U.S. Department of Transportation

ITS4US

IT'S TRANSPORTATION FOR ALL OF US

Georgia Mobility and Accessibility Planner (G-MAP)
Accessible Routing – Pedestrian Impedance Factors and Application

Georgia Department of Transportation (GDOT)
Safe Trips in a Connected Transportation Network (ST-CTN)

March 12, 2024

Webinar Agenda

- **Purpose of this Webinar**
  - Introduce the system development process and how stakeholders are engaged throughout the process to ensure the system will meet user needs
- **Webinar Content**
  - ITS4US Program Overview (Norah Ocel)
  - Project Background (Kofi Wakhisi)
  - G-MAP Routing and Mobility Modes (Jon Campbell)
  - Pedestrian Impedance Factors (Randy Guensler and Angshuman Guin)
  - Questions and Answers
  - How to Stay Connected (Norah Ocel)
- **Webinar Protocol**
  - You are welcome to ask questions via chatbox
  - The webinar recording and the presentation material will be posted on the ITS4US website

ITS4US Program Overview

- A USDOT Multimodal Deployment effort, led by ITS JPO and supported by OST, FHWA and FTA
- Supports multiple large-scale replicable deployments to address the challenges of planning and executing all segments of a complete trip

ITS4US
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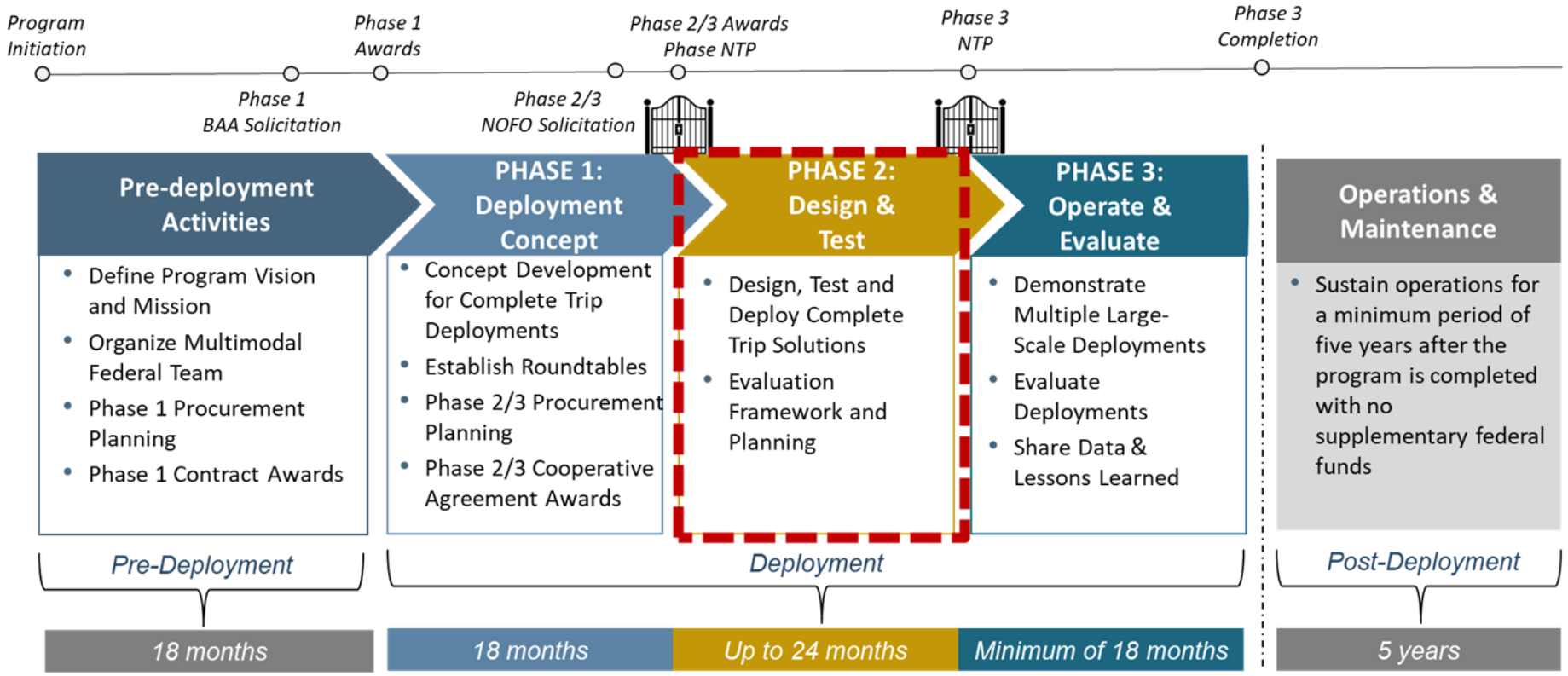
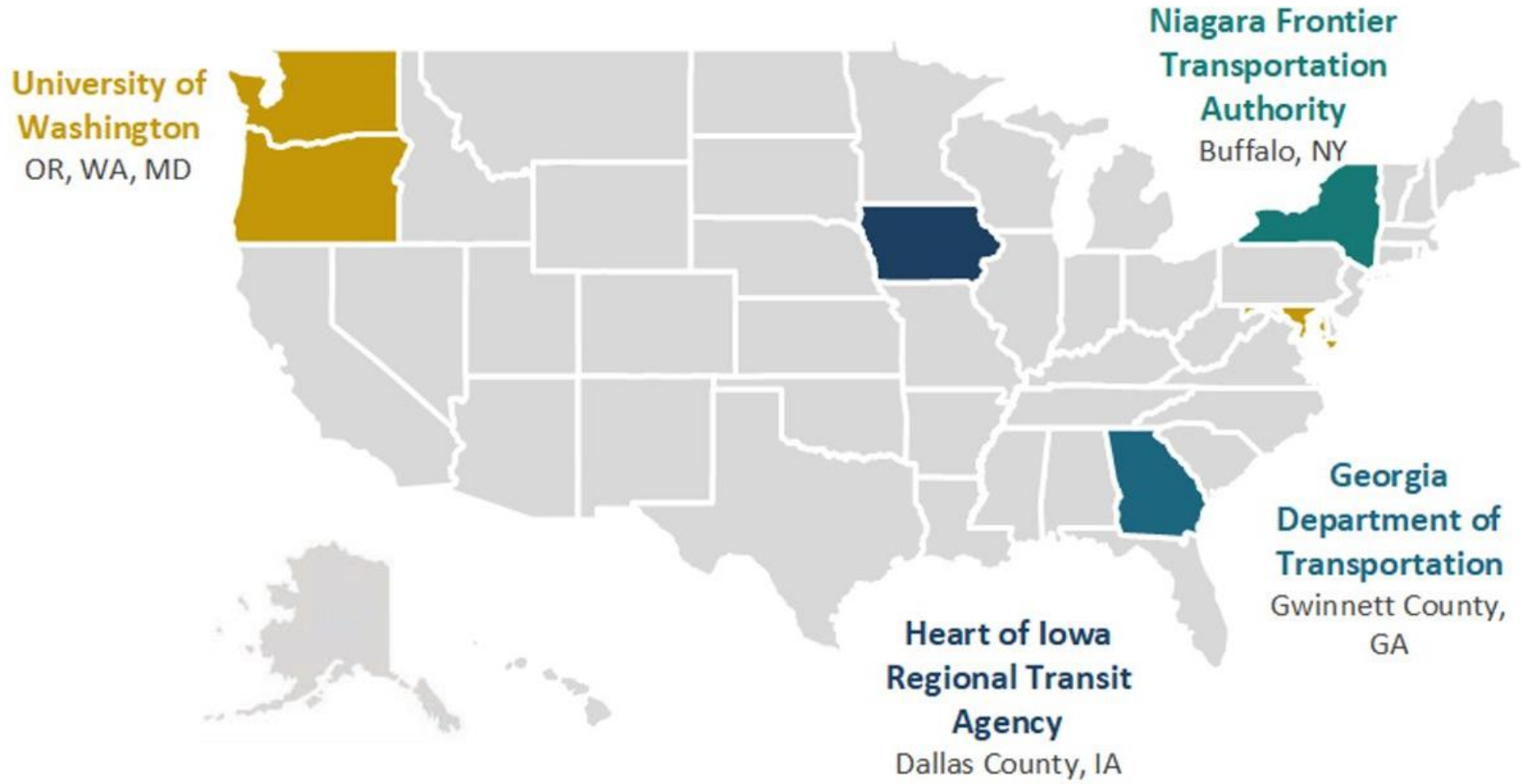
Vision: Innovative and integrated complete trip deployments to support seamless travel for all users across all modes, regardless of location, income, or disability

Deployment Phases



ITS4US Deployment Sites

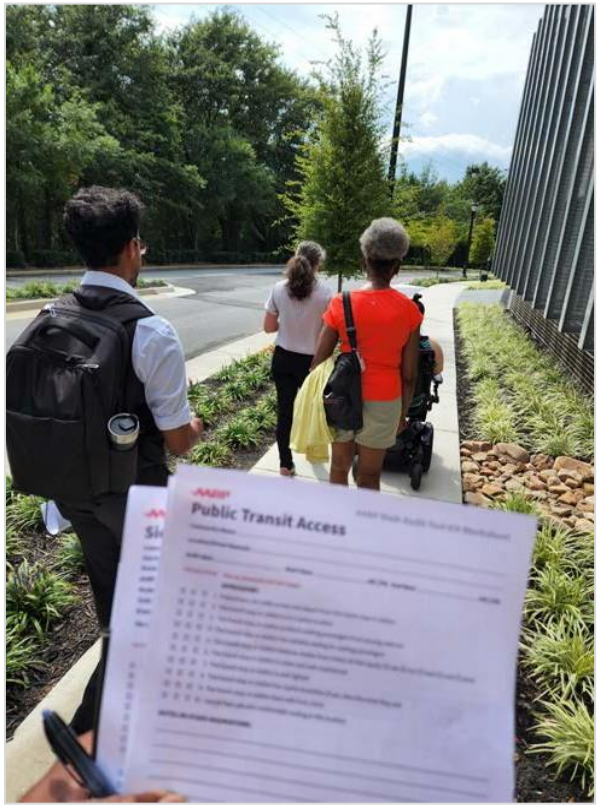


Source: USDOT

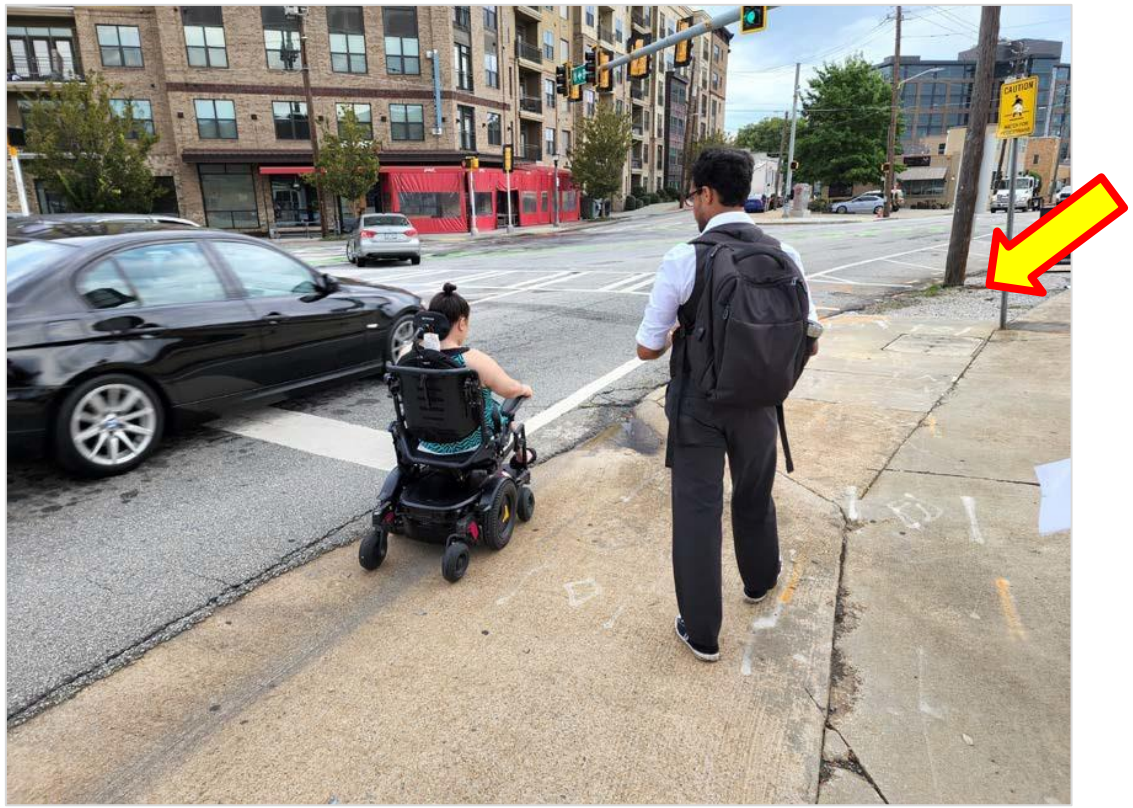
ITS4US Team Photo Collage

Georgia Department of Transportation (GDOT) Deployment Project

Existing Mobility Challenges



- Guided by [AARP Walk Audit]



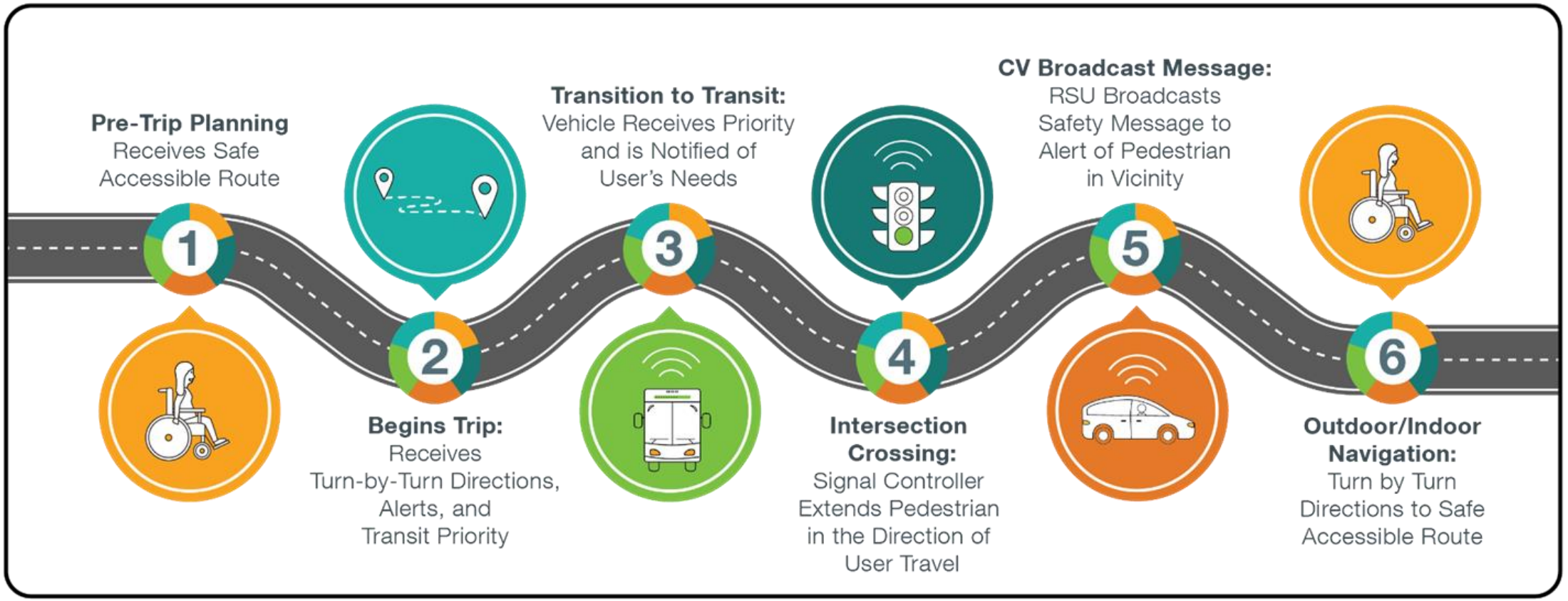
- Uneven, Obstructed Paths
- Poor Sidewalk Quality

Existing Mobility Challenges (continued)

- Missing curb ramps, not Americans with Disabilities Act (ADA) compliant (ex1)

- Missing curb ramps, not ADA compliant (ex2)

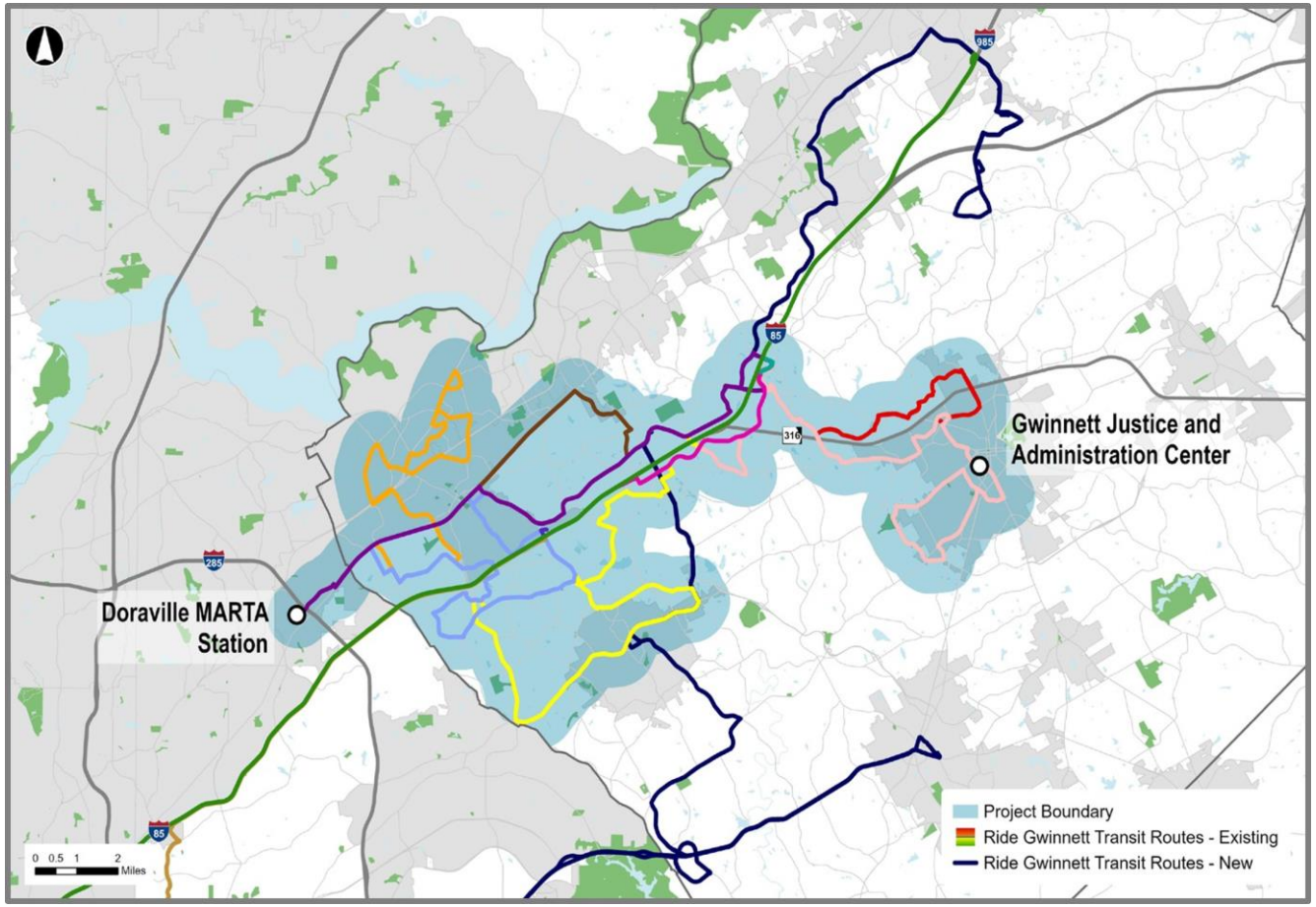
Georgia Mobility and Accessibility Planner (G-MAP)



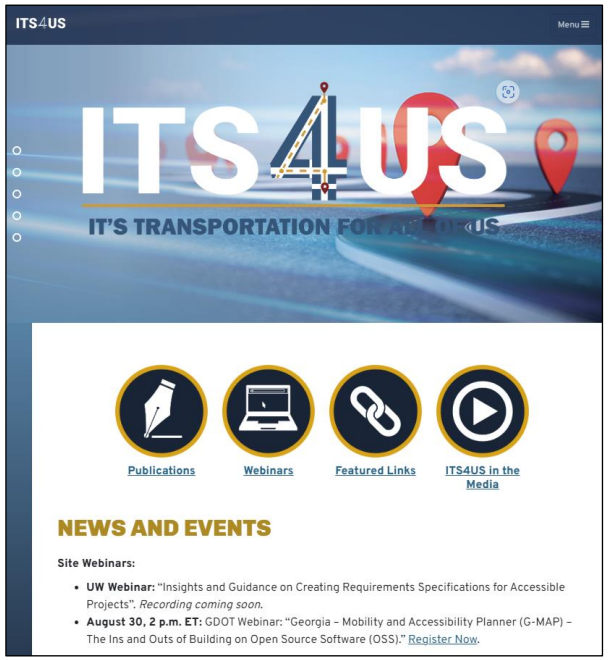
Source: ARC

Project Site – Gwinnett County, GA

- Richly diverse area
- Major transit hubs
- Suburban land use
- Wide and high- speed roadways
- Inconsistent pedestrian infrastructure



Learn More / Resources



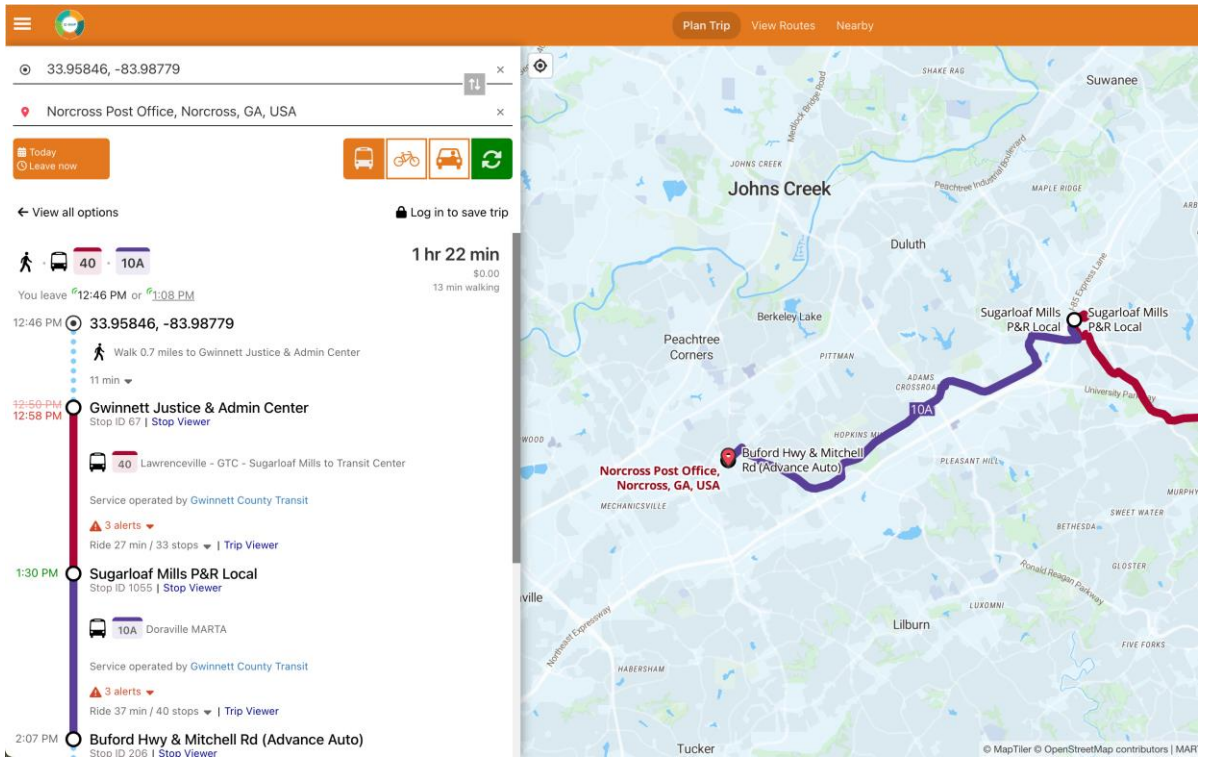
USDOT Website:
USDOT ITS4US

Deployment Website:
Home Page - ITS4US Deployment Program Project (georgia-map.com)

G-MAP Routing and Mobility Modes

G-MAP Routing

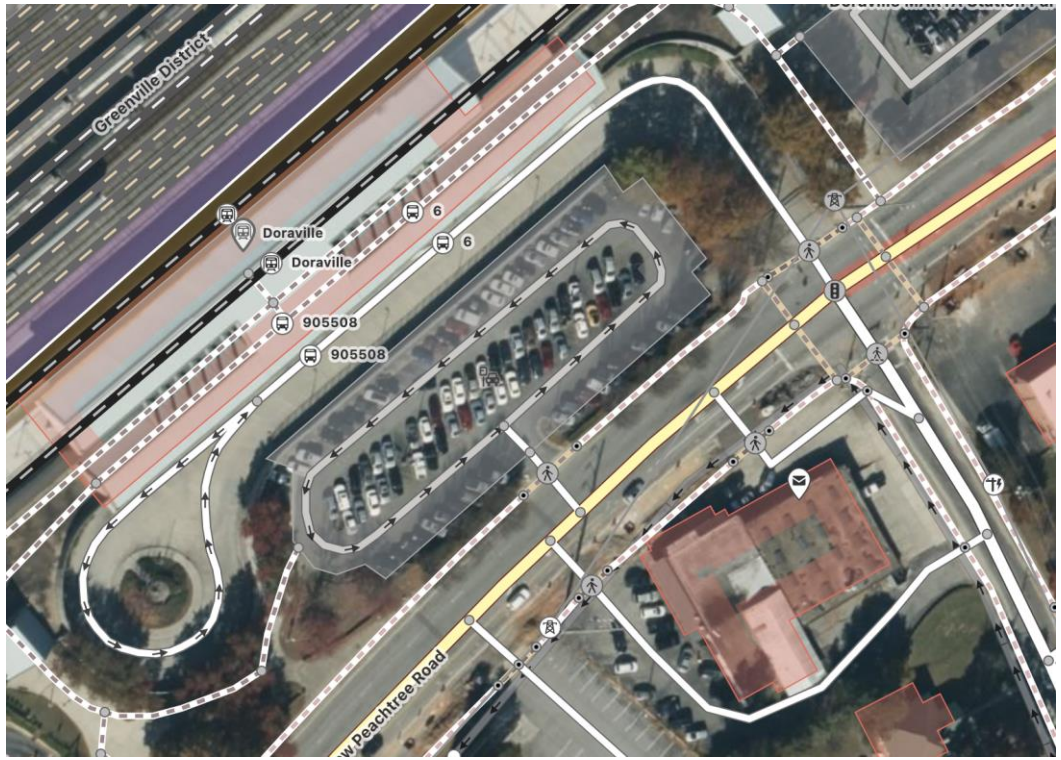
- OpenTripPlanner ingests GTFS, GTFS-realtime, GTFS-flex, GBFS, OSM, and operator API data to build a network graph of all transportation options
- The transit portions of the trip search use the transit network/timetable to find optimal routes



Trip ID	Trip Headsign	Trip Short Name	Central Avenue Southwest ...		Martin Lut... Peachtree		Forsyth Street at Martin Lut...		Central Avenue at Martin L...		Central Avenue at Wall Stre...		Peachtree Center Avenue a...	
t5DC-b139D-sl2	Indian Trail P&R		15:00:00	15:08:00	15:11:30	15:11:30	15:15:00	15:15:00	15:18:38	15:18:38	15:19:33	15:19:33	15:22:16	15:22:16
t640-b139E-sl2	Indian Trail P&R		16:00:00	16:08:00	16:11:30	16:11:30	16:15:00	16:15:00	16:18:38	16:18:38	16:19:33	16:19:33	16:22:16	16:22:16
t65E-b139F-sl2	Indian Trail P&R		16:30:00	16:38:00	16:41:30	16:41:30	16:45:00	16:45:00	16:48:38	16:48:38	16:49:33	16:49:33	16:52:16	16:52:16
t6A4-b13A8-sl2	Indian Trail P&R		17:00:00	17:08:00	17:11:30	17:11:30	17:15:00	17:15:00	17:18:38	17:18:38	17:19:33	17:19:33	17:22:16	17:22:16
t6C2-b13A0-sl2	Indian Trail P&R		17:30:00	17:38:00	17:41:30	17:41:30	17:45:00	17:45:00	17:48:38	17:48:38	17:49:33	17:49:33	17:52:16	17:52:16
t708-b13F0-sl2	Indian Trail P&R		18:00:00	18:08:00	18:11:30	18:11:30	18:15:00	18:15:00	18:18:38	18:18:38	18:19:33	18:19:33	18:22:16	18:22:16

G-MAP Routing (continued)

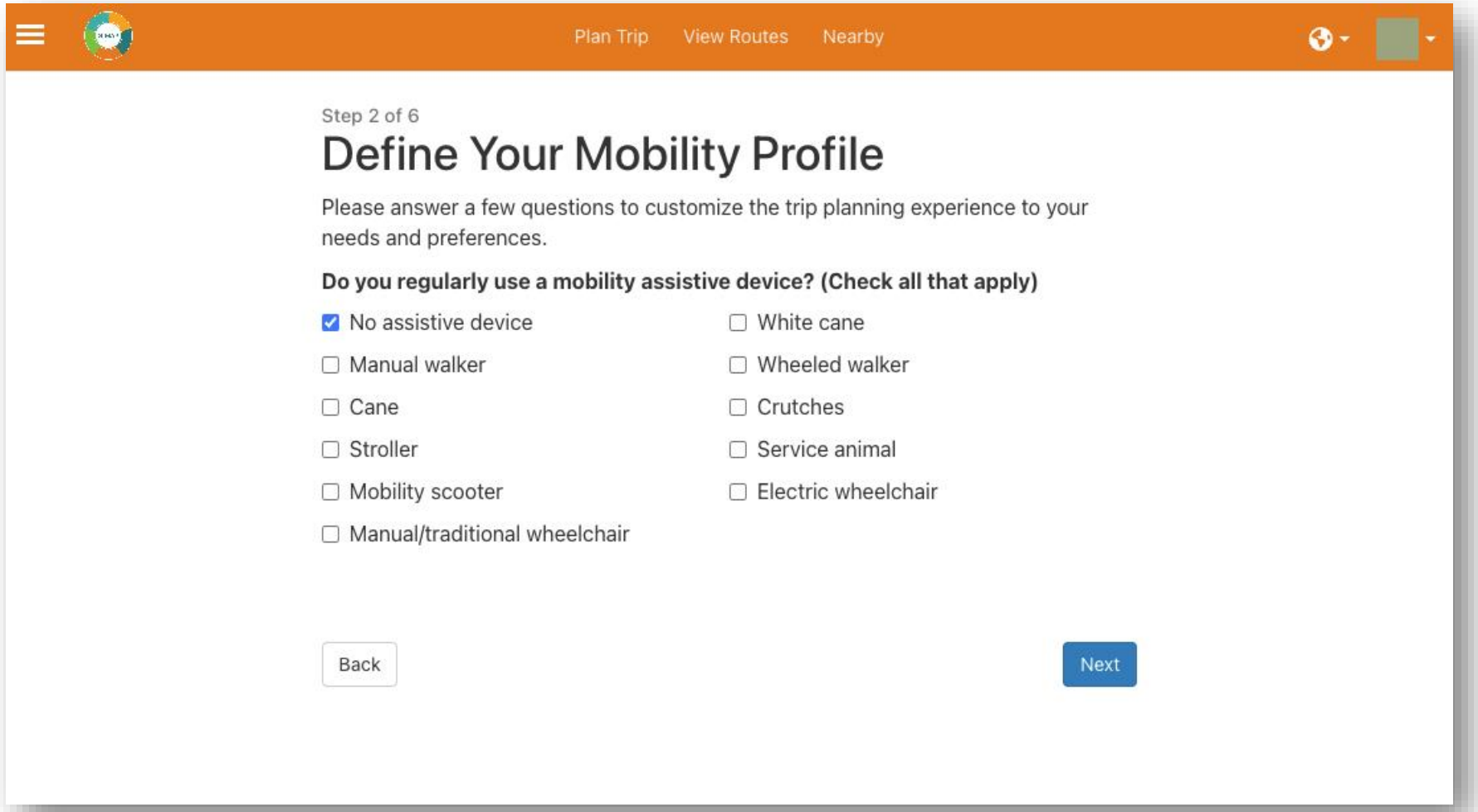
- For non transit parts of the graph, all travel factors are translated into time-cost penalties
- Features to be avoided (slopes, major arterials/highways) get higher time-cost penalties
- Features to prioritize (off-street paths, dedicated bike lanes) get lower (< 1.0x) time-cost penalties to incentivize their use in routes



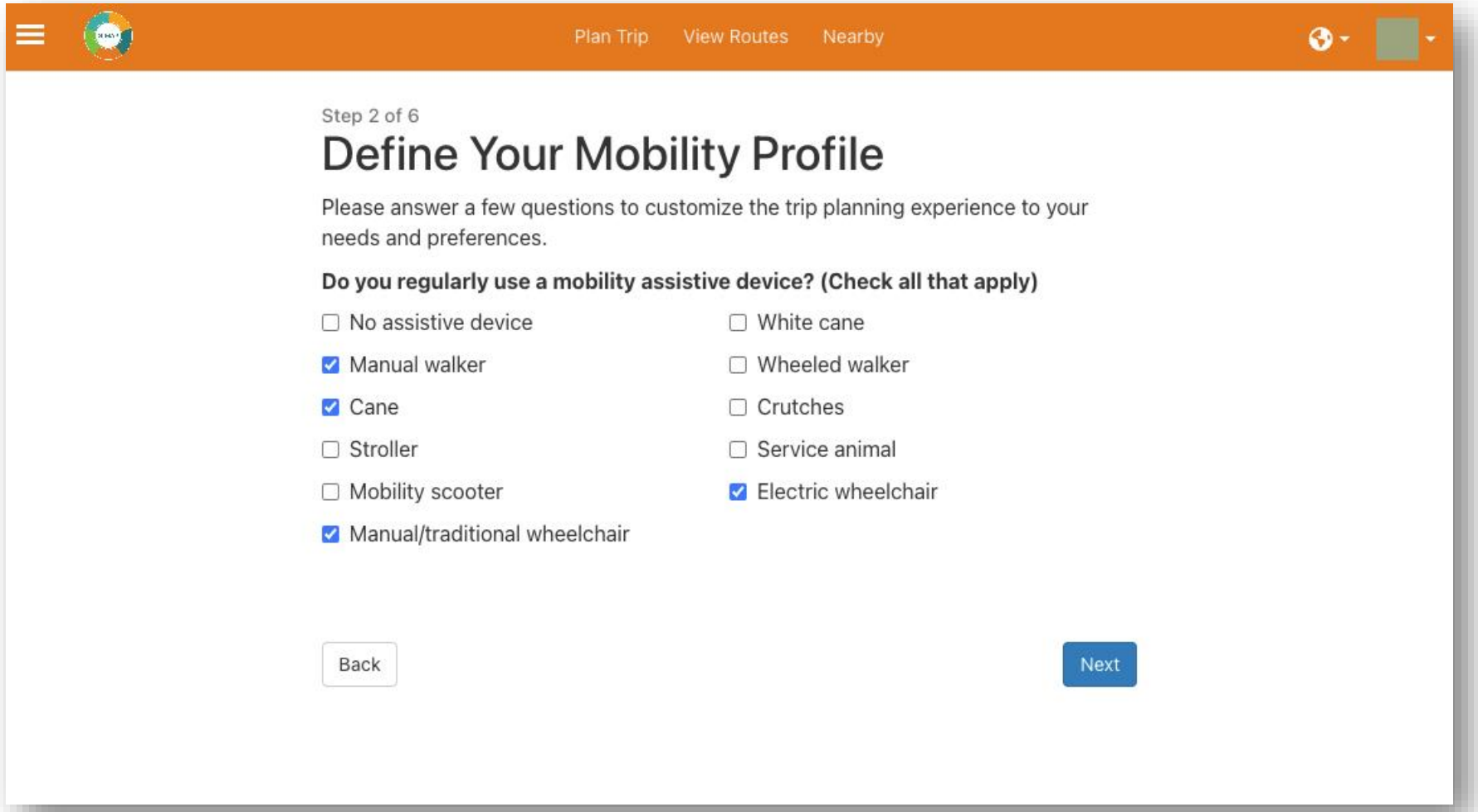
Mobility Modes in G-MAP

- Use different impedance factors for different modes under the Americans with Disabilities Act (ADA)
- Categories (18) include persons who:
  - have no mobility limitations
  - have some (self-reported) limited mobility
  - use a mobility device (cane, walker, etc.)
  - use a manual wheelchair
  - use an electric wheelchair
  - use a mobility scooter
  - have low vision
  - are blind
- Interactions between categories 2-6 x low vision and 2-6 x blind

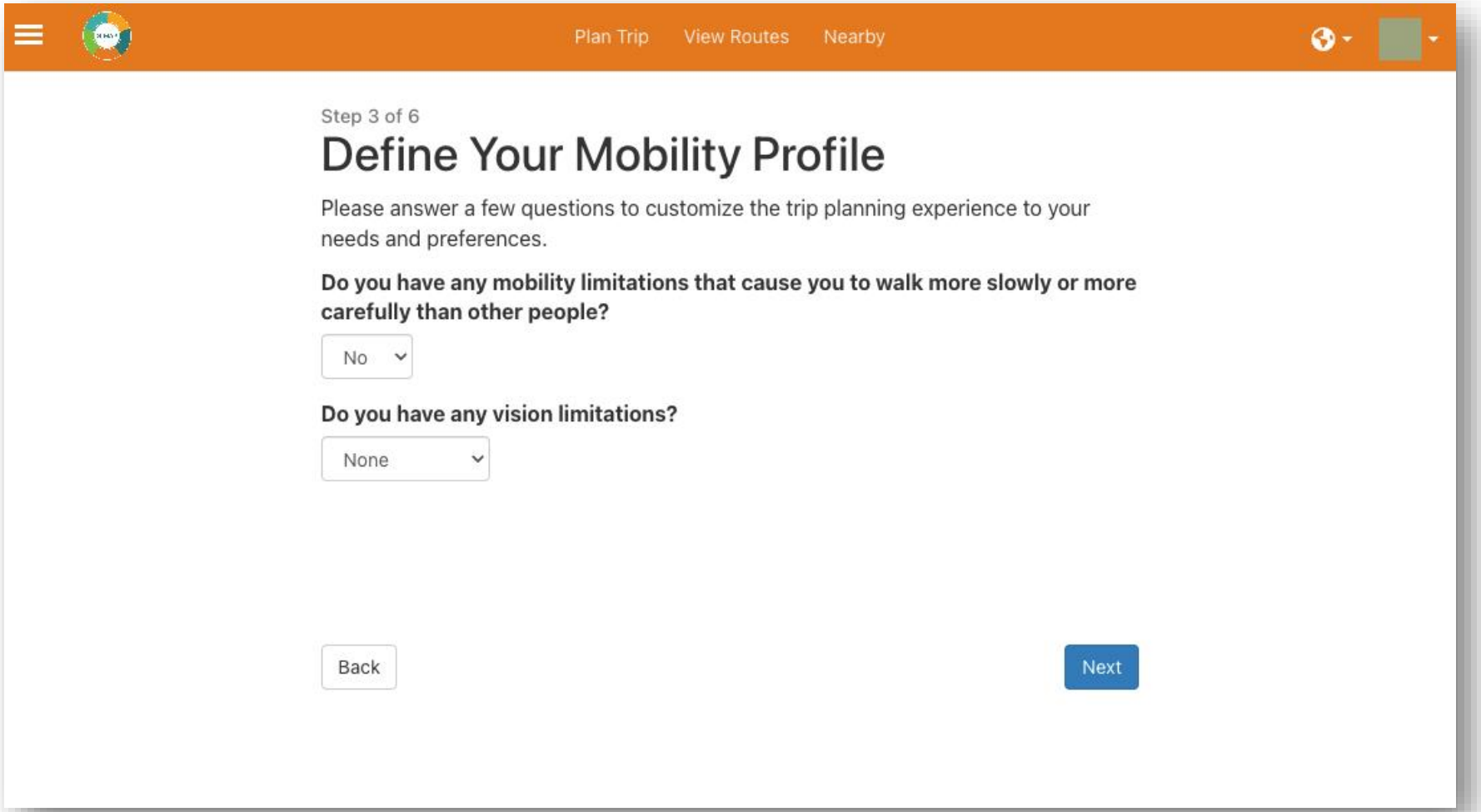
Mobility Profile – Devices



Mobility Profile – Devices (continued)



Mobility Profile – Mobility Needs



Pedestrian Impedance Factors

Impedance Factors in Route Choice

- Factors that disincentivize travel along a route
  - Travel time cost
  - Monetary cost (tolls, parking, fuel, etc.)
  - Physical effort or difficulty
  - Safety (real and perceived)
  - Convenience
  - Other behavioral or social factors
- Impedance is quantified for each transportation link
  - Can be expressed in units of time, money, or utility

- ***How much additional time would you be willing to walk to take a more accessible path?***

ADA Mobility Mode Impedance Factors

- Impedance factors differ across ADA Mobility Modes

ADA Mobility Mode	Examples of Potential Impacts of Missing Curb Ramp on Impedance
No Disability	- potential trip hazard
Low Vision	- significant trip hazard
Manual Wheelchair	- forced to divert to the street - tip over hazard

Factors Affecting Path Choice

- Factors affecting route selection include
  - Travel time impedance
  - Attribute impedance (positive and negative aspects)
- Attribute impedance depends upon the mode of travel
  - Interactions with infrastructure
  - Path design and conditions are important

ITS4US Impedance Calculations

- Start with travel time on every pedestrian link
- Assess conditions and events that affect route choice, e.g.:
  - Walking adjacent to heavy traffic as a disincentive
  - Missing curb ramps (huge impedance to wheelchair travel)
- Impedance factors to link impedance can be:
  - Multiplicative (e.g., uphill grade affects the entire link)
  - Additive (e.g., add time for potholes and cracking)
- Combine travel time impedance and condition/event-based impedance into a single “impedance time” per link

Infrastructure Design and Condition Affects

Infrastructure design and condition affects route viability for specific modes:

- Design and surface condition
  - Width, slope, cross-slope, potholes, trip hazards, etc.
  - Stable, firm, slip resistant
- Path features and conditions
  - Crosswalks*, curb ramps, etc.
- Various factors impede modes of travel differently
  - e.g., manual wheelchair users are more impacted by pavement disjoints than are electric wheelchair users

*The MUTCD defines a “crosswalk” as pedestrian path crossing a road (whether or not a painted crosswalk is provided) and the PROWAG currently defines a “crosswalk” as any pedestrian crossing of a vehicle way (whether or not a painted crosswalk is provided).

ADA Design Standards and Impedance

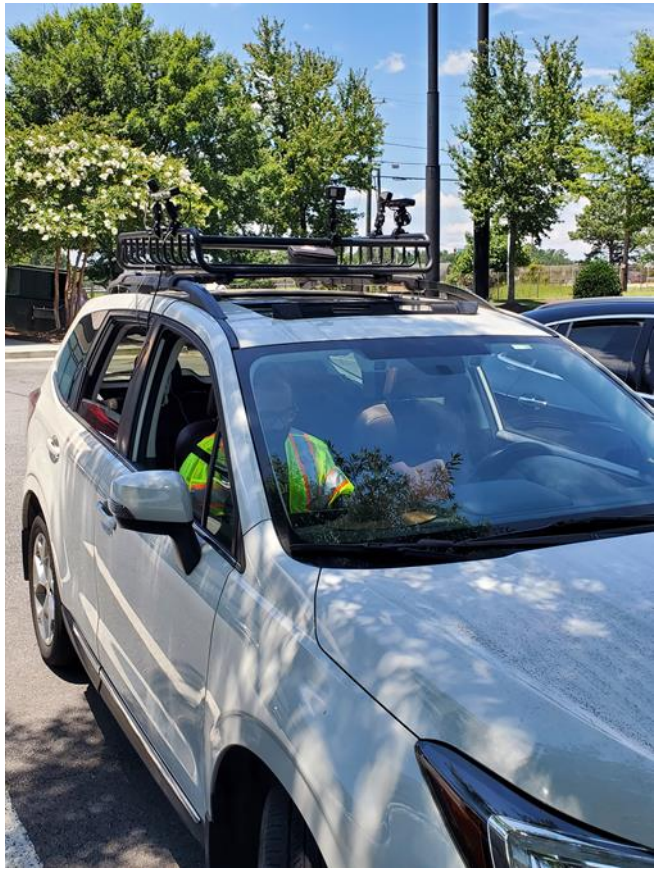
- Minimum ADA design standards exist for a reason…
  - Sidewalk width, slope, cross slope, etc.
  - Sidewalk obstructions and surface conditions
  - Abrupt changes in level (>1/4” or >1/4-1/2” if not beveled), cracking, potholes, etc.
  - Curb ramp widths, passing space widths, landing widths, etc.
  - Curb ramp slopes, cross-slopes, flare slopes, etc.
  - Detectable warning surfaces (texture pads)
  - Etc.

Public Right-of-Way Accessibility Guidelines: https://www.access-board.gov/prowag/

ADA Mobility Mode Paths

- OpenTripPlanner (OTP) is used for G-MAP routing
  - Complete streets network, transit network (GTFS), complete paths network
- Pedestrian path impedance
  - Assigned to logical pedestrian links that can comprise a path for OTP
  - Eliminate undesirable links from potential paths
    - Exclude links or severely penalize with impedance
- Impedance factors incorporate:
  - Pathway surface design and condition impacts
  - Ramp design and condition impacts on crossings
  - Curb design and condition impacts on sidewalk links
  - Adjacent traffic condition impacts
  - Etc.

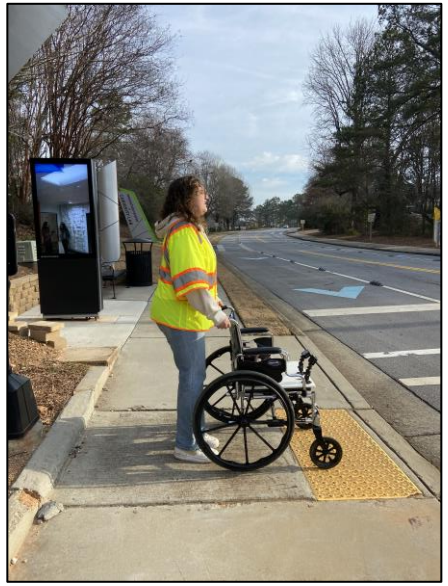
Vehicle Video Data Collection

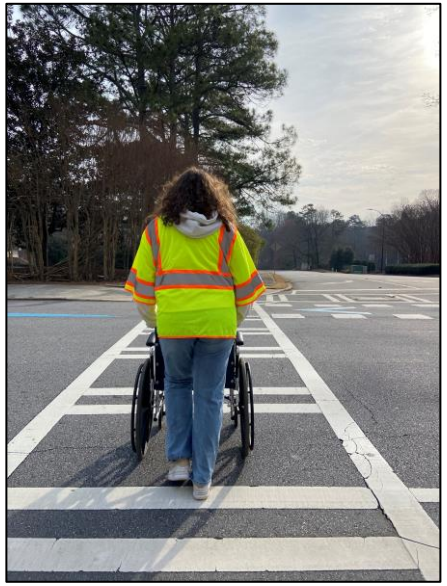


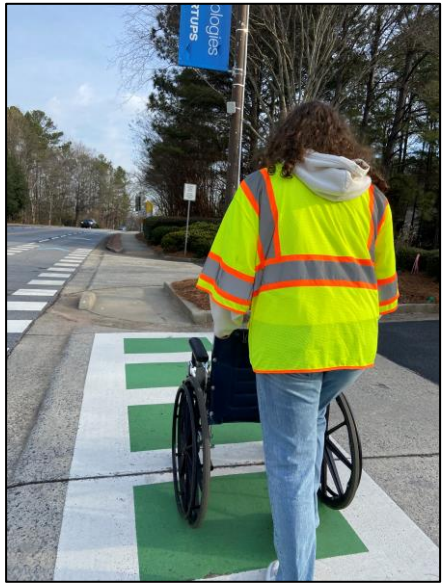
- Identify sidewalks, ramps, curb cuts, and crossings
  - Manual flythrough
  - Machine vision processes
- Prevents inspection crew dispatch errors
- Lateral videos capture both sides (at set angles) to detect sidewalk presence
- Passenger-side video pinpoints ramps, curb cuts, and crossings for inspection

Wheelchair Video Data Collection

- Web-interface video inspections for ADA design and condition data
  - Most ADA design/condition issues can be identified in an online review
- Refine asset location data

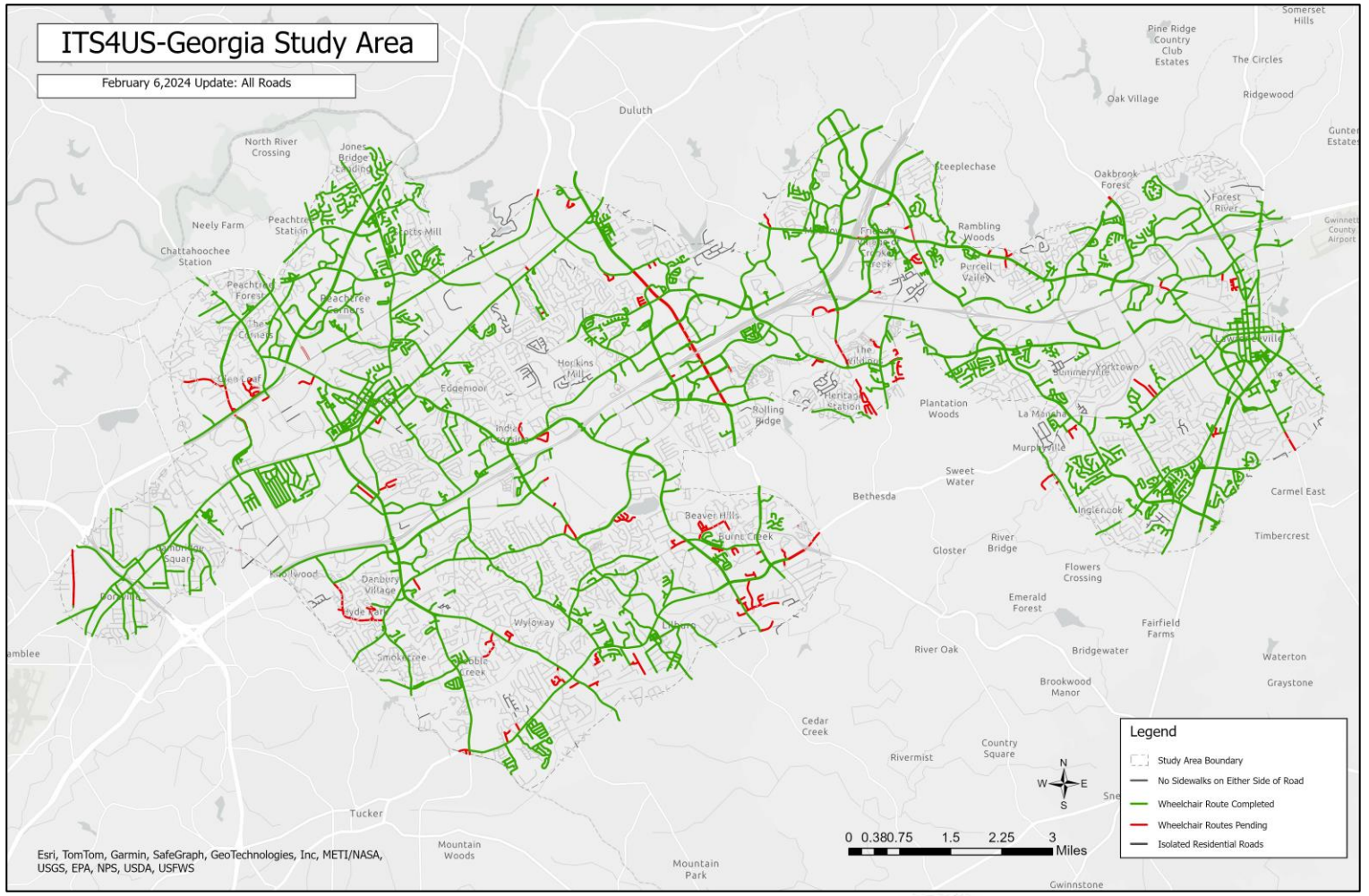




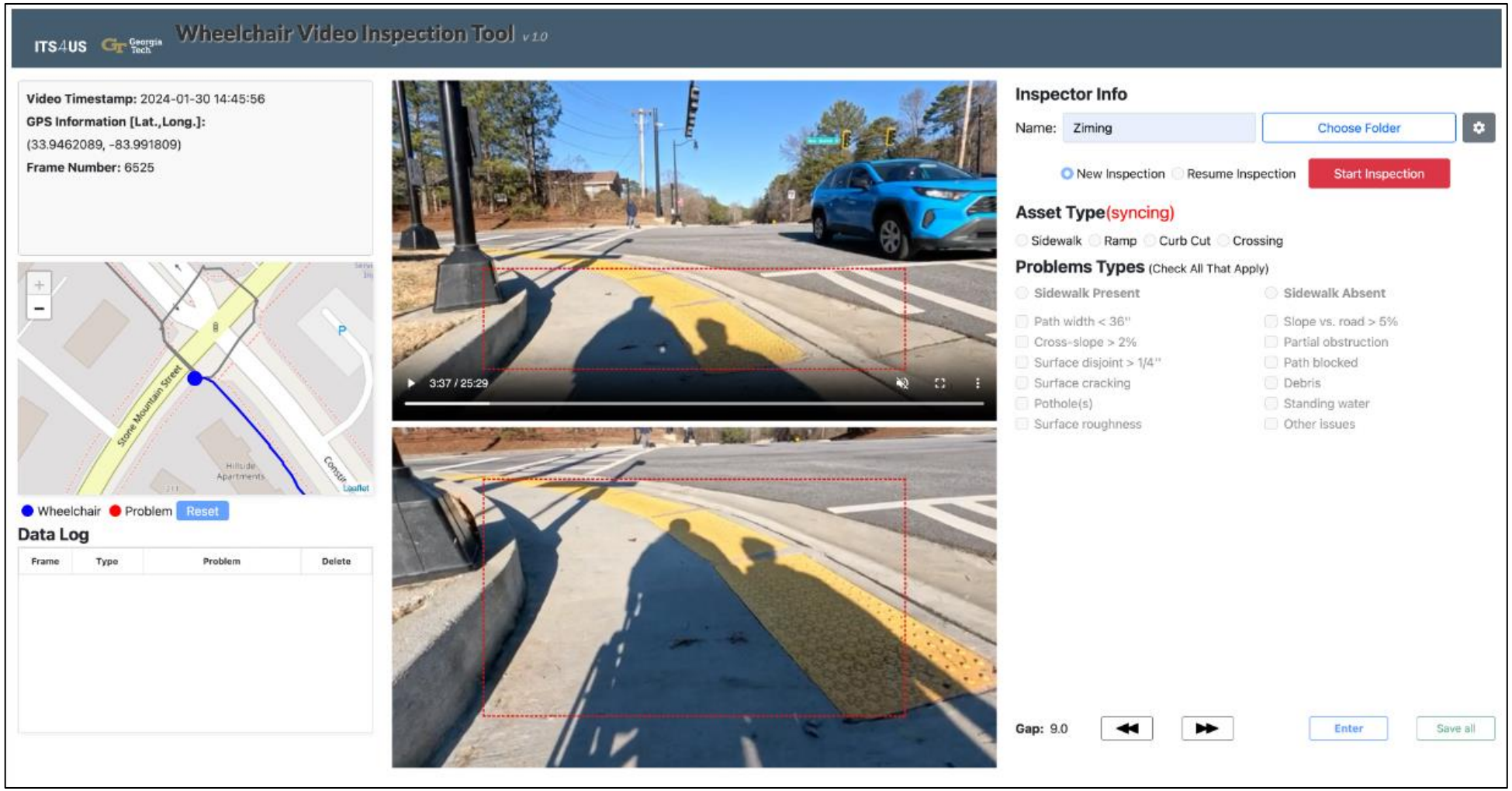


Wheelchair Video Data Collection Status

- Study Area:
- ~1,200 road miles
- ~512 miles have sidewalks
- ~477 miles are complete (~97%)

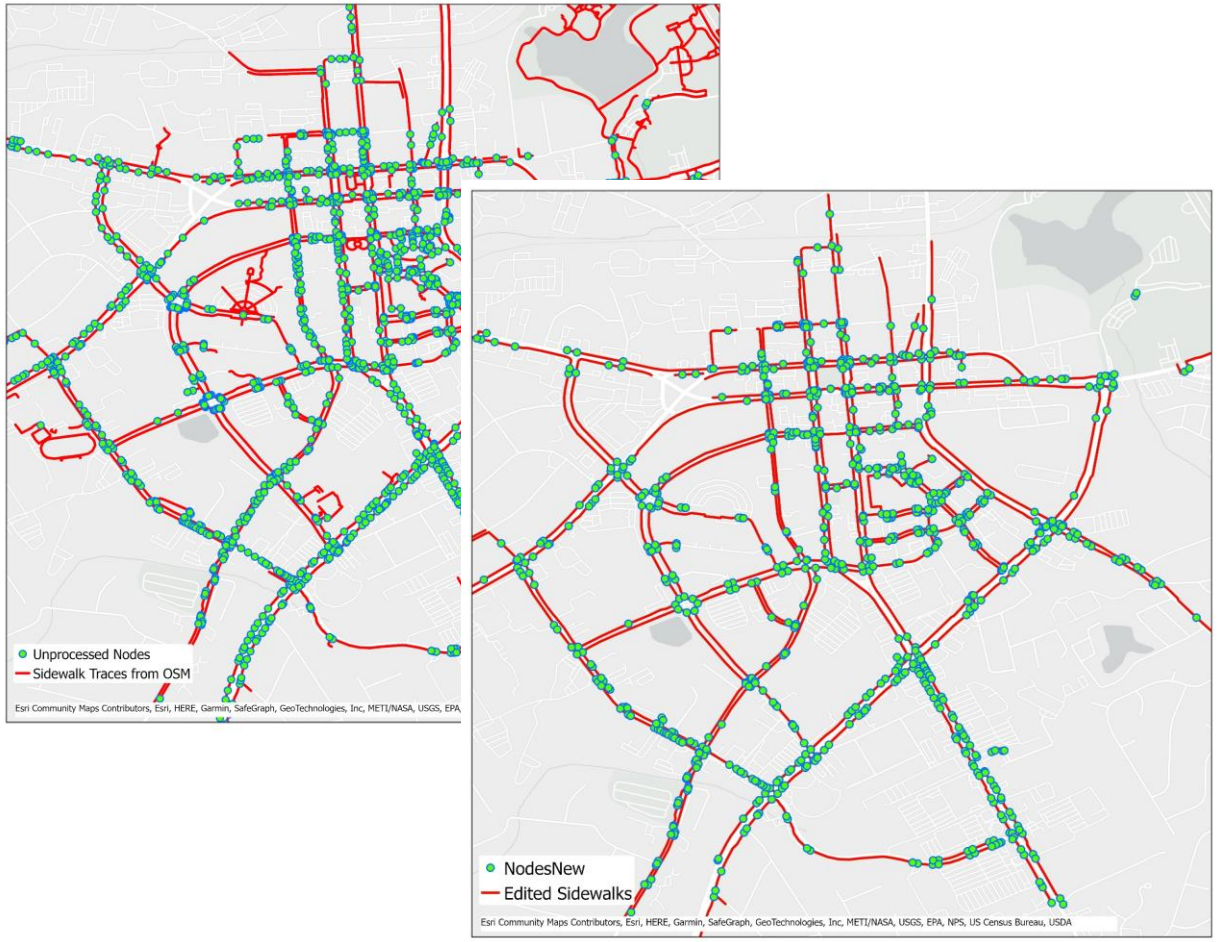


Online Wheelchair Video Review



ADA Network Reconciliation (OSM-Neptune)

- OSM is used in OTP routing
- OSM pedestrian ways
  - OSM ways ≠ logical links
  - Correct ~85% of ways
  - Screen OSM links for ADA paths
    - Exclude parking lots, cut throughs, etc., from navigation
    - Reduce links by ~34%
- Reconcile OSM-Neptune
  - OSM ADA links are carried in Neptune, can be assigned impedance, and can be used in OTP routing



Impedance Calculations in the Cloud

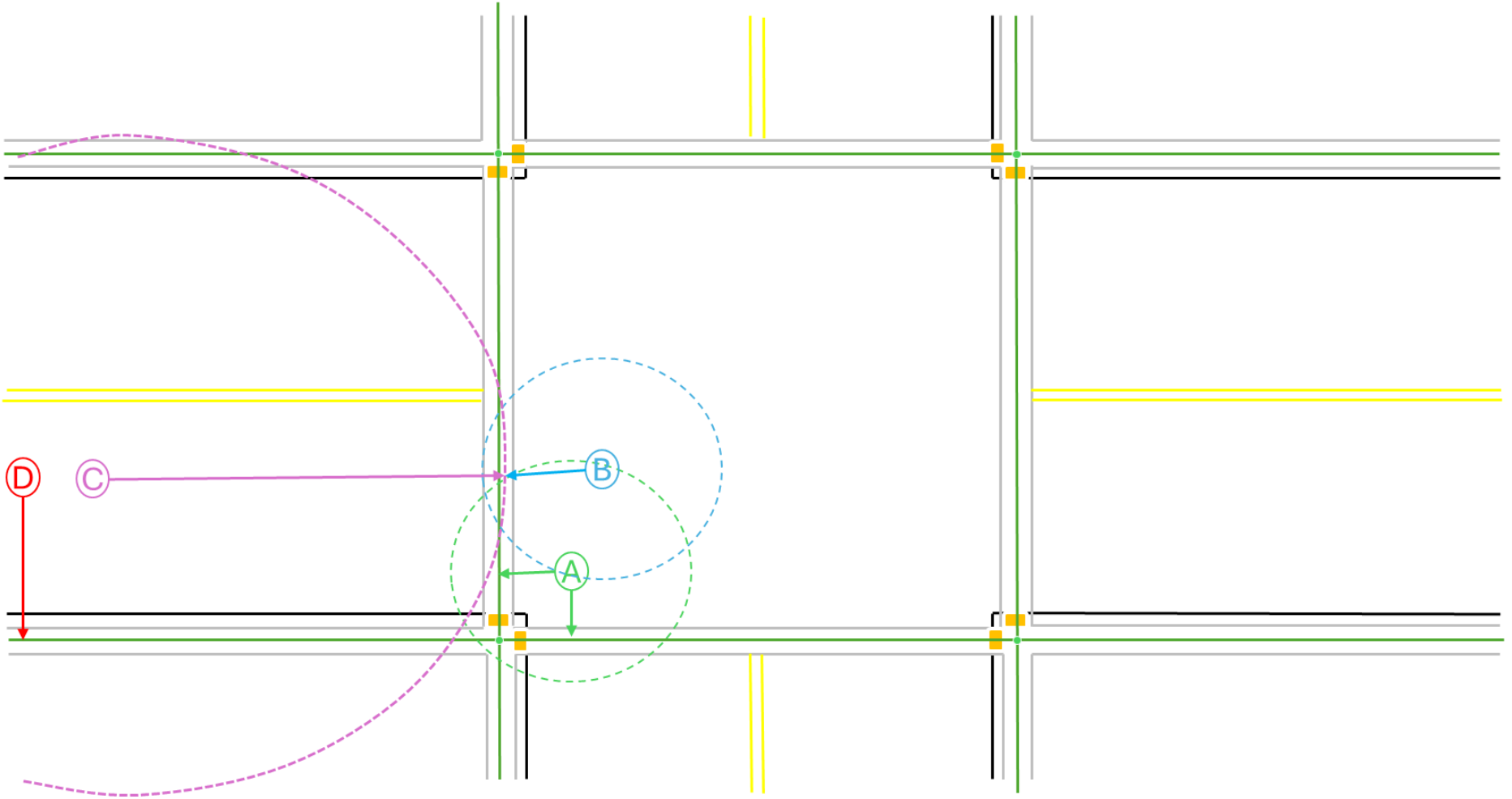
- AWS Neptune (Graph-database) replication of the OSM network
  - G-MAP pedestrian network
  - Subset of OSM with 1:1 link correspondence
  - Employs same IDs for tracking
- Calculate impedance for every link in the G-MAP pedestrian network and transmit
  - G-MAP uses the higher impedance values for routing

Cloud Implementation – Impedance Factor Matrix

- Rows for every impedance factor and condition (enumerated values and measured parameters)
  - Sidewalk design and surface conditions
  - Roadway crossing design and conditions
  - Curb ramp presence/absence, design, and conditions
  - Driveway curb cut (i.e., sidewalk that is perpendicular to vehicle travel) design, and conditions
- Columns for each ADA Mobility Mode (18)
- Cells contain impedance values
- Condition logic (additive or multiplicative)
- Run matrix calculation for every link
- Publish impedance for each link by ADA Mobility Mode (18)

Dynamic Impedance Updates

- Waze
- NaviGAtor Events



Stay Connected (Program / Site)

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Visit the ITS4US Deployment Program Website:

https://its.dot.gov/its4us/

ITS4US Deployment Program Video

https://youtu.be/pztl1lRyXAc

Visit the Georgia-MAP

https://georgia-map.com/

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Questions?