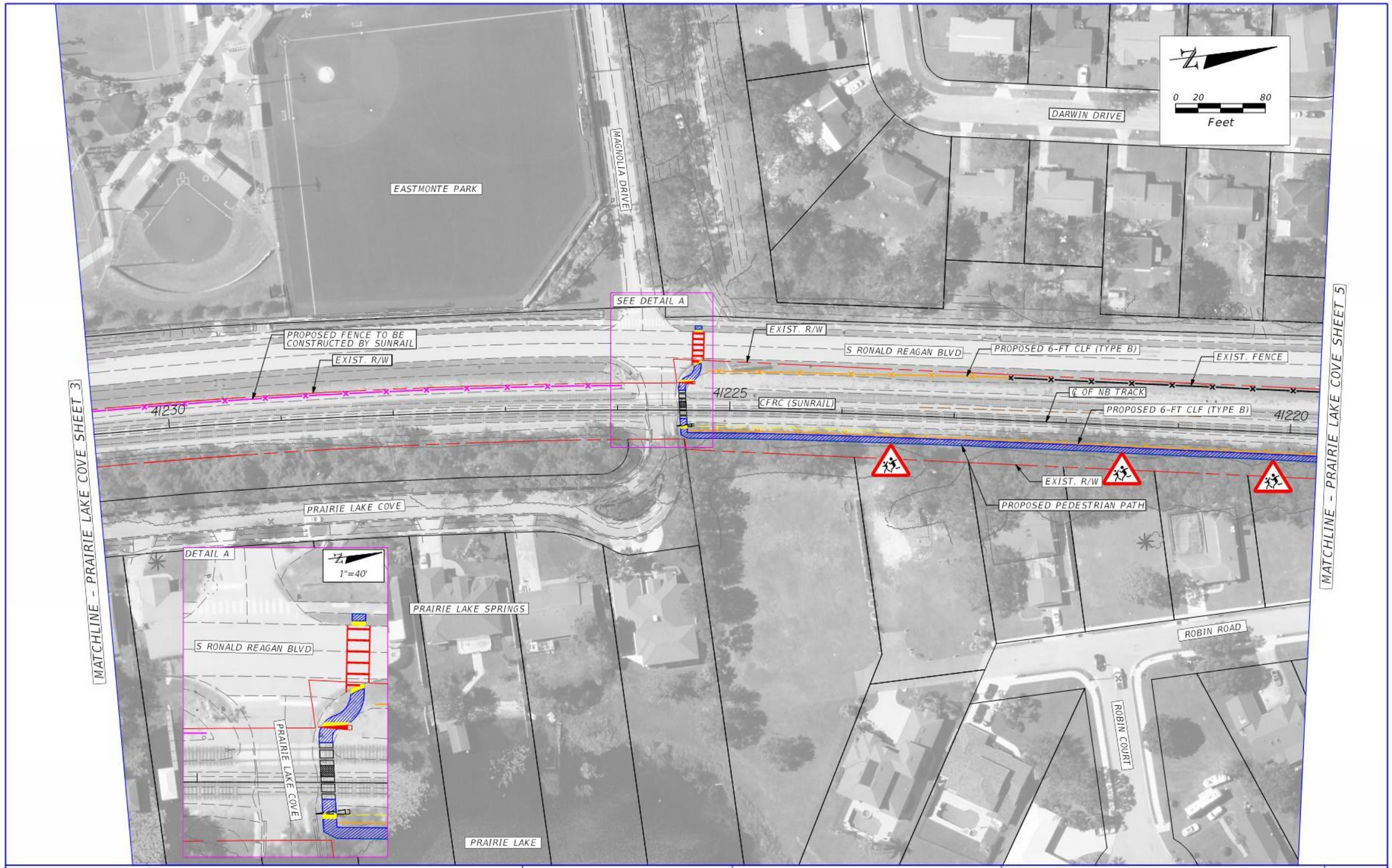

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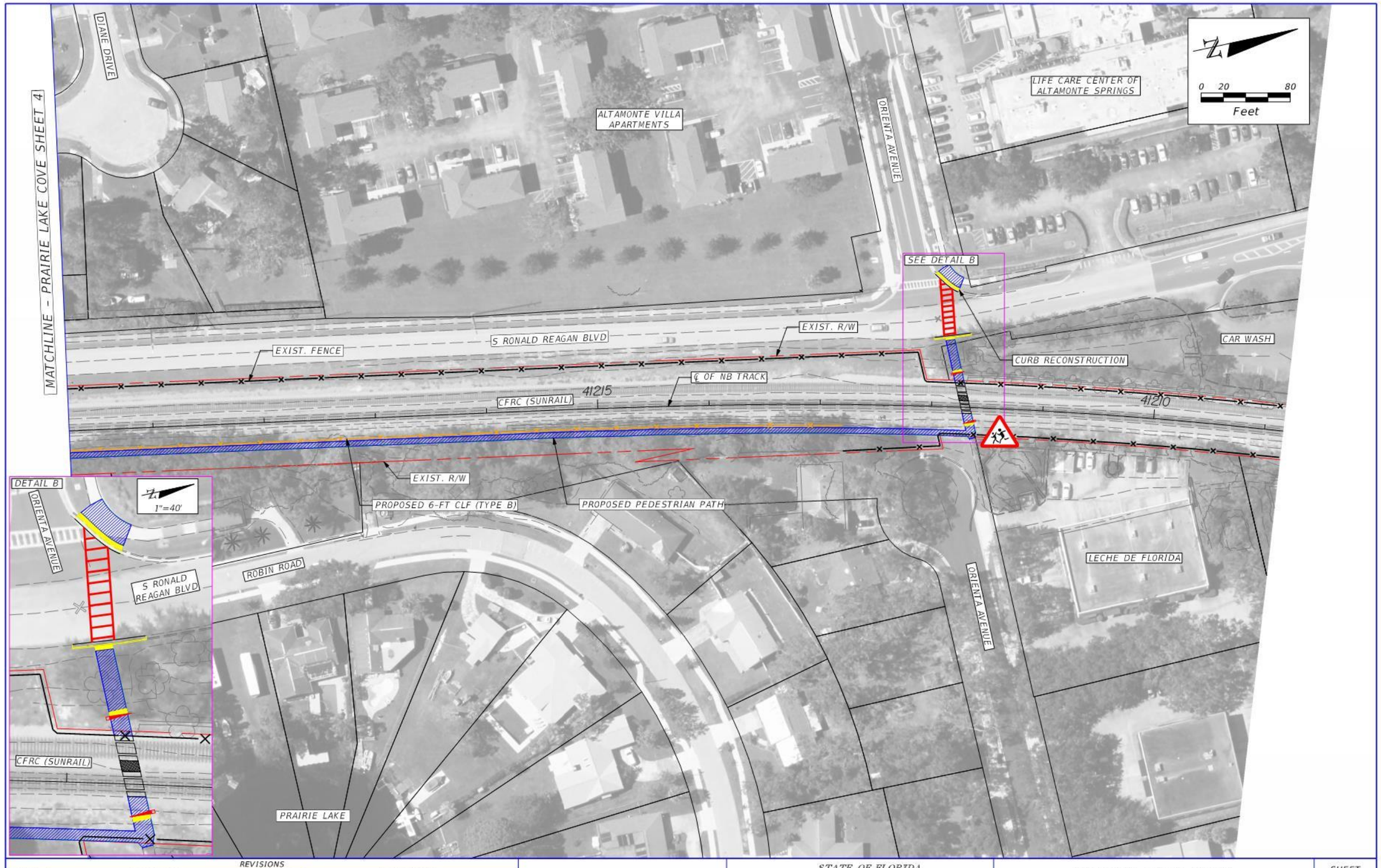

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
CFRC	SEMINOLE	439036-1-12-04

PRAIRIE LAKE COVE
R/W CHANNELIZATION & FENCING
MITIGATION CONCEPT (3A)

SHEET NO. 5

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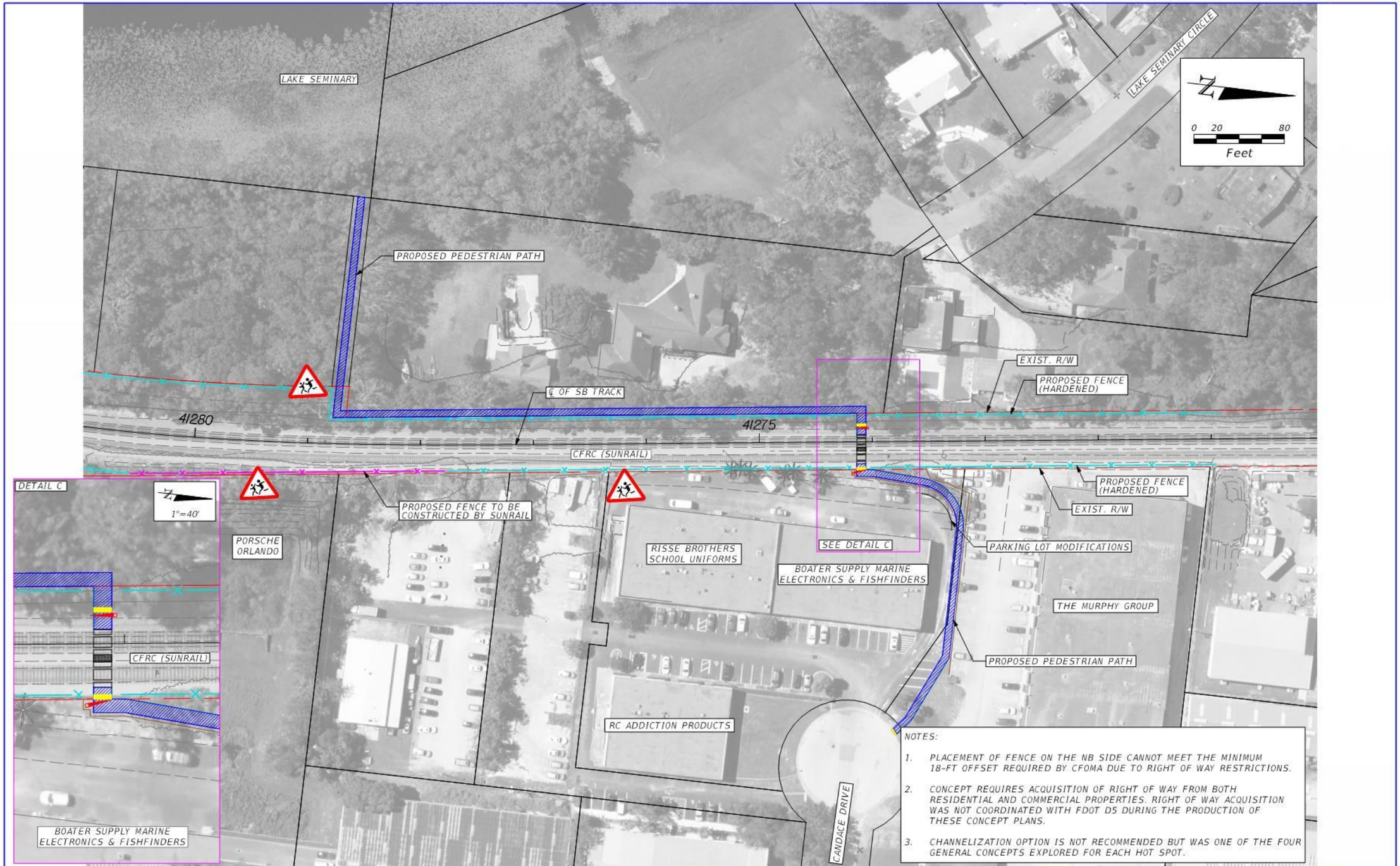

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
CFRC	SEMINOLE	439036-1-12-04

PORSCHE
R/W CHANNELIZATION & FENCING
MITIGATION CONCEPT (4A)

SHEET NO. 6

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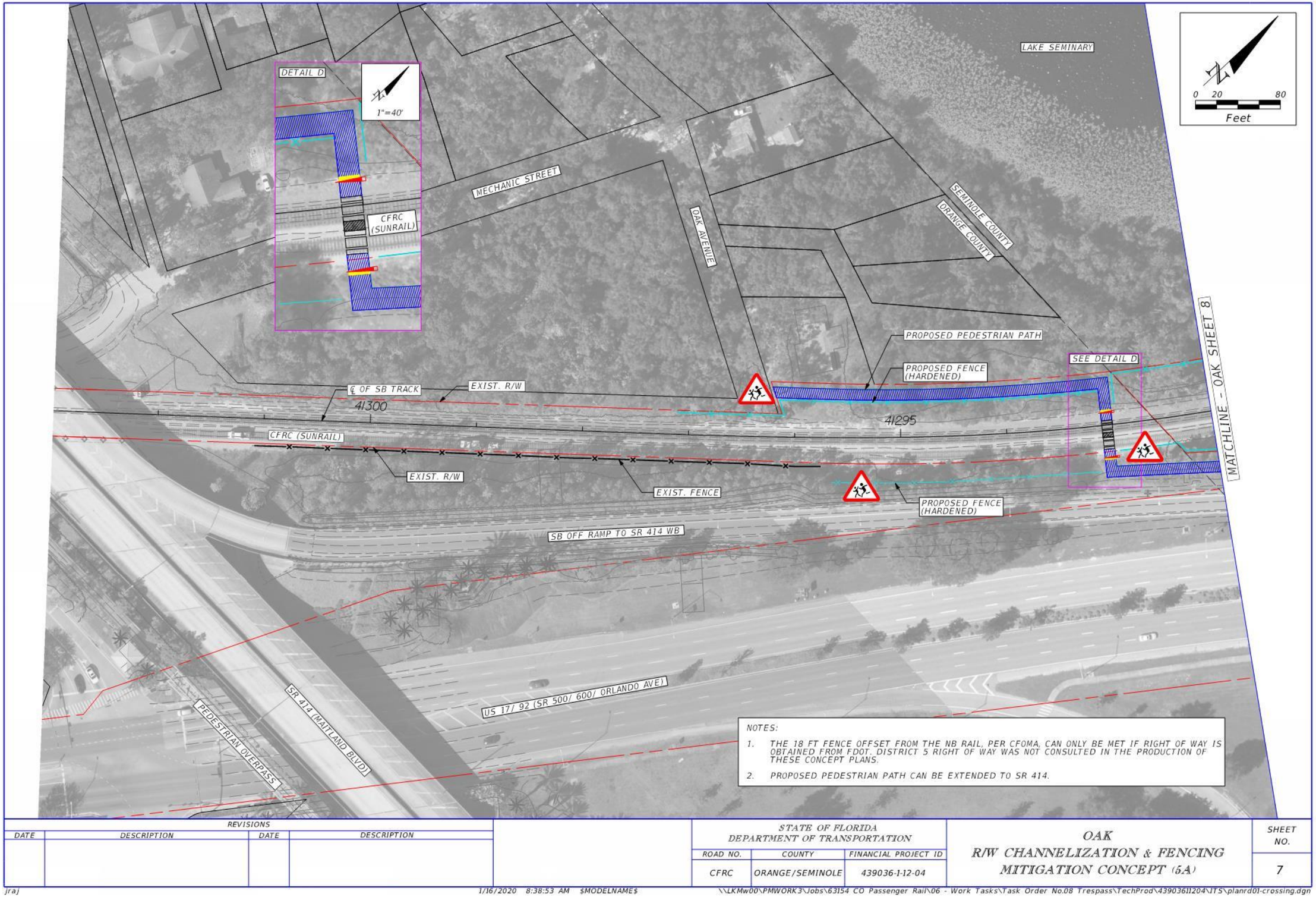

NOTES:

1. THE 18 FT FENCE OFFSET FROM THE NB RAIL, PER CFOMA, CAN ONLY BE MET IF RIGHT OF WAY IS OBTAINED FROM FDOT, DISTRICT 5 RIGHT OF WAY WAS NOT CONSULTED IN THE PRODUCTION OF THESE CONCEPT PLANS.
2. PROPOSED PEDESTRIAN PATH CAN BE EXTENDED TO SR 414.

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			OAK R/W CHANNELIZATION & FENCING MITIGATION CONCEPT (5A)	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
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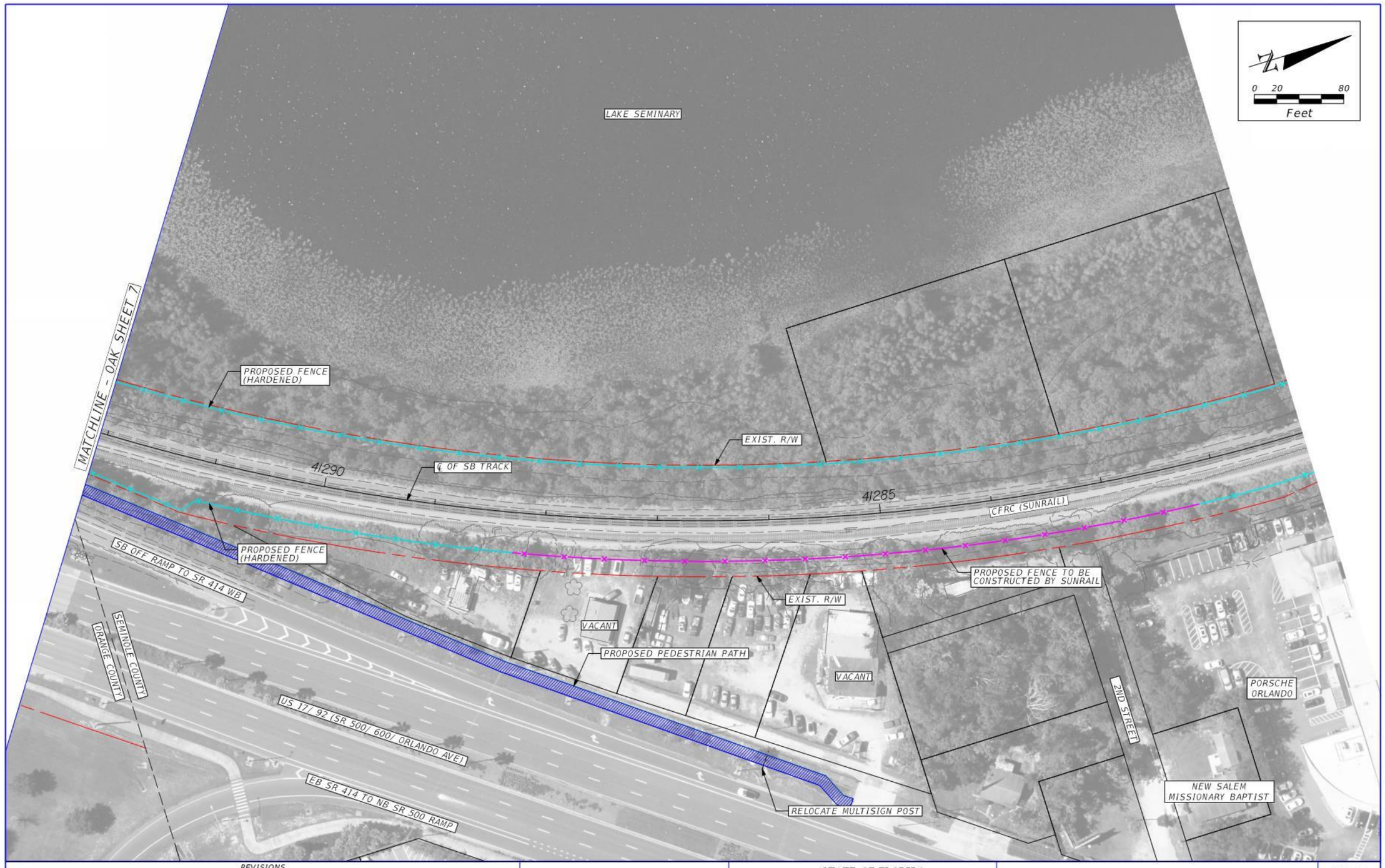

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DATE	DESCRIPTION	DATE	DESCRIPTION		ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
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REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
CFRC	ORANGE	439036-1-12-04

LAKE LILY
R/W CHANNELIZATION & FENCING
MITIGATION CONCEPT (7A)

SHEET NO. 9

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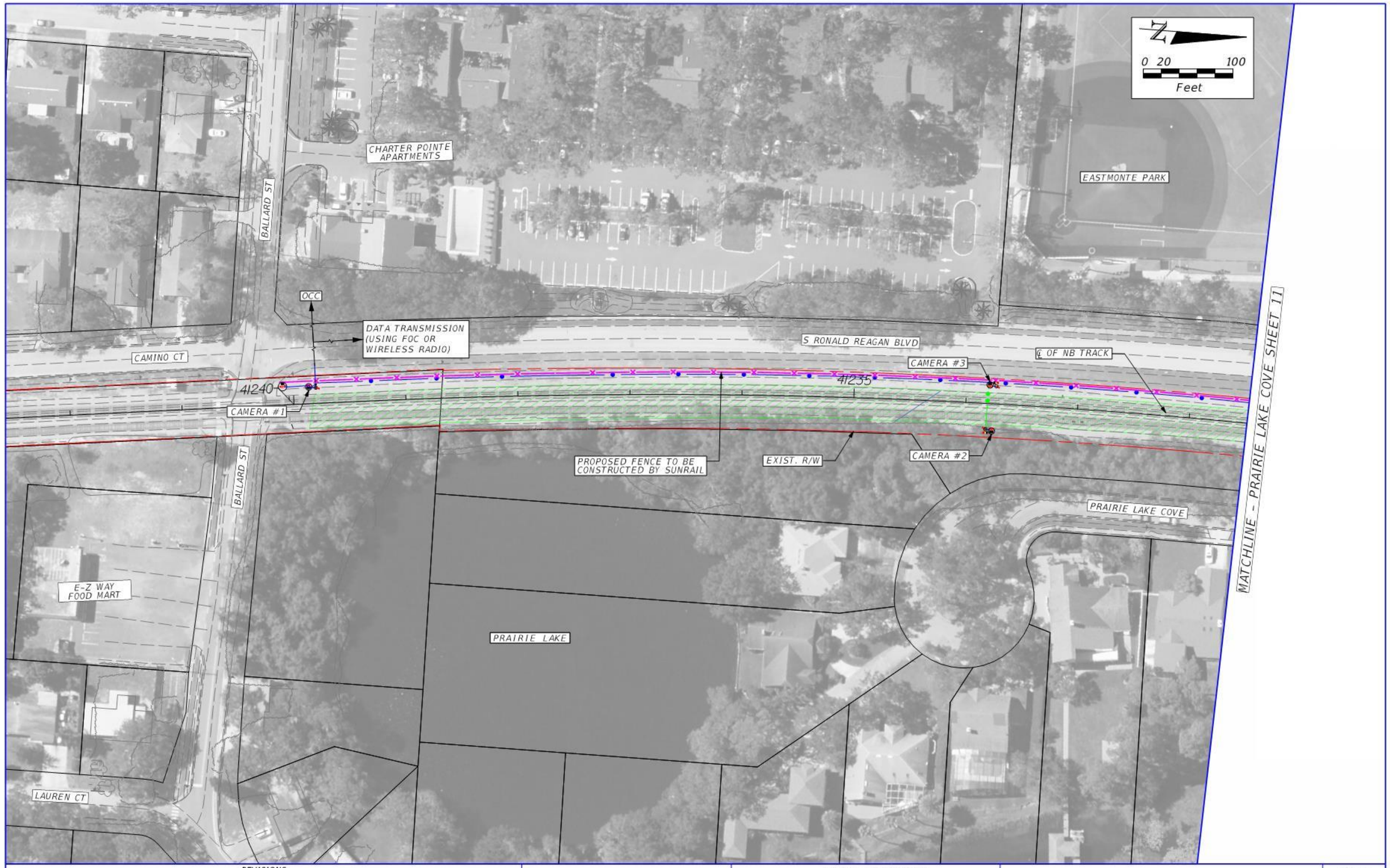

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
CFRC	SEMINOLE	439036-1-12-04

PRARIE LAKE COVE
INTELLIGENT R/W SAFETY SYS.
TRESPASSING MITIGATION (1B)

SHEET NO. 10

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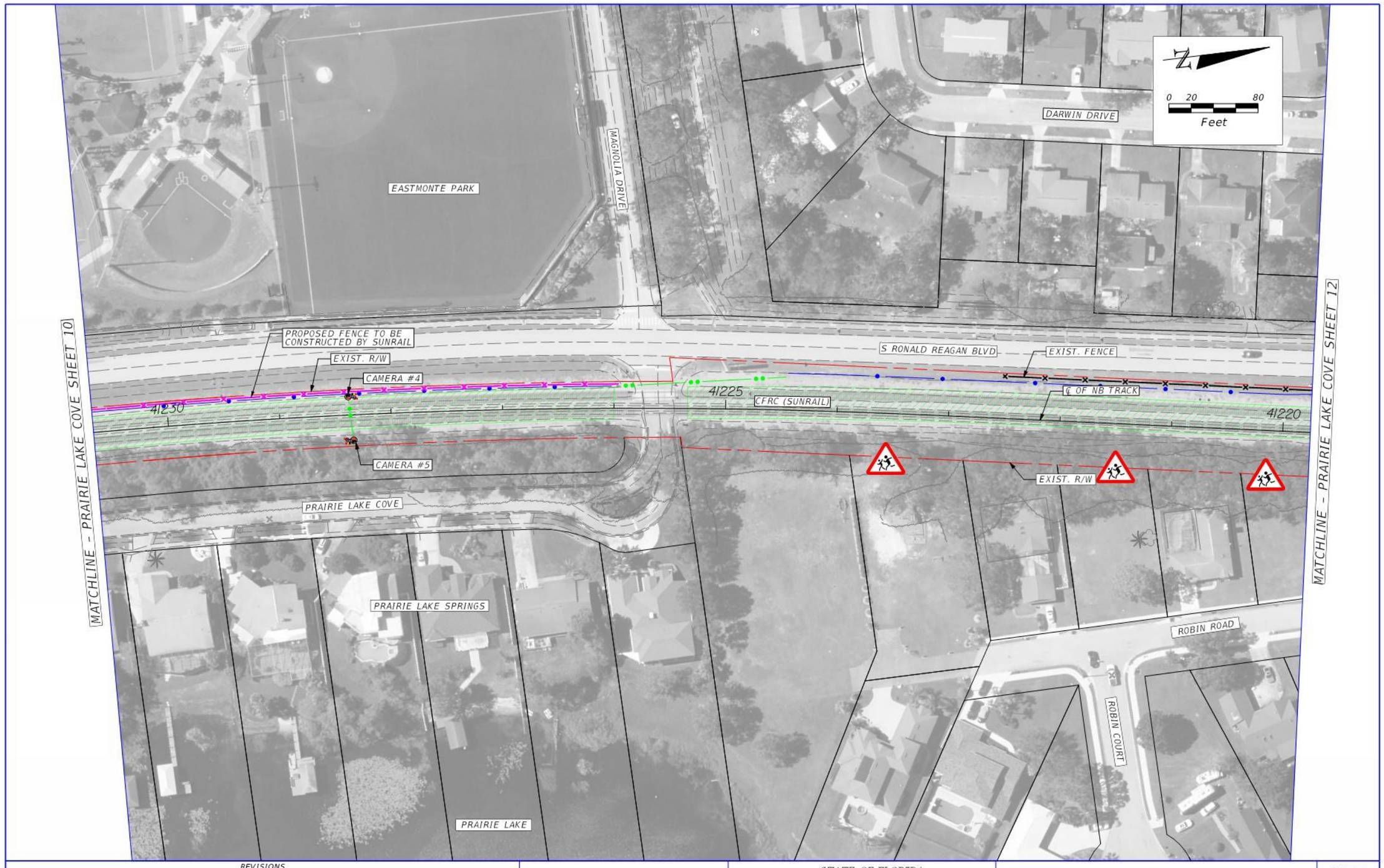

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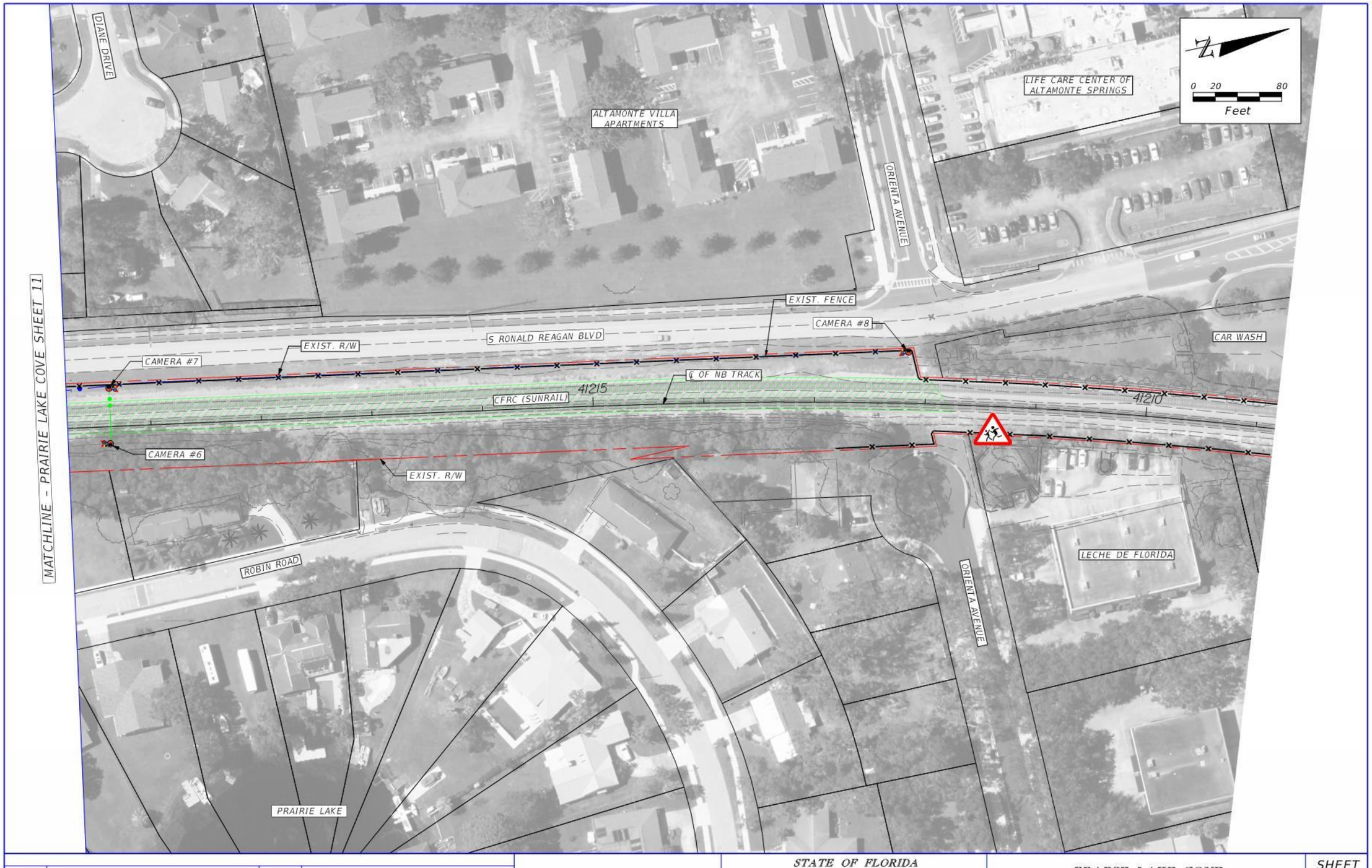

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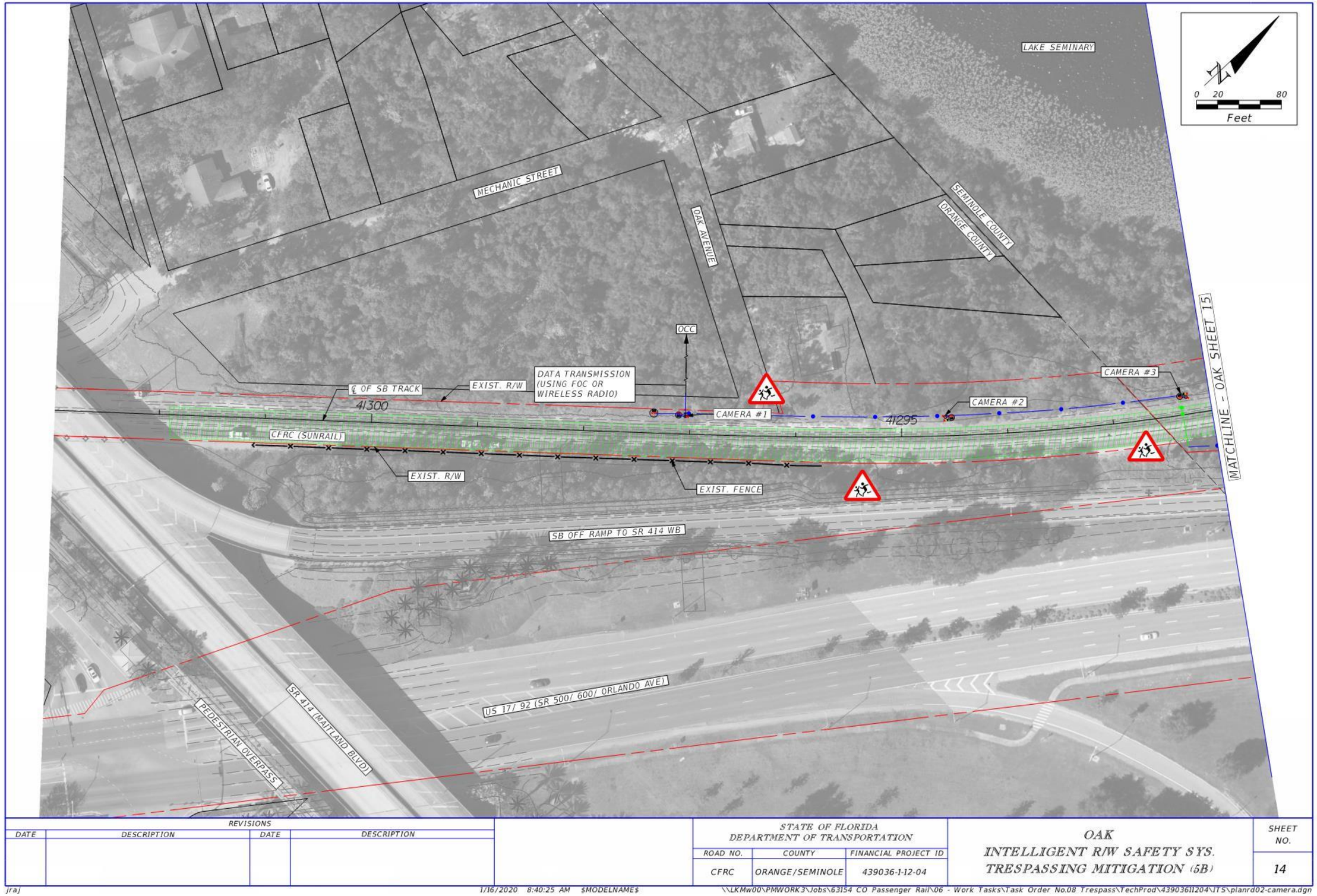
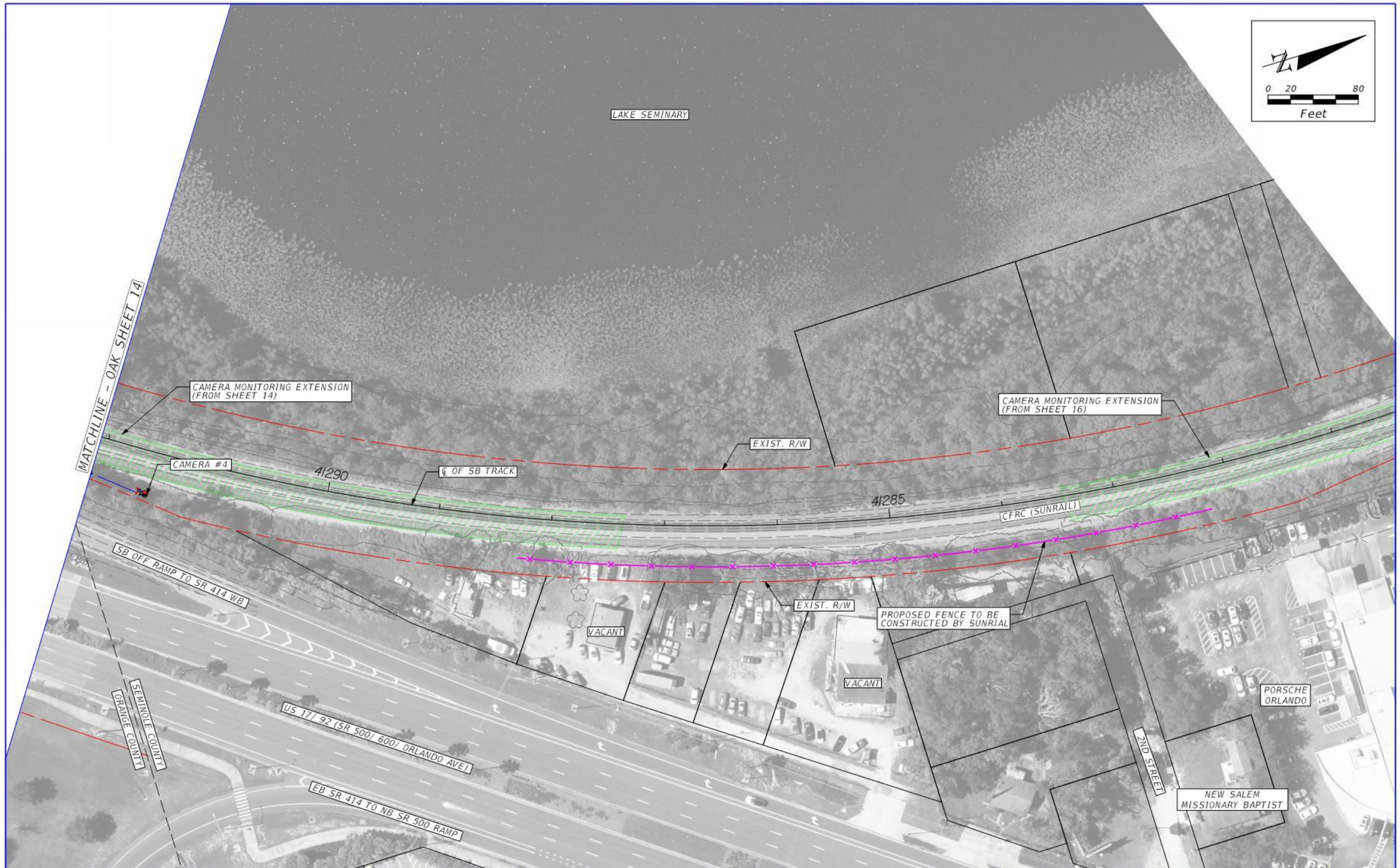


REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			OAK INTELLIGENT R/W SAFETY SYS. TRESPASSING MITIGATION (5B)	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
				CFRC	ORANGE/SEMINOLE	439036-1-12-04		14

jraj 1/16/2020 8:40:25 AM $MODELNAME$ \\LKMw00\PMWORK3\Jobs\63154 CO Passenger Rail\06 - Work Tasks\Task Order No.08 Trespass\TechProd\43903611204\ITS\planrd02-camera.dgn



REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
CFRC	ORANGE/SEMINOLE	439036-1-12-04

OAK
INTELLIGENT R/W SAFETY SYS.
TRESPASSING MITIGATION (6B)

SHEET NO. 15

jraj 1/16/2020 8:40:32 AM $MODELNAME$ \\LKMw00\PMWORK3\Jobs\63154 CO Passenger Rail\06 - Work Tasks\Task Order No.08 Trespass\TechProd\439036112O4\ITS\planrd02-camera.dgn

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			LAKE LILY INTELLIGENT R/W SAFETY SYS. TRESPASSING MITIGATION (7B)	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
				CFRC	ORANGE	439036-1-12-04		16

jraj 1/16/2020 8:40:39 AM $MODELNAME$ \\LKMw00\PMWORK3\Jobs\63154 CO Passenger Rail\06 - Work Tasks\Task Order No.08 Trespass\TechProd\43903611204\ITS\planrd02-camera.dgn

CHARTER POINT APPARTMENTS
BALLARD ST
EASTMONTE PARK
CAMINO CT
EXIST. R/W
S RONALD REAGAN BLVD
TRACK LIGHTING
℄ OF NB TRACK
41240
41235
MATCHLINE - PRAIRIE LAKE COVE SHEET 18
PROPOSED FENCE TO BE CONSTRUCTED BY SUNRAIL
BALLARD ST
TRACK LIGHTING
PRAIRIE LAKE COVE
E-Z WAY FOOD MART
PRAIRIE LAKE
LAUREN CT

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
CFRC	SEMINOLE	439036-1-12-04

PRAIRIE LAKE COVE
VISUAL TRACK WARNING SYS.
MITIGATION CONCEPT (1C)

SHEET NO.
17

jraj 1/16/2020 8:40:47 AM $MODELNAME$ \\LKMw00\PMWORK3\Jobs\63154 CO Passenger Rail\06 - Work Tasks\Task Order No.08 Trespass\TechProd\43903611204\ITS\planrd03-track lighting.dgn

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			PRAIRIE LAKE COVE VISUAL TRACK WARNING SYS. MITIGATION CONCEPT (2C)	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
				CFRC	SEMINOLE	439036-1-12-04		18

jraj 1/16/2020 8:40:54 AM $MODELNAME$ \\LKMw00\PMWORK3\Jobs\63154 CO Passenger Rail\06 - Work Tasks\Task Order No.08 Trespass\TechProd\43903611204\ITS\planrd03-track lighting.dgn

DIANE DRIVE
ALTAMONTE VILLA APARTMENTS
LIFE CARE CENTER OF ALTAMONTE SPRINGS
ORIENTA AVENUE
N
0 20 80
Feet
MATCHLINE - PRAIRIE LAKE COVE SHEET 18
EXIST. FENCE
EXIST. R/W
S RONALD REAGAN BLVD
TRACK LIGHTING
CAR WASH
℄ OF NB TRACK
CFRC (SUNRAIL)
41215
41210
EXIST. R/W
TRACK LIGHTING
ROBIN ROAD
LECHE DE FLORIDA
ORIENTA AVENUE
PRAIRIE LAKE

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
CFRC	SEMINOLE	439036-1-12-04

PRAIRIE LAKE COVE
VISUAL TRACK WARNING SYS.
MITIGATION CONCEPT (3C)

SHEET NO. 19

jraj 1/16/2020 8:41:02 AM $MODELNAME$ \\LKMw00\PMWORK3\Jobs\63154 CO Passenger Rail\06 - Work Tasks\Task Order No.08 Trespass\TechProd\43903611204\ITS\planrd03-track lighting.dgn

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
CFRC	SEMINOLE	439036-1-12-04

PORSCHE
VISUAL TRACK WARNING SYS.
MITIGATION CONCEPT (4C)

SHEET NO.
20

jraj 1/16/2020 8:41:09 AM $MODELNAME$ \\LKMw00\PMWORK3\Jobs\63154 CO Passenger Rail\06 - Work Tasks\Task Order No.08 Trespass\TechProd\43903611204\ITS\planrd03-track lighting.dgn

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			OAK VISUAL TRACK WARNING SYS. MITIGATION CONCEPT (5C)	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
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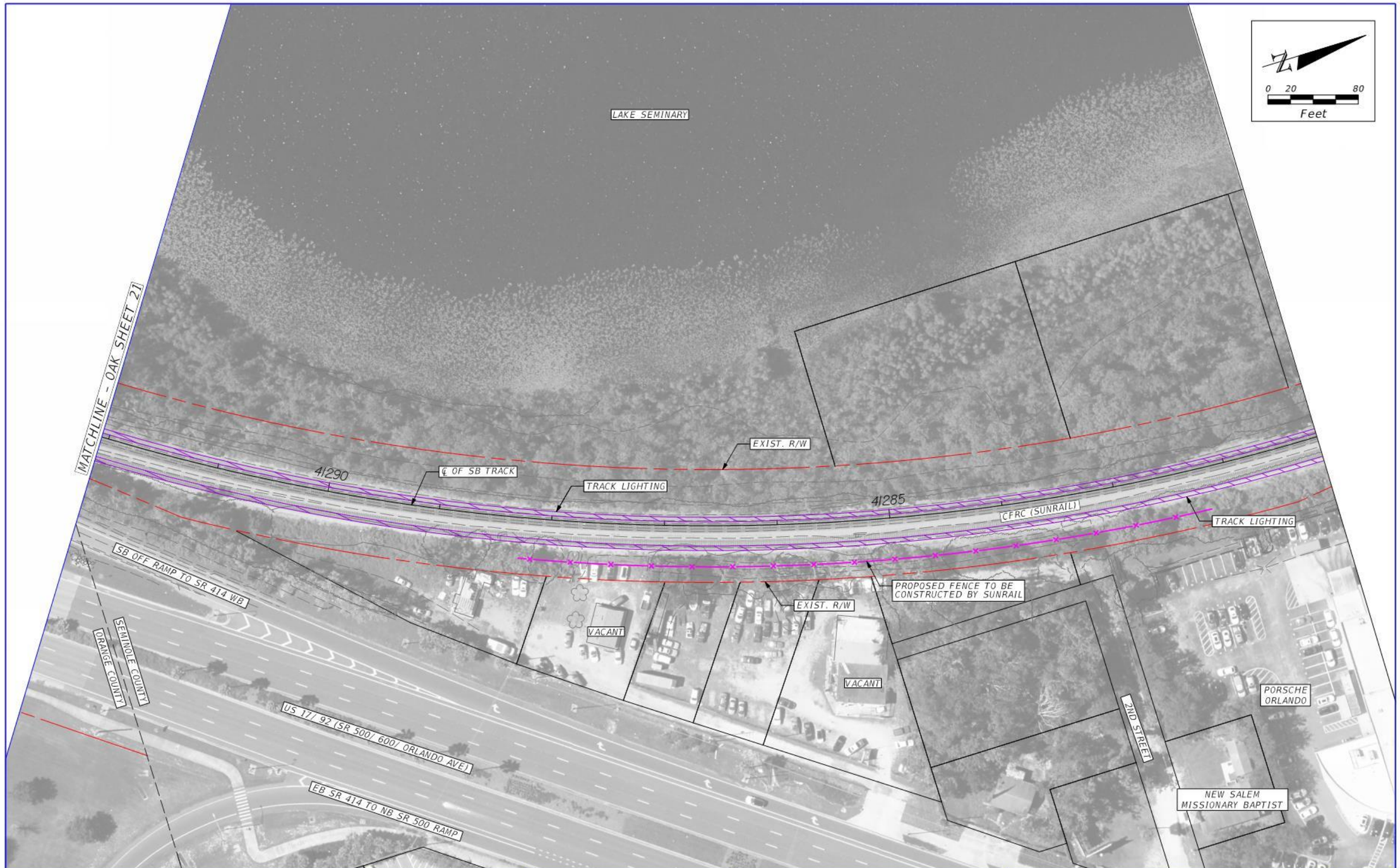

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
CFRC	ORANGE/SEMINOLE	439036-1-12-04

OAK
VISUAL TRACK WARNING SYS.
MITIGATION CONCEPT (6C)

SHEET NO. 22

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REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			LAKE LILY VISUAL TRACK WARNING SYS. MITIGATION CONCEPT (7C)	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
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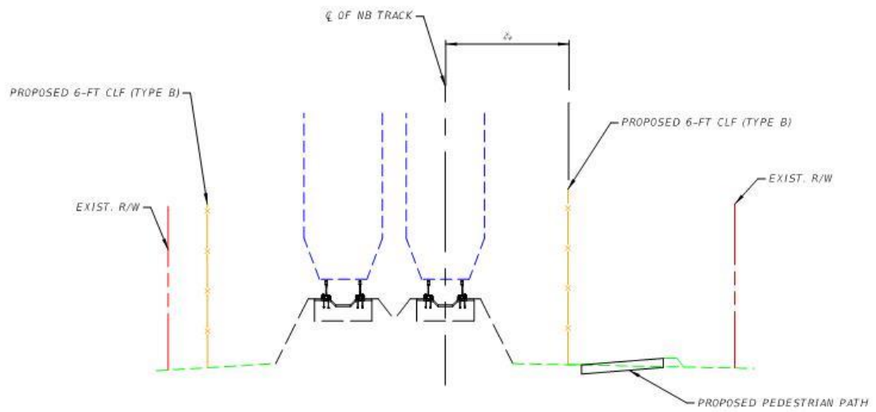
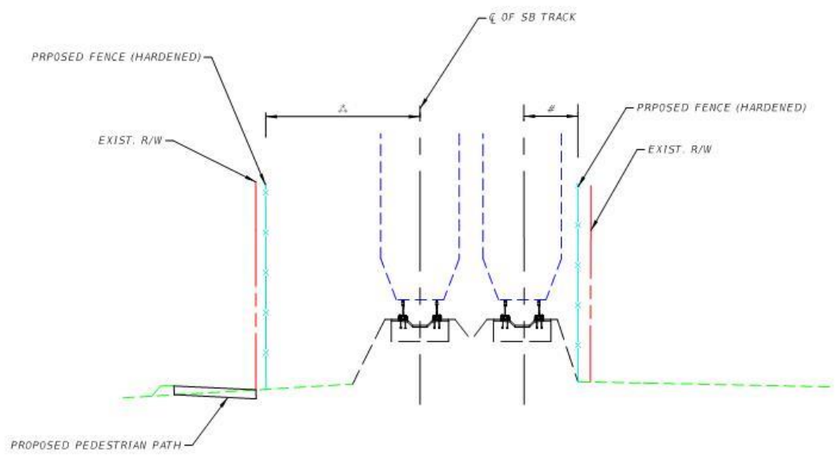


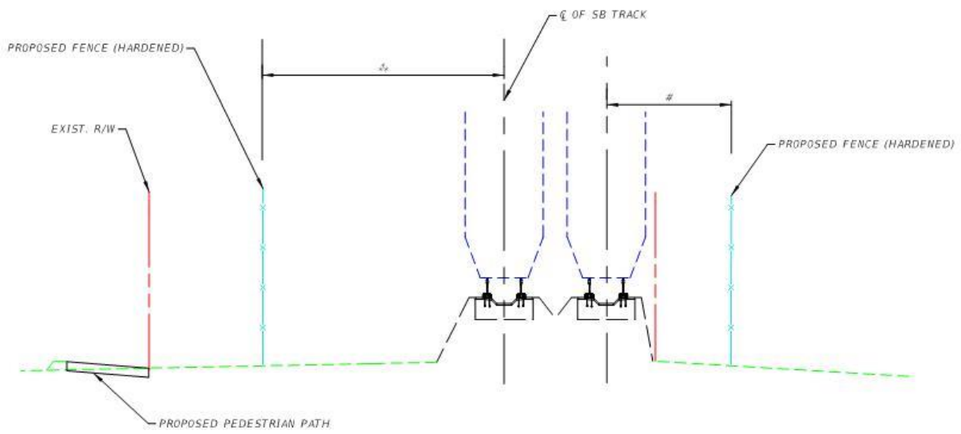
PRAIRE LAKE COVE TYPICAL
N.T.S.

⁂ 18-FT MINIMUM CLEARANCE FROM ℄ OF NB TRACK



PORSCHE TYPICAL
N.T.S.

⁂ 18-FT MINIMUM CLEARANCE FROM ℄ OF SB TRACK
18-FT MINIMUM CLEARANCE FROM ℄ OF NB TRACK CANNOT BE MET DUE TO RIGHT OF WAY CONSTRAINTS



OAK TYPICAL
N.T.S.

⁂ 18-FT MINIMUM CLEARANCE FROM ℄ OF SB TRACK
THE 18-FT FENCE OFFSET FROM THE NB RAIL, PER COMA, CAN ONLY BE MET IF RIGHT OF WAY IS IS OBTAINED FROM FDOT. DISTRIC 5 RIGHT OF WAY WAS NOT CONSULTED IN THE PRODUCTION OF OF THESE PLANS.

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

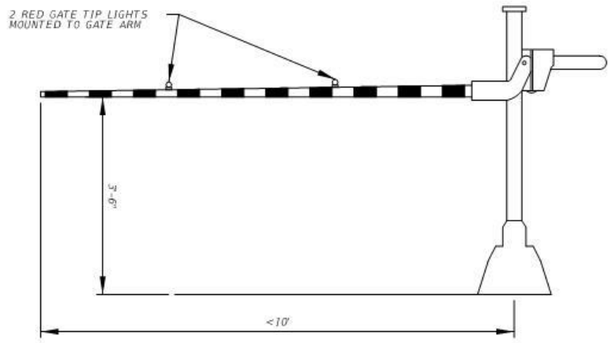
STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
CFRC	ORANGE/SEMINOLE	439036-1-12-04

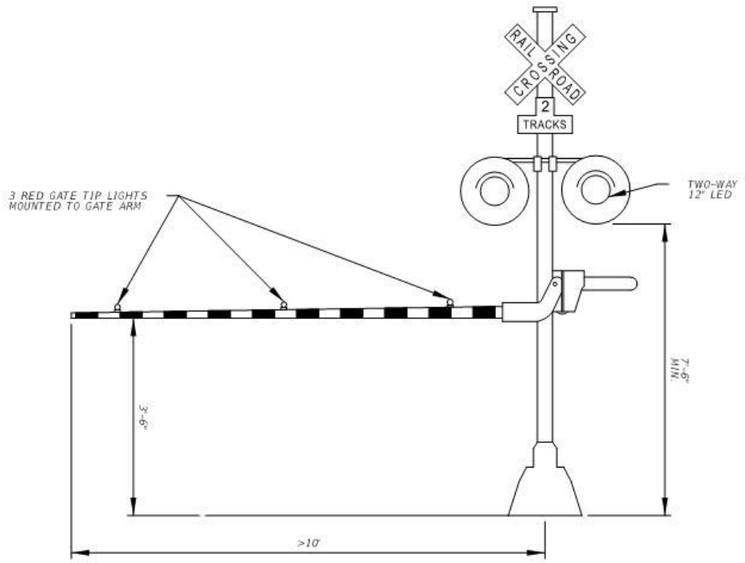
PEDESTRIAN PATH TYPICAL

SHEET NO. 24

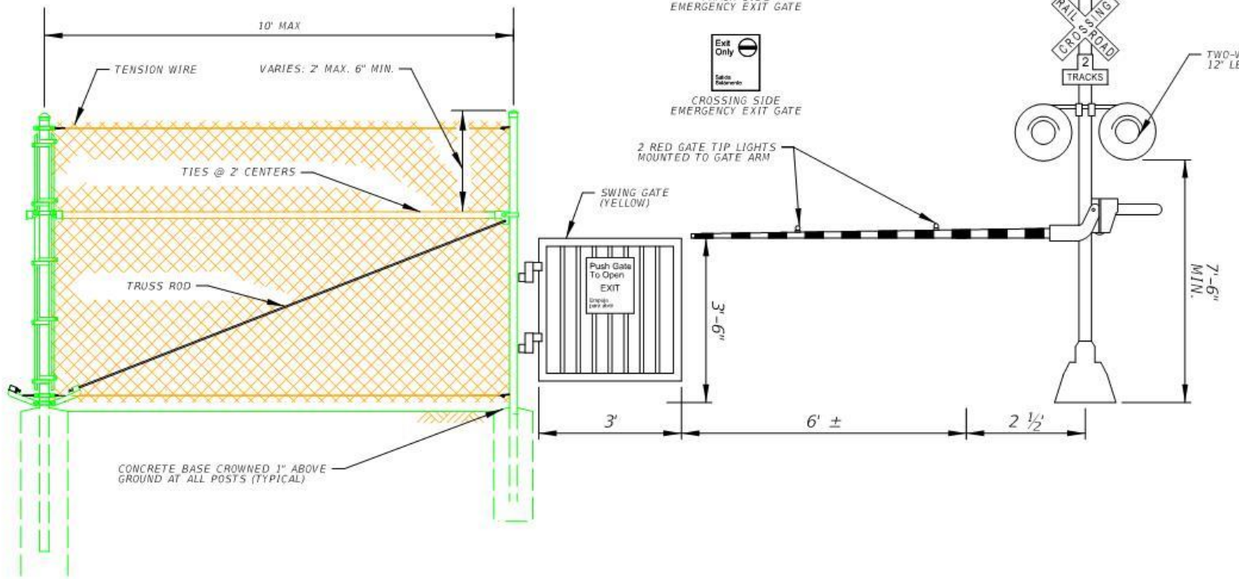
jraj 1/16/2020 8:41:40 AM $MODELNAME$ \\LKMw00\PMWORK3\Jobs\63154 CO Passenger Rail\06 - Work Tasks\Task Order No.08 Trespass\TechProd\439036112O4\ITS\TYPICAL.dgn



SHORT MAST PEDESTRIAN GATE TYPICAL



STANDARD PEDESTRIAN GATE TYPICAL (WITH TALL MAST, FLASHERS, CROSSBUCK, AND TRACK NUMBER SIGN)



PROPOSED 6-FT CHAINLINK WITH PEDESTRIAN GATE TYPICAL

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

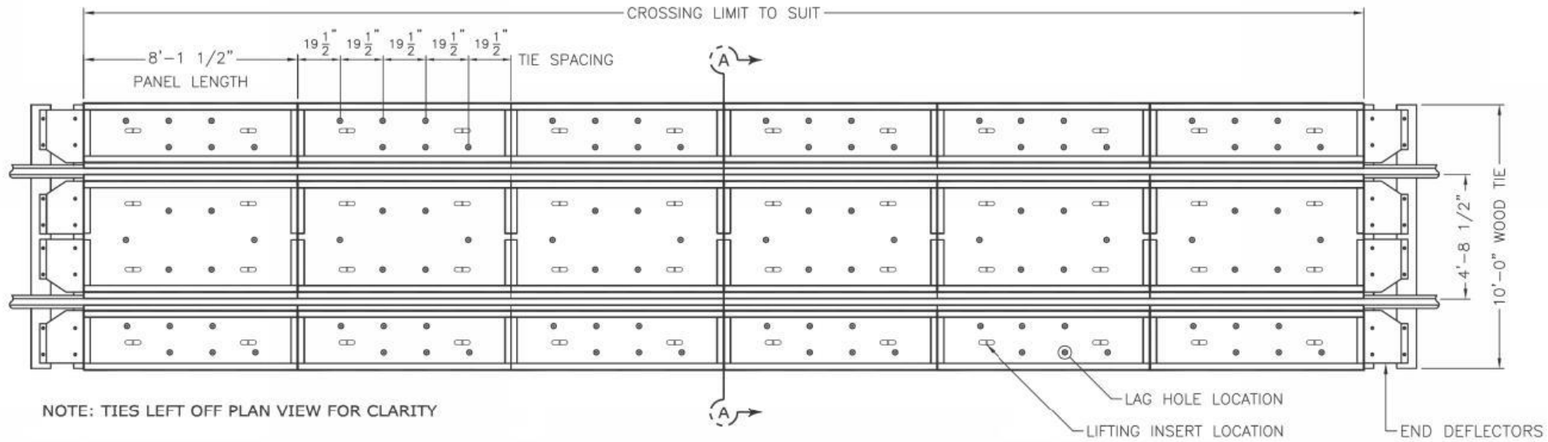
STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
CFRC	ORANGE/SEMINOLE	439036-1-12-04

PEDESTRIAN CROSSING GATE DETAIL

SHEET NO. 25

jraj 1/16/2020 8:41:41 AM $MODELNAME$ \\LKMw00\PMWORK3\Jobs\63154 CO Passenger Rail\06 - Work Tasks\Task Order No.08 Trespass\TechProd\439036112041TS\TYPICAL.dgn



NOTE: TIES LEFT OFF PLAN VIEW FOR CLARITY

CROSSING PLAN VIEW

MATERIAL SPECIFICATIONS:

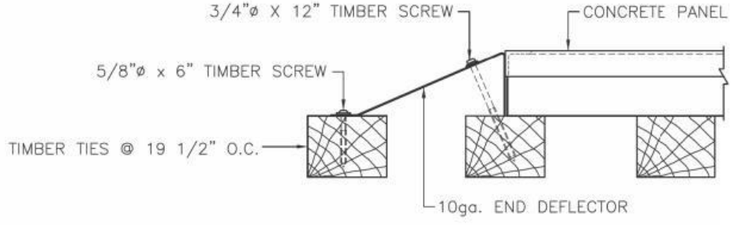
1. STRUCTURAL STEEL SHALL CONFORM TO ASTM A–36 SPECIFICATIONS. WELDING TO BE PER AWS CODE.
2. REINFORCING STEEL SHALL CONFORM TO CURRENT ASTM A706 SPECIFICATION, GRADE 60.
3. 3/16"ø WEEP HOLES SHALL BE PLACED EVERY 2–FT. MIN. ALONG THE TOP OF THE STEEL FRAME ALONG A LINE 3/4" FROM OUTSIDE EDGE.
4. CONCRETE MATERIAL MIXING, PLACING AND CURING TO BE IN ACCORDANCE WITH PCI "MANUAL FOR QUALITY CONTROL: PRECAST AND PRESTRESSED CONCRETE." MANUAL 115, EDITION 4. CEMENT SHALL HAVE NO MORE THAN 0.6% TOTAL ALKALI CONTENT. MAXIMUM WATER/ CEMENT RATIO = 0.44 (BY WEIGHT). AIR ENTRAINMENT = 6%±1% IN PLASTIC CONCRETE. SLUMP 8" MAXIMUM.
5. TOP SURFACE SHALL BE NON–CRACK DESIGN AND IS TO BE SEALED TO PREVENT ION MIGRATION DUE TO SALTING.
6. CONCRETE COMPRESSIVE STRENGTH SHALL BE AS FOLLOWS:
   @28 DAYS = 6000psi MINIMUM
   @REMOVAL FROM FORMS = 2500psi MINIMUM
7. PANEL REINFORCEMENT TO MEET AASHTO HS–20 LOADING SPECIFICATION WITH 30% IMPACT INCREMENT.
8. EACH PANEL TO HAVE TWO 2–TON MINIMUM LIFTING HOOKS, 1/2"ø MIN. HOT–DIPPED GALV.
9. ALL EXPOSED SURFACES OF STEEL ANGLE FRAME TO HAVE ONE COAT RUST INHIBITIVE COATING

TOLERANCES:

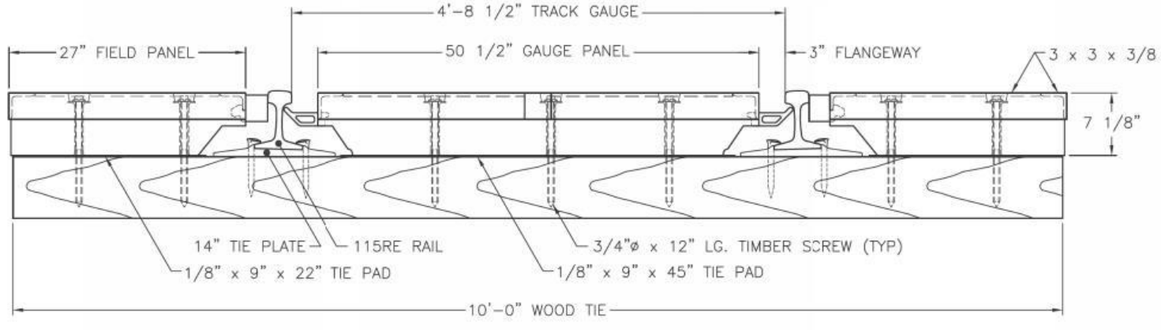
1. OUT OF SQUARE 3/16" (MEASURED ALONG DIAGONAL)
2. LENGTH, WIDTH, AND THICKNESS: ±1/8"
3. REINFORCEMENT PLACEMENT SHALL BE ±1/2" HORIZONTAL, ±1/4" VERTICAL
4. THE BOTTOM SURFACE, WHICH WILL BE IN CONTACT WITH THE TIES, SHALL NOT UNDULATE IN ANY DIRECTION MORE THAN 3/32".
5. LAG SCREW LOCATION TOLERANCE: ±1/2" IN ANY DIRECTION.
6. LIFTING POCKET LOCATION TOLERANCE: ±1" IN ANY DIRECTION.
7. RUBBER LENGTH TOLERANCE: +0, –1/8" OF ADJACENT PANEL ENDS.

RUBBER PROPERTIES:

1. TENSILE STRENGTH: 2000psi MINIMUM (ASTM D412)
2. HARDNESS SHORE A: 65 ± 5 DUROMETER (ASTM D2240)
3. ELONGATION AT BREAK: 400% MINIMUM (ASTM D412)



END DEFLECTOR DETAIL
4 x SCALE



SECTION A–A (4 x SCALE)

Rev. No.	Description	By	Date

OMNI PRODUCTS INC
P.O. BOX 15319 PORTLAND, OREGON 97214

CSX STANDARD HEAVY DUTY GRADE CROSSING SYSTEM

TYPICAL XING PLAN & SECTION VIEWS, 115RE RAIL, 10' TIMBER TIES, 8'–1 1/2" PANEL LENGTH

Date: 05–04–06 By: MTL Plot Scale: 1=25
Approved: Dwg. No. 10–1284–00

REVISIONS			
DATE	DESCRIPTION	DATE	DESCRIPTION

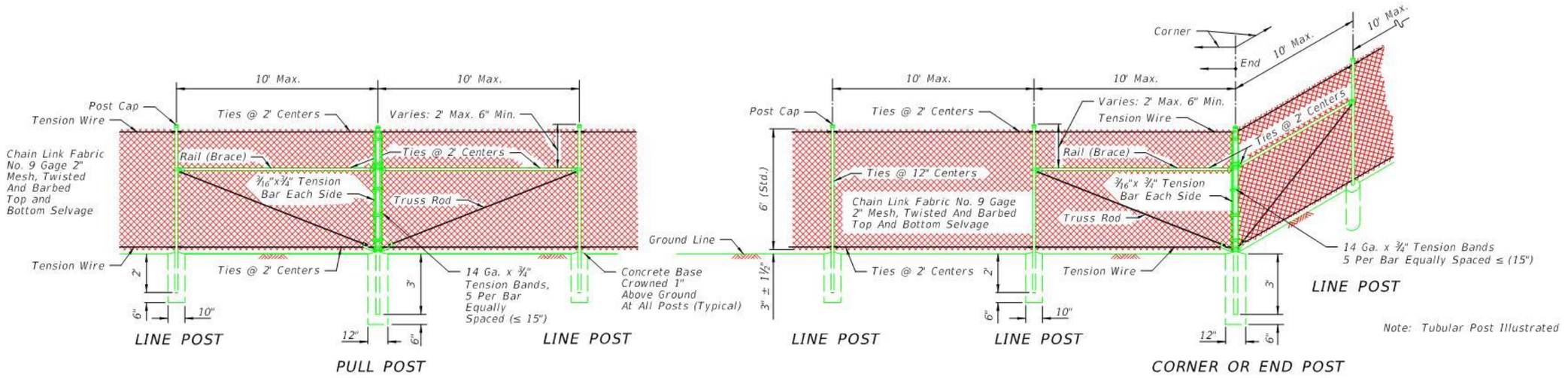
STATE OF FLORIDA
DEPARTMENT OF TRANSPORTATION

ROAD NO.	COUNTY	FINANCIAL PROJECT ID
CFRC	ORANGE/SEMINOLE	439036-1-12-04

CONCRETE GRADE CROSSING DETAIL

SHEET NO. 26

jraj 1/16/2020 8:41:42 AM $MODELNAME$ \\LKMw00\PMWORK3\Jobs\63154 CO Passenger Rail\06 - Work Tasks\Task Order No.08 Trespass\TechProd\439036111204\ITS\TYPICAL.dgn



GENERAL NOTES

1. This fence to be used generally in urban areas.

2. For supplemental information refer to Specification 550.

3. Chain link fabric, post, truss rods, tension wires, tie wires, stretcher bars, gates and all miscellaneous fittings and hardware shall meet the requirements of AASHTO and ASTM signify current reference.

4. Fence Component Options:

   A. Line post options:
   - (1) Galvanized steel pipe, Schedule 40– 1½" nominal dia. zinc galvanized at the rate of 1.8 oz./ft².: ASTM A53 Table 2 (Grade A or B), ASTM F1083, and AASHTO M111.
   - (2) Aluminum coated steel pipe: ASTM A53, Table 2 (Grade A or B): Schedule 40– 1½" nominal dia., 1.90" OD; coated at the rate 0.40 oz./ft.: AASHTO M111.
   - (3) Aluminum alloy pipe– 2" nominal dia.: ASTM B241 or B221, Alloy 6063, T6.
   - (4) Steel H-Beam– 1⅞"x 1⅜": Zinc Galv. 1.8 oz./ft.: AASHTO M111 and Detail.
   - (5) Aluminum alloy H–Beam– 1⅞"X 1⅜" Detail.
   - (6) Steel C– 1⅞"X 1⅝": Galv.: 1.8 oz/ft. zinc: AASHTO M111; OR , 0.9 oz./ft². zinc–5% aluminum–mischmetal: ASTM F1043 and Detail.
   - (7) Resistance welded steel pipe; 50,000 psi min. yield strength ASTM A569/A569M, A653/A653M or undepleted stock of discontinued A446/A446M base materials; ASTM F669 Group IV (Alternative Design); fence industry 2" OD, 1½" NPS, 1.900" dec. equiv., 0.120" min. wall thick. and min. wt. 2.28 lb./ft.; with ASTM F1043 metric equivalent internal coating Types A, B, C or D and external coating Types A, B, or C; the chromate conversion coating of external Type B shall have a thickness of 15µg/in². min. and the polymer film topcoat shall have a thickness of 0.0003" min.; internal and external coatings are not restricted to the combinations of Table 2, ASTM F1043.

   B. Corner, end, and pull post options:
   - (1) Galvanized steel pipe, Schedule 40– 2" nominal dia. zinc galvanized at the rate of 1.8 oz./ft².: ASTM A53 Table X 2, ASTM F1083, and AASHTO M111.
   - (2) Aluminum coated steel pipe: ASTM A53 steel, X 2 Tables: Schedule 40; 2" nominal dia., 2.375" OD; coated at the rate 0.40 oz./ft.: AASHTO M111.
   - (3) Aluminum alloy pipe– 2½" nominal dia.: ASTM B241 or B221, Alloy 6063,T6.
   - (4) Resistance welded steel pipe; 50,000 psi min. yield strength ASTM A569/A569M, A653/A653M or undepleted stock of discontinued A446/A446M base materials; ASTM F669 Group IV (Alternative Design); fence industry 2½" OD, 2" NPS, 2.375" dec. equiv., 0.130"min. wall thick. and min. wt. 3.117 lb./ft.; with ASTM F1043 metric equivalent internal coating Types A, B, C or D and external coating Types A, B, or C; the chromate conversion coating of external Type B shall have a thickness of 15µg/in². min. and the polymer film topcoat shall have a thickness of 0.0003" min.; internal and external coatings are not restricted to the combinations of Table 2, ASTM F1043.

   C. Rail options:
   - (1) Galvanized steel pipe, Schedule 40– 1¼" nominal dia. zinc galvanized at the rate of 1.8 oz./ft².: ASTM A53 Table X 2, ASTM F1083, and AASHTO M111.
   - (2) Aluminum coated steel pipe; ASTM A53 steel, X 2 Tables Schedule 40; 1¼" nominal dia., 1.660" OD; coated at the rate 0.40 oz./ft.: AASHTO M111.
   - (3) Aluminum alloy pipe– 1¼" nominal dia.: ASTM B241 or B221, Alloy 6063, T6.
   - (4) Resistance welded steel pipe; 50,000 psi min. yield strength ASTM A569/A569M, A653/A653M or undepleted stock of discontinued A446/A446M base materials; ASTM F669 Group IV (Alternative Design); fence industry 1⅝" OD, 1¼" NPS, 1.660" dec. equiv., 0.111" min. wall thick. and min. wt. 1.836 lb./ft.; with ASTM F1043 metric equivalent internal coating Types A, B, C or D and external coating Types A, B, or C; the chromate conversion coating of external Type B shall have a thickness of 15µg/in². min. and the polymer film topcoat shall have a thickness of 0.0003" min.; internal and external coatings are not restricted to the combinations of Table 2, ASTM F1043.

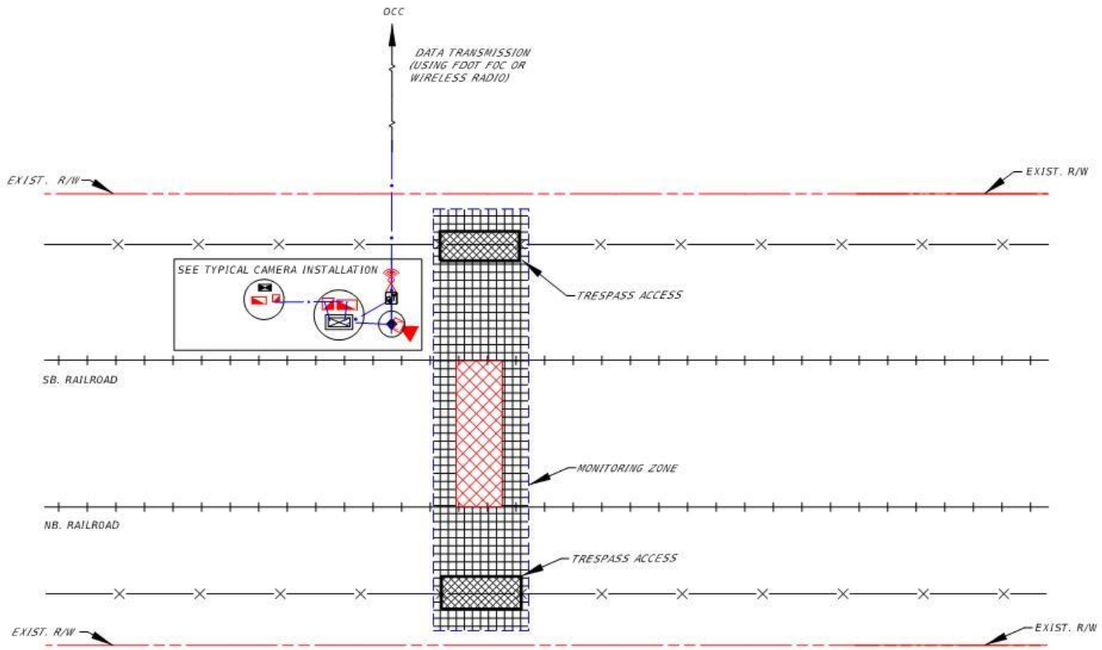
   D. Chain link fabric options (2" mesh with twisted and barbed selvage top and bottom for all options except as described in Note 10):
   - (1) AASHTO M181 Type I – Zinc Coated Steel, No. 9 gage (coated wire diameter), coated at the rate of 1.8 oz/ft². (M181 Class D 2.0 oz./ft². modified to 1.8 oz./ft².).
   - (2) AASHTO M181 Type II –Aluminum Coated Steel, No. 9 gage (coated wire diameter), coated at the rate of 0.40 oz./ft².
   - (3) AASHTO M181 Type IV– Polyvinyl Chloride (PVC) Coated Steel, No. 9 gage (coated core wire diameter), core wire–zinc coated steel. PVC coating: M181 Class A (either extruded or extruded and bonded) or Class B (bonded). See table right. Unless the plans call for M181 standard colors medium green, dark green or black the coating color shall be soft gray matching that of No. 36622 of Federal Standard 595a.

   E. Tension wire options:
   - (1) Steel wire No. 7 gage zinc galvanized at the rate of 1.2 oz./ft².: AASHTO M181.
   - (2) Aluminum alloy wire with a diameter of 0.1875" or larger conforming to the requirements of ASTM B211, Alloy 5056 Temper H38, or, Alclad Alloy 5056 Temper H192.
   - (3) Aluminum coated steel wire No.7 gage coated at the rate of 0.040 oz./ft².: AASHTO M181.

   F. Tie wire and hog ring options:
   - (1) Steel wire No.9 gage zinc galvanized at the rate of 1.2 oz./ft².
   - (2) Aluminum alloy wire with a diameter of 0.1443" or larger conforming to the requirements of ASTM B211, Alloy 5056 Temper H38, or, Alclad Alloy 5056 Temper H192.
   - (3) Aluminum coated steel wire No. 7 gage coated at the rate of 0.040 oz./ft².

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			6 FT CHAINLINK (TYPE B) FENCE DETAIL	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
				CFRC	ORANGE/SEMINOLE	439036-1-12-04		27

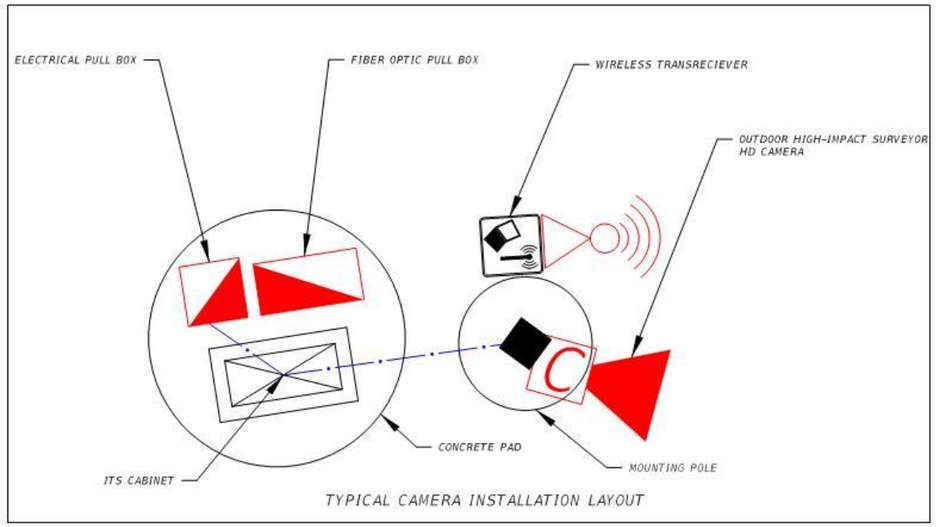
jraj 1/16/2020 8:41:50 AM $MODELNAME$ \\LKMw00\PMWORK3\Jobs\63154 CO Passenger Rail\06 - Work Tasks\Task Order No.08 Trespass\TechProd\43903611204\ITS\TYPICAL.dgn



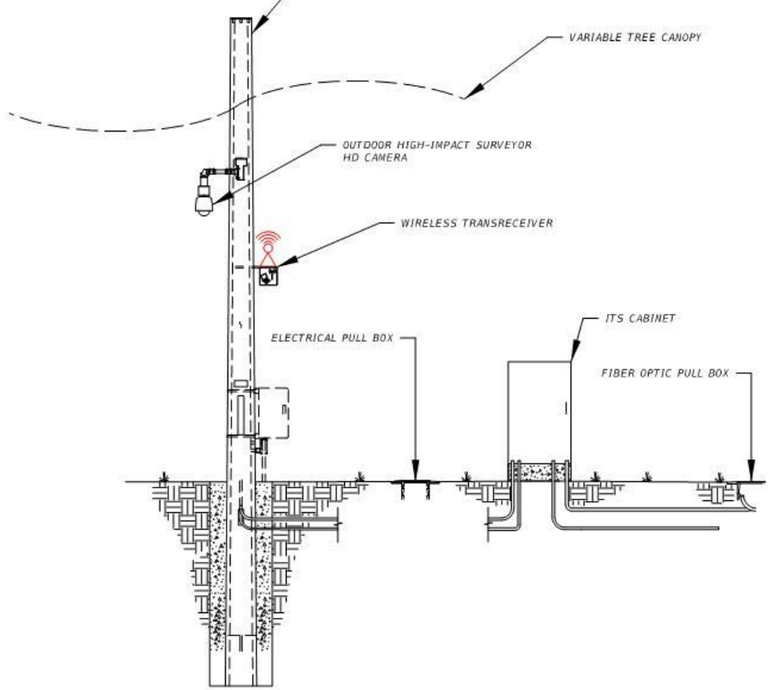
CONCEPTUAL MONITORING TYPICAL

PROPOSED CONCEPT OF OPERATION

DETECTION OF TRIGGER EVENT → SYSTEM RECORD (10 FPS FOR 5 SEC) WITH TIME STAMP → DATA TRANSMISSION (USING FDOT FOC OR WIRELESS RADIO) → OPERATIONAL CONTROL CENTER



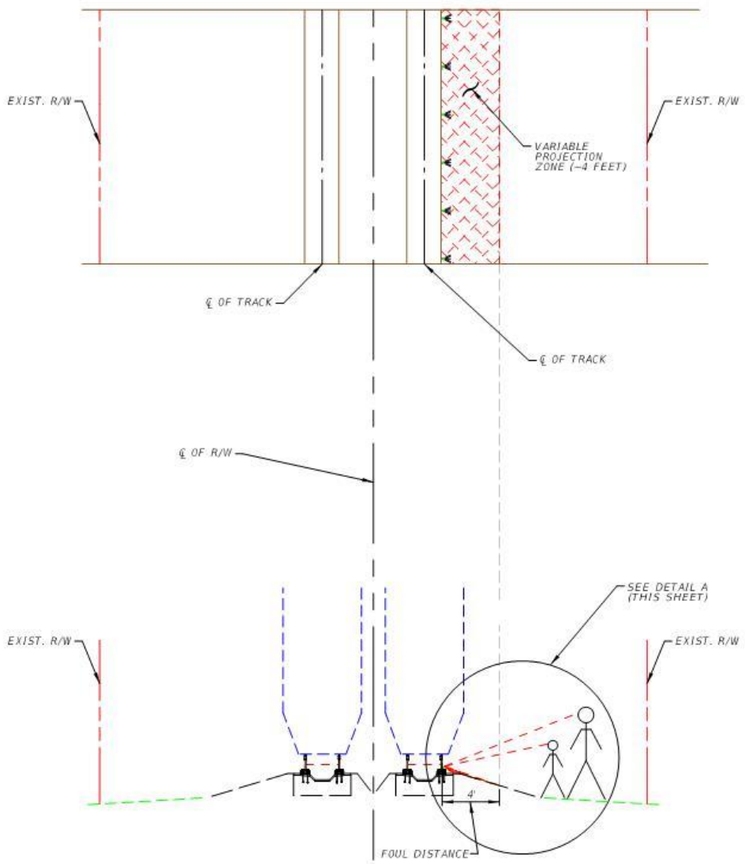
TYPICAL CAMERA INSTALLATION LAYOUT



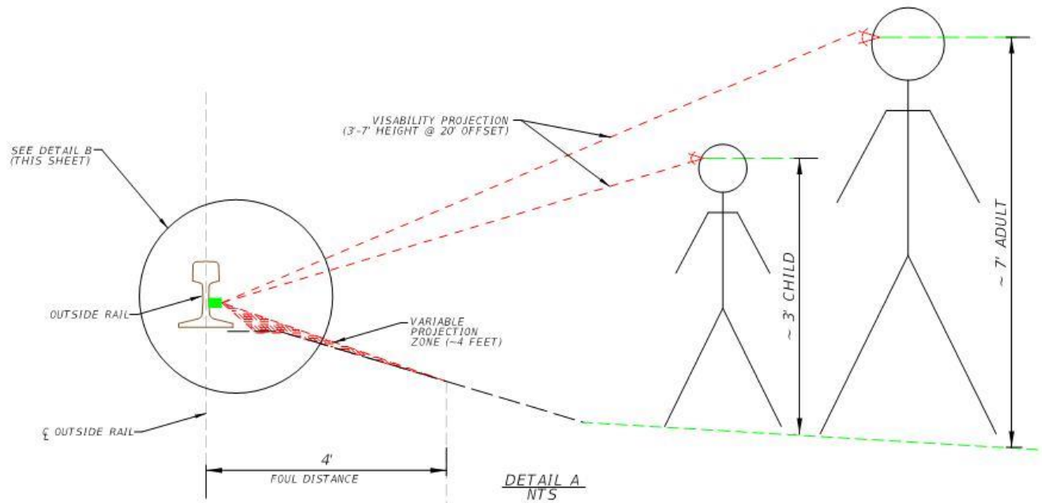
CCTV POLE ASSEMBLY

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			CCTV CONCRETE POLE DETAIL	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
				CFRC	ORANGE/SEMINOLE	439036-1-12-04		28

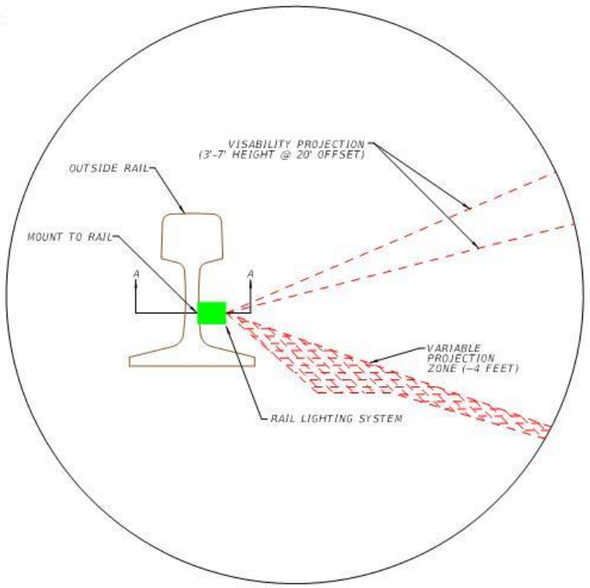
jraj 1/16/2020 8:41:51 AM $MODELNAME$ \\LKMw00\PMWORK3\Jobs\63154 CO Passenger Rail\06 - Work Tasks\Task Order No.08 Trespass\TechProd\439036112O4\ITS\TYPICAL.dgn



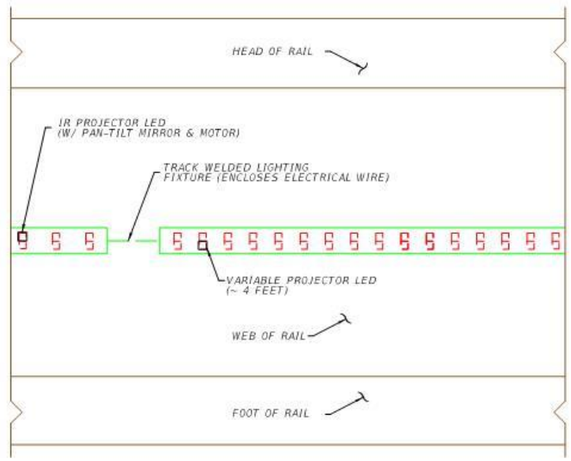
GENERAL CROSS SECTION
NTS



DETAIL A
NTS



DETAIL B
NTS



A - A

REVISIONS				STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION			CONCEPTUAL RAIL LIGHTING SYSTEM	SHEET NO.
DATE	DESCRIPTION	DATE	DESCRIPTION	ROAD NO.	COUNTY	FINANCIAL PROJECT ID		
				CFRC	ORANGE/SEMINOLE	439036-1-12-04		29

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Appendix A-3 Researched Mitigation Technologies

Potential Mitigations Methods

Detection and Surveillance System

A CCTV system can alert law enforcement or track operators to respond to trespassing events. CCTV cameras can be set up in several locations including:

- **Fixed** cameras at key locations can provide security and deterrent. Key areas include: stations, at-grade crossings, bridges, and identified hot spots. Cameras improve data reporting and prevention and when utilized in conjunction with a speaker system, the trespasser can be alerted via an alarm or other audible warning. Fixed cameras can have blind spots and can be avoided by trespassers. Other transportation systems (limited access expressways) are moving to complete Right of Way coverage with their CCTV systems.
- **Drones** can provide a mobile camera platform that can be used during significant events, or to monitor critical locations. A drone can move to provide different angles and limit the ability of trespassers to avoid known camera locations; however, flying drones can be unnerving to local businesses and residents as the scope of the surveillance and owner of the drone is not clearly understood or known. Currently, regulatory rules prohibiting the recording of individuals and flights close to airports, and limiting flights to within the line of sight of the operator restrict the widespread application of the drones.

Many CCTV systems exist off the shelf and include data storage and evaluation algorithms. System monitoring can be done by an individual or through the use of algorithms that will identify potential events. Artificial Intelligence algorithms can use the video Infrastructure to watch for, recognize, and understand trespassing events in real-time. The algorithm can be coupled with a live alert system that sends trespassing alerts to the designated destination.

Detectors and Sensors

Use of detectors and sensors automatically detects the presence of vehicles and trespassers. The sensors can be used to alert authorities, or trespassers and motor vehicles by activating an audible and visual system to alert them that they are trespassing. Sensor technologies can include fiber optic, magnetometer, radar, camera and infrared. Details on fiber optic cabling and magnetometer are below:

<u>Fiber Optic</u>

Fiber Optic Acoustic Detection (FOAD) has been utilized for security in other industries, especially in the oil and gas sectors. In many cases, there already exists multicore, single-mode fibers that are buried along rail Rights of Way as part of different regions'

telecommunication networks. It is common practice among telecommunications operators to install more cores than are needed. It is often possible to use one of these dark strands to enable a fiber optic-based detection system. This technology uses a process called Rayleigh Backscatter – when light is pulsed down the fiber, minute reflections can be detected throughout the length of the cable. Changes in these millions of reflections can be evaluated, allowing FOAD to measure the acoustic vibrations within the physical fiber. In effect, the fiber is transformed into a continuous sensor that works like a string of microphones.

Railroad right-of-way is often used as fiber optic corridors providing the potential for use with limited new infrastructure. Current fiber optic acoustic detection does not have sensitivity to be used effectively for this project on the CFRC but may become viable in the future. Fiber would provide trespassing detection and data without the need for cameras and observation bias implicit in those systems.

Magnetometer Sensors[1]

Anisotropic magneto resistive (AMR) magnetometers sense the change in the earth's ambient magnetic field that is caused by a metallic object. In the absence of any other metal objects, a vehicle will disturb the earth's magnetic field. The presence of a large metal object causes these magnetic lines to be distorted. The AMR magnetometer measures this change in the earth's magnetic field. Hence, when a car drives past the middle magnetic sensor in the forward direction, the magnetometer measures the change in the magnetic field.

- Trains were shown to have their own unique magnetic signatures. These signatures are very large in magnitude, relative to cars, and are very complex due to the number of cars and the amount of ferrous material. It should be possible to use some part of these signatures as a tripwire for activating crossing warning devices.
- Signature repeatability was established with cars in the parking lot by repeatedly driving back and forth over a sensor. However, signature repeatability could not be established in the field for trains since a train could not pass the sensor multiple times to confirm its signature. The best sensor location was determined to be 7.5ft offset from the first (nearest) rail. This distance reduced signal saturation and vibration caused by passing trains. This distance was also used as the minimum approach threshold for street vehicles.

Magnetometer sensors for railroad and highway equipment detection: for quick grade-crossing warning recovery and displaying the unique magnetic signature of a metal object, moving the past sensor, use of Anisotropic Magneto-Resistive (AMR) magnetometers are very feasible, which is also available commercially (COTS).

[1] http://onlinepubs.trb.org/onlinepubs/archive/studies/idea/finalreports/highspeedrail/hsr-53final_report.pdf

Lighting

Lighting devices can be used to influence behavior. Use of blue LED lights reduces psychological stress and deviate the suicidal thoughts. When installed on Japanese rail platforms, a study found that it reduced suicide rates by 84%[2].

Increased overhead lighting along the corridor can also reduce the desirability of locations for criminal behavior and trespassing. To reduce energy use, lights can be linked to motion sensors to light when movement is detected on the rail corridor.

Digital Twin for Designed Surveillance System

A digital twin is a digital representation of a physical asset, process, or system, as well as the engineering information that allows us to understand and model its performance. A digital twin is a highly detailed model asset that might be anything from a ticket vending machine in a station, to track, the switches, and crossings. In complex, high-risk areas, like stations, a digital twin will allow for the design of CCTV or other security systems without leaving any locations without coverage. A digital twin can also improve performance and reliability, off-site maintenance and future prediction of performance for all subsystems or the whole system together. However, digital twins can require a high initial investment.

Digital Device Tracking

Digital tracking can give information on congestion levels and passenger journey information. This tracking can be done indirectly through the continuous connection of users' smartphones with wi-fi or Bluetooth connections or a smartphone application. By tracking devices, individual user journey patterns or specific station congestion levels can be determined. A station that has more congestion may be more susceptible to trespassing events or accidental encroachment of the track. Trains can reduce their speed while proceeding through stations, and additional station support personnel can be dispatched to help. Any personal information can be removed to avoid identifying users/individuals.

Fencing and Barriers

Fencing has a number of benefits including:

- Creates a nice separation between high speed line and slow line.
- Can be done according to trespassing pattern and environment.
- Area could be used to reinforce the desired behavior by providing an attractive corridor alternative for biking, hiking, jogging and walking.

However, trespassers can still find a way to climb the fence and result in more dangerous routes for trespassers and are typically is not envisioned as systemwide intervention.

Besides fencing other potential barriers include:

[2] Matsubayashia, T, Y. Sawadab, and M. Uedac (2013) Does the installation of blue lights on train platforms prevent suicide? A before-and-after observational study from Japan, *Journal of Affective Disorders*, Vol 147, Issues 1-3, p.p. 385-388

- Sliding doors at platforms
- Anti-trespassing panels (see detail below)
- Symbolic deterrent fencing.
- Nets at bridges
- Measure to soil clothes.

Picture of Decorative Fencing

Anti-Trespass Panels

Anti-trespass panels (ATP) make walking almost impossible because of the panel's surface profile. The aim is to create a ground-level physical barrier that restricts pedestrian or animal access at unauthorized places. The panels prevent access where fencing is infeasible, including at the ends of at-grade crossings and station platforms[3]. The panels can be unsightly, difficult to maintain and makes access to the corridor for authorized personnel more difficult.

[3] http://restrail.eu/toolbox/spip.php?article106

Picture of Anti-Trespass Panel

Appendix A-4 Intelligent Right of Way Safety Systems

duostech
connected intelligence

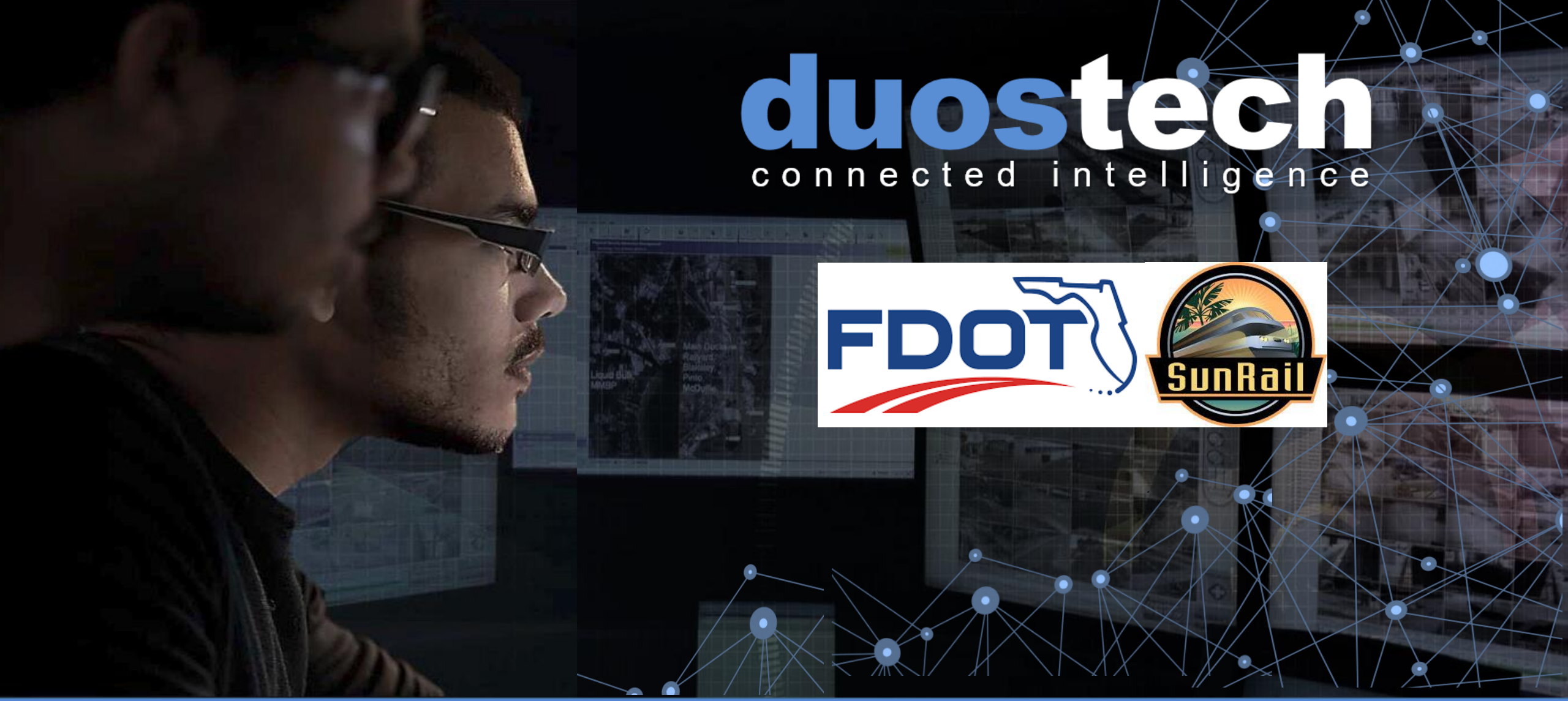
FDOT SunRail

presented by:

Rob Brownell, Director Rail Business Development

trackAware™ Intelligent Right of Way Safety Systems

Sanford FL - December 17, 2019



Introduction to Duos Technologies Inc

Who We Are

Headquartered in **Jacksonville, FL**

Staff of 73 employees and 11 full-time contractors (**84** Total)

Design, develop and implement

Advanced Intelligent Technologies

- Intelligent Sensor and Data Acquisition
  - *Inputs from virtually any sensor or data output/input, with*
- Artificial intelligence (AI) Analytics
- Enterprise Information Management (EIM)
  - *Translate and present that information to end users creating:*
- Turnkey Engineered Solutions

Industry-agnostic with a primary focus on:

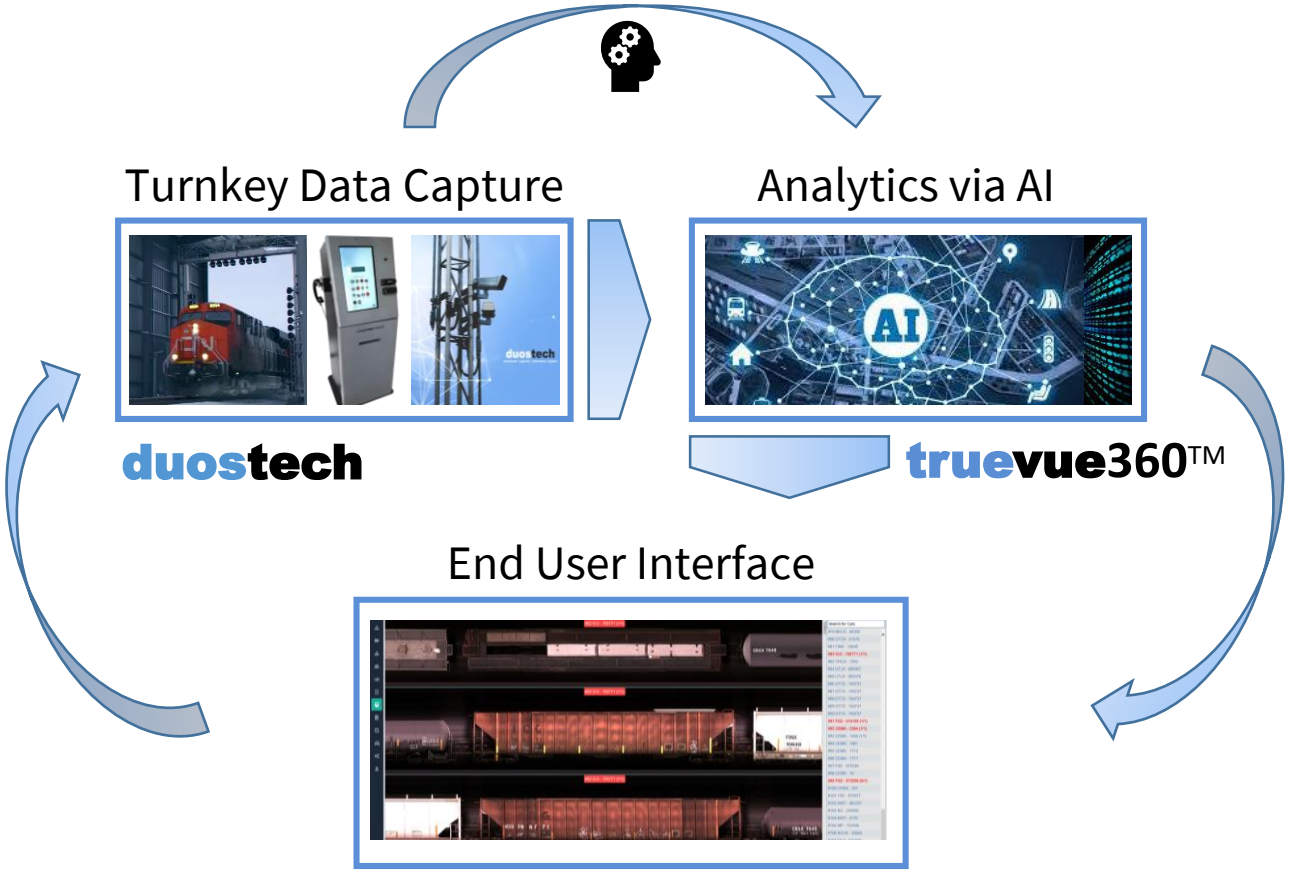
Rail transportation

Retail distribution centers

Critical infrastructure security

Connected Intelligence

- Increasing Complexity of Advanced Intelligent Technologies
- Multi Skill Requirements
- Industry-wide Trend to Outsource Development and Maintenance of Complex Technology systems
- Duos differentiator:
  - We provide **end-to-end** solutions



Rail Applications

FREIGHT

TRANSIT

rip®
Railcar Inspection Portals

vue® Vehicle Undercarriage Examiner

apis® Automated Pantograph Inspection System

tvue™ Thermal Vehicle Undercarriage Examiner

trackaware™ Track Intrusion Detection System

centraco®
Inspection Workflow Software Platform

duostech connected intelligence FDOT SunRail

Relevant Project Experience

Year	Railroad and System	Location
2006	Conrail - Gondola Inspection System	Philadelphia, PA
2007	Metra - Pantograph Inspection System	Chicago, IL
2007	UP - Train Rider Detection System	Sierra Blanca, TX
2009	UP - Border Security Inspection System	Eagle Pass, TX
2010	UP - Border Security Inspection System	Nogales, AZ
2010	UP - Border Security Inspection System	Calexico, CA
2010	UP - Border Security Inspection System	El Paso, TX
2010	KCSM - Rail Inspection Portal	Saltillo, MX
2010	KCSM - Rail Inspection Portal	San Louis Potosi, MX
2011	UP - Rail Inspection Portal	Eagle Pass, TX
2013	TTCI - Vehicle Undercarriage Examiner	Pueblo, CO
2015	CSXT - Rail Inspection Portal	Hamlet, NC

Relevant Project Experience

Year	Railroad and System	Location
2015	BNSF - Railway Vehicle Undercarriage Examiner	Abo, NM
2016	Ferromex - Rail Inspection Portal	Fresnillo, MX
2016	TTCI – Thermal Vehicle Undercarriage Examiner	Pueblo, CO
2017	Amtrak – Platform & Facility Security	Los Angeles, CA
2017	Amtrak – Facility Security	Seattle, WA
2017	NYCT – Train Platform Intrusion Detection System	New York, NY
2018	CN – Rail Inspection Portals (4 Sites)	Winnipeg, CA
2019	CN – Rail Inspection Portal	Toronto, CA
2019	CN – Rail Inspection Portal (2 Sites)	Memphis, TN
2019	Metra – Automated Pantograph Inspection System	Chicago, IL
2019	CSX – Rail Inspection Portal	Race Pond, GA
2020	KCSM – Rail Inspection Portal	Saltillo, MX

Experienced Team

Our key team members average over 21 years of experience		
Gianni Arcaini	Chairman, President, CEO	35 Years within Technology & Rail
Wm. Scott Carns	EVP & Interim COO	20 Years within Technology & Rail
David Ponevac	SVP Chief Technology Officer	15 Years in Software Engineering & AI
Michael Halter	VP Engineering	29 Years of Electronics Engineering
Javier Acosta	VP Field Operations	25 Years of Operations and Engineering
Rob Brownell	Director BD Rail	25 Years in Rail Transportation
Charles Hoeppner	Director of R&D	25 years of Software Development
Derrick Schmenk	Director of IT	18 years of IT Management
Shawn Moyer	Senior Program Manager Rail	10 years Rail Signal and Comm.
Jason Jeans	Director Product Dev.	15 years of Product Dev. Rail
Cody Stewart	Program Manager R&D	5 years Software Development

duostech connected intelligence FDOT SunRail

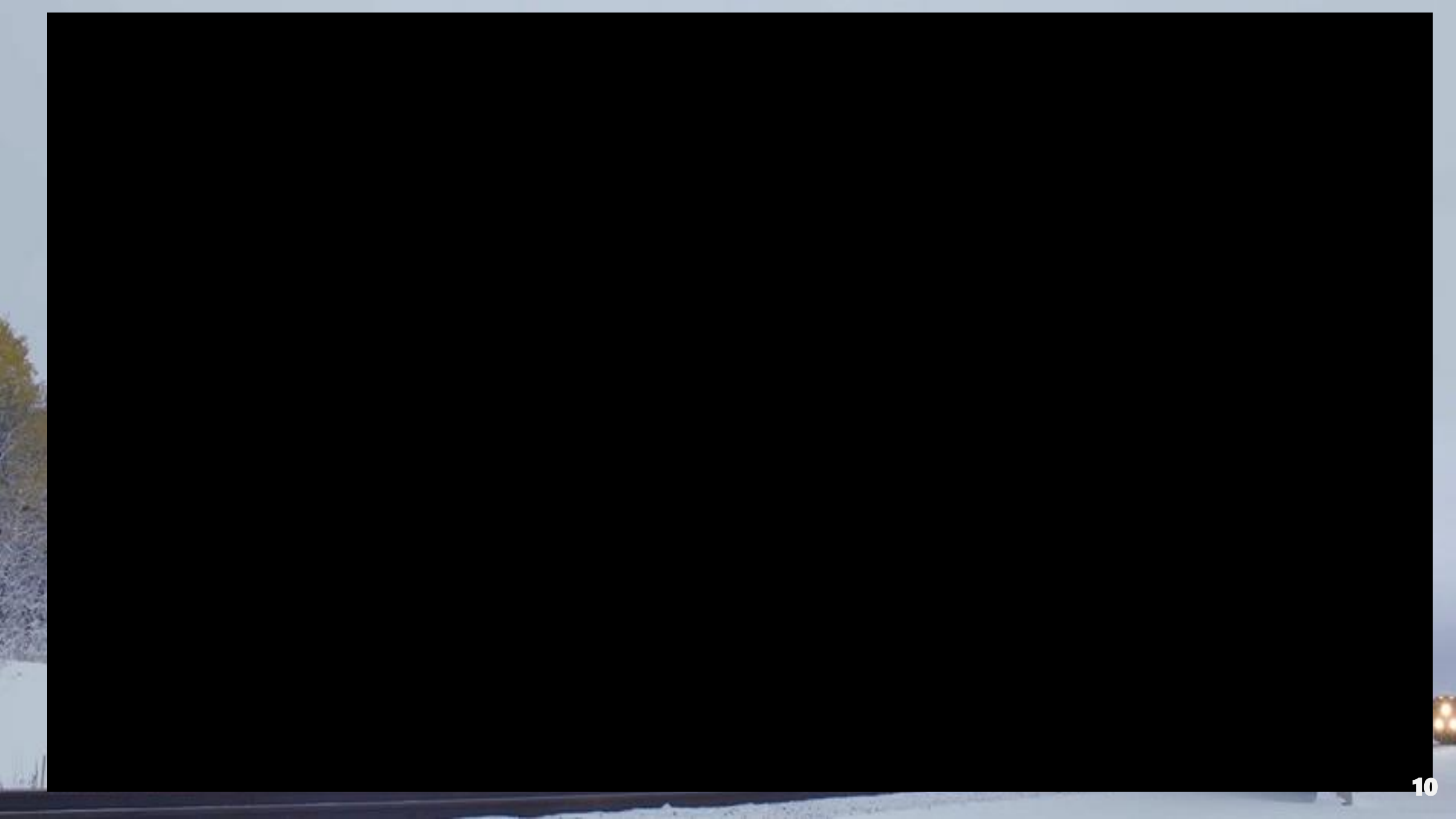
Our Mission

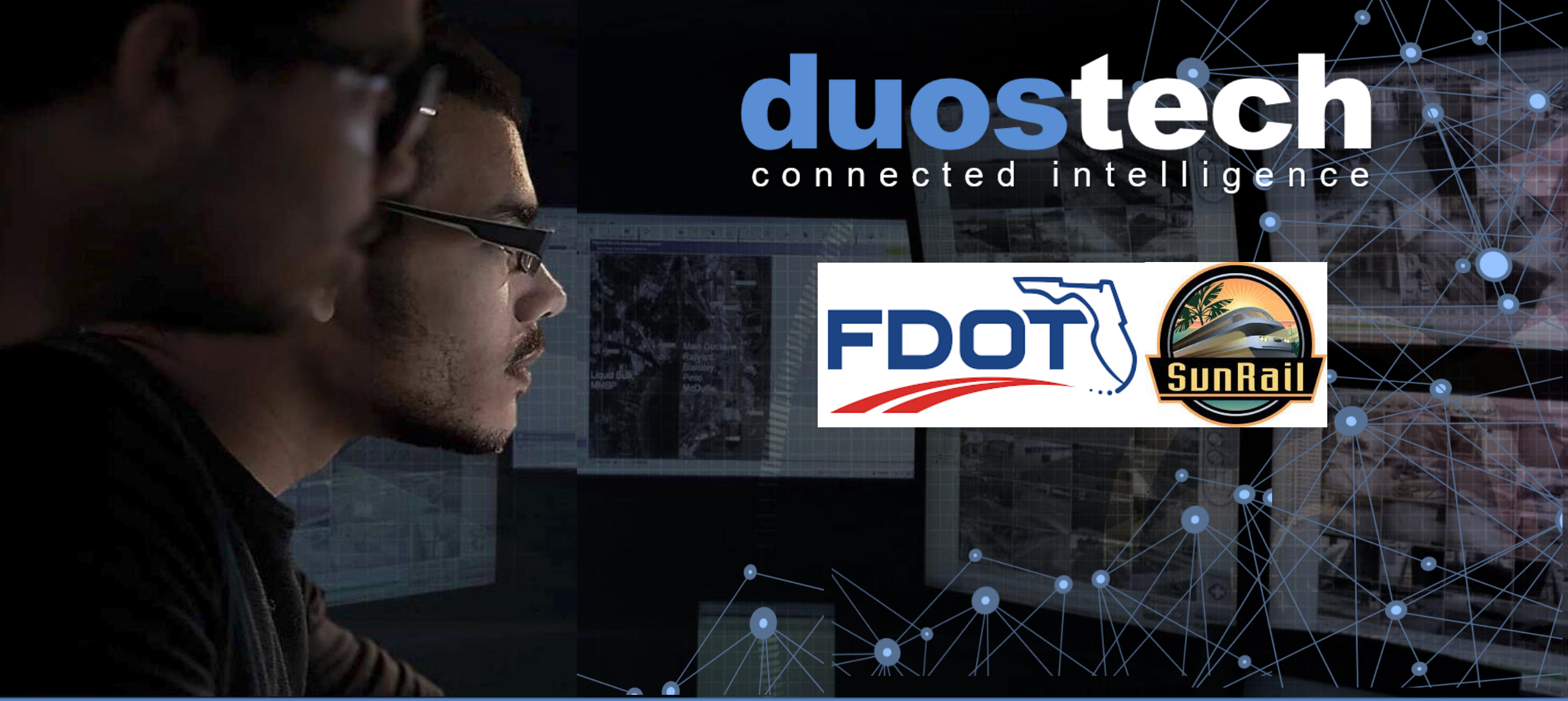
provide transportation teams with state-of-the-art technologies to **modernize**, **optimize** and **improve** the rail car inspection process, resulting in:

- Improved Safety
- Reduced Online Failures
- Greater Productivity
- Improved Yard & Network Fluidity
- Increased System Velocity

…most importantly, make it a more **reliable** and **safer** railroad.

duostech connected intelligence FDOT SunRail





Section 130 and the State of Florida

The FRA has identified 6 areas of Focus thru 2021

1. Safety
2. PTC (Positive Train Control)
3. Regulatory Form
4. Crossing & Trespasser Accidents
5. Amtrak
6. Technology

U.S. Department of Transportation
Federal Railroad Administration

Key Technology Points from the FRA

1. Developing Opportunities to promote safe methods to support growth.
2. Applying Prescriptive Regulations will do more harm for safe growth
3. Augmenting performance & Prescriptive-based rule making

Culture change with Technology

"The Federal Railroad Administration cannot issue regulations fast enough to keep up with technology advancements within the railroad industry"

"White Papers and interaction with vendors and railroads will help support advancement that is favorable with FRA "

Ronald Batory – FRA Administrator, March 26, 2019

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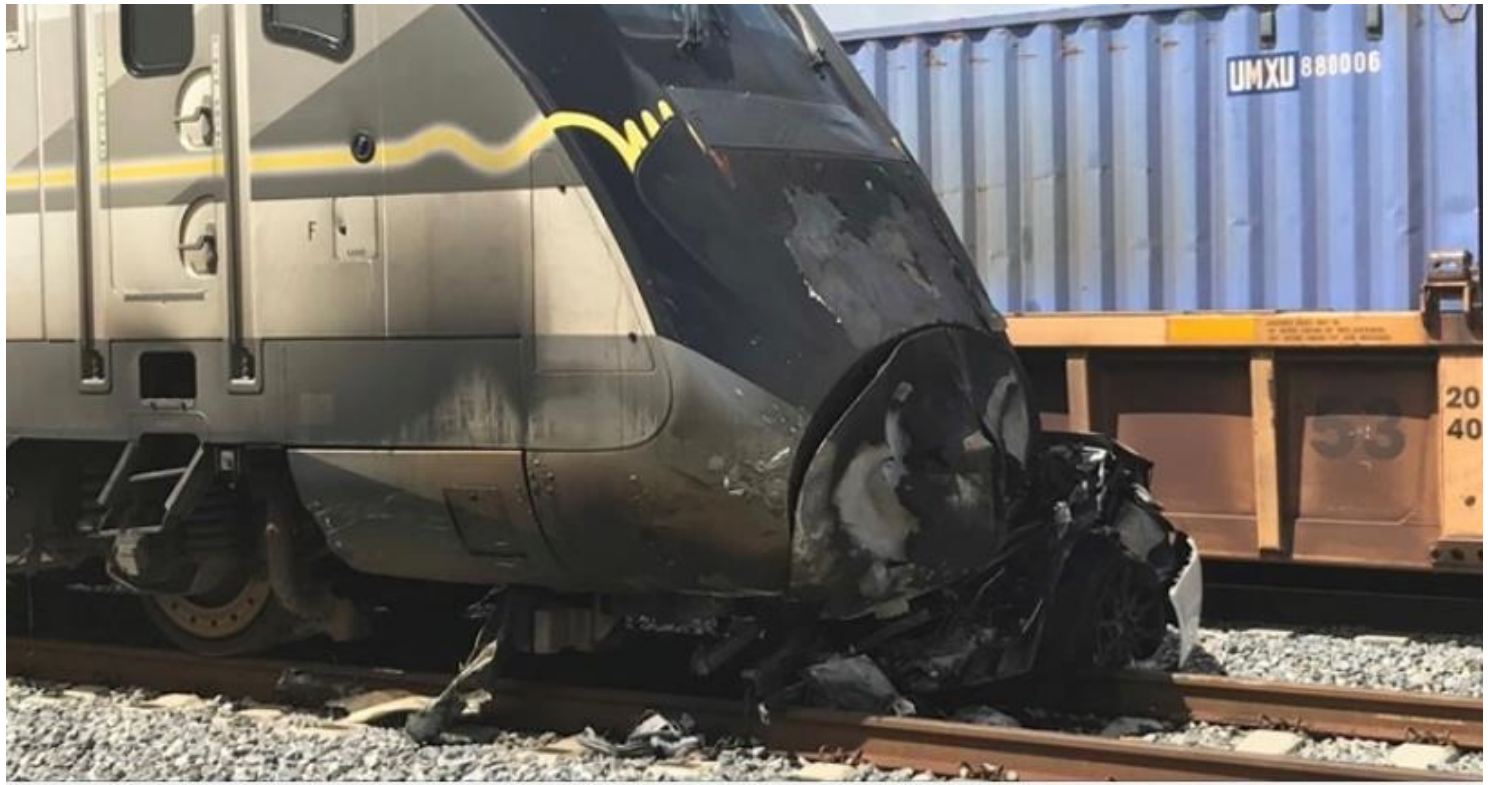
November 26, 2019 - Press Release from Gov of Florida

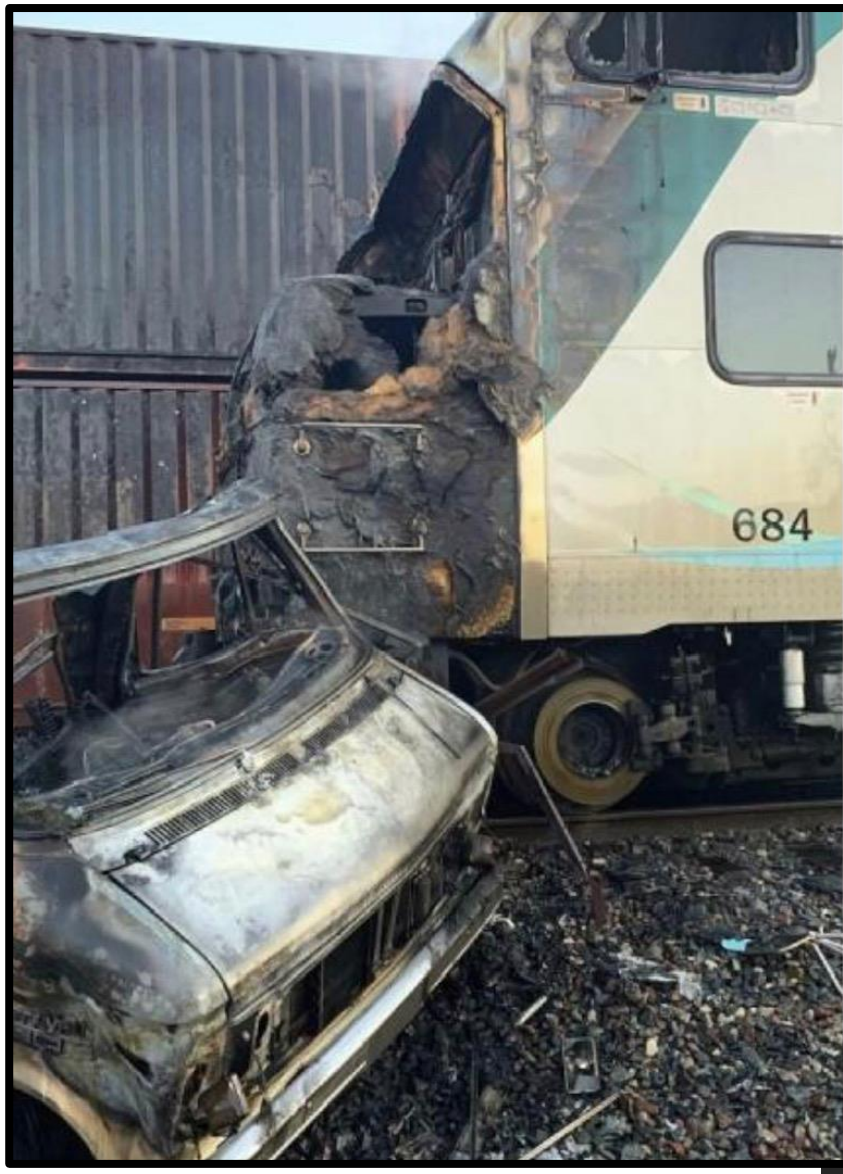


ORLANDO SENTINEL · 4 MIN READ

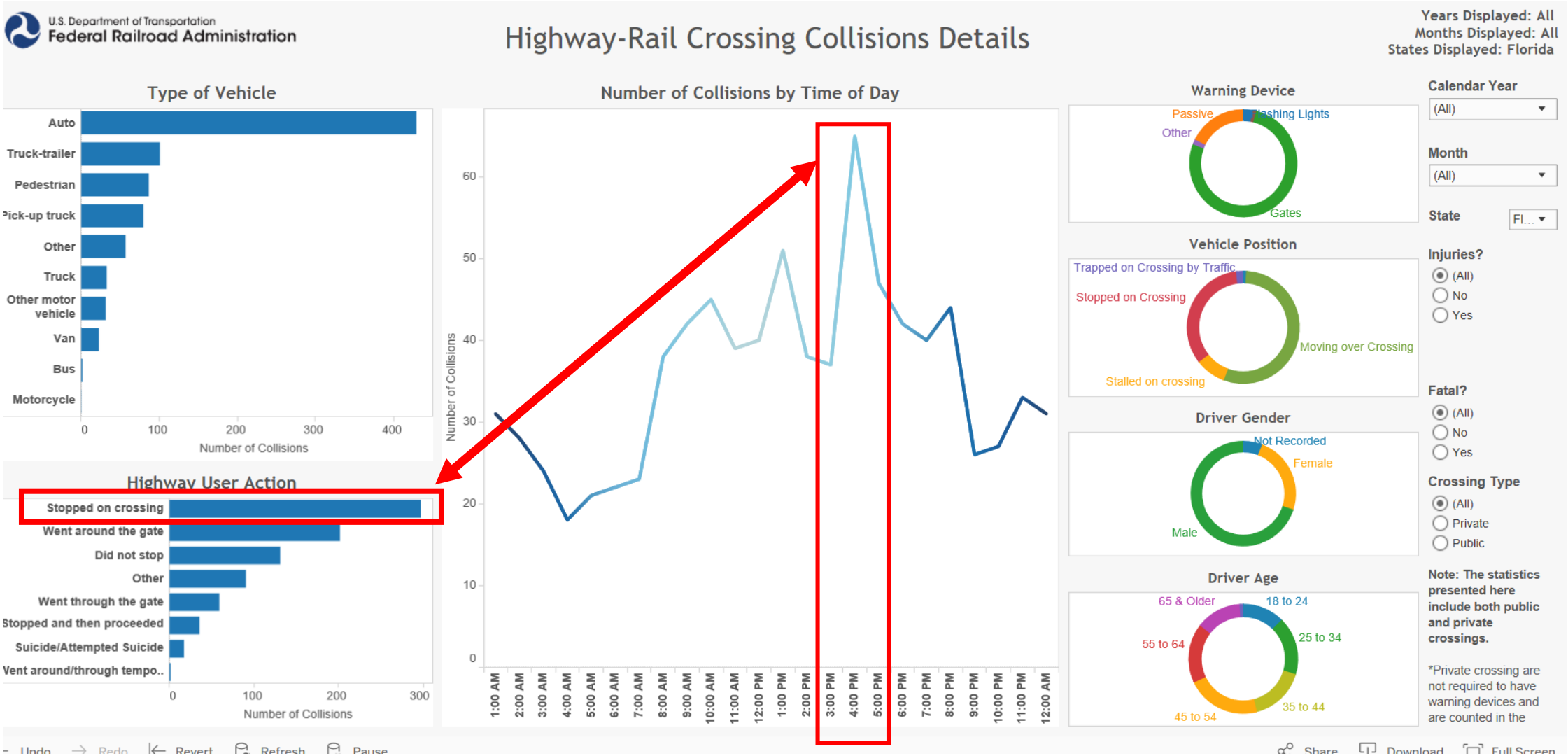
Train deaths prompt Gov. DeSantis to seek more safety measures

What is section 130 and how is it funded ?

- Also called “Rail-Highway Crossings Program”
- Title 23 of the United States Code, Section 130, was created by Congress in 1987 to provide funds for the “Elimination of Hazards” at public railway-highway crossings
- Section 130 funds are set-aside from a State’s Highway Safety Improvement Program (HSIP) funds through FHWA
- Funds are apportioned to States by formula
- Minimum of 0.5% to each State



Florida Highway Rail Crossing Collision Details Since 2009

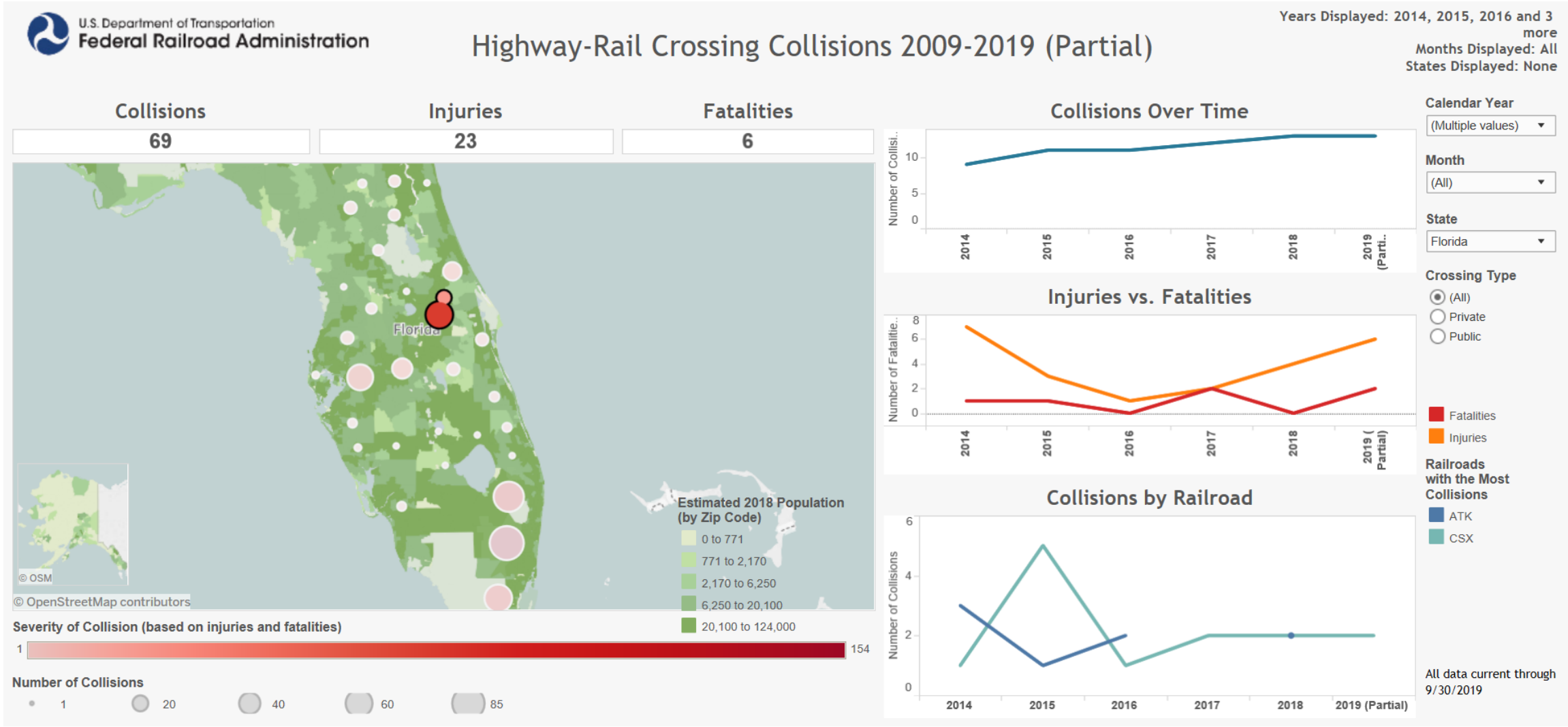


Florida Highway Rail Crossings

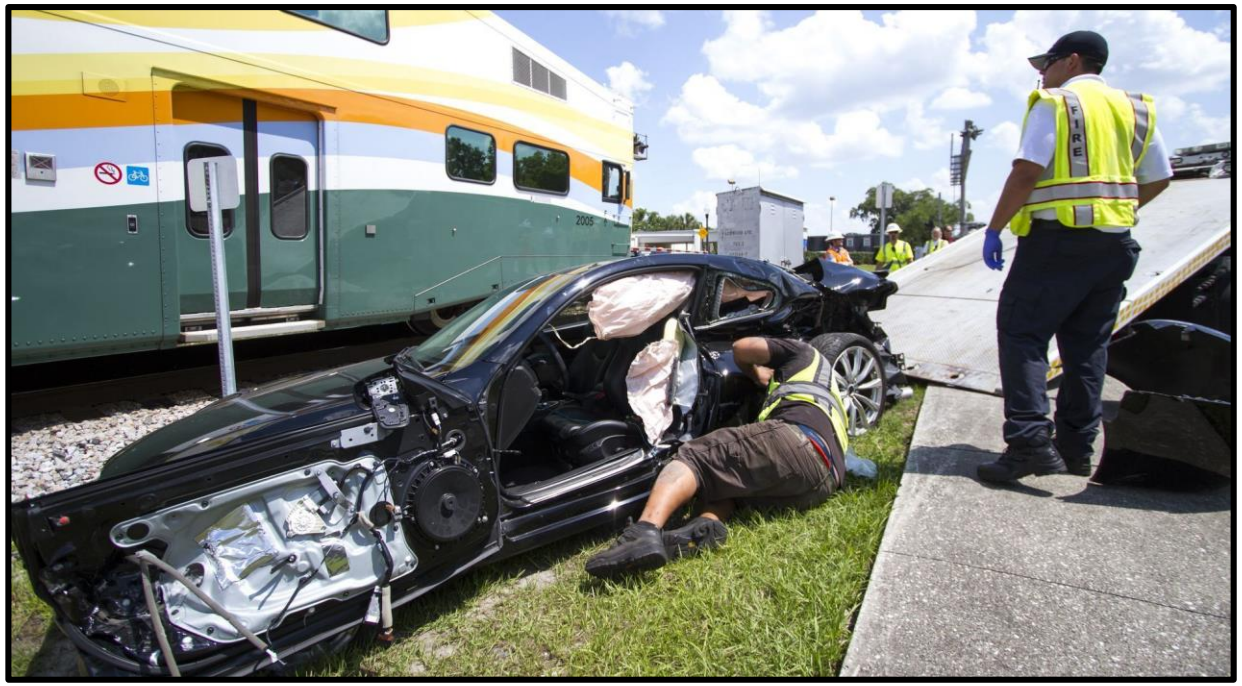
#1 Cause is Stopped in the danger zone

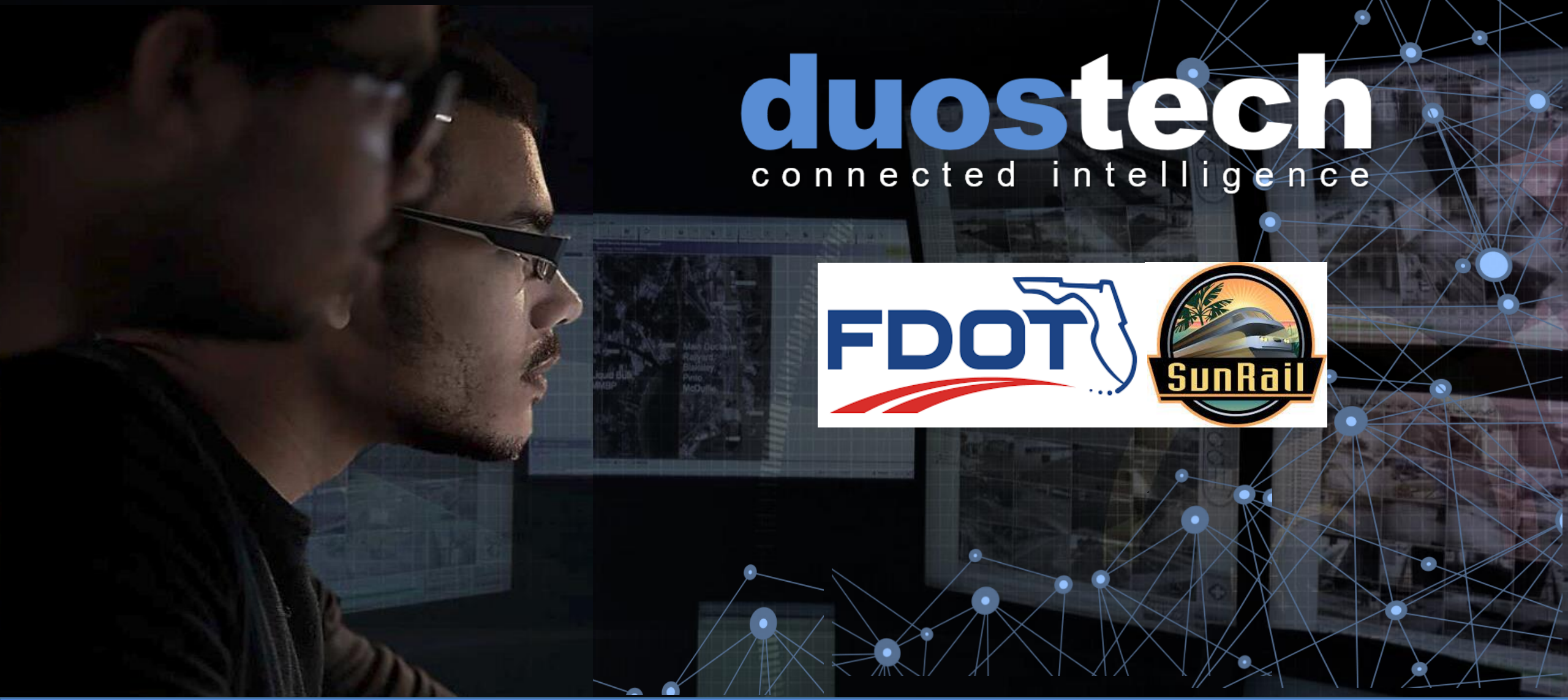
Florida Highway Rail Crossings - #1 Cause is Stopped in the zone

Breakdown of Orange and Seminole Counties 2014 to 2019



Florida Highway Rail Crossing Accidents are preventable!



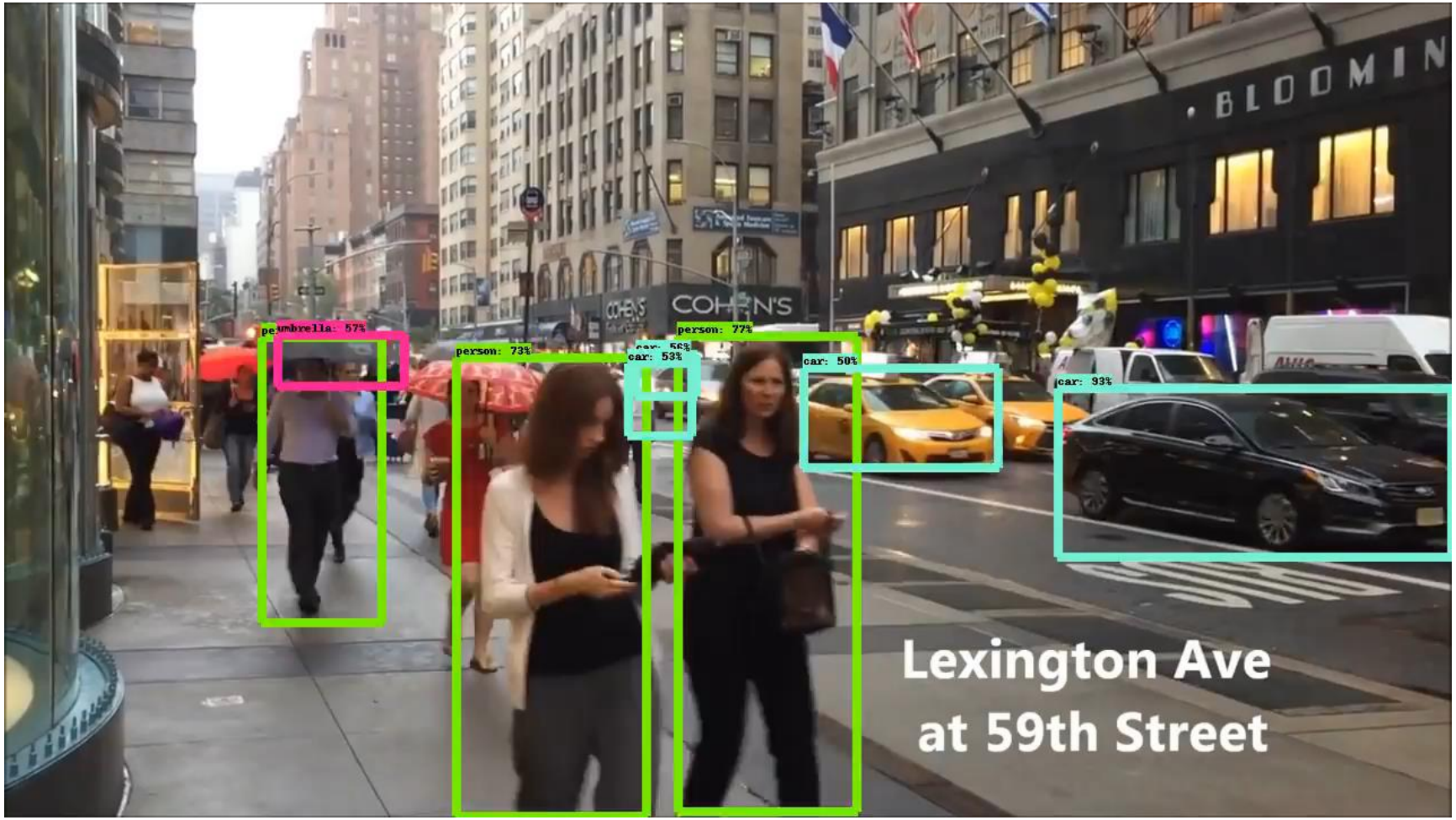


trackAware™ Intelligent Right of Way Safety System

trackAware™ Intelligent Right of Way Safety System

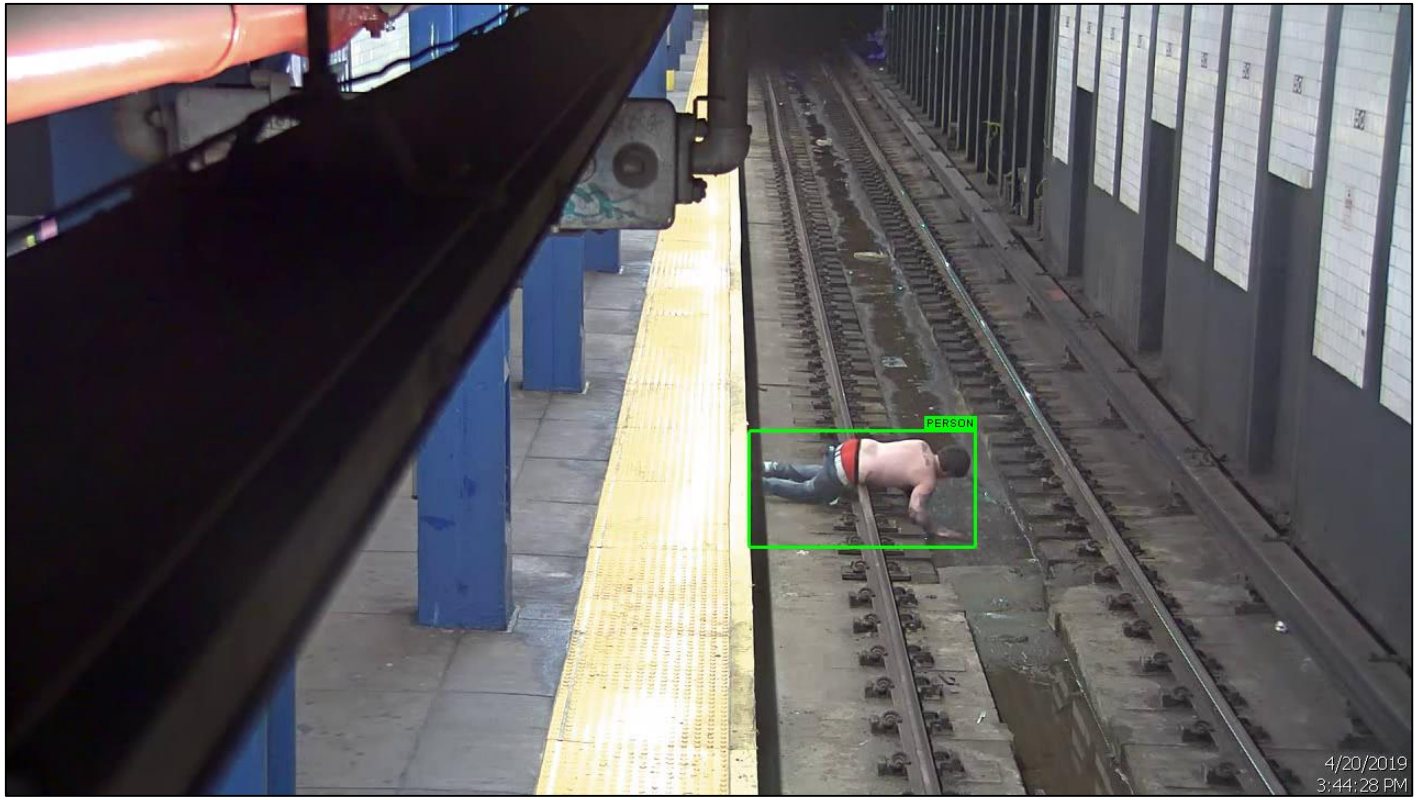
- Virtual fence, multiple zones
- Object classification
- Object tracking
- Directional movement
- Object counting per class
- Defect identification

trackAware™ Intelligent Right of Way Safety System



trackAware™ Intelligent Right of Way Safety System

- **100%** accurate human detection with proper pixels on target
- Distinguish/Identify specific markings (hardhat, safety vest etc.)
- People Counting



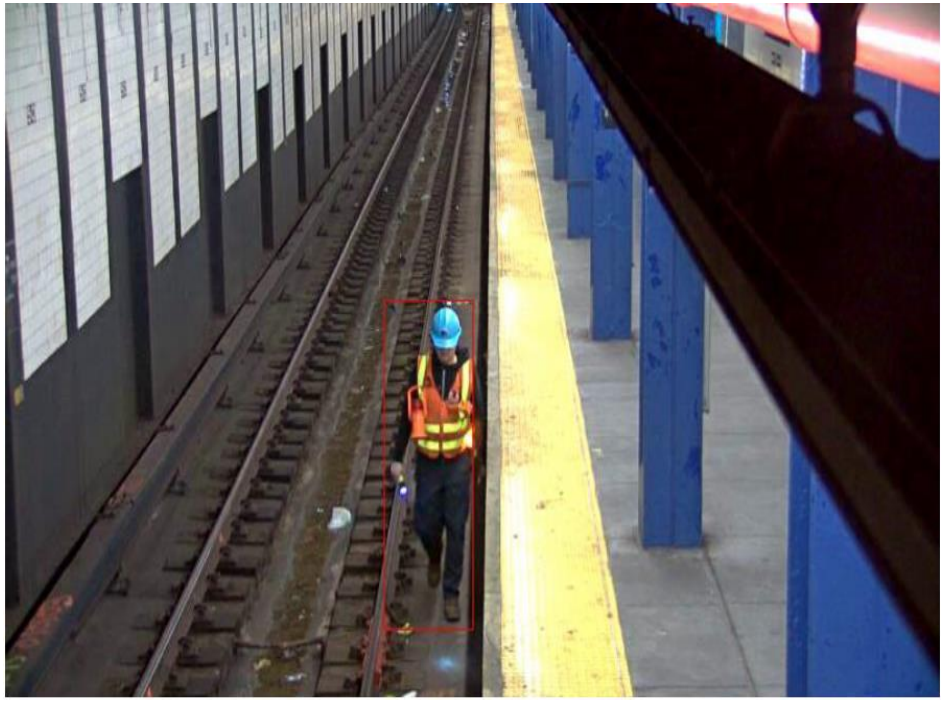
Track Aware Intrusion Detection – NYC Transit

trackAware™ Intelligent Right of Way Safety System

NYCT TIDS
DuosTech 50th Street SB Platform D3

February 6th, 2019 from 01:19 to 01:24

Device: Camera 1, 2, 4

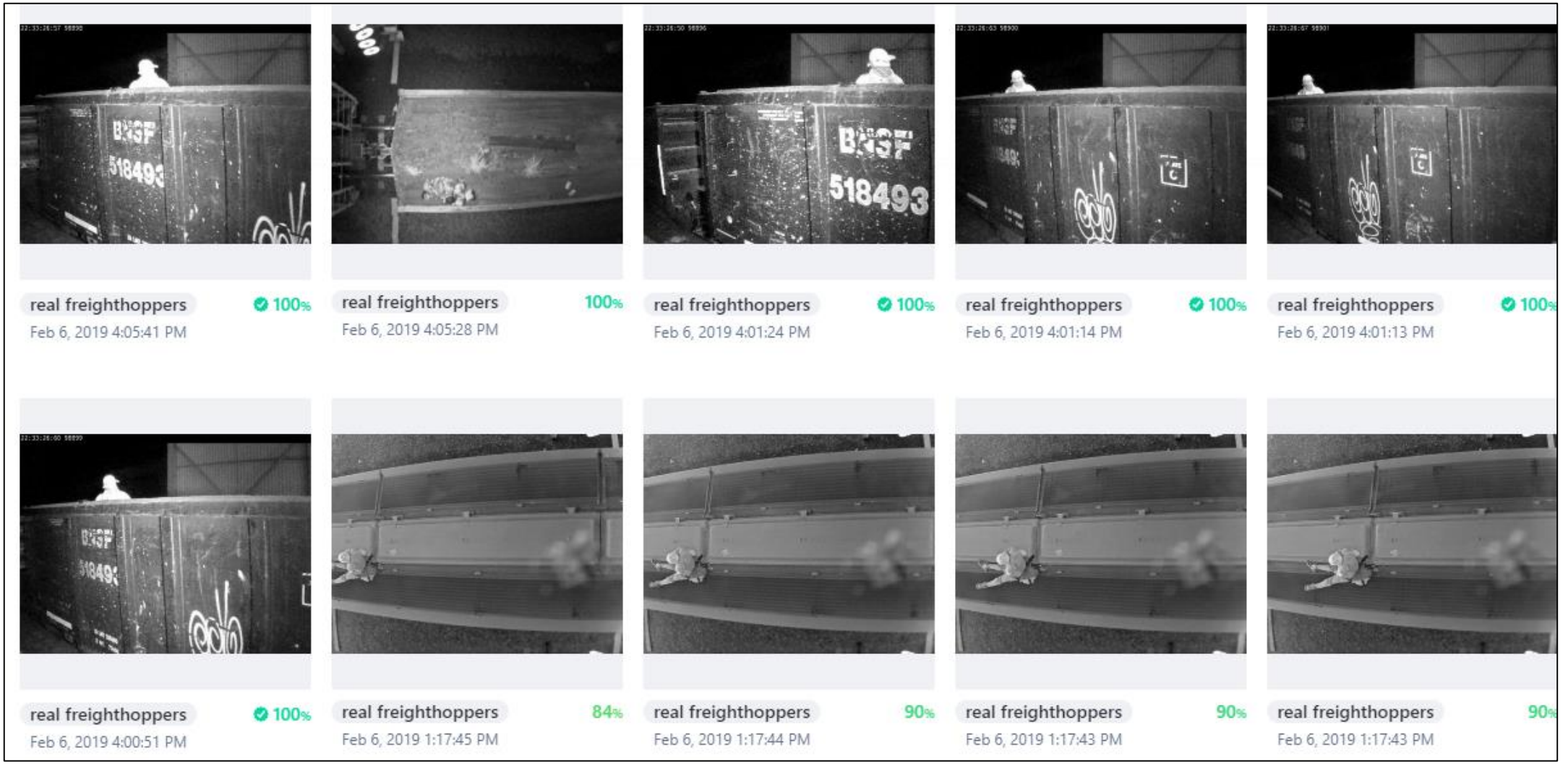


Case Study – Hazmat Placards

- 99% accuracy of localization and 100% accuracy on OCR

Case Study – trids® *(Illegal Rider Detection Mexican/US Border Crossings)*

- 99% accuracy in 1 week with enough training data



trackAware™ Intelligent Right of Way Safety System

duostech connected intelligence FDOT SunRail

trackAware™ Intelligent Right of Way Safety System

Our systems have the following capabilities:

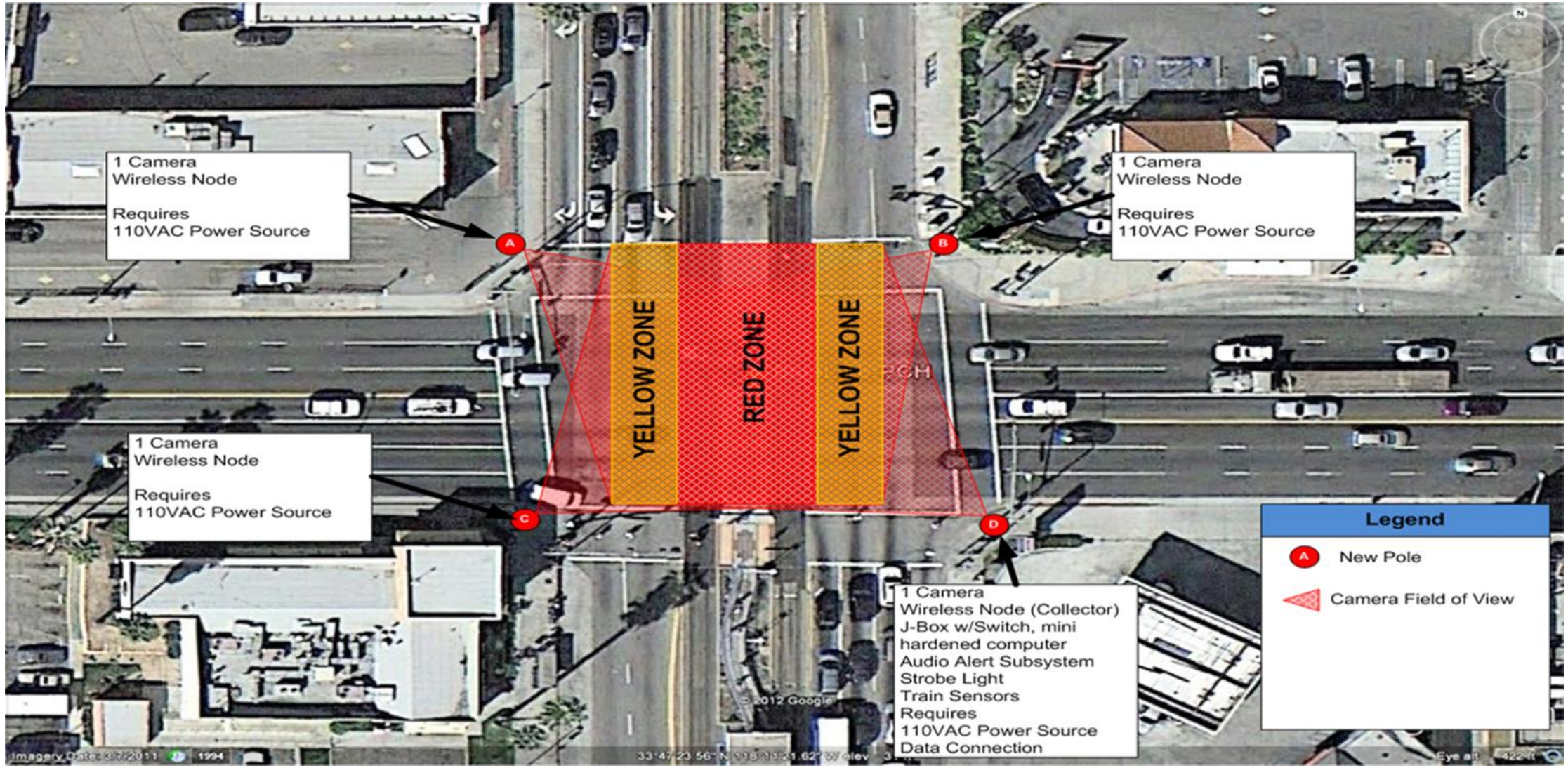
- Automatic detection of security events
- Multi-lingual warning annunciation
- Strobe lights for visual deterrence
- Remote video monitoring
- Network-based distributive alerts
- Bidirectional audio communications
- Centralized command and control
- Does not require PTC for application of system

The mission being to enhance safety at railroad grade crossings and ultimately, to enable train engineers, surface road vehicle operators and pedestrians to take effective collision avoidance action.

trackAware™ Intelligent Right of Way Safety System

- Provides remote access, viewing and archive of crossing activity.
- Automatically analyze, process, and exchange information and alarms between grade crossings, approaching trains, and system operators.
- Collect operational data and a visual history of intersection control traffic
- Creates a forensic record of vehicle driver and pedestrian behavior at crossings.

trackAware™ Intelligent Right of Way Safety System



trackAware™ Intelligent Right of Way Safety System

When the signaling system activates the gate arms to stop traffic, the system will automatically engage the distinct alarm zone. Whenever a pedestrian, bicyclist, object or motor vehicle infringes upon or is within the zone, the following will occur immediately:

- Automated Zone Obstruction Radio Message transmitted via the railroad AAR radio channel to the on coming train to take action using proper train handling
- An alarm will be transmitted visually and audibly to the OCC
- Real-time video will be automatically streamed to the OCC
- Potential to use cell notification within zone
- Locally, in addition to the existing bells from the gate arms, our system will begin to flash high intensity strobe lights and locally annunciate a warning message in multiple languages.

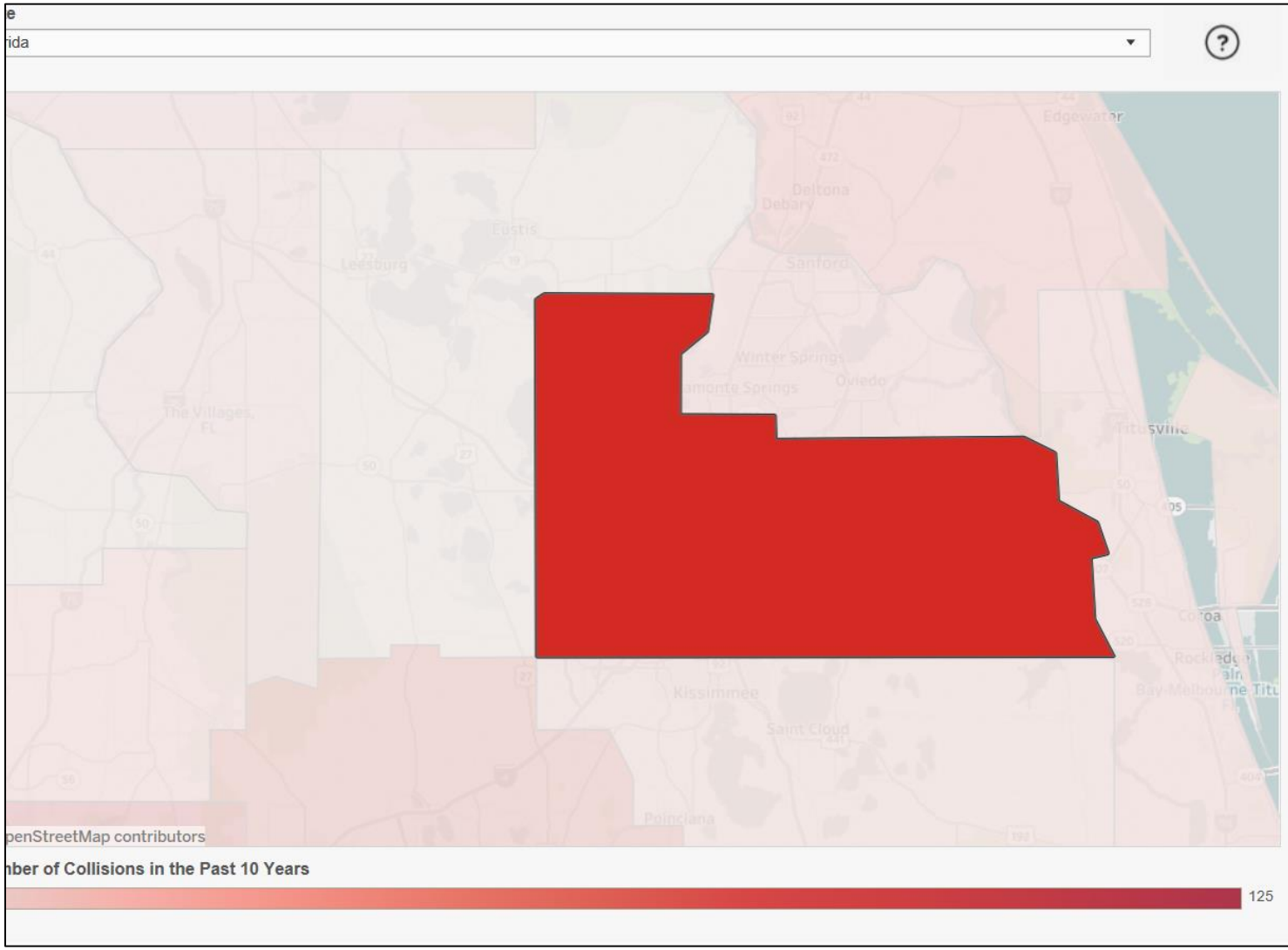
We would welcome input from FDOT for vehicle strobe light warning

Table 3: Location of Pedestrian Trespasser Casualties, Excluding Suicides, November 2013 to October 2017

Distance from a Highway-Rail Grade Crossing *(feet)*	Casualties Nationwide		Casualties in Top 10 Counties	
	Cumulative Number	Cumulative Percentage	Cumulative Number	Cumulative Percentage
600 to 700	2,798	66 %	21	67 %
700 to 800	2,945	69 %	16	70 %
800 to 900	3,049	72 %	10	72 %
900 to 1,000	3,142	74 %	12	74 %
1,000 to 1,250	3,328	78 %	25	79 %
1,250 to 1,500	3,477	82 %	21	82 %
1,500 to 2,000	3,711	87 %	30	88 %
2,000 to 3,000	3,950	93 %	21	92 %
3,000 to 5,000	4,107	97 %	24	96 %
5,000 to 10,000	4,186	99 %	12	98 %
More than 10,000	4,242	100 %	11	100 %
Total Casualties	**4,242**		**559**	

Source: FRA analysis.

trackAware™ - Orange County Top 3 Crossings

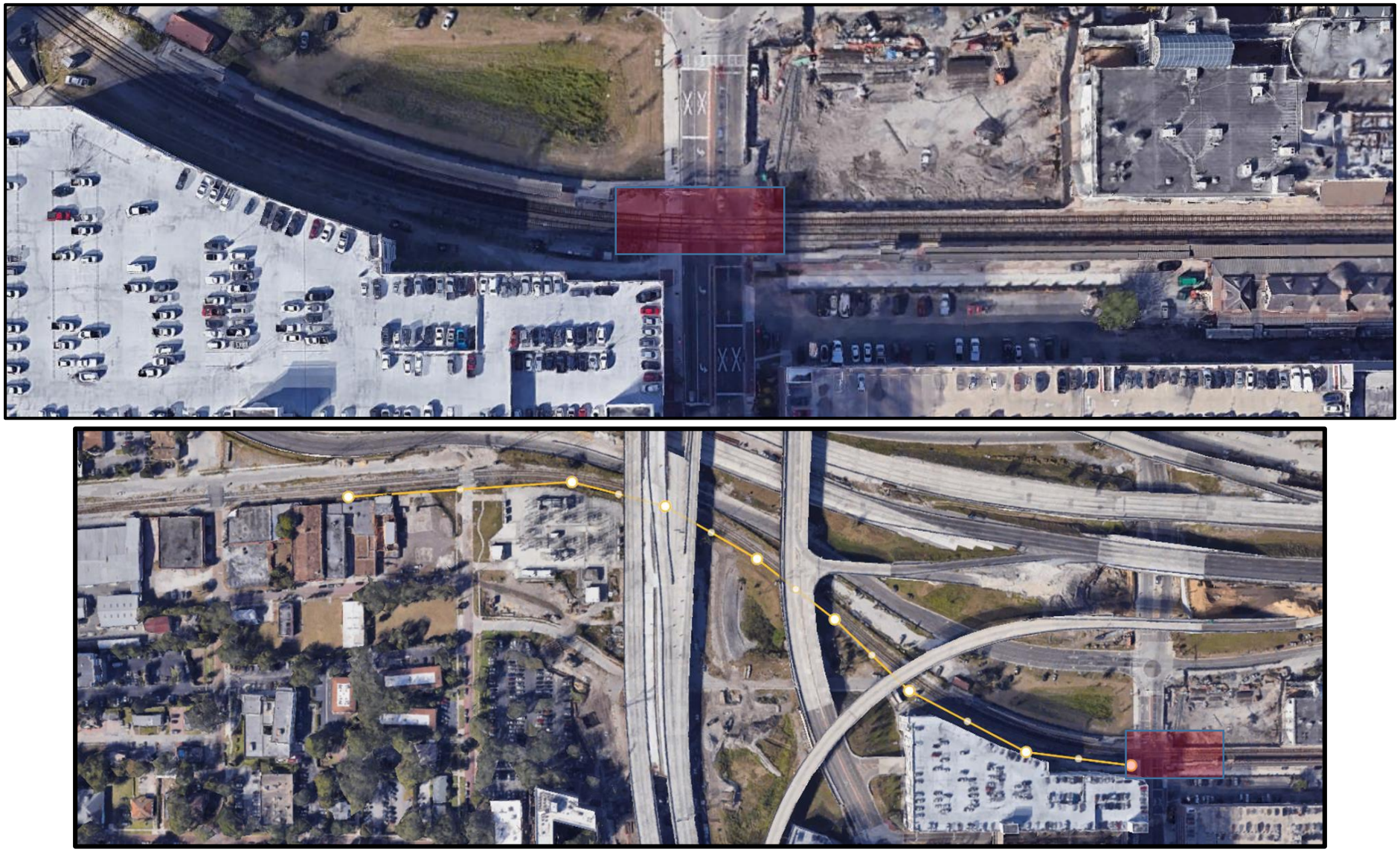


Collisions, Injuries, and Fatalities per Crossing
(Ranked by Number of Collisions Over the Past 10 Years)

Crossing ID	Highway	Collisions Injuries and Fatalities
622181A	; COLONIAL D	1 1 1
	COLONIAL D	1 0 0
	COLONIAL DRIVE	1 1 0
	W COLONIAL STREET	1 0 0
	W. COLONIAL DR	1 0 0
	W. COLONIAL DR.	1 0 0
	W. COLONIAL DRIVE	2 4 0
622192M	SOUTH (1W) S	1 1 0
	SOUTH STREET	1 0 0
	WEST SOUTH ST	2 1 0
622307E	W MICHAGAN ST	1 0 0
	W. MICHIGAN STREET	1 0 0
	WEST MICHIGAN ST	1 0 0
	WEST MICHIGAN ST.	1 0 0

trackAware™ Colonial Drive MP A 789.4 622181A

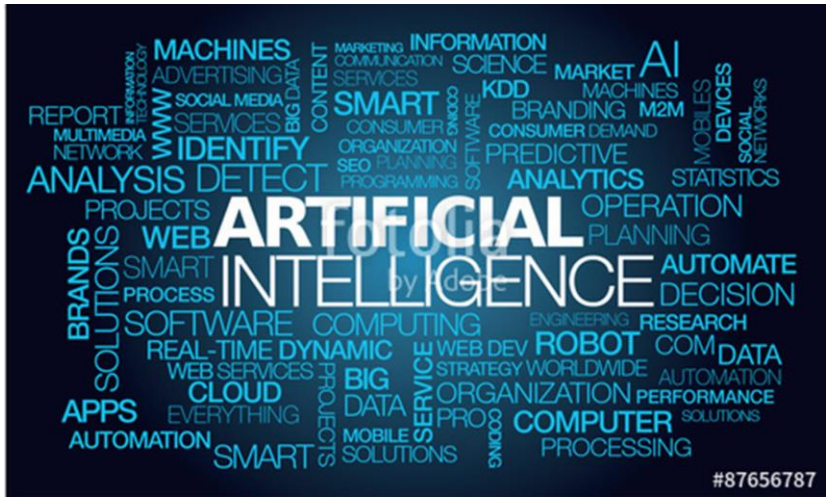
trackAware™ - South Street MP A 790.4 622192M



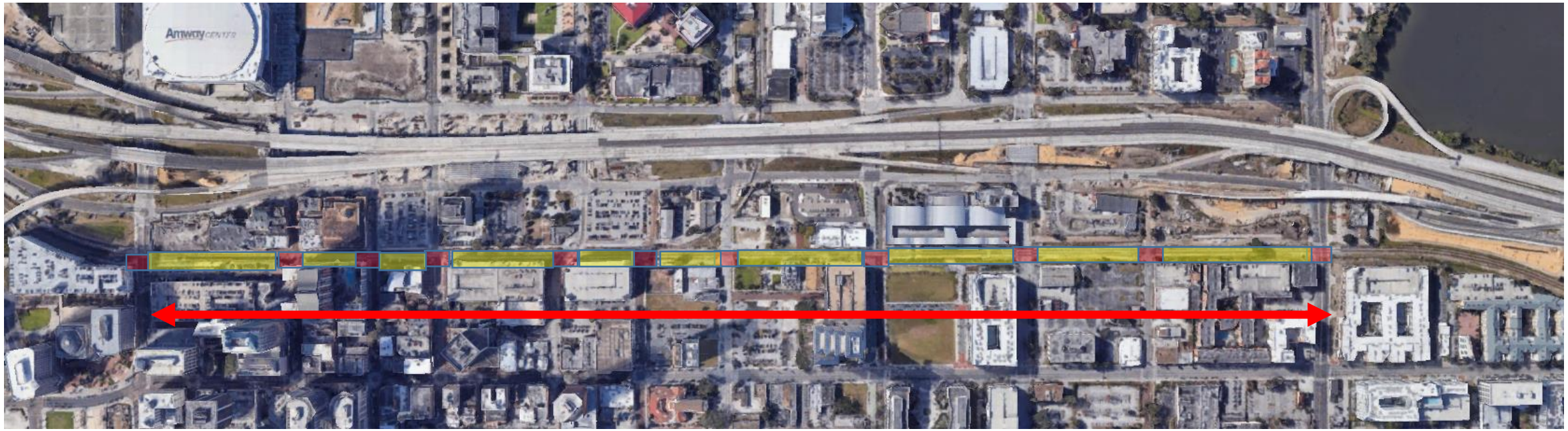
trackAware™ - CFRC Sunrail Smart Corridor

With a predefined security zone from Colonial Drive to South Street, the system will actively monitor the zone(s) 24 hours a day for the following security events:

- Intrusion into the secure zone (by a person or object)
- Car Stuck on the tracks past specified time
- Homeless encampments or loitering behavior
- Abandoned objects within the zone
- Removal of objects or Railroad property from the zone

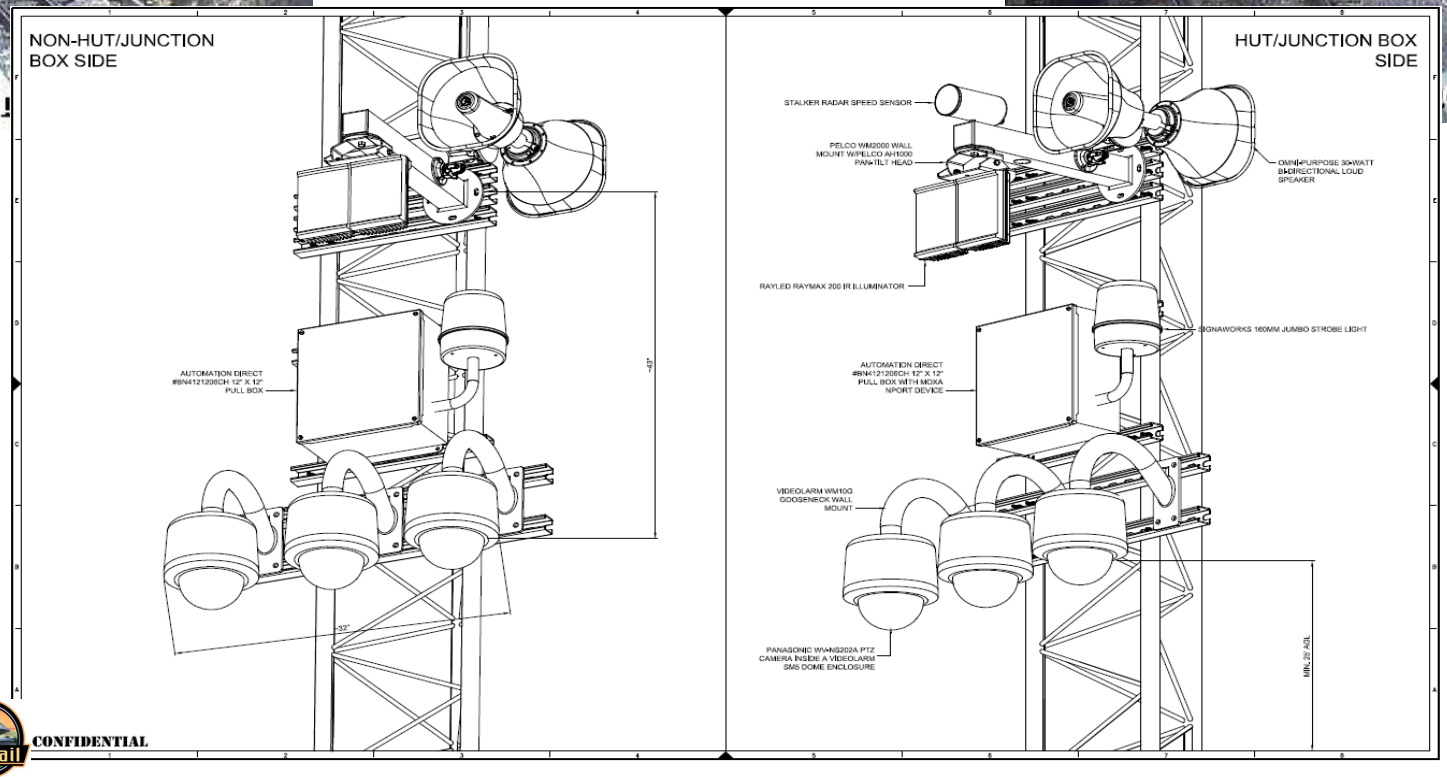


trackAware™ - CFRC Sunrail Smart Corridor



Our technology cane define a “sterile” or secure area within the crossing and extend approximately 1000’ in either direction along the tracks from the crossing.

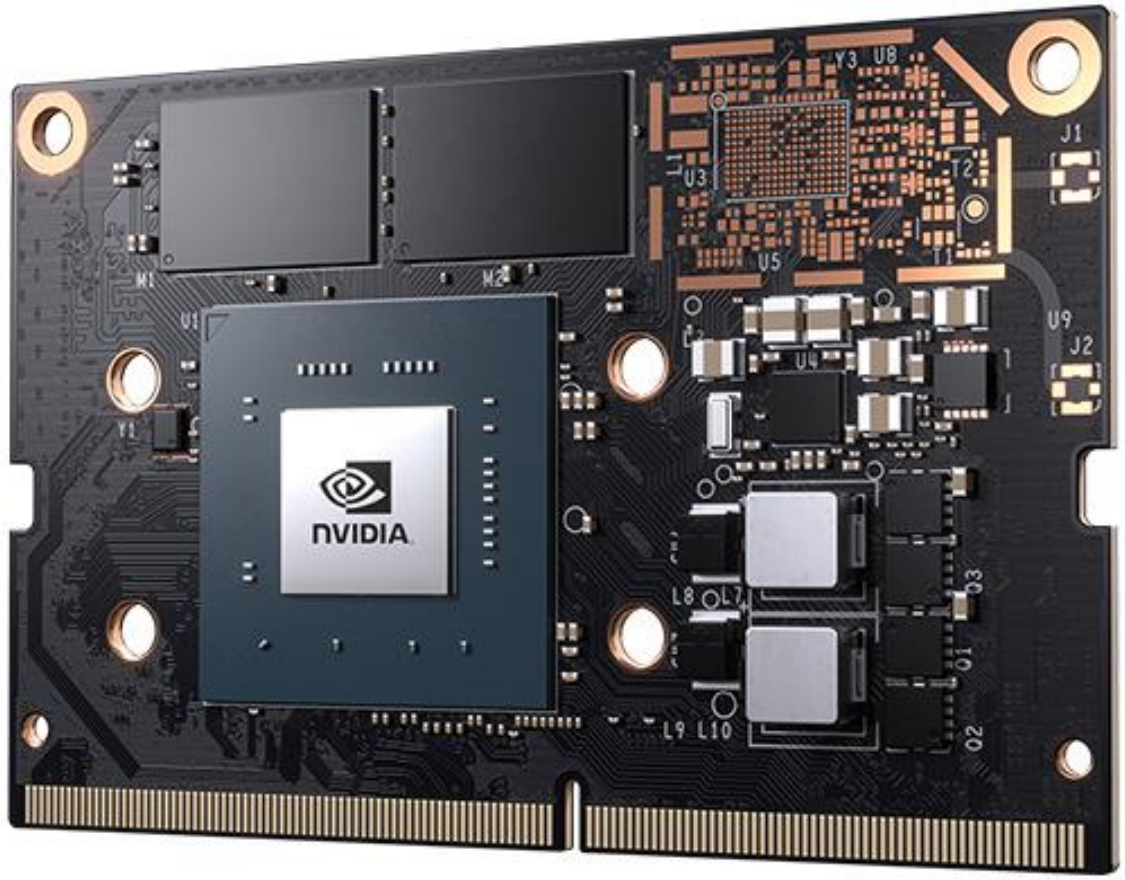
trackAware™ Intelligent Right of Way Safety System



trackAware™ Intelligent Right of Way Safety System

The Platform - Hardware

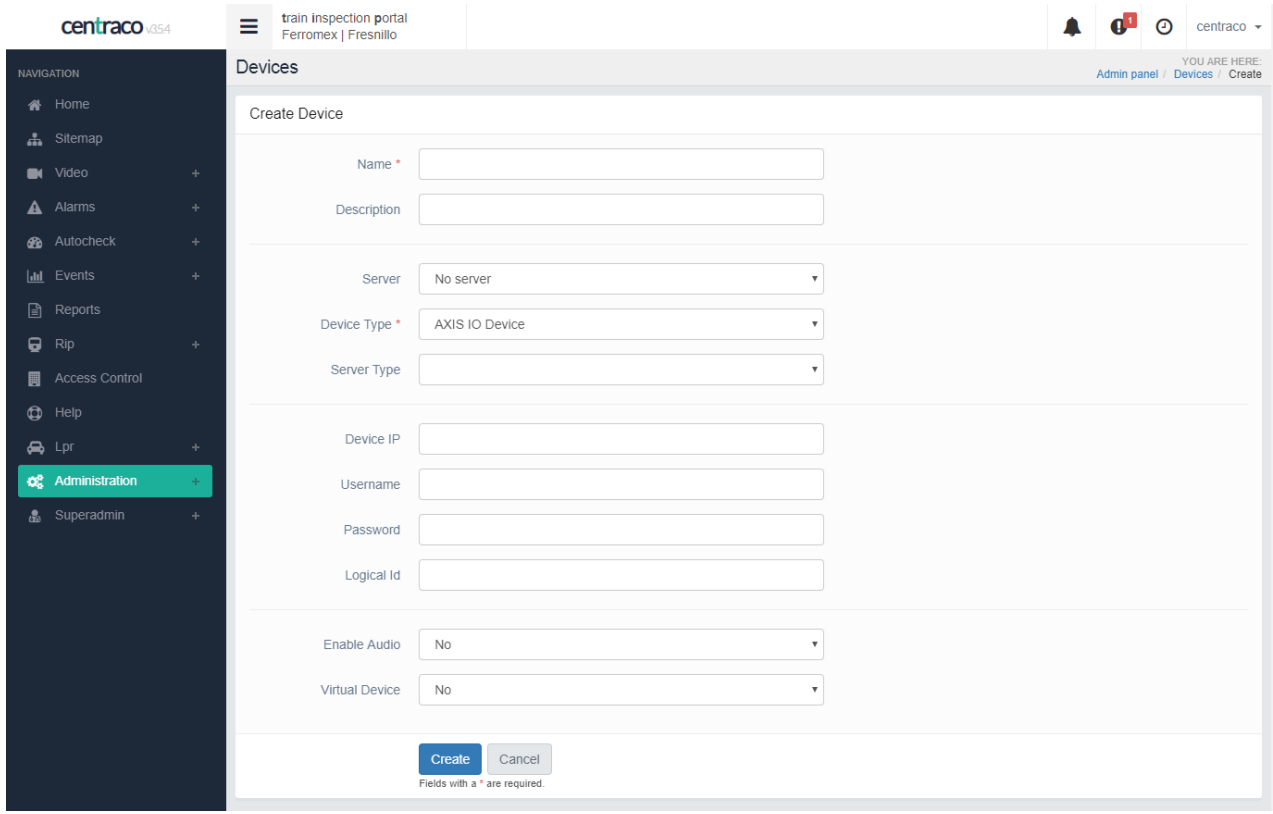
- It is an appliance,
  - **no cloud access is needed**
- Training can happen directly on the unit
- Inference on GPU and CPU
- Supports wide variety of hardware
  - **From single board to server class**



trackAware™ Intelligent Right of Way Safety System

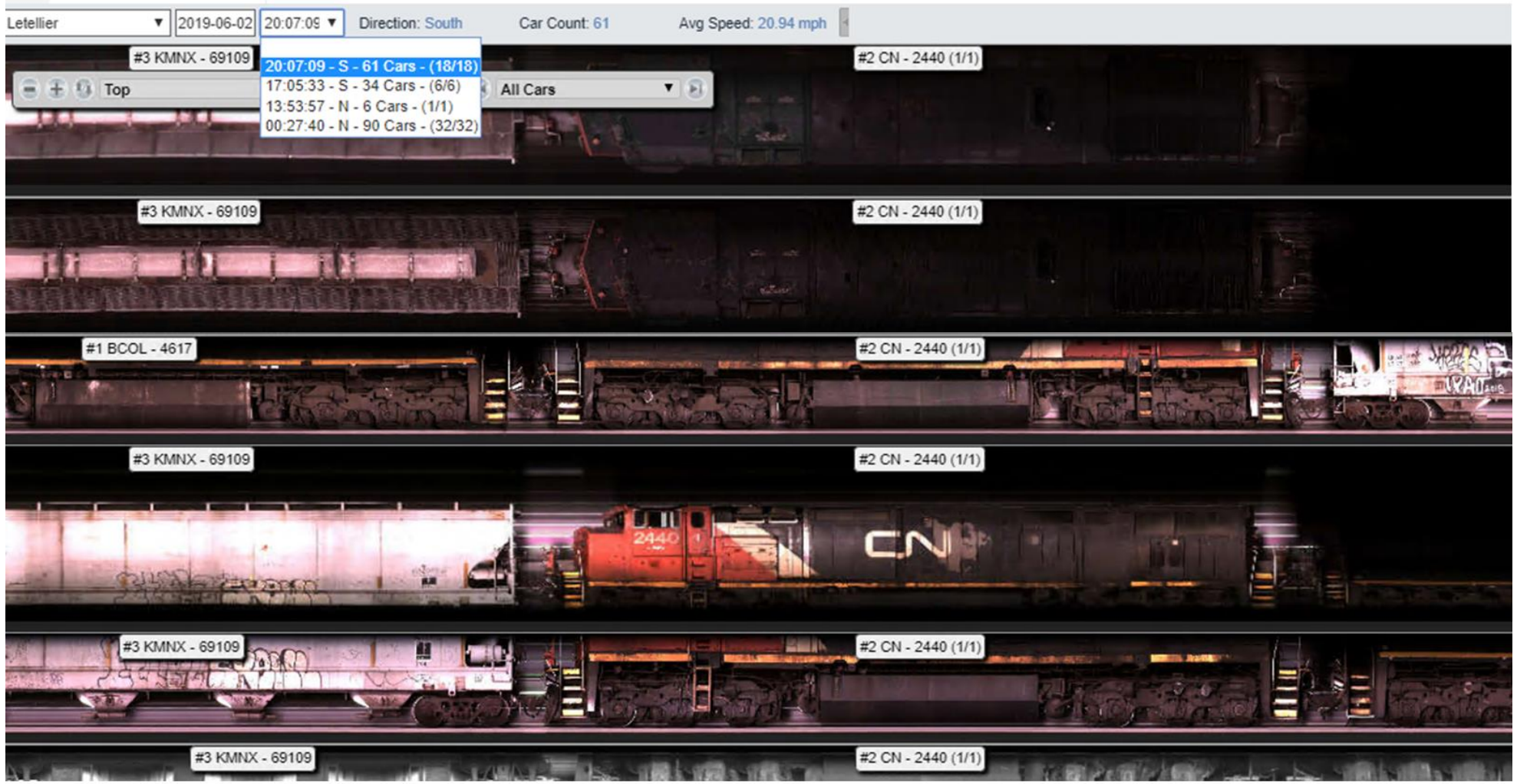
The Platform - Interface

- Using a **centraco®** GUI
  - Add streams (cameras)
  - Attach models (algorithms) to streams
- View video archive and detections
- Define outputs (callbacks) to feed your system



As simple as that… That's it!

centraco® Command and Control Inspection Workflow Software Platform with a User Friendly Interface

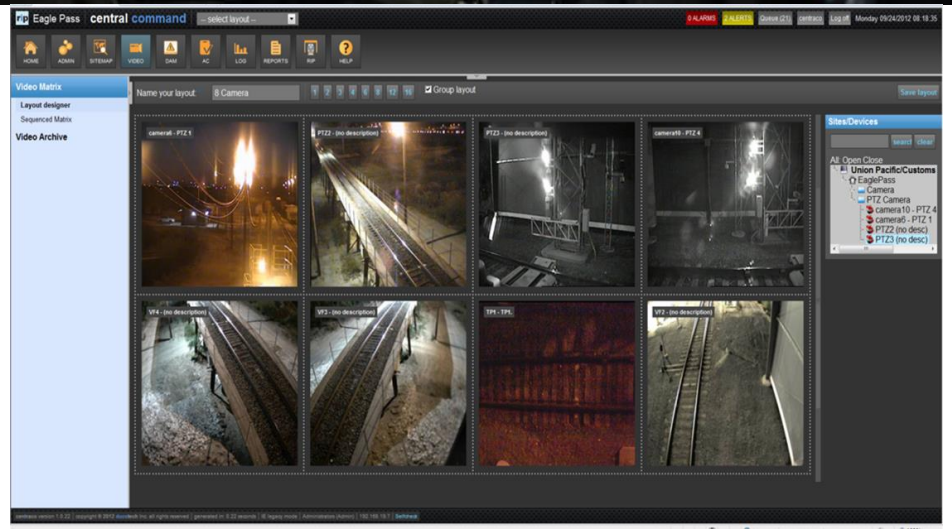


Service & Maintenance

- Dedicated Service Desk
- 24/7/365
- Automated AutoCheck
- Real Time Monitoring
- Proactive Response
- Software Updates

OPTIONAL SERVICES

- Field Service
- Preventive Maintenance
- Full Hardware Warranty



Service & Maintenance

- Hardware systems are proven and reliable
- Average system uptimes of our currently deployed sites is over 98%

Estimated rip Hardware MTTR		
Where are hardware spares?	**How is site manned?**	**Estimated MTTR**
On-Site	24 hours a day	30 minutes
On-Site	Operator is on call 24/7/365	1 hour
Onsite/Off-Site	Regular working hours on week days as well as weekends and holidays	3 hours
Onsite/Off-Site	Regular working hours on week days only	1 day
Offsite. Shipped by courier when fault condition is encountered	Operator notified by system when a fault is detected.	48 hours
Offsite. Parts ordered from duostech.	System is remotely located. Operator needs to be flown in to replace the hardware.	72 hours

Implementation

duostech Project Team

Each team consists of the following dedicated personnel and is scaled to accommodate the project as necessary:

Field Team

- Senior Program Manager
- Project Manager
- Field Technicians
- QA/QC Engineer

Software/AI Team

- Software Program Manager
- Lead Data Scientist
- Multiple Labelers & Support Staff

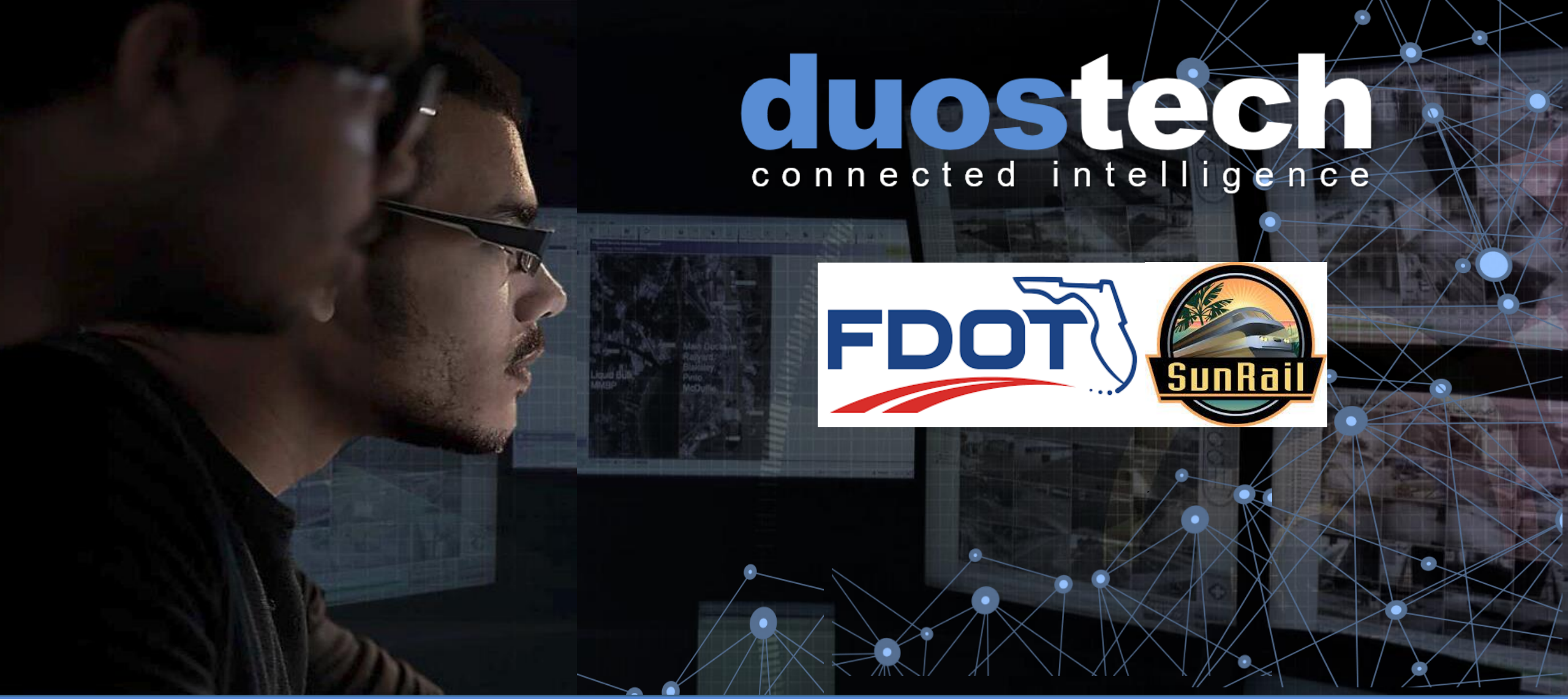
Training

2 weeks before deployment

- 1 Day of full class room training for designated teams
- 1 Day of Training to OCC Managers/employees
- Provide 3 sessions of on-site maintance training to signal and communications employees at location a TBD
- Provide Appropriate user manuals

Initial Deployment of system

- 5 Days of on-site user assistance (All Shifts)
- 5 Days of on site technician assistance for signal and communications
- 24hr User Help Desk after commissioning



Thank You – Q&A and Next Steps