Fort Worth Intelligent Micro-Weather Network for Autonomous Vehicles (AVs) and Advanced Air Mobility (AAM) Smart Grant

2 April 2025

Armond Bryant, AICP
Multi-Modal Transportation Manager
Transportation & Public Works

Don Berchoff, CEO TruWeather Solutions

TruWeather Solutions provides high-fidelity weather intelligence for age of autonomy

- In light of the Ice Storm Wreck of 2021
  - 133 car pile up
  - 6 fatalities
  - 36 straight hours of below freezing weather conditions
  - NTSB report indicated deficient monitoring process
    - “If environmental sensor stations had been installed near the crash location, NTEMP S3 would have had additional data at its disposal, which might have helped it to detect that the location needed additional deicing treatments before the crash.”

      (Source:chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.ntsb.gov/investigations/AccidentReports/Reports/HIR2301.pdf)

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BEYOND ORDINARY

TruWeather Solutions provides high-fidelity weather intelligence for age of autonomy

We are a micro-weather data, analytics, and services company focused on safely moving people and goods via remotely controlled air and/or autonomous vehicles, and crew-flown electric Vertical Takeoff and Landing (eVTOL) vehicles

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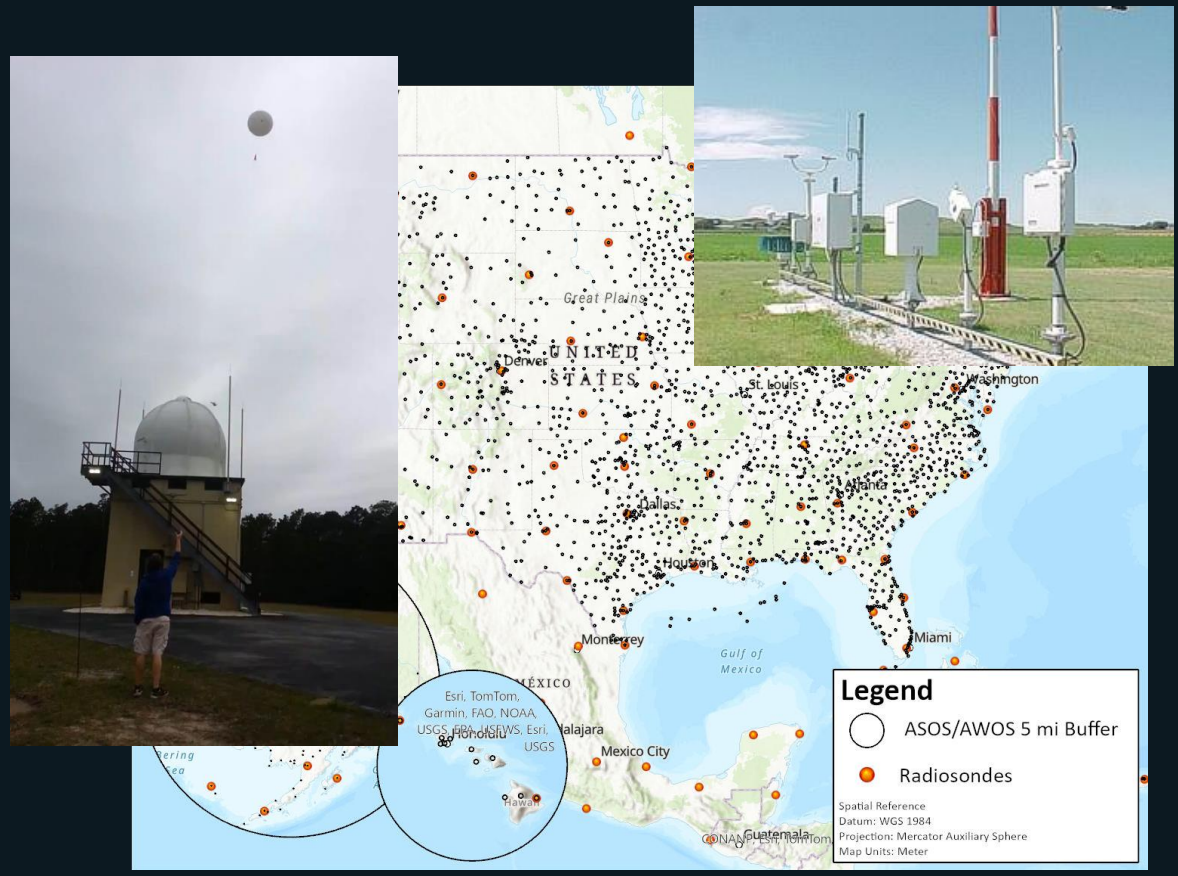
Current State of Weather System

- Weather system was not built for uncrewed autonomous aircraft or Level 4 or 5 ground vehicles
- The weather system has few weather measurements from the surface to 5,000 feet.
- Less than 5% of land areas have weather measurements
- Road systems have large weather gaps
- Weather data feeding air and ground decision systems may be synchronized



ASOS Automated Surface Observation System
AWOS Automated Weather Observation System

https://www.carmagazine.co.uk/car news/tech/autonomous car levels different driverless technology levels explained/

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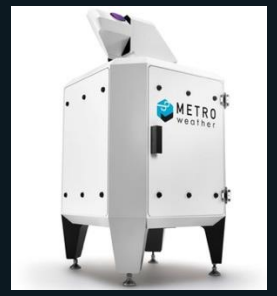
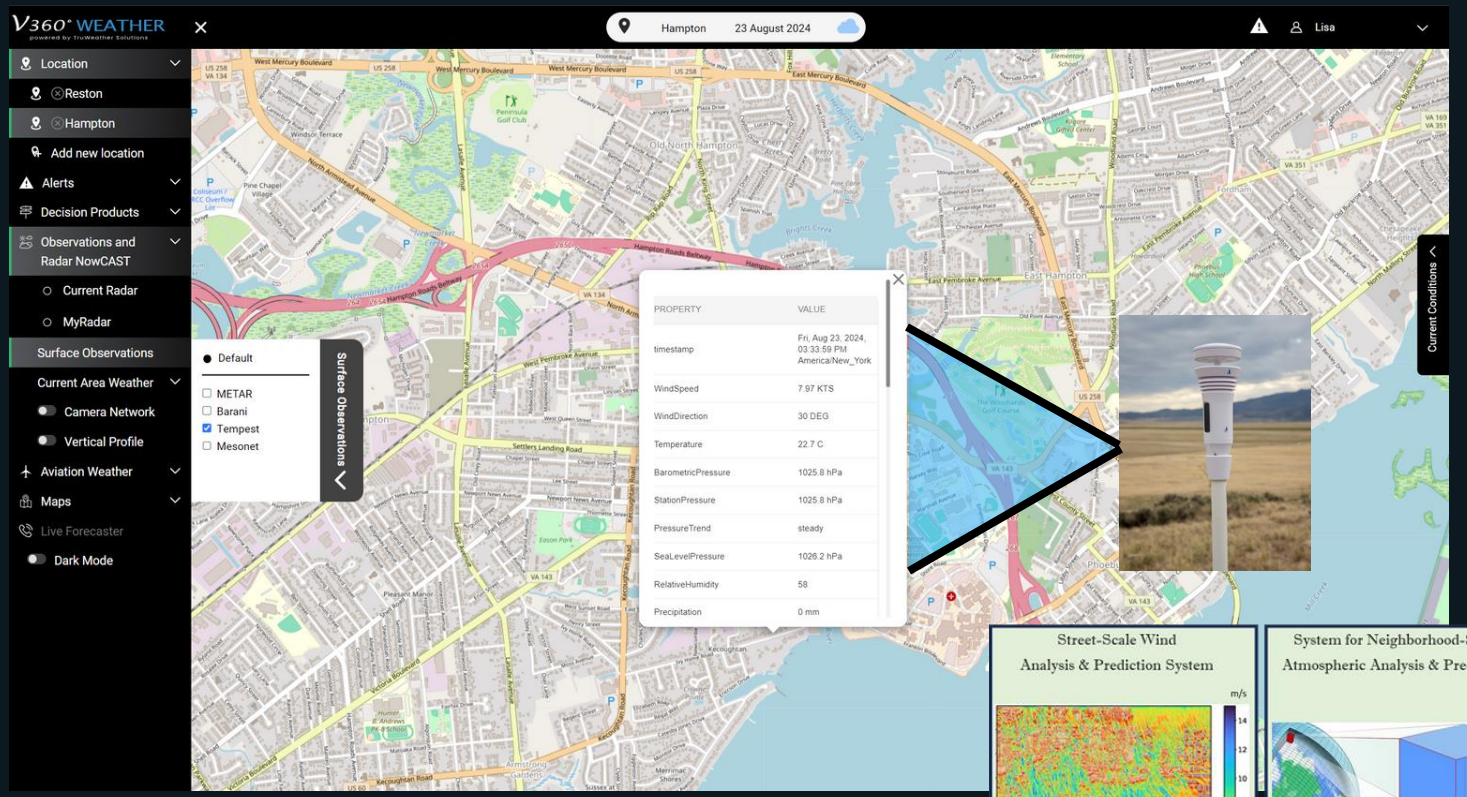
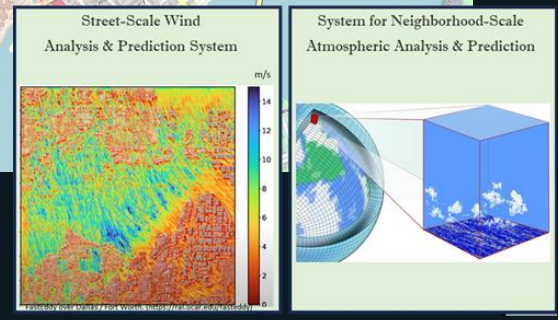
V360° WEATHER
powered by TruWeather Solutions

TruWeather seamlessly integrates new weather science software, weather data sources, and innovative sensing solutions to generate a more precise picture of the low altitude and surface micro-weather hazards







TruWeather Capabilities in 2025 -->

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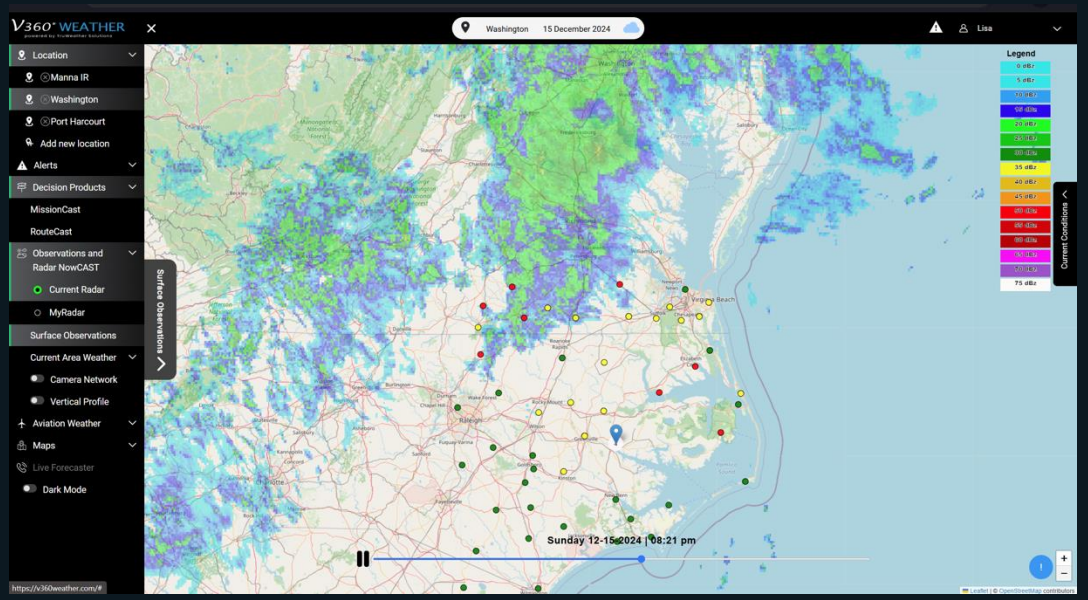
V360 Service Delivery

The Business Model and Revenue Streams



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Low-Cost Weather Sensors:

Choose from a variety of sensors to meet use case, plug into V360 and make visible within an ecosystem of existing weather networks

SaaS Subscriptions:

Subscription-based SaaS model providing continuous real-time hyper-local data and predictive weather analytics, integrated with autonomous systems.

Data Licensing:

Licensing weather data to third-party providers, including governments, airports, and enterprises.

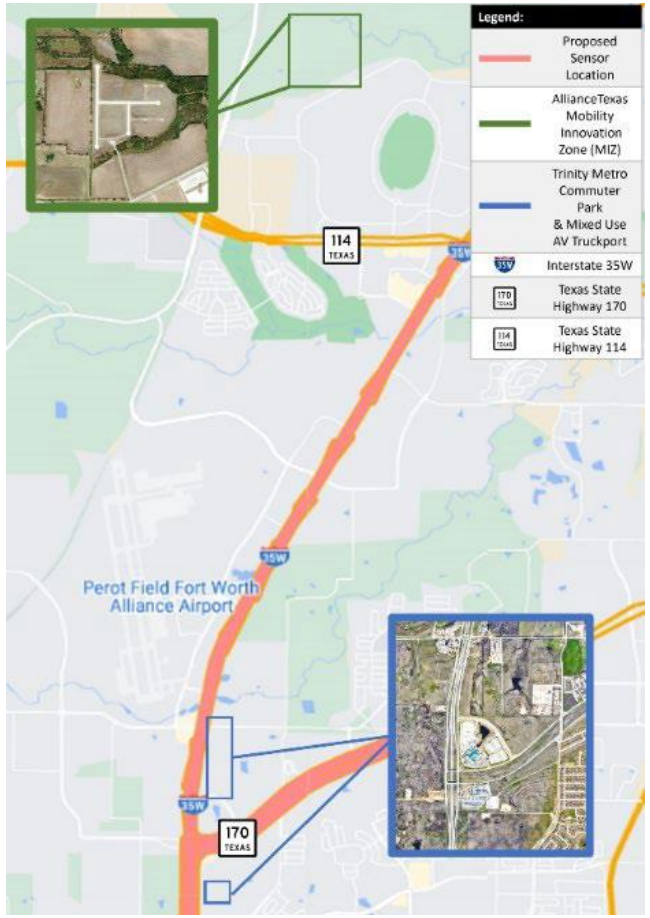
Professional Services:

Custom integration and consulting services to enhance operational weather management for high-volume users.

SMART Operational Concept (City of Ft. Worth)

Demonstrate ability to deploy and integrate a suite of IoT weather sensors to provide a consistent air and ground weather picture of weather hazards for autonomous vehicles (AV)

- This effort will utilize a diverse set of sensors to address low-altitude and surface weather data gaps for Advanced Air Mobility (AAM) and ground-based transportation, respectively.
- Weather data will feed advanced weather models and road-weather models for display in V360 web application.
- The weather data will be tested, validated, and refined to further advance its application for AVs and DOT applications.



IOT Sensor Map Coverage

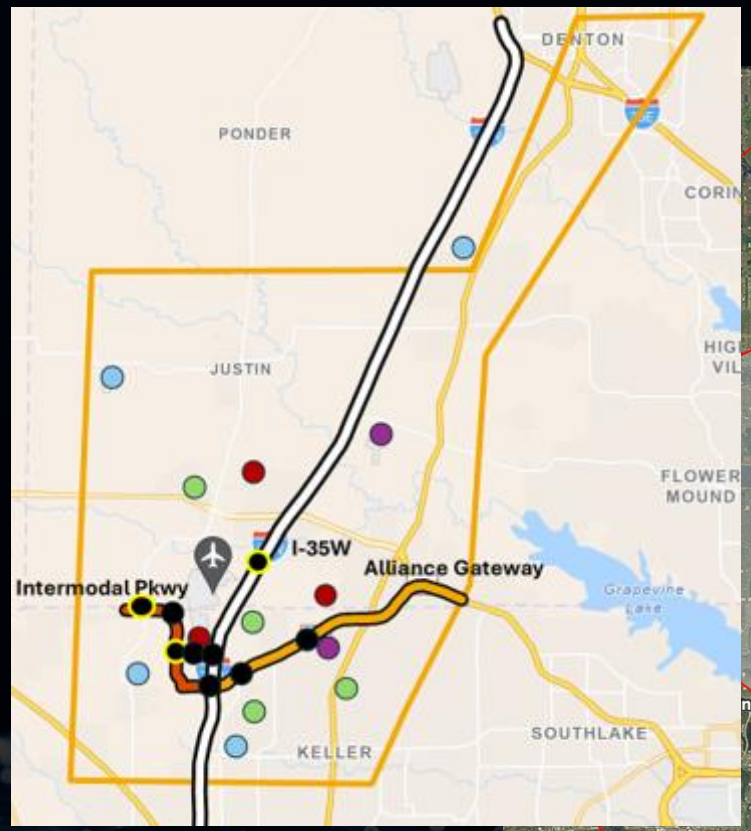
SMART Grant Sensors

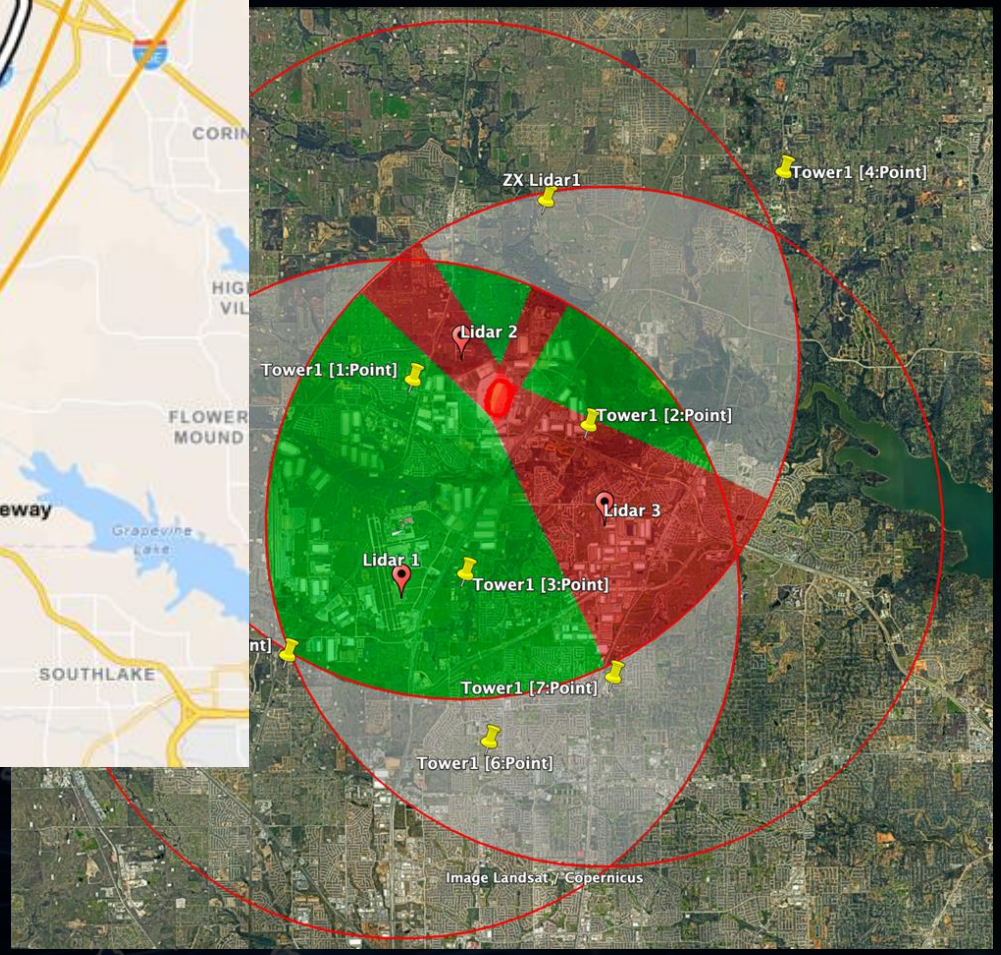
Total Operational Coverage Area

- 2 Intellisense MWS-C600
- 1 MetroWeather Wind Scanning LiDAR
- 6 Frost Roadway Systems
- 4 Frost/Tempest

Harmonized Sensors

- 5 NRG ZX300 Vertical Profiler and Anemometers
- 2 MetroWeather Wind Scanning LiDAR
- 4 Barani





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Key Milestones

Objective 1: Conduct feasibility study

Objective 2: Select sensor complement

Objective 3: Deploy sensors

Objective 4: Perform road weather sensor and CASA radar integration

Objective 5: Integrate advanced weather models and road weather model outputs into V360

- Augment Street-Scale Wind Analysis and Prediction System (SWAPS) to produce micro-scale wind information for integration into Frost's road-weather models
- Outputs will be integrated into V360 to facilitate intermodal transit planning

Objective 6: Conduct systems test

- Test the ensure proper weather model data integration into V360 decision tools

Objectives

Objective 7: Facilitate key partner integrations

- Work with key partners to facilitate their integration of TruWeather's APIs to access its data and products

Objective 8: Evaluate performance under operational scenarios

- Work with key partners to develop key measures of performance and effectiveness to quantify the benefits of intermodal transit activities
- Collect these and other metrics over a variety of operational scenarios thus establishing a performance baseline, notable divergence from baseline will be included in final report

Questions

Office of the
COUNTY ENGINEER

SMART Grant

Nicole Chinea, PTMP
Senior Planner | Community Planning & Transportation

FY 22 SMART AWARD

Project Type: Sensors

Technology Leveraged: Intelligent, sensor-based infrastructure

Description: Study and implement a user dashboard to alert residents in flood prone areas of Harris County.

Grant Award: $2,000,000

SENSORS

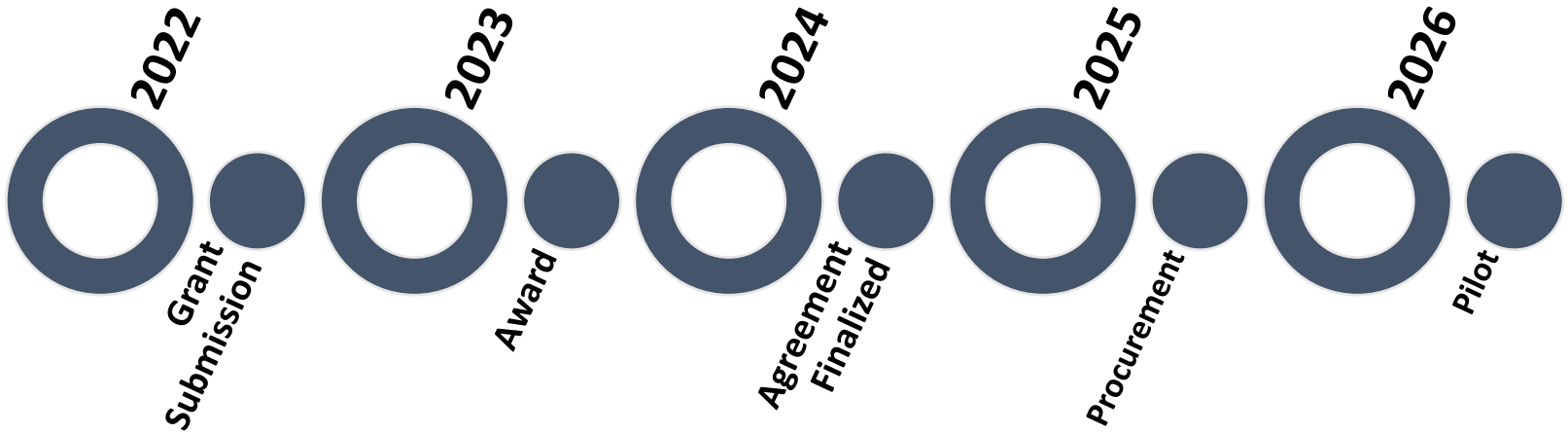
SYSTEMS INTEGRATION

SMART GRID

TRAFFIC SIGNALS

SMART Grant Timeline

Harris County was awarded the SMART Grant in 2023 and will be complete the pilot program in 2026.



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Emergency Measures Study (EMMS)

As adopted by Commissioner's Court in 2023, EMMS provides a baseline understanding of overall scores based on the following metrics & weights:

Safety	25%
Equity	25%
Resiliency	25%
Economic	25%

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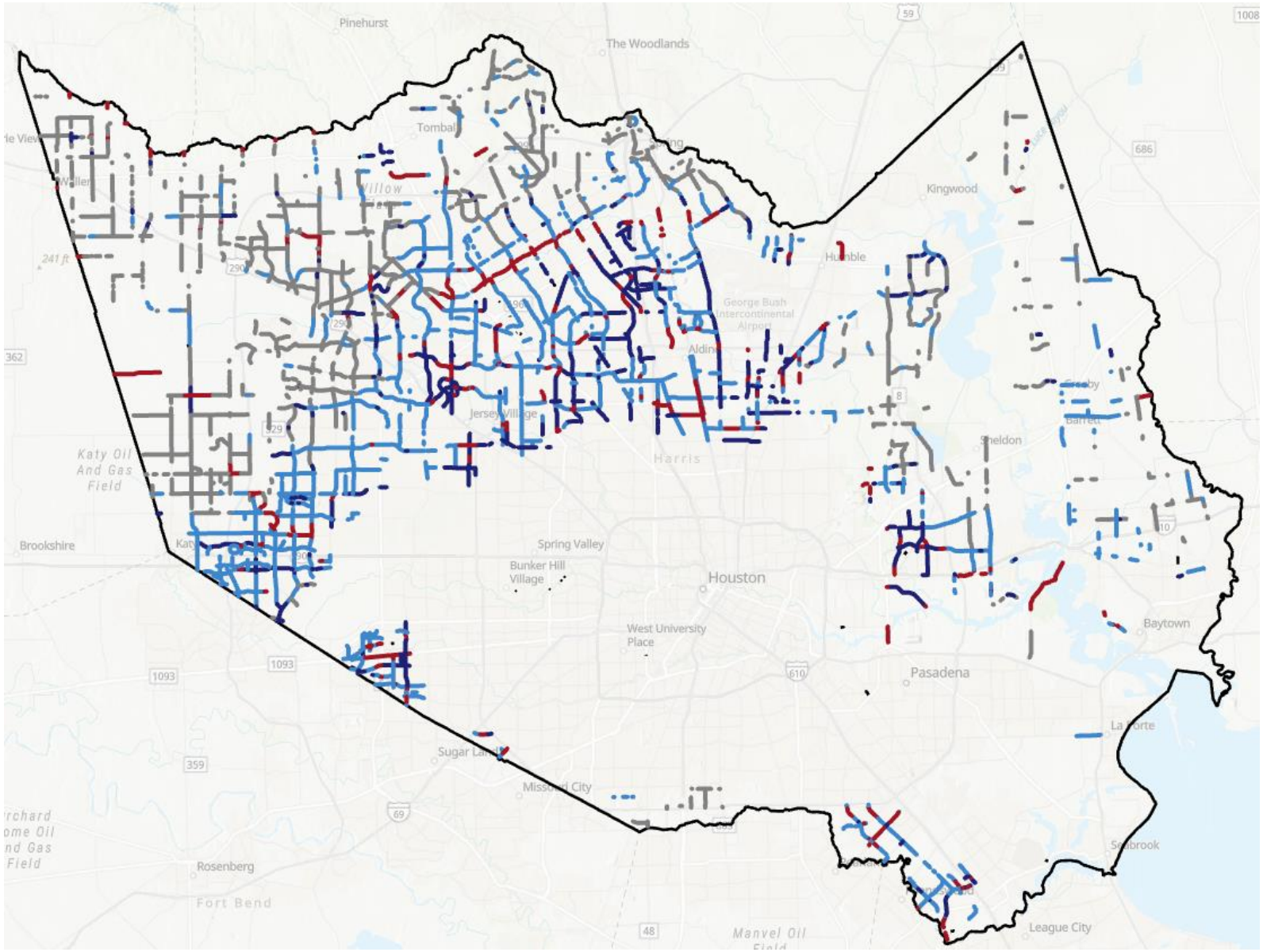

Overall Segment Score

- <85
- 35-45
- 25-35
- <25

SMART Pilot Locations

Not all locations will be tested in the same manner, but each precinct agency will have the opportunity to select between riverine flooding risk locations and road flooding risk locations per the EMMS Study.

OFFICE OF THE COUNTY ENGINEER
HARRIS COUNTY

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SMART Pilot Technologies

The main objective of selecting locations is to test a prototype integration of multiple industry standard technologies, across a vast geographical area and effectively communicated to the public.

In addition to the chosen locations, the pilot will include a location that touches with another municipality or county, to comply with the framework of the grant.

Vehicle detection on flooded roadways with Vision

SYSTEMS INTEGRATION

** Not all technologies will be selected to be tested at every location **

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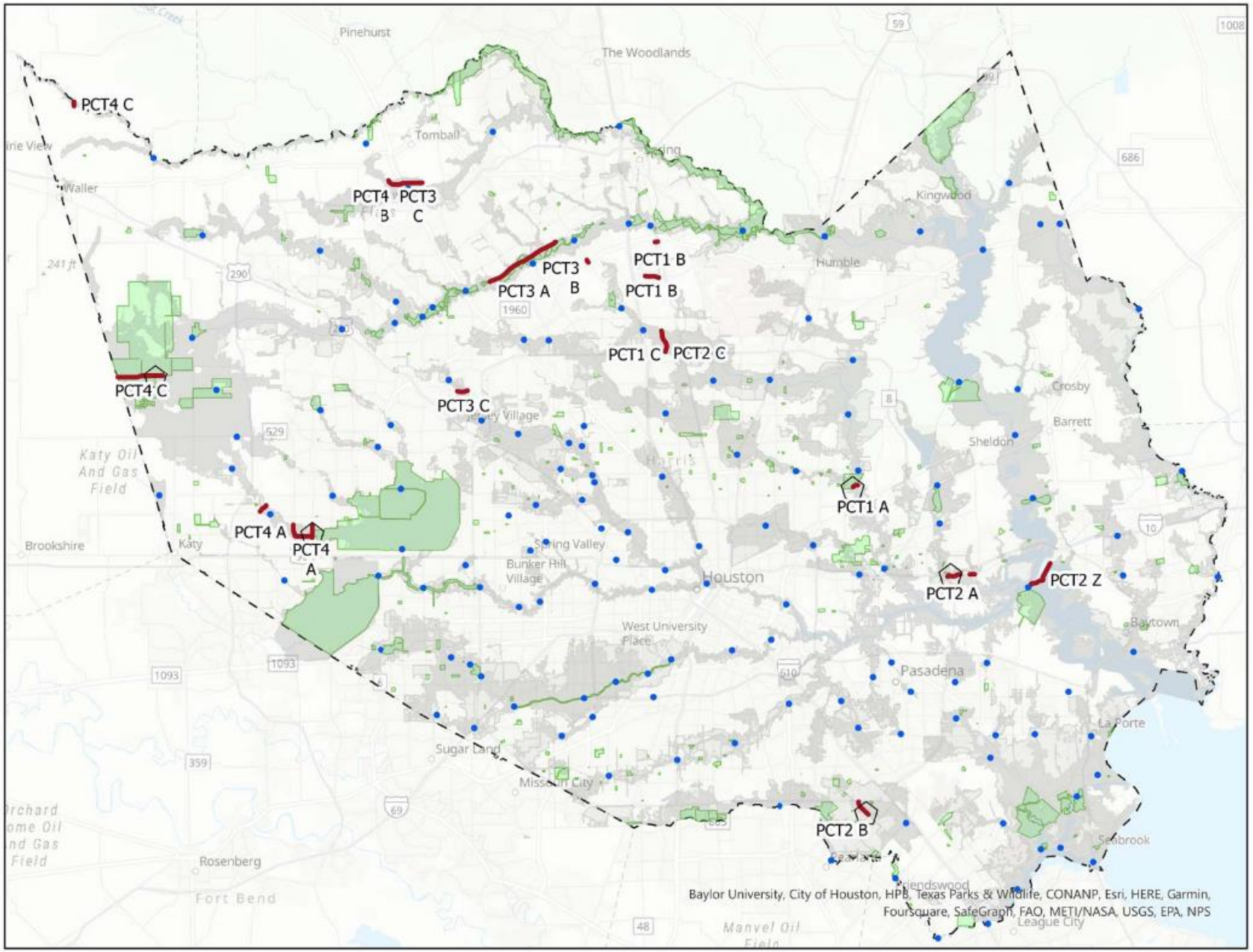
SMART Pilot General Map

Showing an overlay of FEMA Floodway, Parks and Greenspaces, Harris County Flood Control Gage Locations and selected SMART Pilot corridors by precinct and by category.

- Parks and Greenspaces
- FEMA Floodplains
- Existing HCFCD Gages within 500ft of SMART corridor
- Other HCFCD Gages



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SMART Technology Approach

Three unique approaches to testing the system integrations in the prototype.

Tipping Buckets/Rain Gauges

Monitors actual road surface conditions, separate from the riverine condition.

Flashers and/or CCTV devices

Flashers and/or CCTV devices

Connection – Data Channels

Via API or scripted data, sensors activate based of nearby sensors.

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Degrees of Implementation

Level 1:
New Hardware & Software

Level 2:
Existing Hardware & New Software

Level 3:
Existing Hardware & Software integration

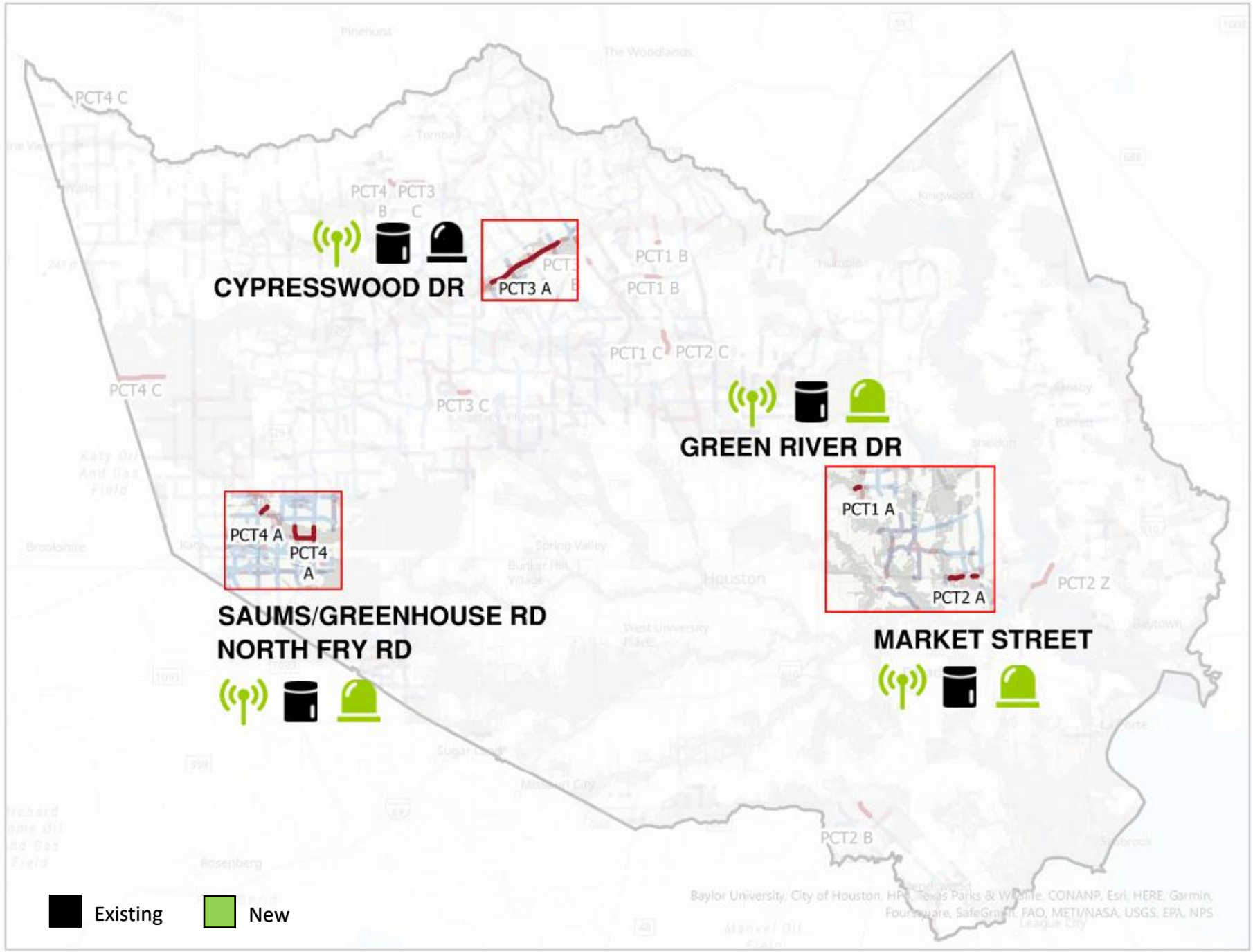
Level 4:
Inter-agency coordination

Recommendation

Riverine Flooding Location Testing

County wide locations that are at high risk of flooding due to riverine conditions.

All degrees of implementation will be tested at each location, but not every location will have the same technology.



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PCT1 [A]
GREEN RIVER DR

EMMS Rank: 33

Prioritization Scores: 66

Existing HCFCD Gage at channel.

Known low point at intersection.

Not HCED maintained.

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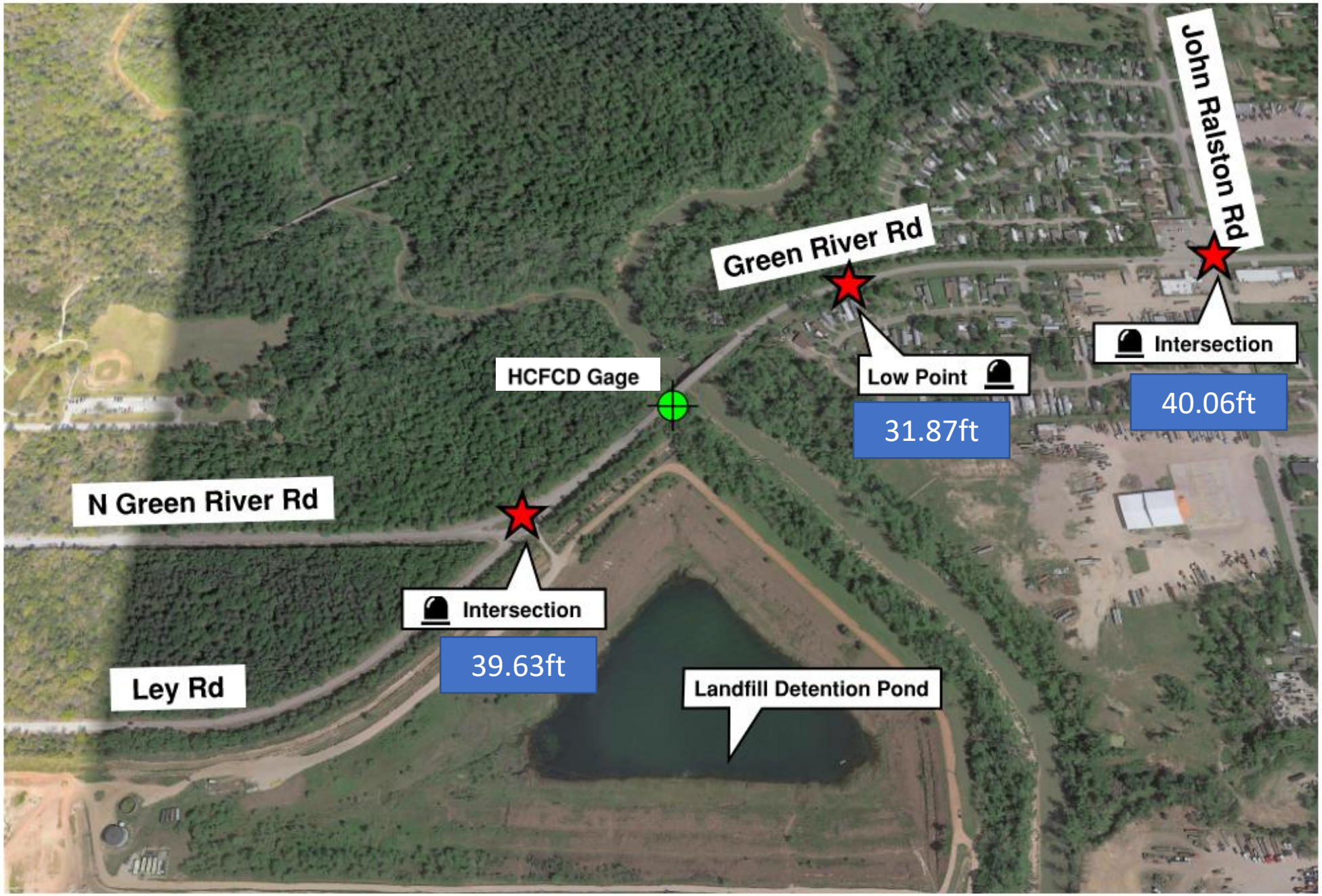


PCT2 [A] MARKET ST

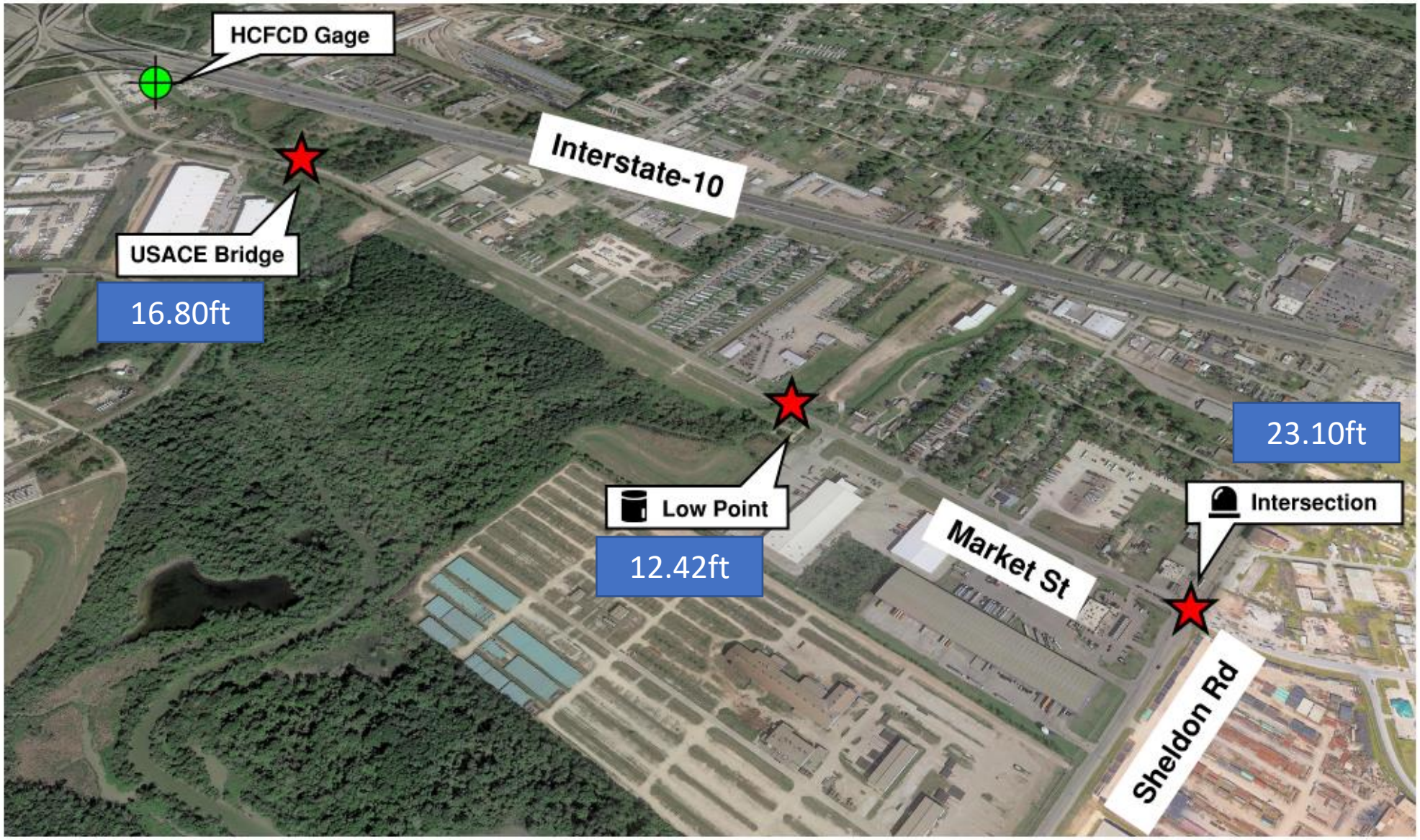
EMMS Rank: 38

Prioritization Scores: 64

Existing HCFCD Gage at channel upstream.

No gage at low road point.

Sheldon @ Market Intersection slated to be the south anchor for Adaptive Corridor Network.



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PCT3 [A] CYPRESSWOOD DR

EMMS Rank: 15, 20

Prioritization Scores: 64

Existing HCFCD Gage at channel.

TCS Cabinets raised on +18", but not enough to mitigate flooding.

Existing fiber optic cameras

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PCT4 [A]
SAUMS RD
GREENHOUSE RD

EMMS Rank: 22, 59

Prioritization Scores: 65, 51

Existing HCFCD Gage at channel.

Known low point at intersection.

School flashers nearby.

Existing wire traffic signal and raised TCS Cabinet.

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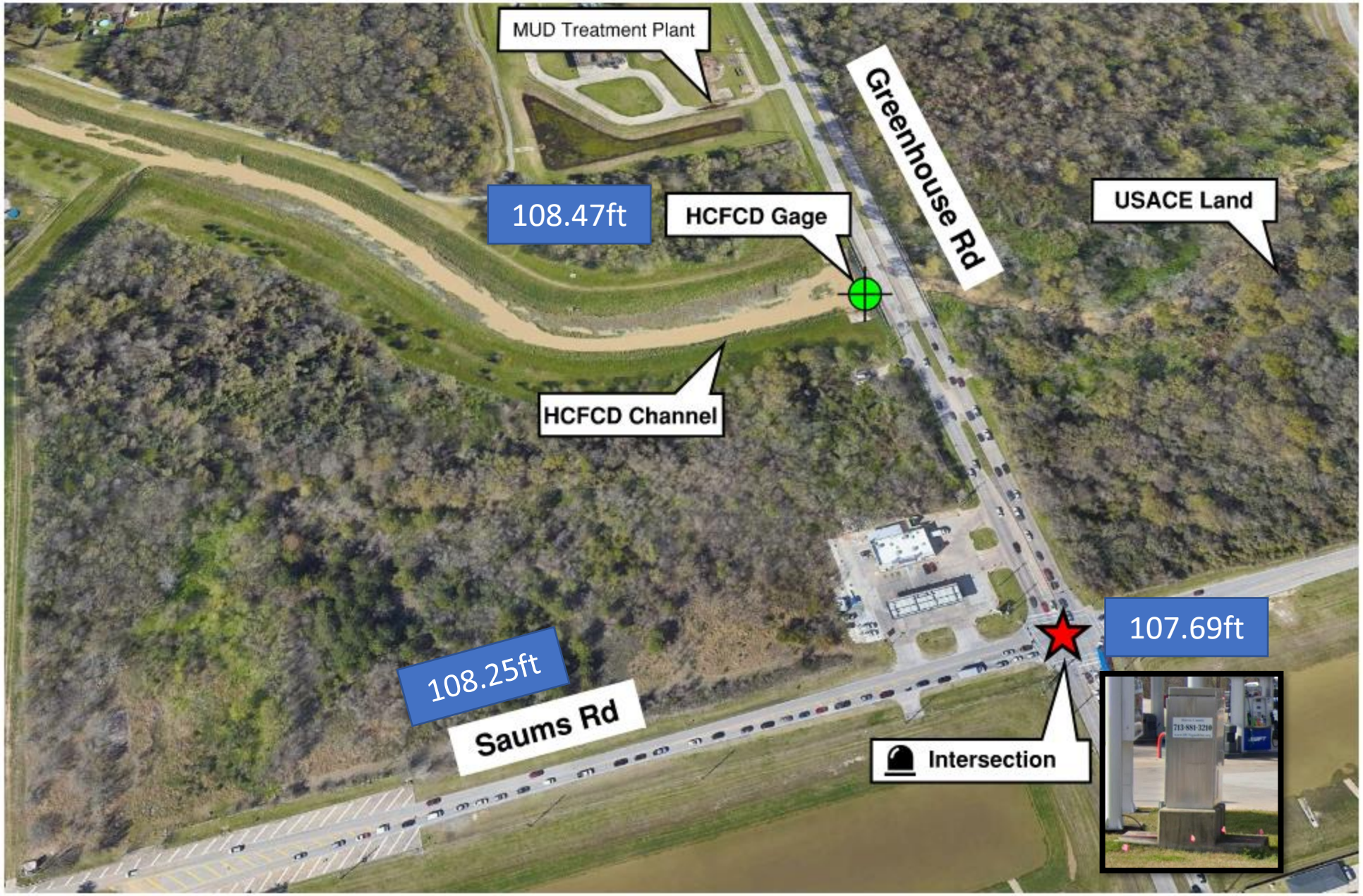

PCT4 [A]
N FRY RD
SAUMS RD

EMMS Rank: 17, 22

Prioritization Scores: 63, 65

Existing HCFCD Gage at channel.

Known low point at intersection.

School flashers nearby.

Existing wire traffic signal and raised TCS Cabinet.

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Multi-jurisdiction Location Testing

By exploring locations in the pilot that are adjacent/at the border of another municipality, jurisdiction or subdivision of government, it allows the team to provide the federal government that the project can:

1. Confirm that technologies are capable of being integrated with existing transportation systems.
2. Promote public and private sharing of data and best practices.

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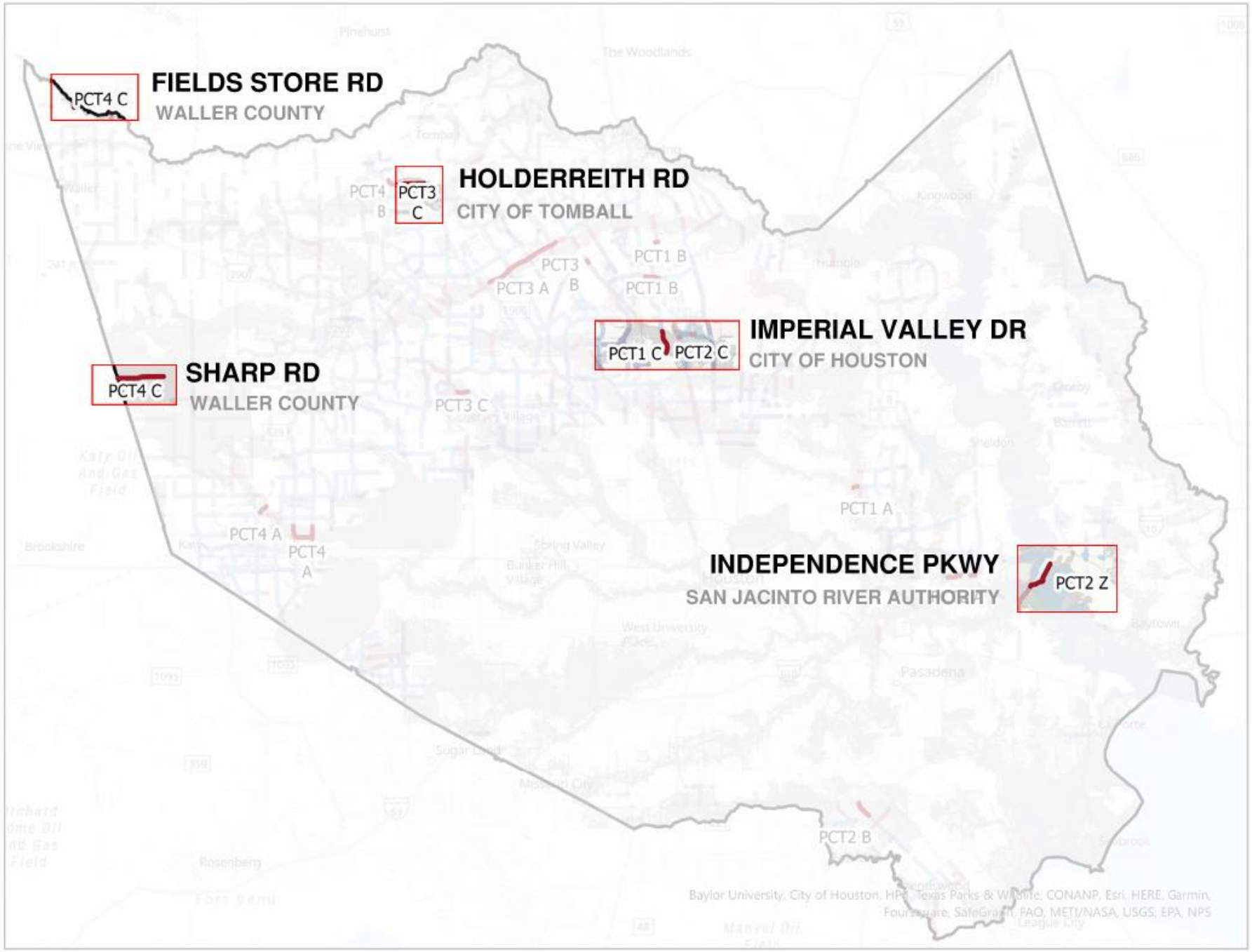
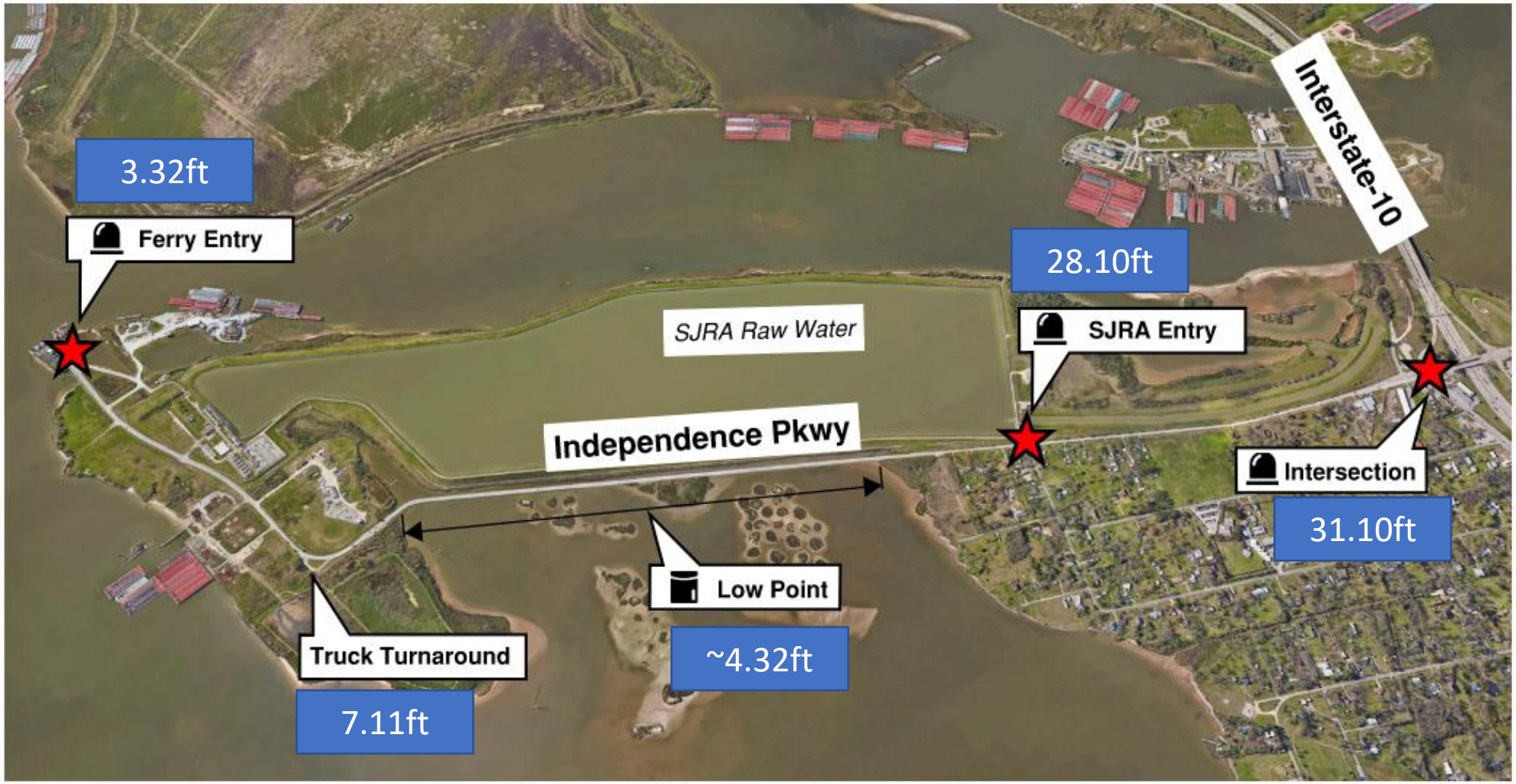


INTER-AGENCY INDEPENDENCE PKWY

EMMS Rank: 262

Prioritization Scores: 52

- Low elevation
- Heavy Industrial use
- Existing Signage and DMS for Ferry – HCTRA & TXDOT
- Critical entrance to Lynchburg Community



All existing hardware – only connection – data channels needed

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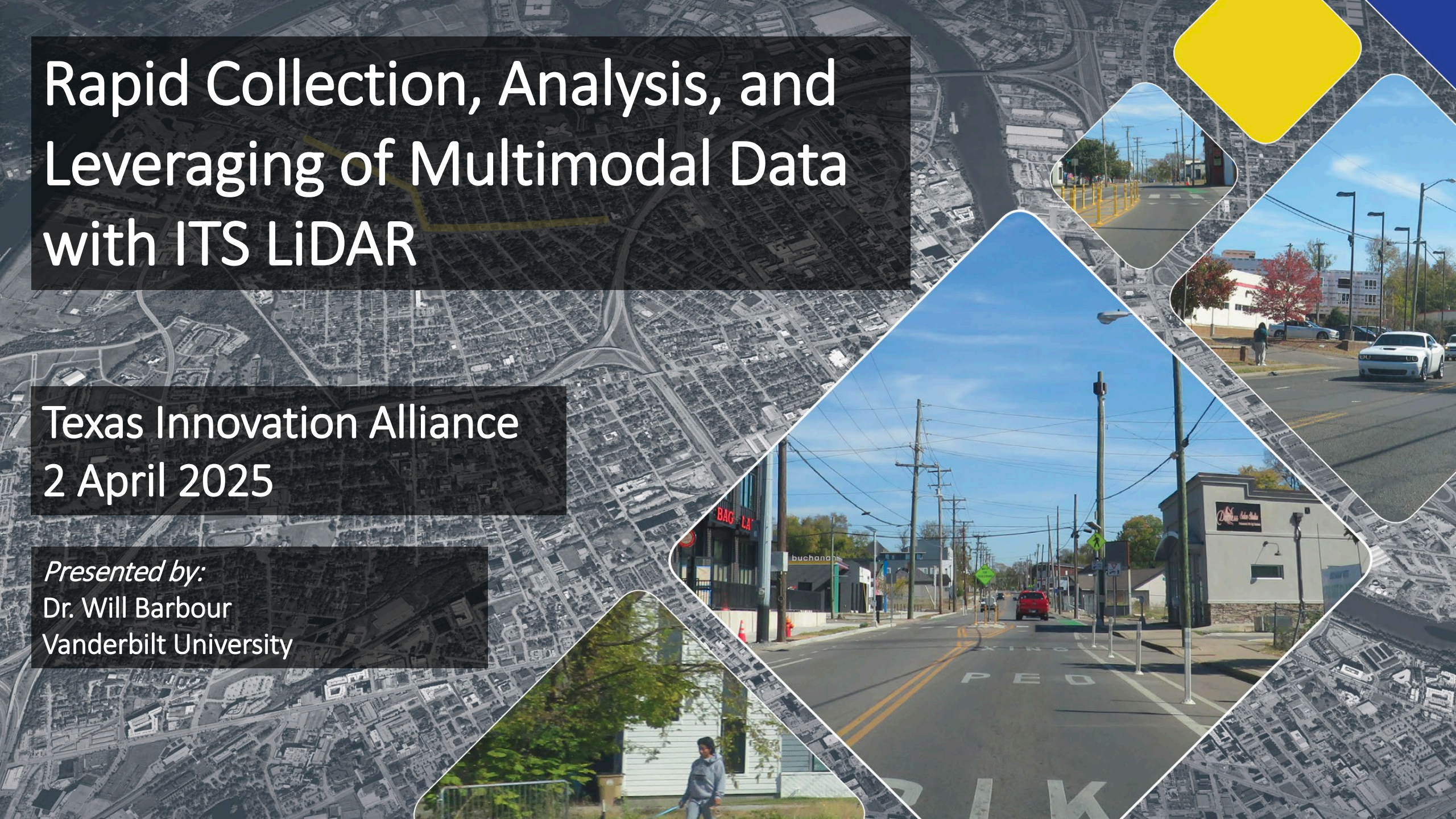
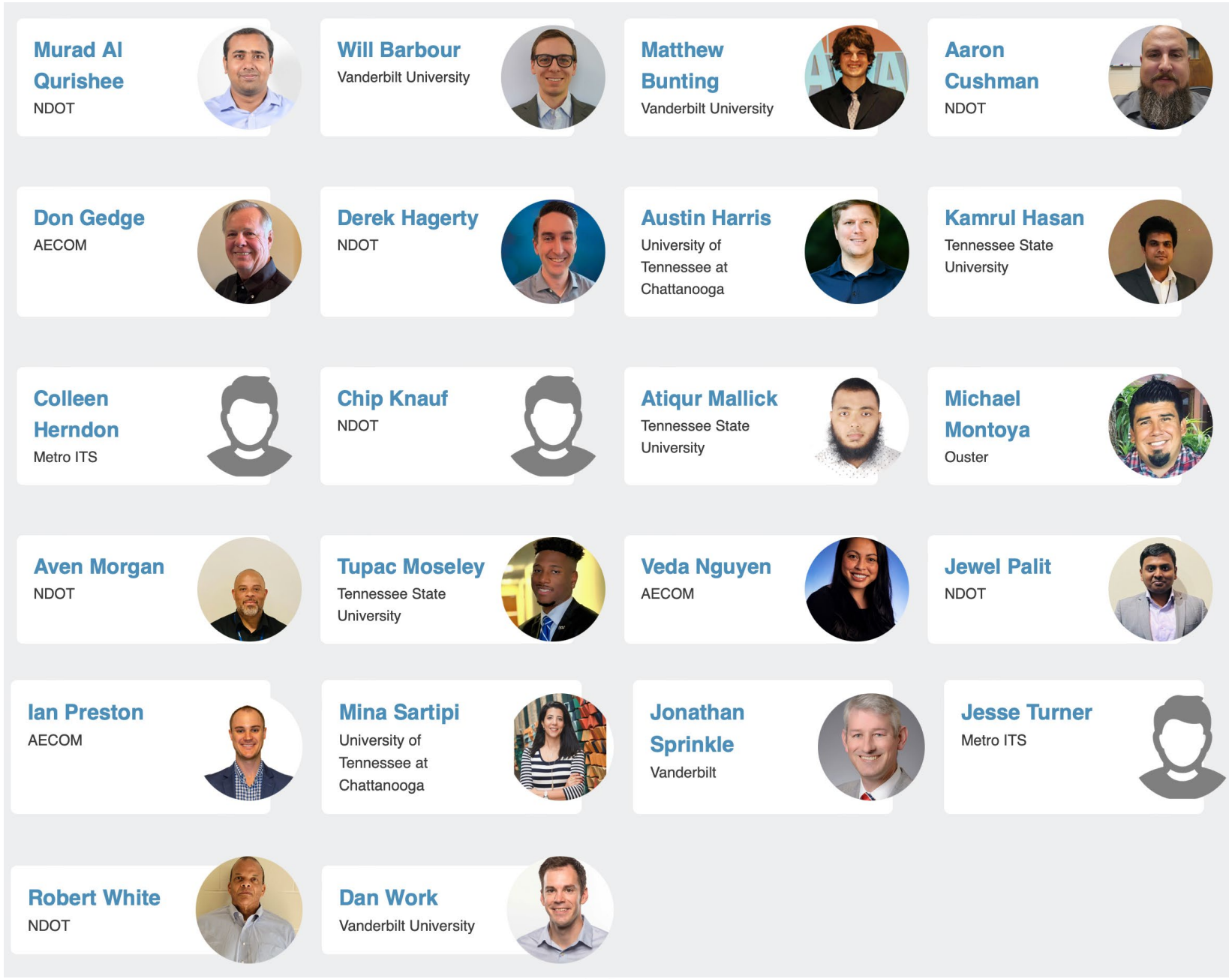
Rapid Collection, Analysis, and Leveraging of Multimodal Data with ITS LiDAR

Texas Innovation Alliance
2 April 2025

Presented by:
Dr. Will Barbour
Vanderbilt University



The team:



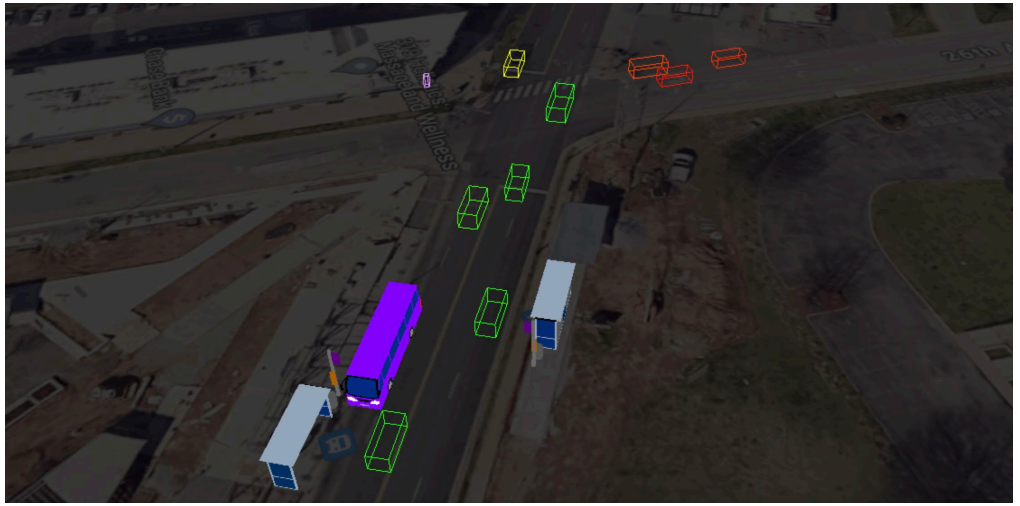
LADDMS

NDOT TDOT Department of Transportation AECOM The University of Tennessee Chattanooga Tennessee State University Vanderbilt University Stansell Electric Company, Inc. Ouster

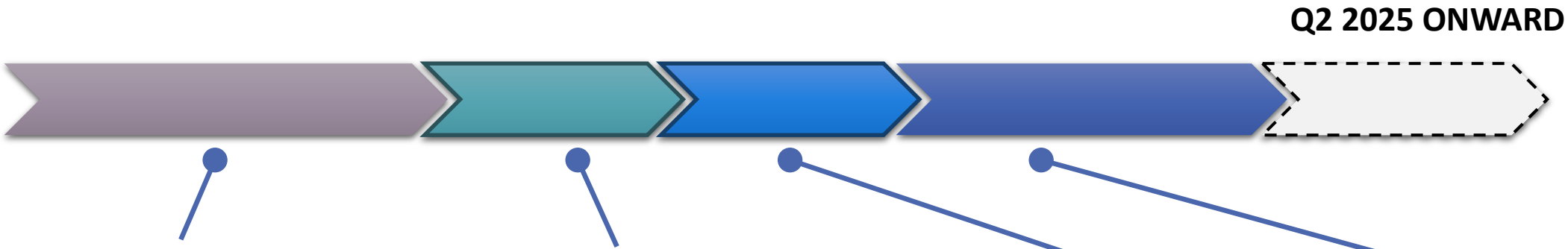
Project Summary

- **Objectives:** Advance Vision Zero goals to increase safety for vulnerable users.
- **Need:** Traditional crash reporting methods have left gaps in pedestrian safety and activity data.

- **Objectives:** Improve traffic efficiency in targeted areas and corridors.
- **Need:** High resolution vehicle data (frequent time/location points) has been costly to collect across large areas.



Project Timeline



Q4 2023 / Q1 2024

- TEAM FORMATION
- PROJECT PLANNING
- SITE WALKTHROUGH
- PUBLIC ENGAGEMENT
- COORDINATION WITH OUSTER ON LIDAR SPECIFICATIONS, SITE CHARACTERISTICS, AND INSTALLATION CONSIDERATIONS

Q2 2024

- TECHNICAL INTEGRATION WITH OUSTER
- FIRST DEVICES ARRIVE, BENCH TESTING AND PILOT INSTALLATION COMPLETE @ **26TH AVE N & CLARKSVILLE PIKE**
- DATA ANALYSIS (BEGINS)
- WORKFORCE DEV AT *ITS TN ANNUAL CONFERENCE*
- *WORKFORCE DEV TRAINING WITH CONTRACTOR*

Q3 2024

- REMAINING EQUIPMENT & MATERIALS RECEIVED
- BENCH TESTING
- INSTALLATIONS FOR REMAINING INTERSECTIONS AND MIDBLOCKS
- DATA EVALUATION AND SAFETY INTERVENTIONS
- MOBILE TRAILER INTEGRATION

Q4 2024 / Q1 2025

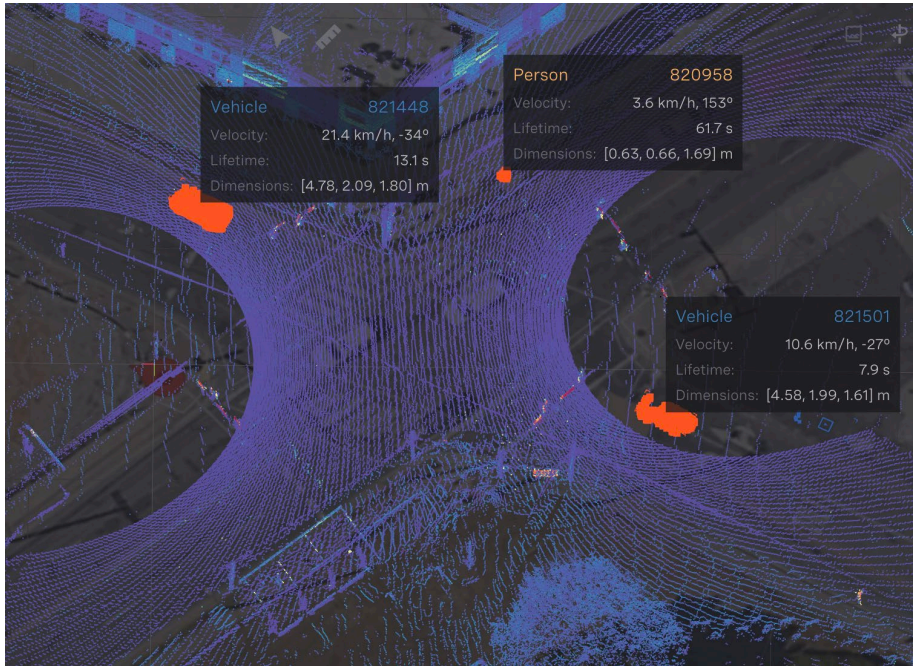
- MOBILE TRAILER DEPLOYMENT
- PERMANENT SIGNAL INTEGRATION
- CONTINUED TECHNICAL COORDINATION WITH OUSTER
- INCREASE DATA SHARING
- PLAN FOR EXPANSIONS

Outline

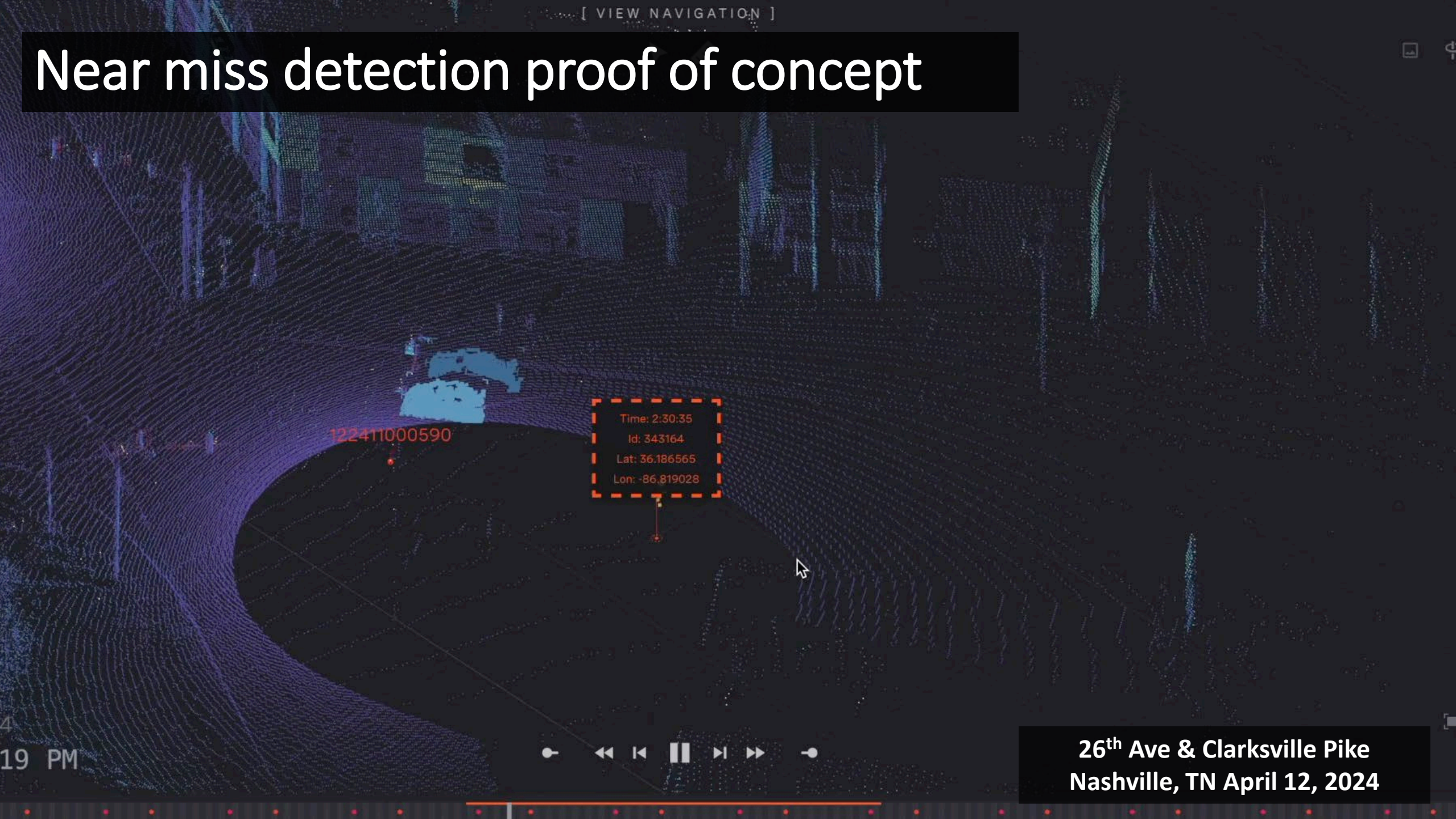
1. Introduction to ITS lidar
2. Fixed infrastructure sensing
3. System evaluation
4. Mobile sensing
5. Future plans

Lidar ITS infrastructure

- Multiple sensors cover blind spots and occlusion by vehicles.
- Classifies pedestrians, bikes, and vehicles (moving or stationary).
- Zone detection for all modes, precise down to a few inches.
- Lidar edge computers can put in calls to traffic controllers.



Near miss detection proof of concept



26th Ave & Clarksville Pike
Nashville, TN April 12, 2024

Sneak peak of the project

Positive community and municipal support

Mayor O'Connell highlighting LiDAR projects during speech to NSF Smart & Connected Communities Program.

LiDAR addresses community concerns about cameras and privacy.

Fixed infrastructure sensing

Pilot installation: 26th Ave N & Clarksville Pike

Installation involves:

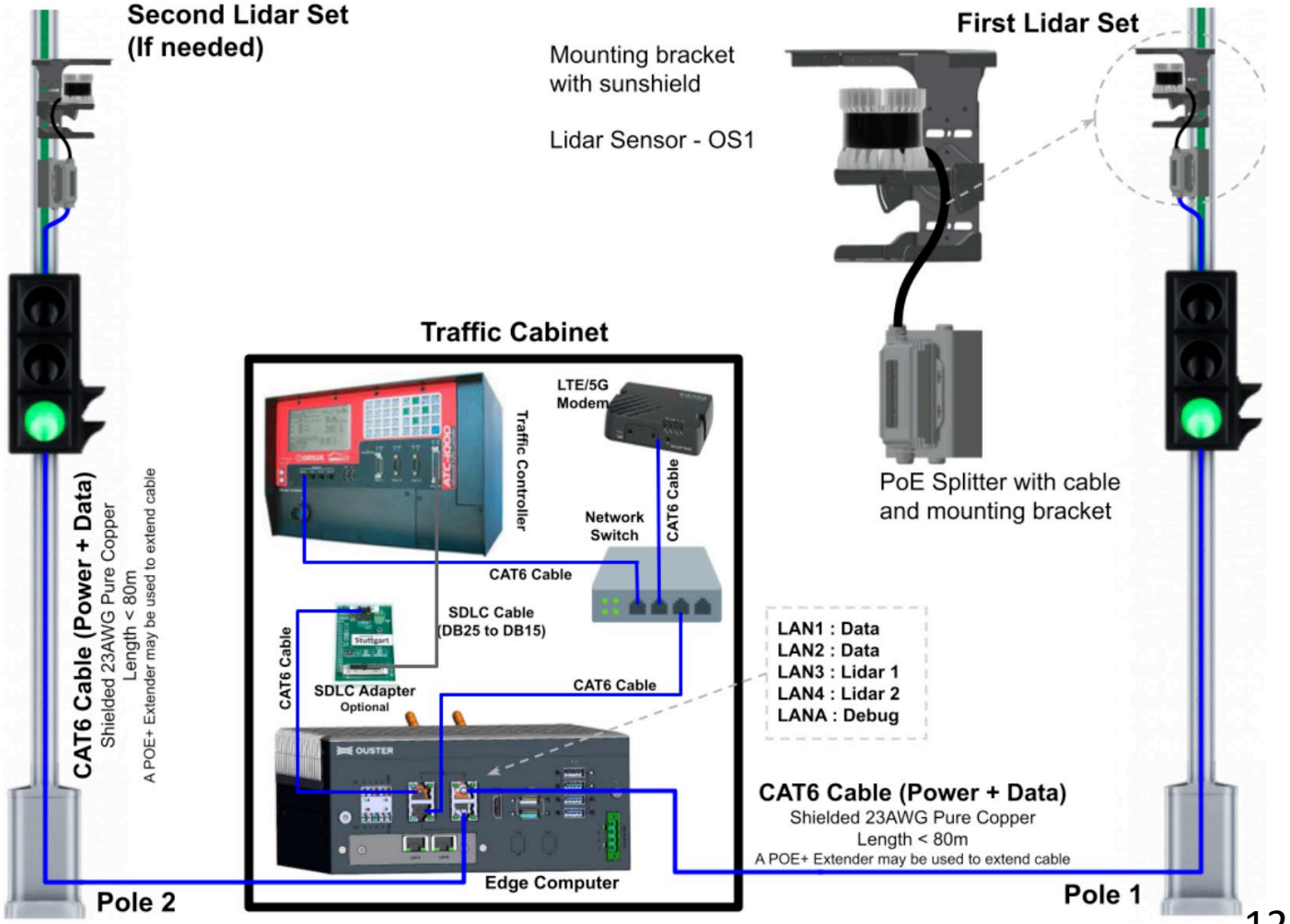
1) Installing sensors on signal poles
2) Running ethernet cable to sensors
3) Installing cabinet equipment

Total installation time around 3-4 hours.

April 8th, 2024

System layout

- Sensors run on PoE reduced to 24V, supplied by lidar edge computer.
- Sensor ethernet can run 300ft, 500-600ft with PoE extender.
- Laptop can be connected directly to edge computer or run through a local area network.
- Cellular modems for now, NDOT network later.

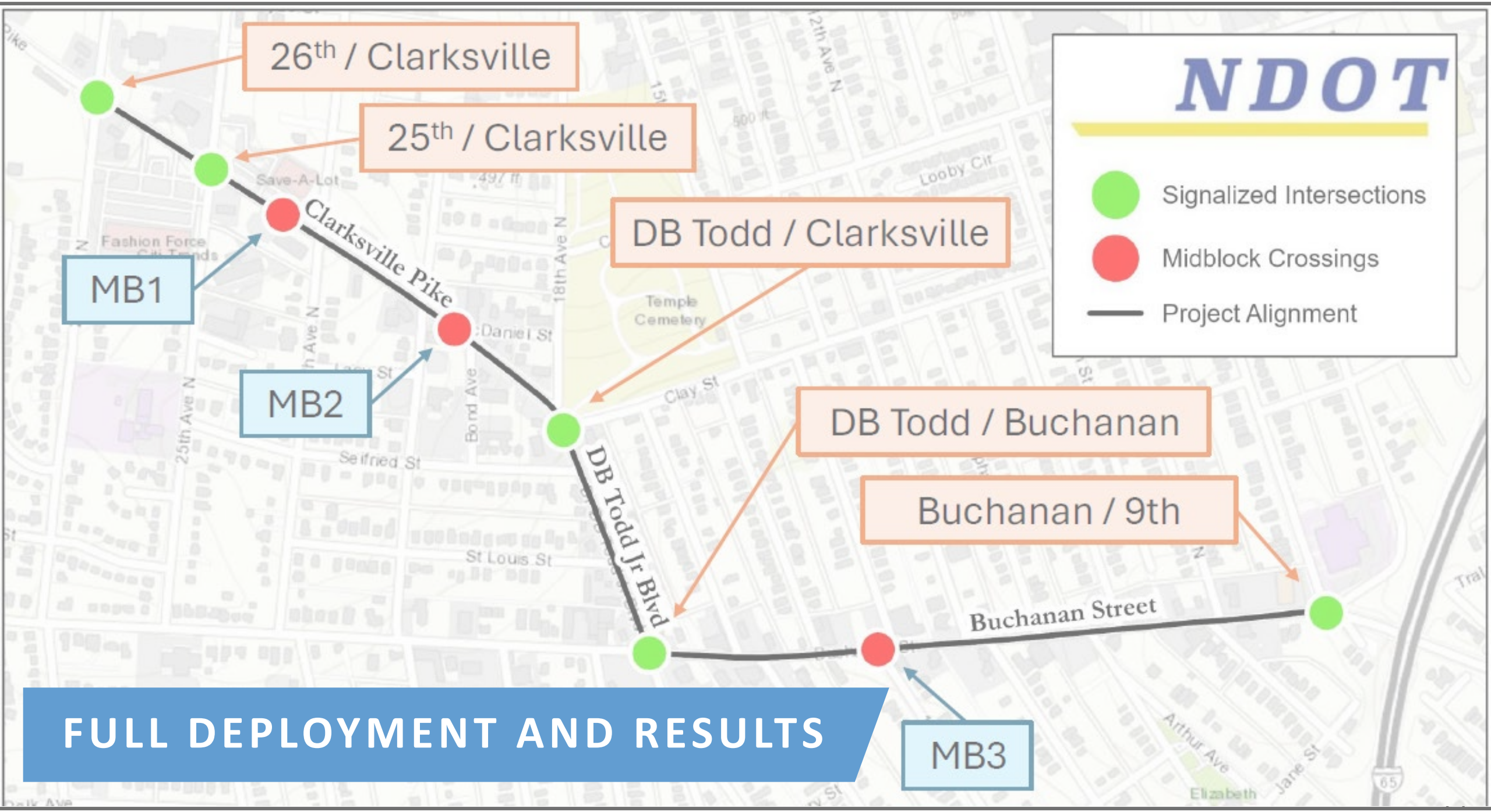


First views of pedestrian crossing locations

48 hours post-installation

Begins to confirm concerns about mid-block crossings through the corridor

April 10th, 2024

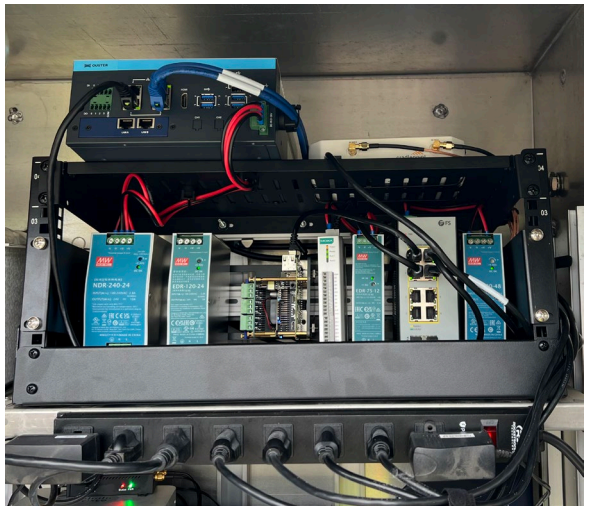


FULL DEPLOYMENT AND RESULTS

Installation methods

Traffic cabinet drop-in rack

- Used on pilot install and upcoming oversize intersection.
- Future standard for modern traffic cabinets.



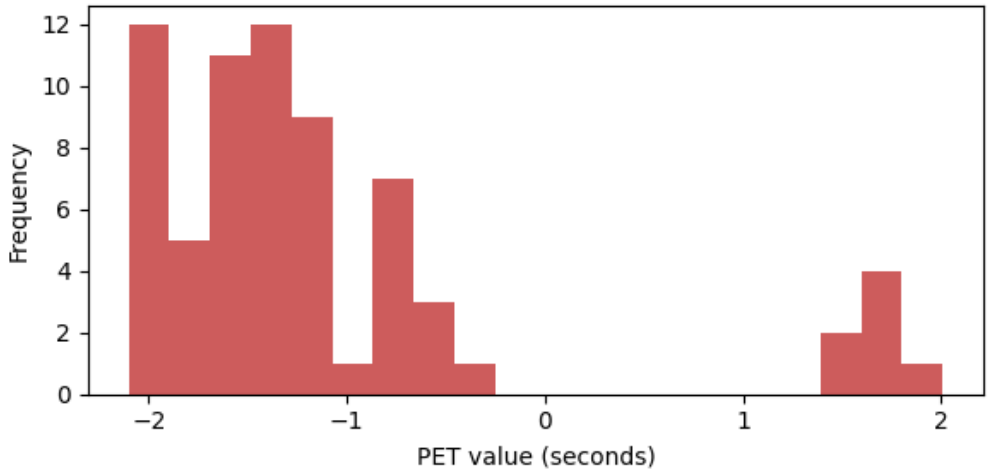
Pre-fabricated auxiliary cabinet

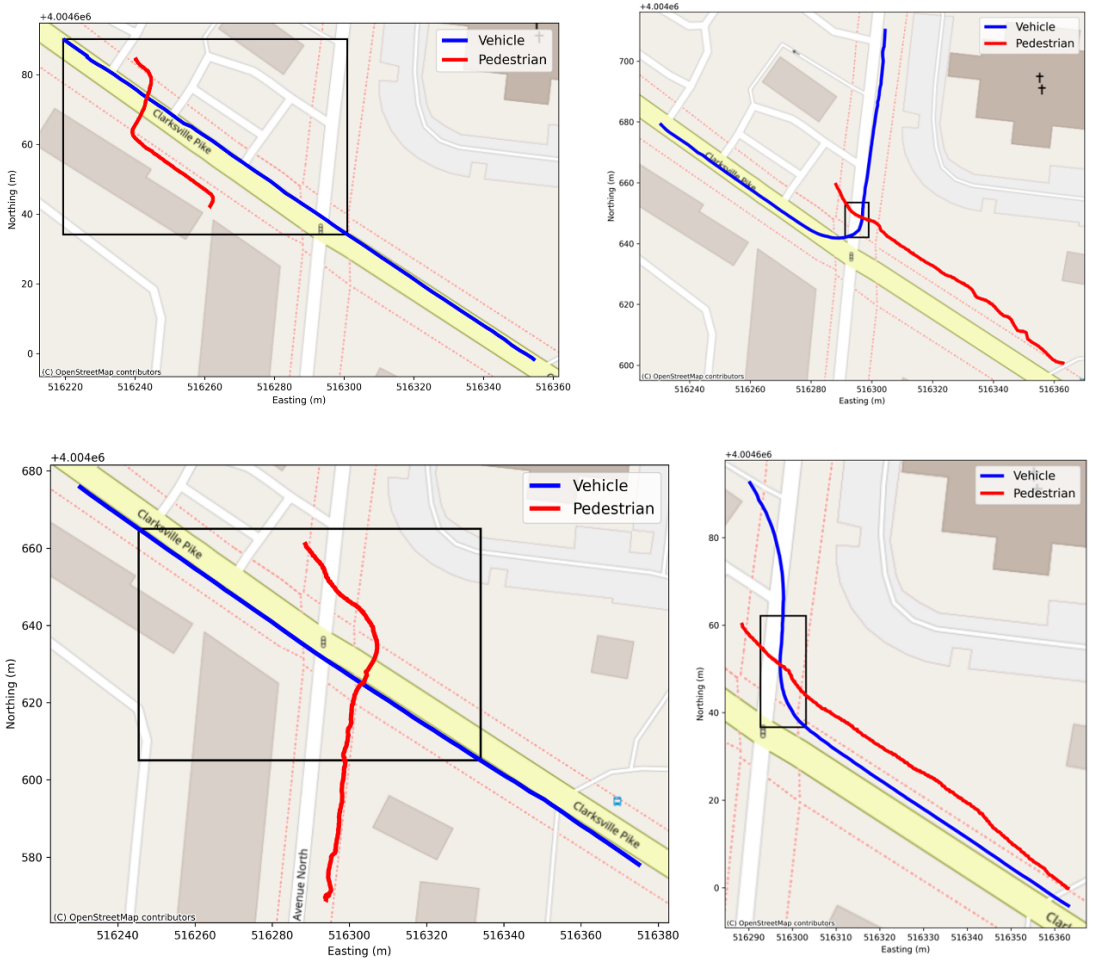
- Helpful on intersections with small, legacy traffic cabinets and mid-block installations.
- Fabrication, integration, and testing performed in shop.

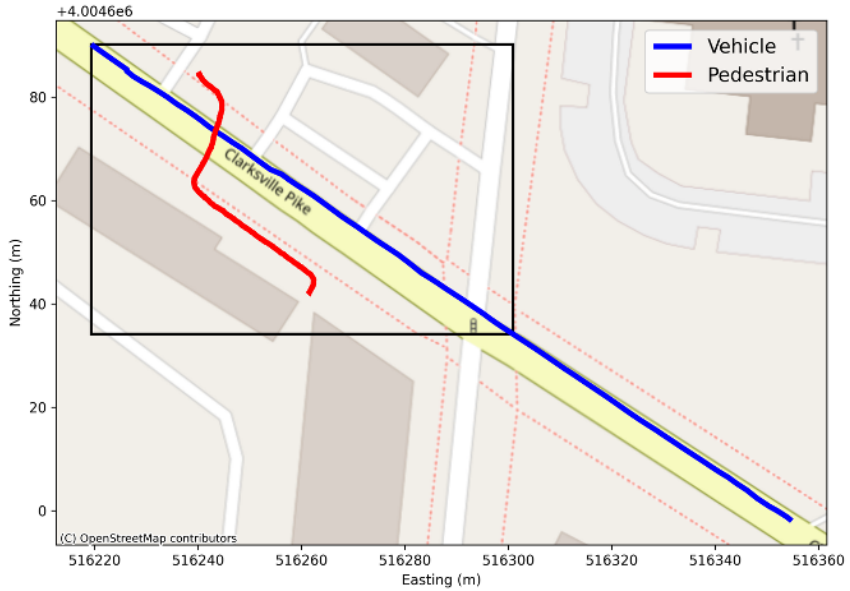
System evaluation and safety countermeasures

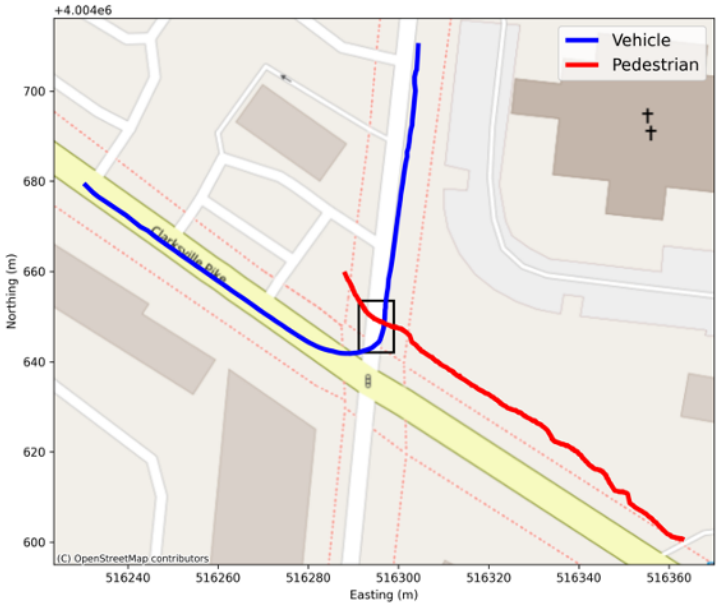
Near-miss detection and validation

- Use post-encroachment time as detection metric for near-miss.
- After filtering for non-roadway events and stopped vehicles, all remaining events were manually validated.
- 90% are negative PET; 10% positive (i.e., pedestrian then vehicle).






+4.0046e6
Vehicle
Pedestrian
Clarksville Pike
Northing (m)
Easting (m)
(C) OpenStreetMap contributors

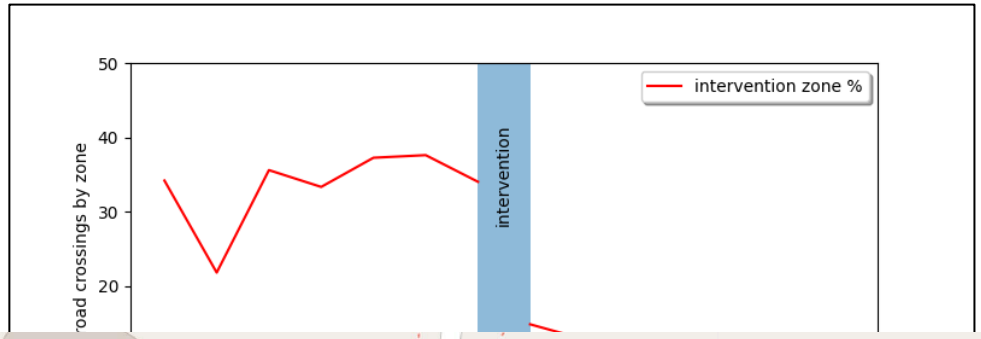

+4.004e6
Vehicle
Pedestrian
Clarksville Pike
Northing (m)
Easting (m)
(C) OpenStreetMap contributors


+4.004e6
Vehicle
Pedestrian
Clarksville Pike
Clarksville Pike
Avenue North
Northing (m)
Easting (m)
(C) OpenStreetMap contributors


+4.0046e6
Vehicle
Pedestrian
Northing (m)
Easting (m)
(C) OpenStreetMap contributors

Pedestrian crossing behavior

- Data from intersection crossings and mid-block areas (important for crash safety).
- Installed 2-week intervention to evaluate lidar pedestrian data and behavior change.



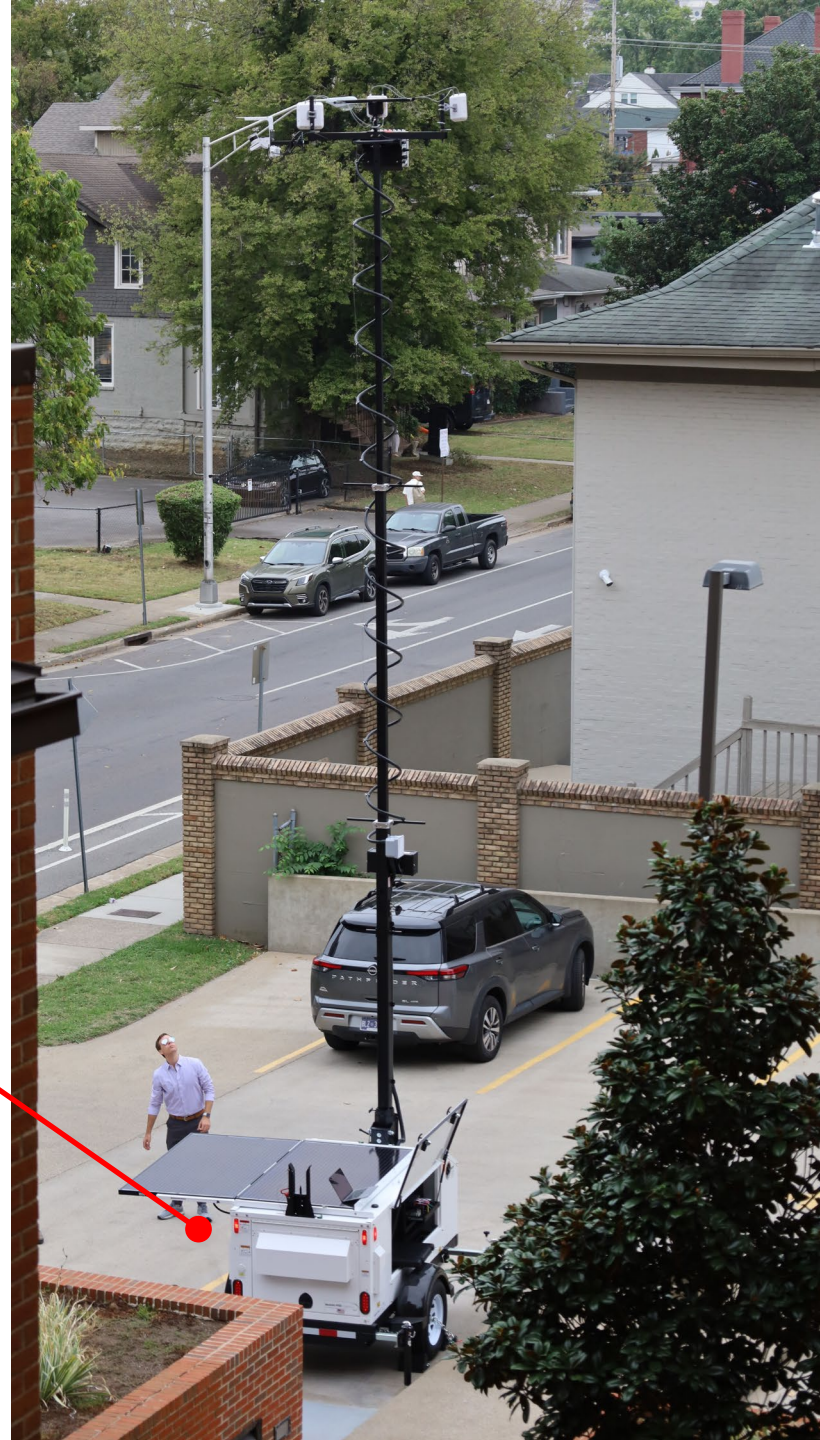
Vehicle speed intervention

- Deployed temporary mobile speed trailers to inform drivers.
- The share of super-speeders (traveling 40+ mph in a 25-mph zone, and 60+ mph in a 40-mph zone), decreased by 30% and 35% at two treated areas in the corridor.
- Problem identification, treatment, and evaluation took 4 days, 10x faster than prior methods.

Mobile sensing

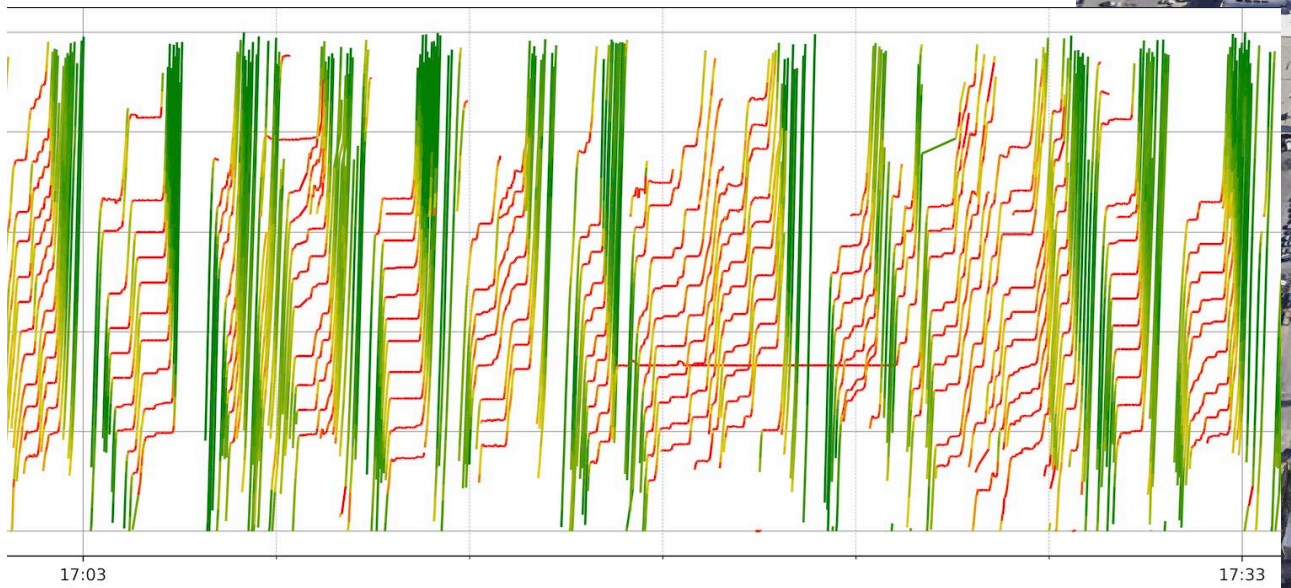
Nashville lidar trailer deployment

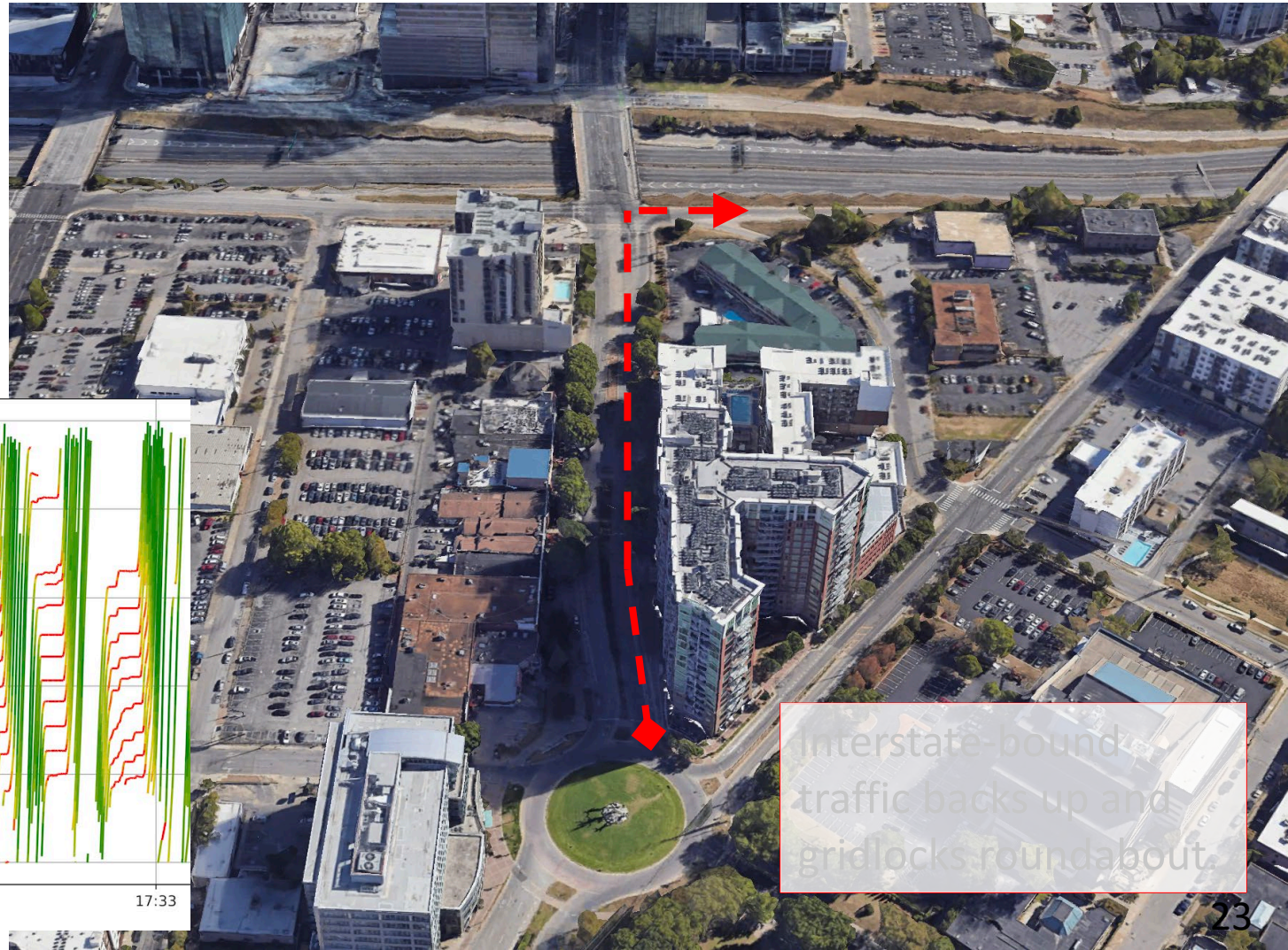
- Targeted data collection at areas of interest.
- Up to 32ft mounting height.
- 1+ month no-touch runtime using solar, battery, and generator.



Nashville lidar trailer deployment

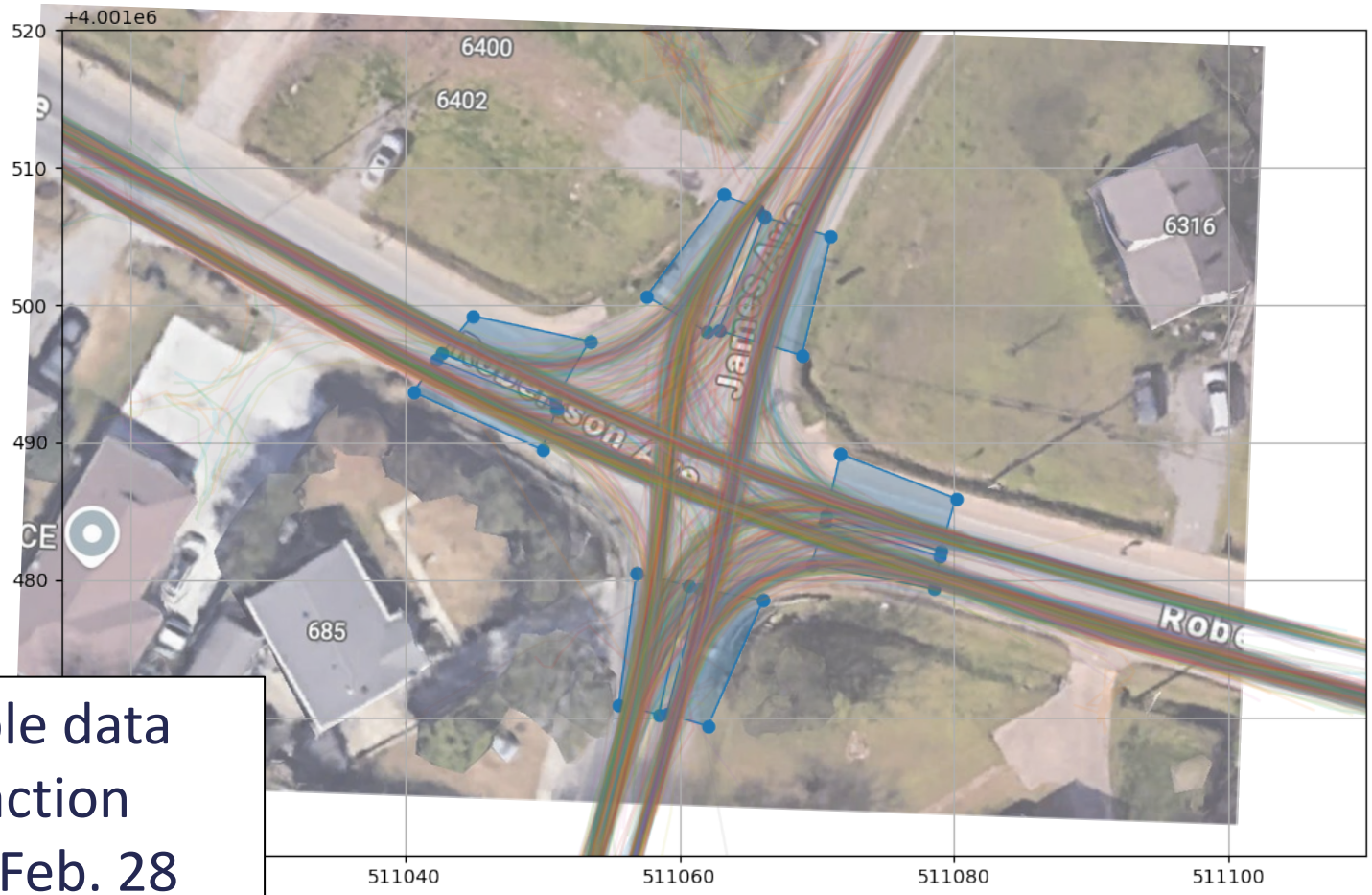
- Determined queueing period and severity to adjust signal timing.
- Measured vehicle throughput, max queuing time, queue buildup frequency.





Robertson Ave 4-way stop warrant

Existing two-way stop being evaluated by NDOT for 4-way stop, following complaints from residents/motorists.



Example data extraction Friday Feb. 28

Monday March 3

Turning movement summary

Future plans

Nashville ongoing development

- $10M Stage II SMART grant will install lidar along Nolensville Pike and connecting streets.
- Partner city installations for technology sharing.
- 110 installations beginning 2025.
- $3B Nashville Transit Referendum with $170M dedicated for “Smart Signals”

Permanent Broadway deployment

- Measuring and automated alerting for sidewalk overflow.
- Extension of pedestrian phases during events or high traffic periods.
- **Need goalpost detection for upcoming Vanderbilt football season.**

Rapid Collection, Analysis, and Leveraging of Multimodal Data with ITS LiDAR

Texas Innovation Alliance
2 April 2025

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