



GATIS Bicycle Features

Reid Passmore, Paul Moser
NC-BPAID July Meeting

Topics from last month

- Sidewalks and accessibility attributes
- Tier model and attribute presence
- Routable networks
- GATIS feature types
 - Edges
 - Nodes
 - Points
 - Zones

Overview

- GATIS geometric representation for bicycle facilities
 - Road centerline representation
 - Network representation
- GATIS attributes for describing bicycle facilities
- Appendix / future draft

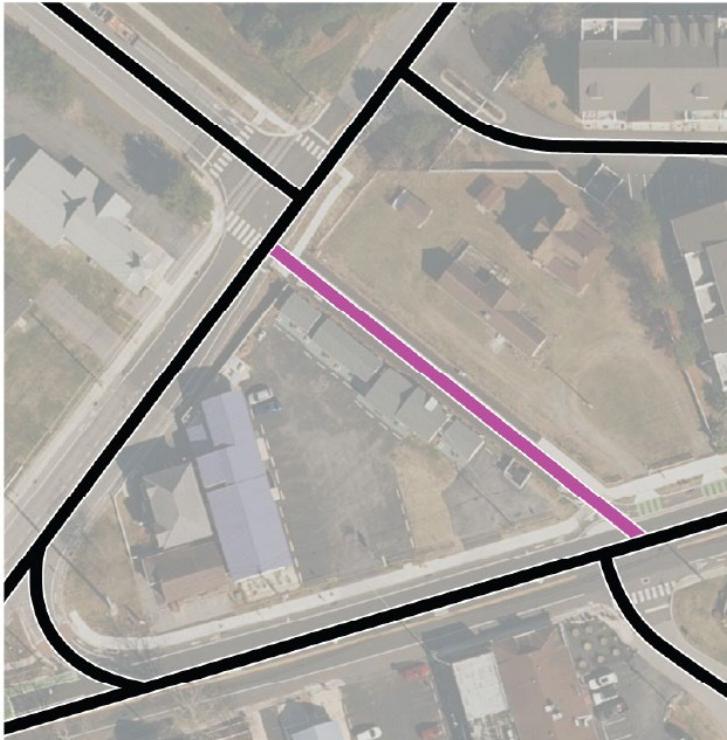
GATIS geometric representation



GATIS supports two methods of geometric representation for bicycle and pedestrian facilities

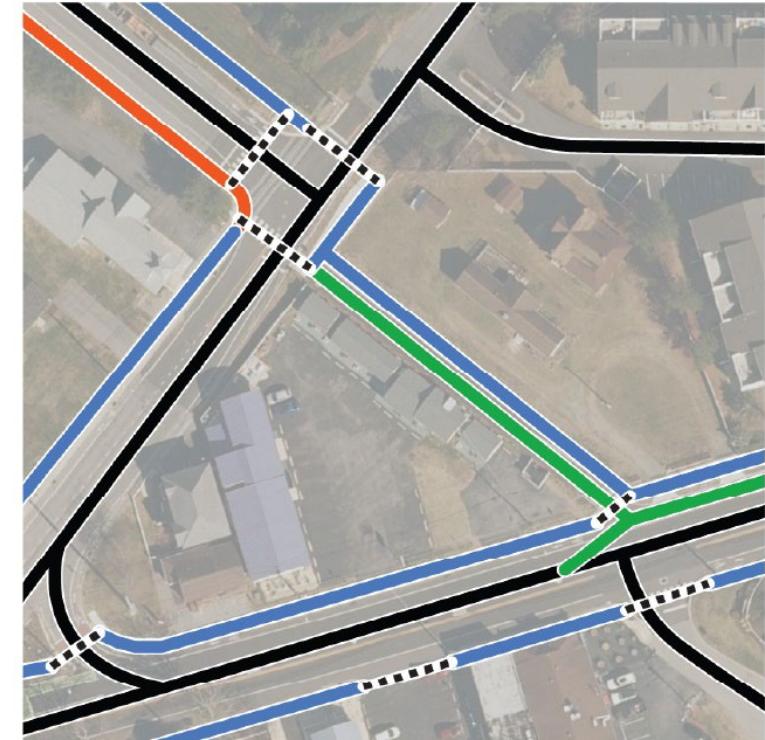


Satellite view



Road centerline representation

Bike and pedestrian facilities are
***described on the roadway
centerline with attributes***



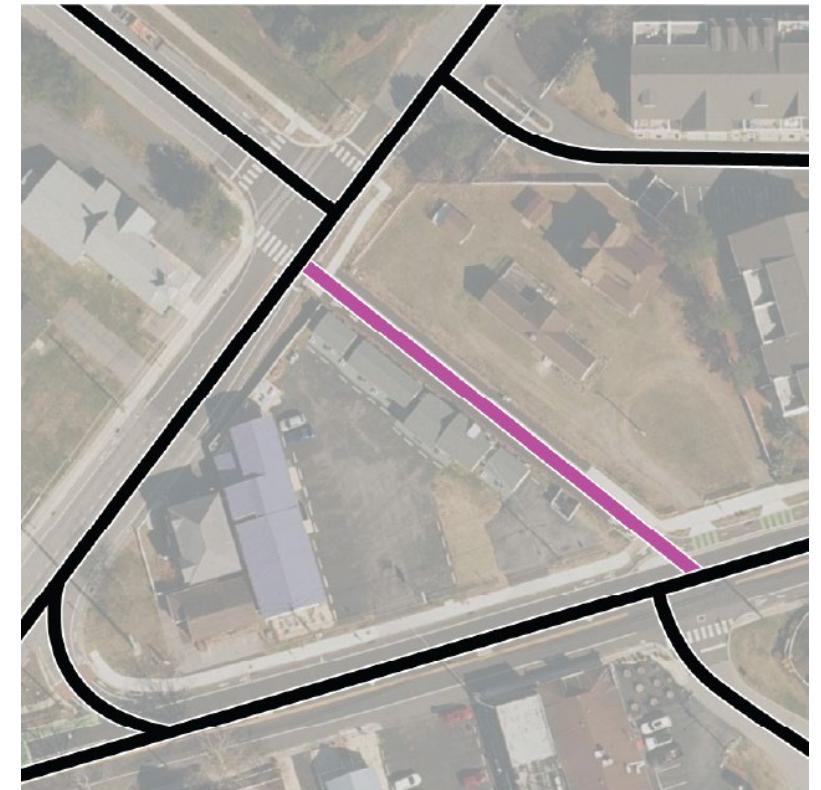
Network representation

Bike and pedestrian facilities
are ***drawn as separate
features***

Road centerline representation

Road centerline representation

- **Roadway aligned** facilities are represented with attributes on the road centerline
- These facilities are to the **left** or **right** of the road
 - In relation to the road's sequence of edge vertices (from start to end)



Road centerline representation

Roadway aligned facilities

- Along, within, or around roadways
- Bike lanes, cycletracks, sidewalks
- Sidepath multi-use paths
- **Can be represented with attributes on the road centerline**



Raised bike lane
and sidewalk



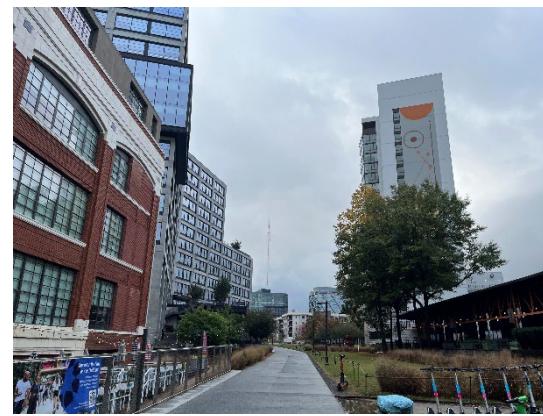
Sidepath
(Google Maps)

Non-roadway aligned facilities

- Do not follow the road alignment
- Multi-use trails, pedestrian paths
- **Cannot be represented with attributes on the road centerline**
- **Need their own geometric representation**



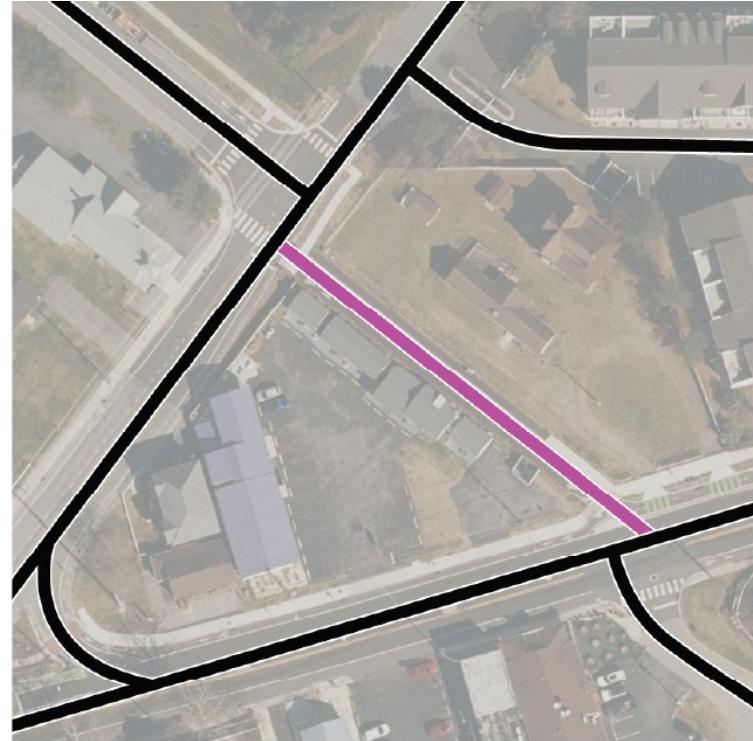
Path through a park



Multi-use trail

Purpose of roadway aligned features

- Determine which segments **cannot be represented with the roadway centerline**
- Associate data from the roadway to the adjacent sidewalk or bike facility (traffic speeds, volumes, etc) when using network representation



Examples

- OpenStreetMap:
 - “cycleway:left=yes” for a bicycle facility on the left side of the road
- DelDOT
 - “R_BL_T” for type of bike lane on the right side of the road
- Utah DOT
 - “Bike_L” for bike facility on the left side of the road
- Madison, WI
 - “shoulder_left” for shoulder on the left side of the road
- MassDOT
 - “left sidewalk width” for the width of the sidewalk on the left side of the road

Centerline representation example – facility presence

edge_type
orientation
attribute_name

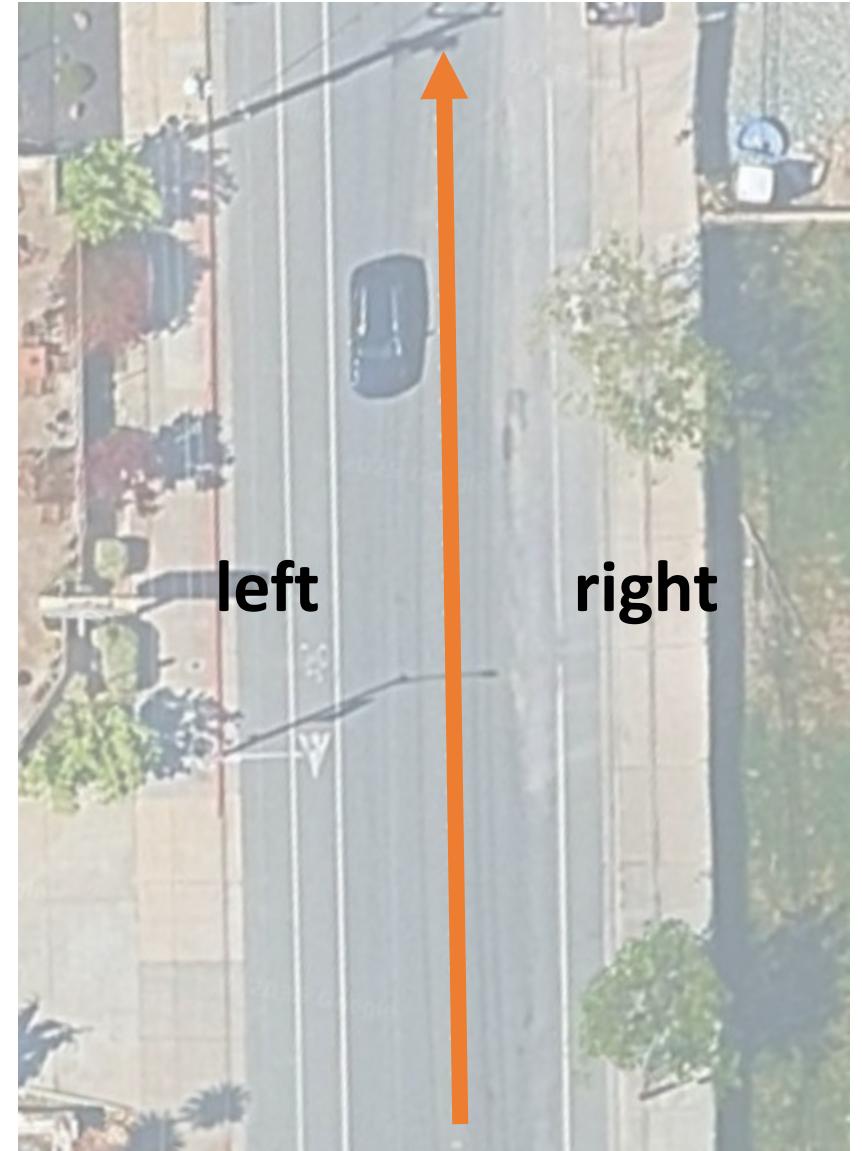
... = placeholder for more attributes that will be described later

	Name	Value
edge_type	edge_type	road
orientation
attribute_name	sidewalk:left:presence	yes

	sidewalk:right:presence	yes

	bikeway:left:presence	yes

	bikeway:right:presence	yes

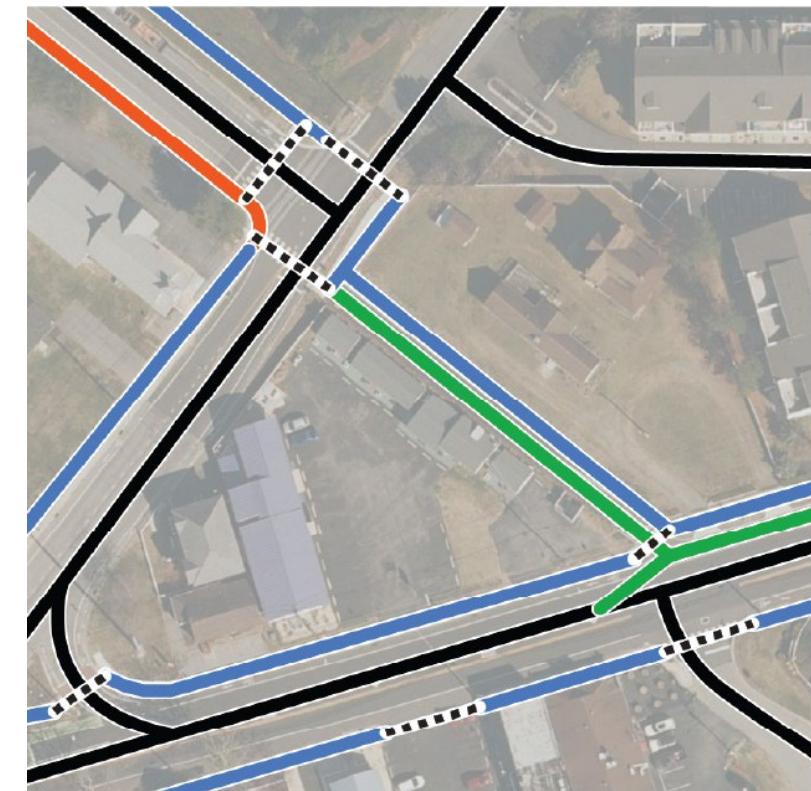


Road with bike lanes and sidewalks

Network representation

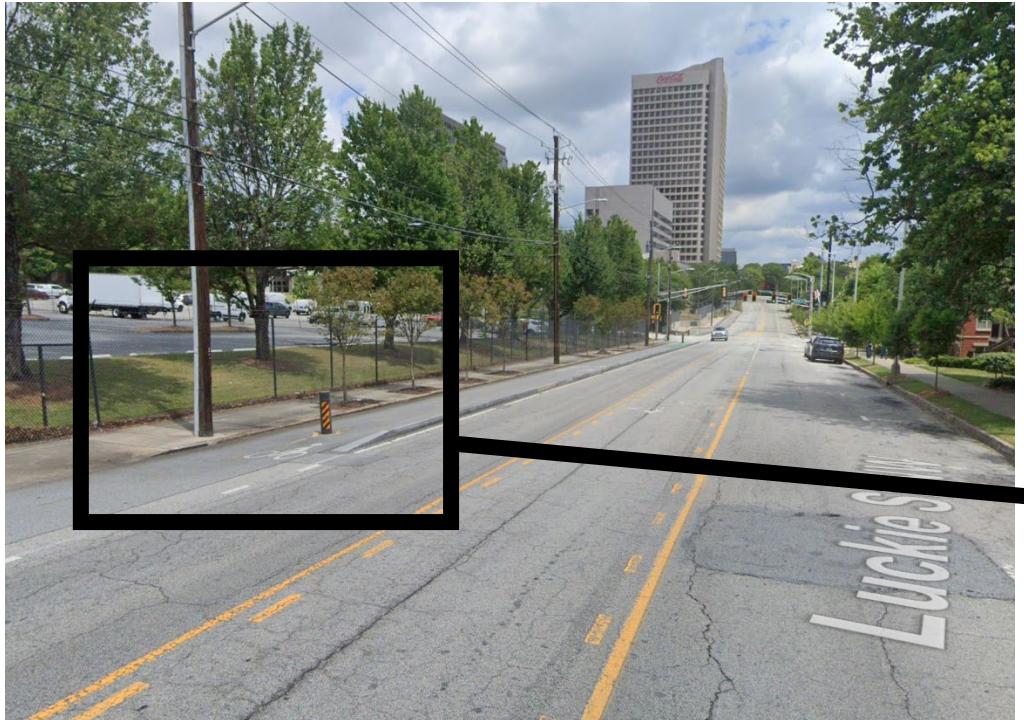
Network representation

- Bike and pedestrian features are drawn separately from the road features
- Can better reflect the pedestrian and bicycle environment
- **However, *most bike lanes* and certain other types of bicycle facilities should still be referenced to the road centerline**



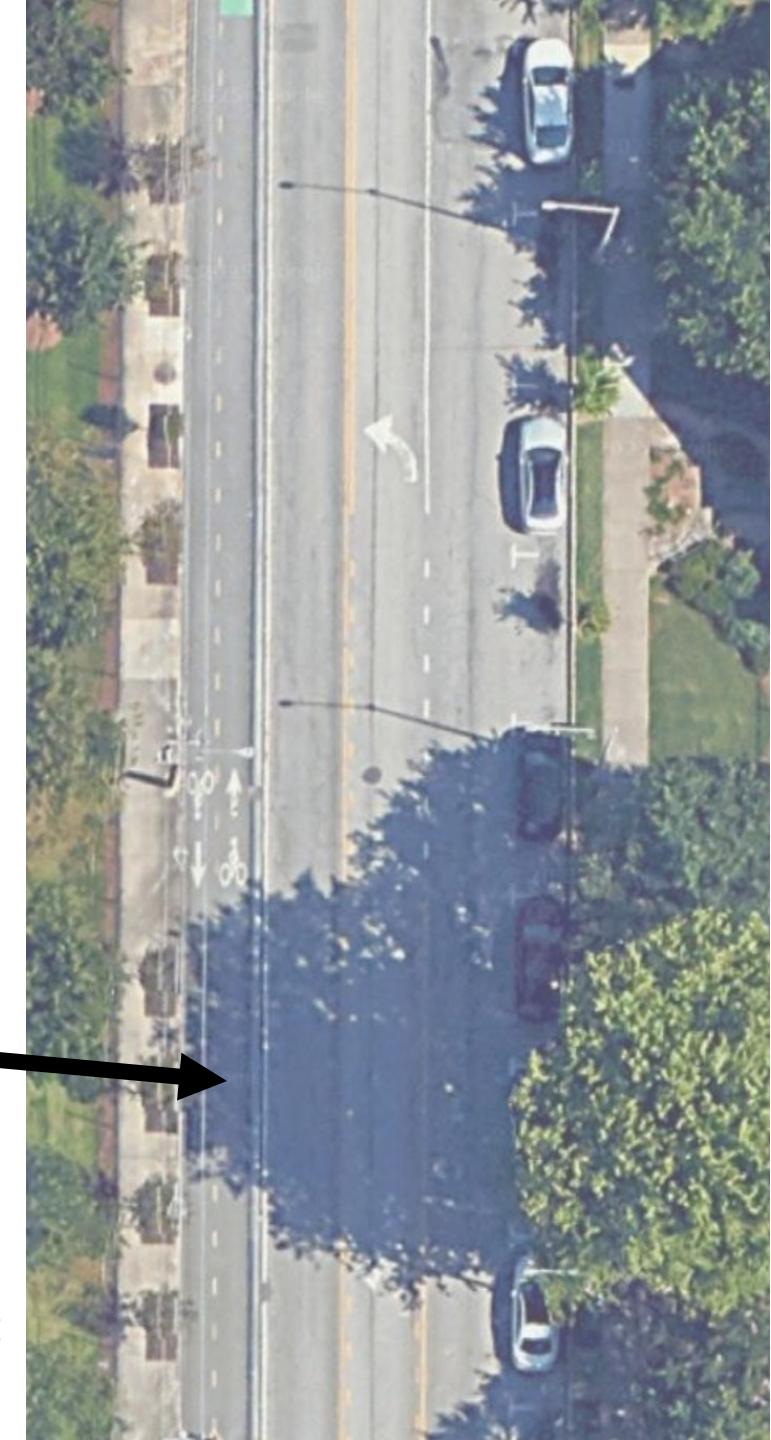
Network representation

Network representation example



Two-way separated bike lane

Road with sidewalks, two-way separated bike lane and street parking ([Google Maps](#))



Network representation example

Name	Value
edge_type	road
...	...

Name	Value
edge_type	bikeway
...	...

Name	Value
edge_type	sidewalk
...	...

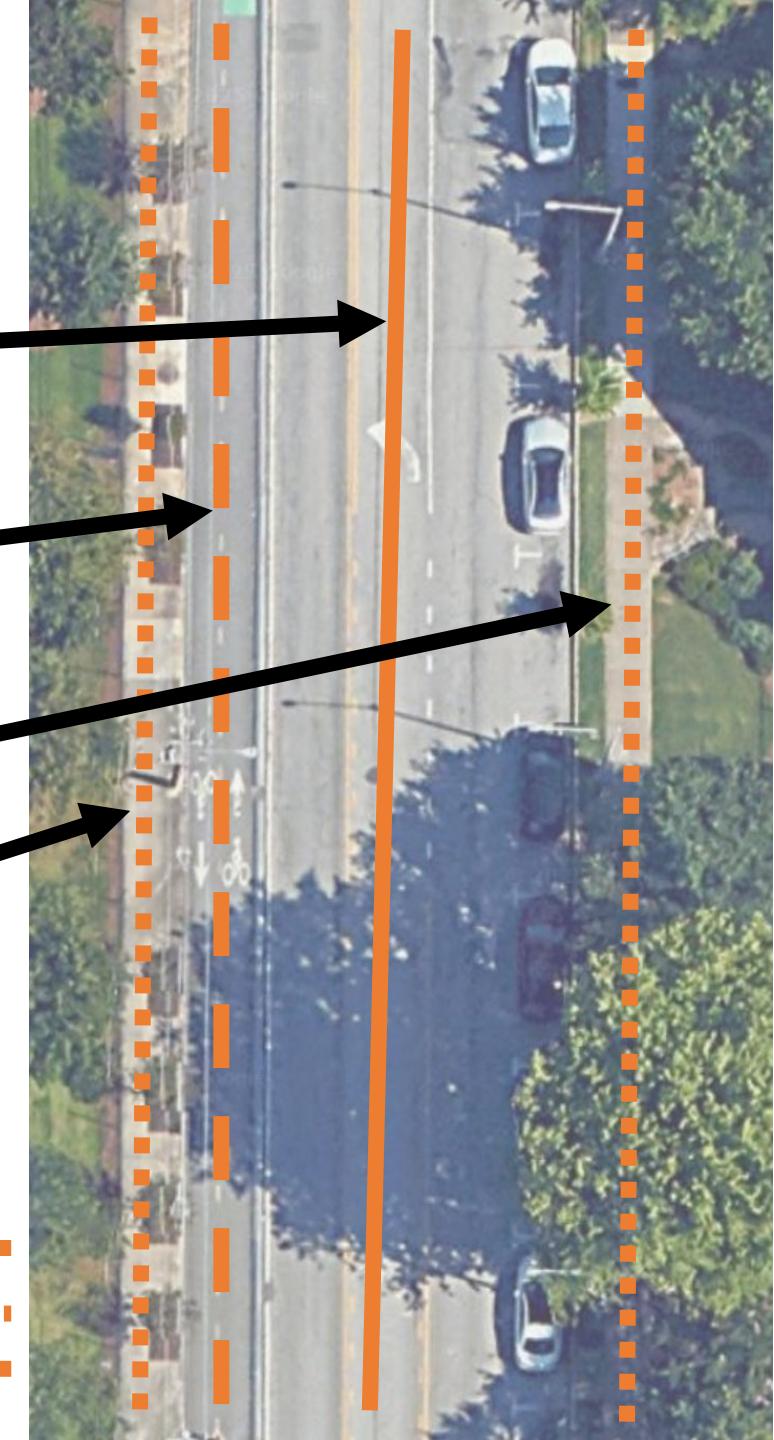
Name	Value
edge_type	sidewalk
...	...

Road with sidewalks, two-way separated bike lane and street parking ([Google Maps](#))

Road

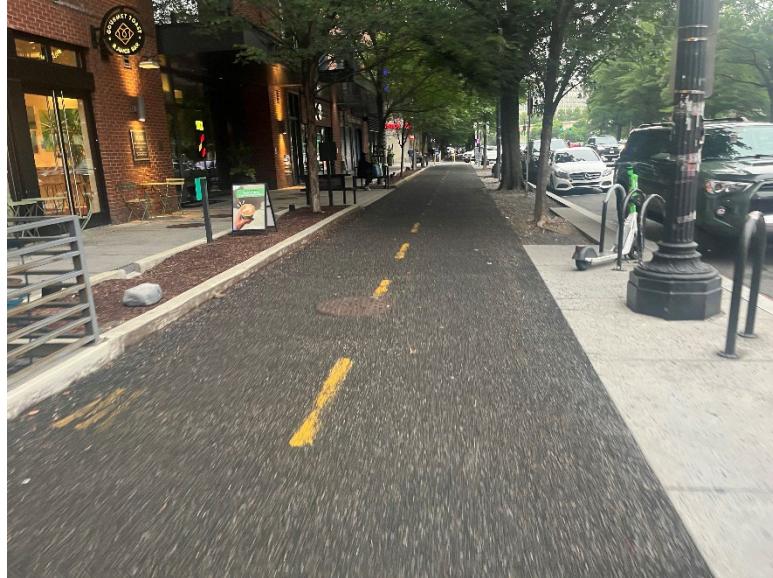
Separated Bike Lane

Sidewalk



Should bikeway be a separate feature or an attribute on the road edge?

Separate feature



Both supported



Attribute on road edge



GATIS accommodates both representations

Representing Intersections

Technical details for Intersections were not included in the first draft, notes presented here represent preliminary concepts for modeling intersections

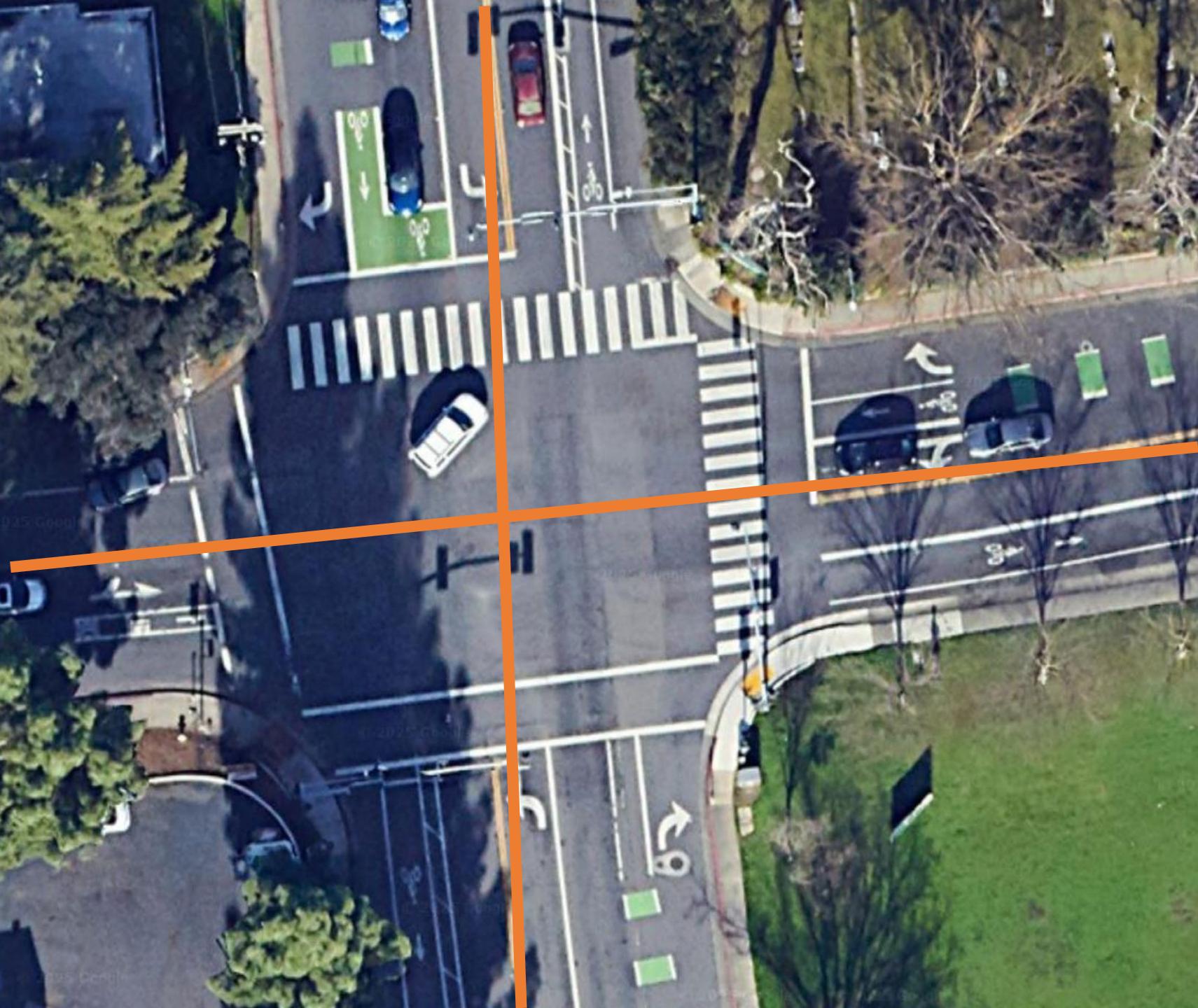
Intersection with
painted bike lanes or
mixed traffic

Only map the road
centerlines

Bike lanes represented
with attributes on the
road

*Specific data on the intersection and
different ‘turning movements’ may
be modeled with ‘Relation Tables’*

Road 
Separated Bike Lane 
Sidewalk 



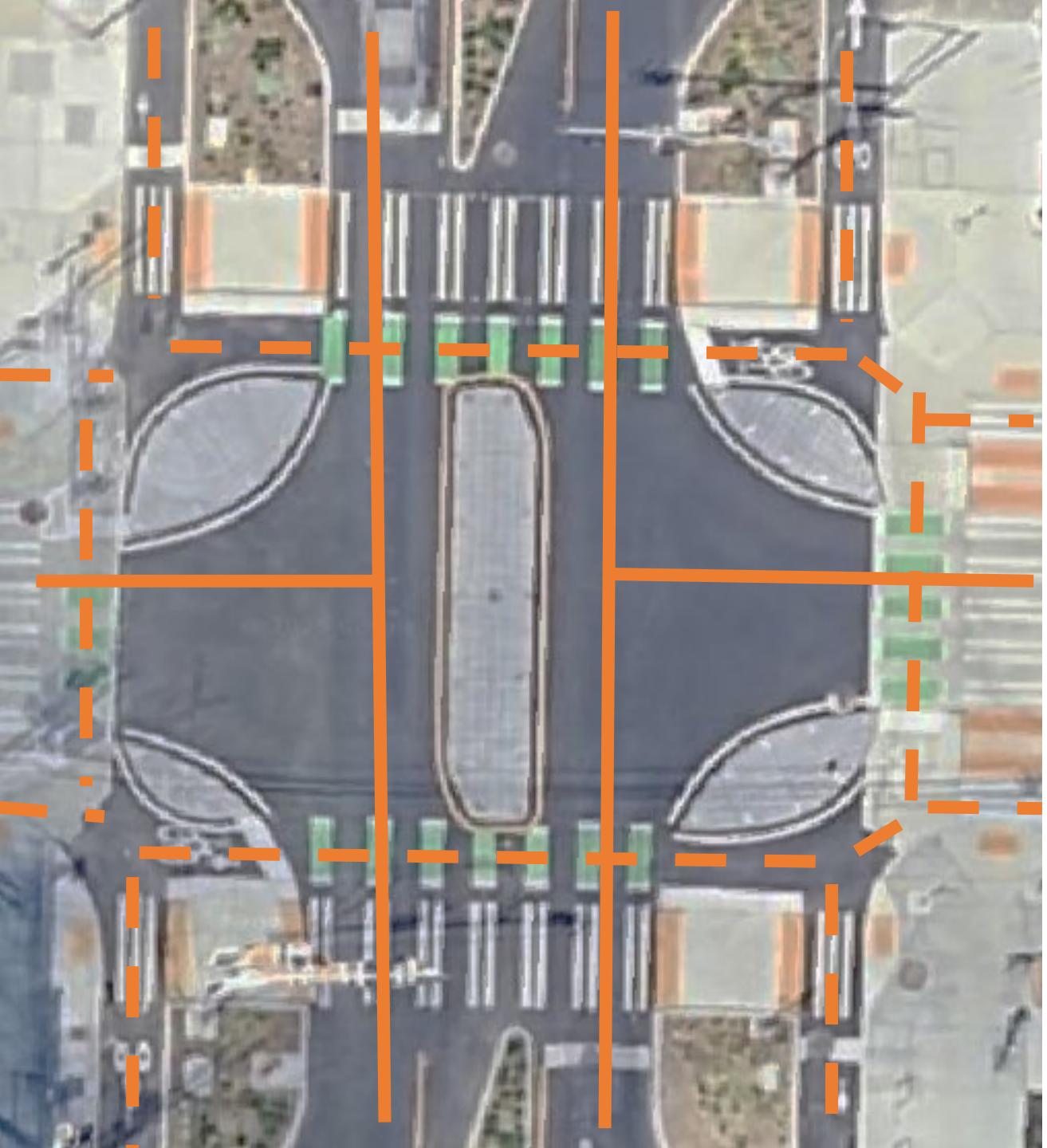
Protected intersections are mapped like sidewalks and crosswalks

Separated bike lanes mapped as separate features

And so are the queuing areas

Intersection crossings can be modeled on the 'crossing' edges, or further information modeled using 'Relation Tables'

Road
Separated Bike Lane
Sidewalk



Attributes for Describing Bicycle Facilities

Bikeway Edge Fields

- bikeway_type
- bikeway_grade_separation
- separation_elements
- separation_permeable_car
- buffer_width
- street_parking
- street_parking_buffer
- mup_modal_delineation
- wheel_channel

Attribute presence not discussed here but can be examined on the GATIS Explorer site:
<https://dotbts.github.io/BPA/>

bikeway_type

- Text field with recommended values from NACTO, AASHTO, and the National Bicycle Network
- This field is meant to be flexible to account for the wide array of bicycle facilities that exist and the naming variations
- Examples:
 - separated bike lane
 - two-way separated bike lane
 - contra-flow bike lane
 - parking separated bike lane

bikeway_type =
“bike lane”



bikeway_type =
“two-way separated bike lane”



National Bikeway Network

Facility Types

Table 1-A Definition of Bicycle Facility Types (Item 6 - BKFACTP)

Code	Definition	Description
1	Bike Lane	This code identifies the presence of a bicycle lane on a roadway facility.
2	Buffered Bike Lane	This code identifies the presence of a buffered bicycle lane on a roadway facility.
3	Separated Bike Lane	This code identifies the presence of a separated bike lane on a roadway facility.
4	Counter-Flow Bike Lane	This code identifies the presence of counter flow bike lane on a roadway facility.
5	Paved Shoulder	This code identifies the presence of a paved shoulder on a roadway facility.
6	Shared Lane	This code identifies the presence of a shared lane (with or without markings) on a roadway facility.
7	Shared Use Path	This code identifies the presence of a shared use path that is either immediately adjacent and parallel to a roadway or on an independent alignment.
8	Off-Road Unpaved Trail	This code identifies the bike facility as an off-road, unpaved trail.
Z	Other facility type that does not meet any of the criteria	Any bicycle facility that does not meet any of the criteria. May add additional comments to COMMENT field in Table 1.

bikeway_grade_separation

- Enumerated field with valid options of:
 - “at_grade”
 - “raised”
 - “sidewalk_level”
- Used to indicate if there is grade separation between the bicycle facility and the road and sidewalk next to it.



separation_elements

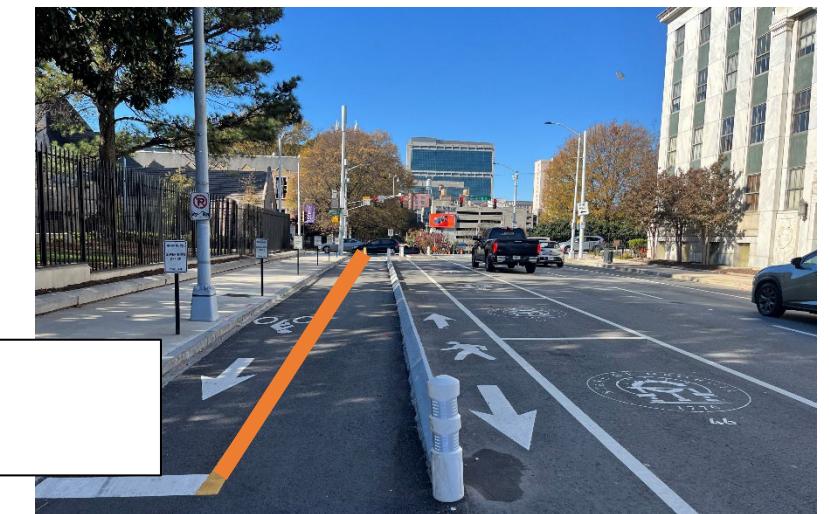
- Array<Text> field for capturing the separation elements with some recommended values
- Accounts for when there are multiple separation elements



separation_elements =
{"flexible delineator posts"}



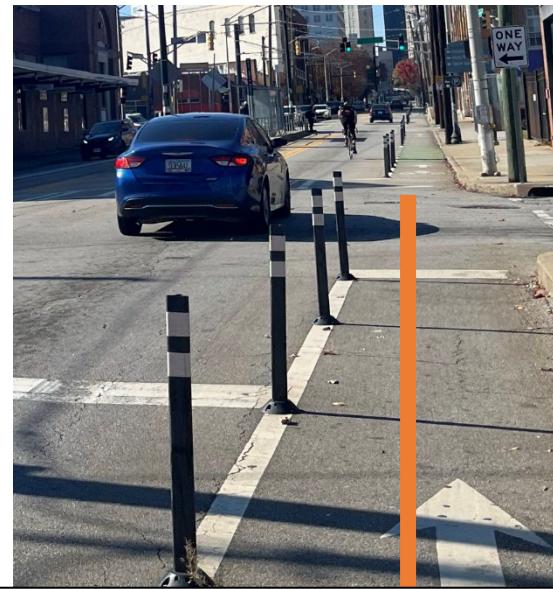
bikeway_grade_separation =
"raised lane separator"



separation_elements =
{"curb","flexible delineator posts"}

separation_permeable_car

- Enumerated field for capturing the ability of the separation elements to keep cars out of the bike facility
- Some room for subjectivity here
 - Are there concrete separation elements?
 - Do cars frequently park in the bike facility?
- *Any better ideas for the value names??*
 - ‘soft separation’
 - ‘hard separation’



separation_permeable_car =
“soft separation”



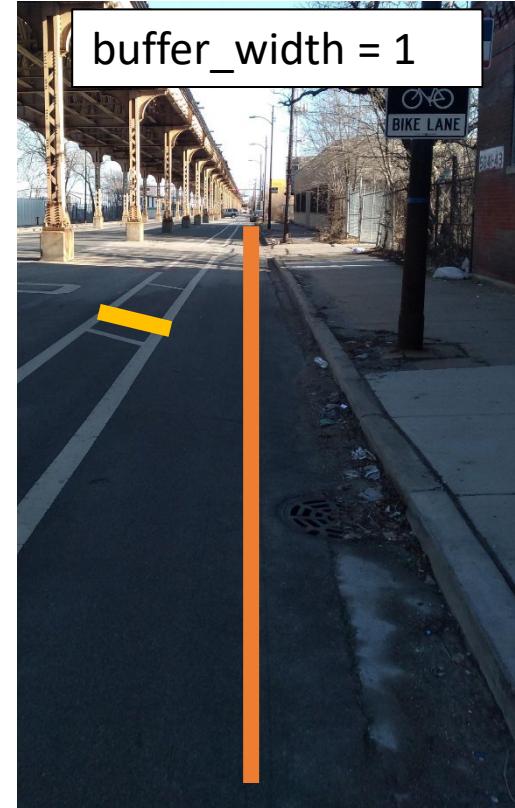
separation_permeable_car =
“soft separation”



separation_permeable_car =
“hard separation”

buffer_width

- Float field for recording the distance between the motor vehicle space and bicycle facility
- Can be used on bicycle facilities with separation elements



street_parking

- Enumerated field for indicating the presence and orientation of street parking relative to a bicycle facility
- Valid Values
 - parallel
 - perpendicular
 - angled
 - floating



street_parking =
“parallel”



street_parking = “floating”

street_parking_buffer

- Float field to measure the space between the street parking and the bicycle facility



street_parking_buffer = 0



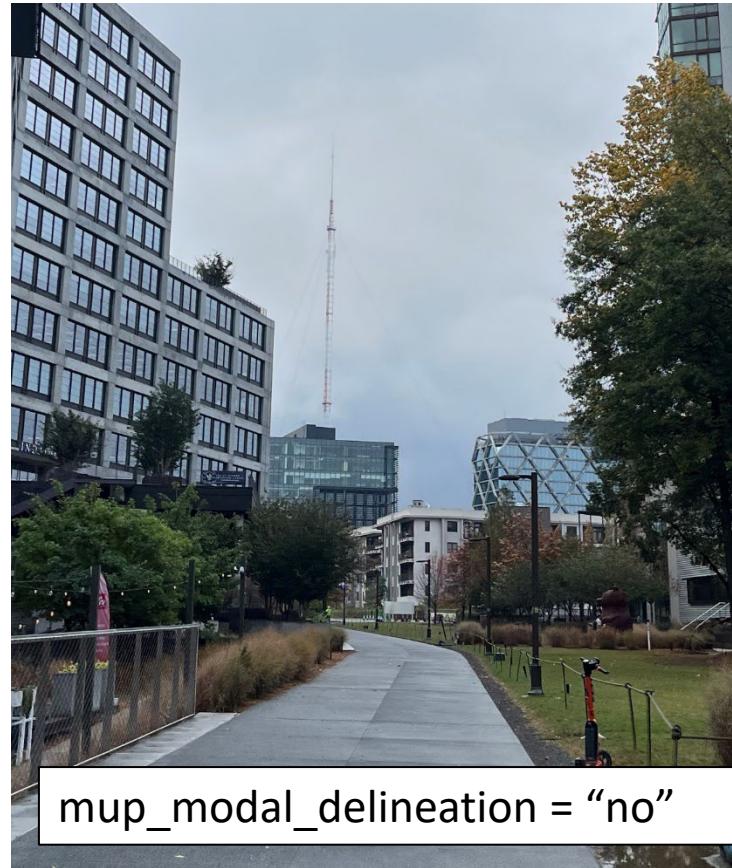
street_parking_buffer = 2



street_parking_buffer = 4

mup_modal_delineation

- Boolean field for designating if bikes have separately delineated space from pedestrians on multi-use paths
- Used in cases where it doesn't make sense to have a separate geospatial feature for each



wheel_channel

- Boolean field for indicating if a staircase has a wheel channel for bicycles



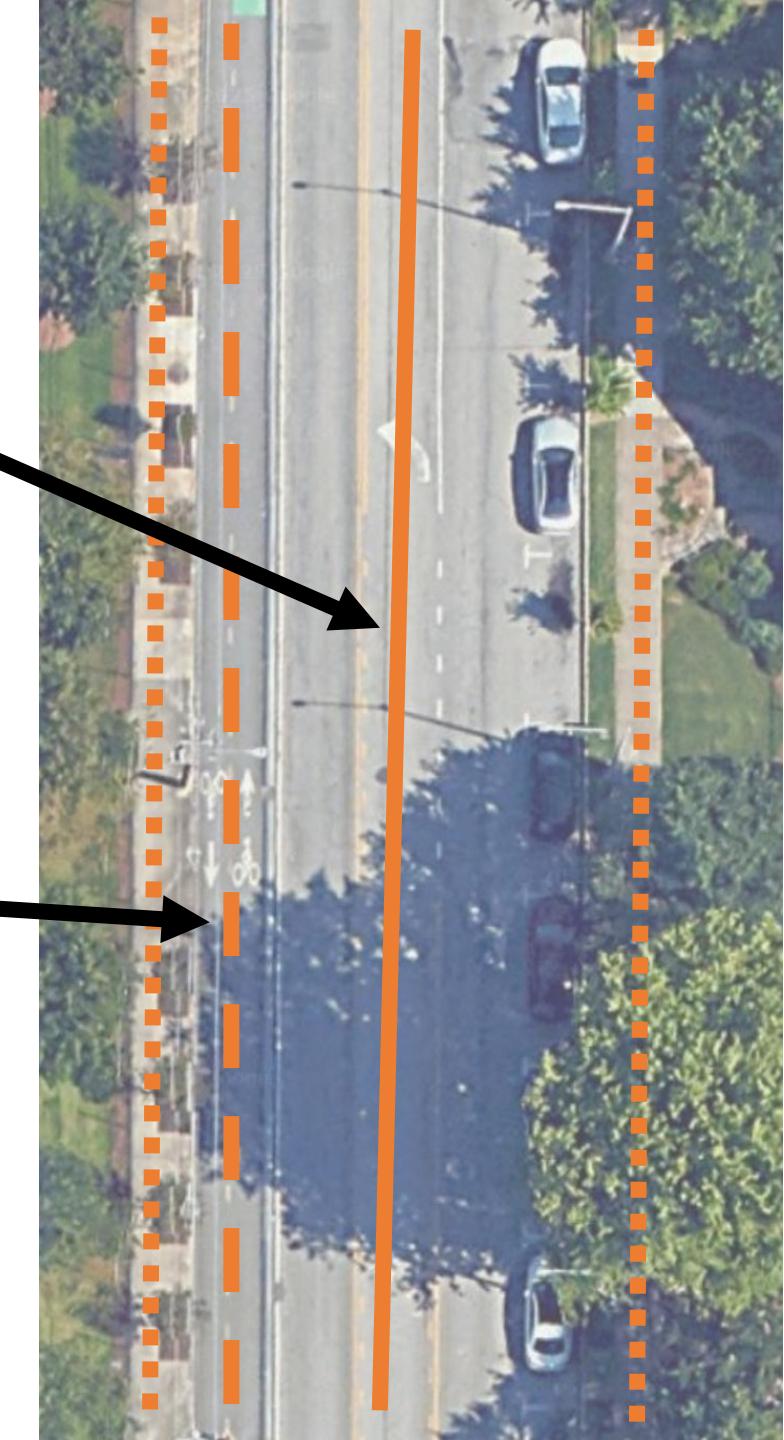
Stairway with wheel channel for bicycles ([Seattle Bike Blog](#))

Roadway-aligned association

- road_associated
- road_reference_id
- reference_ids

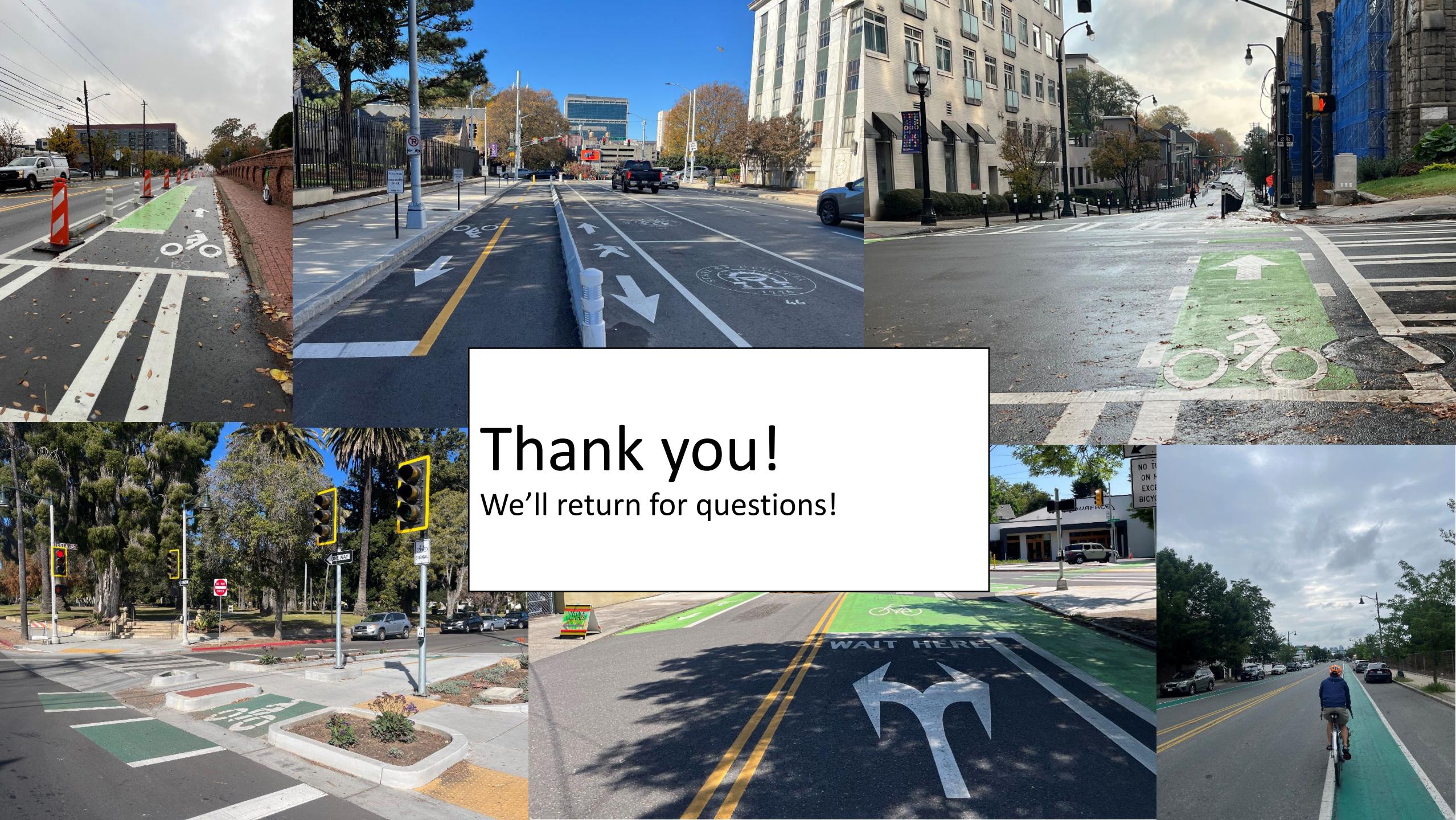
Name	Value
edge_type	road
edge_id	20
road_reference_id	101
...	...

Name	Value
edge_type	bikeway
edge_id	30
road_associated	yes
road_reference_id	101
...	...



Road edge fields relevant to bicycle accessibility

- traffic_volume
- posted_speed_limit
- car_freeflow_speed
- thru_lanes
- aux_lanes
- shoulder_width
- roadway_centerline



Thank you!
We'll return for questions!

Appendix

Edge Segmentation

Edge segmentation (road centerline)

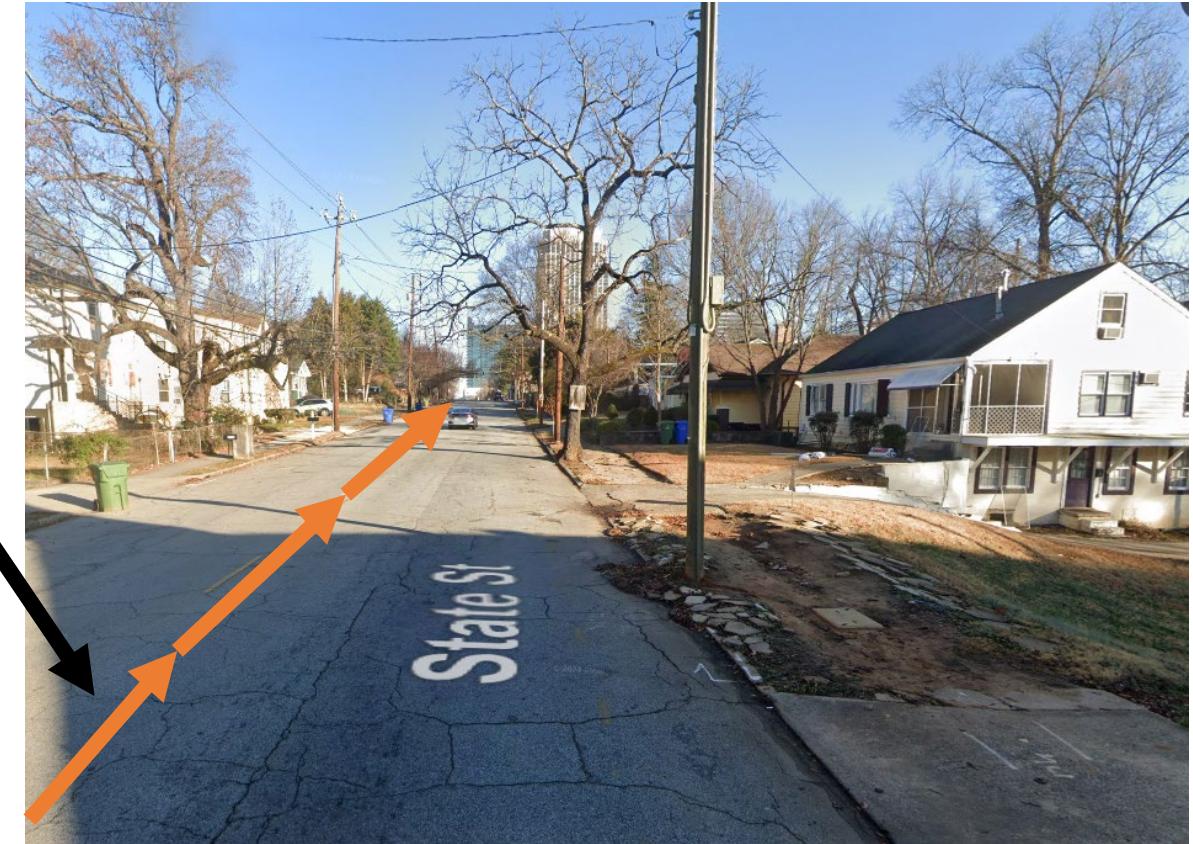
- GATIS only supports one set of attributes per feature
- When using centerline representation, edge must be segmented to reflect changes in:
 - Sidewalks
 - Bike facilities



Road centerline split into three edges to indicate where the sidewalk drops off and picks up ([Google Maps](#))

Edge segmentation (road centerline)

Name	Value
edge_type	road
...	...
sidewalk:left:presence	yes
...	...
sidewalk:right:presence	yes
...	...



Road centerline split into three edges to indicate where the sidewalk drops off and picks up ([Google Maps](#))

Edge segmentation (road centerline)

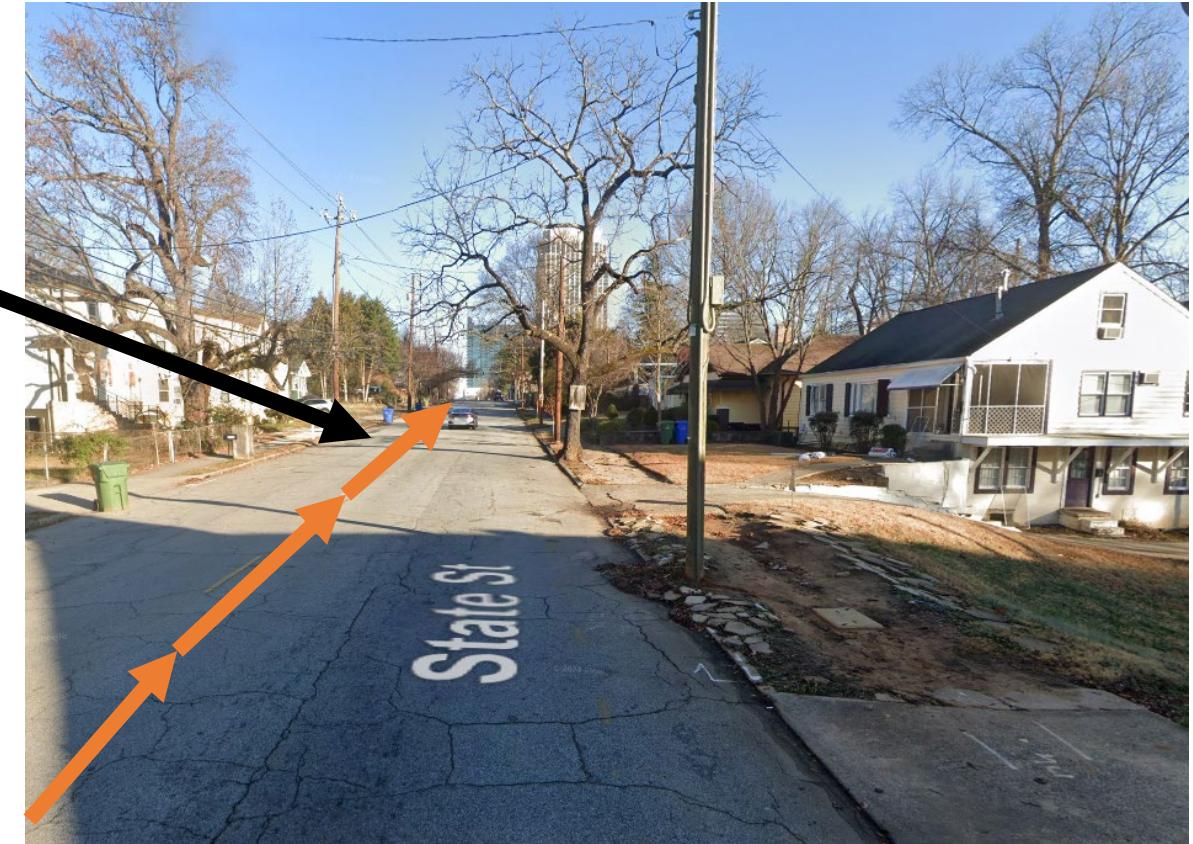
Name	Value
edge_type	road
...	...
sidewalk:left:presence	yes
...	...
sidewalk:right:presence	no
...	...



Road centerline split into three edges to indicate where the sidewalk drops off and picks up ([Google Maps](#))

Edge segmentation (road centerline)

Name	Value
edge_type	road
...	...
sidewalk:left:presence	yes
...	...
sidewalk:right:presence	yes
...	...



Road centerline split into three edges to indicate where the sidewalk drops off and picks up ([Google Maps](#))

Edge segmentation (network)

Name	Value
edge_type	road
...	...

Name	Value
edge_type	sidewalk
Presence	yes
...	...

Name	Value
edge_type	sidewalk
Presence	no
...	...



Road centerline split into three edges to indicate where the sidewalk drops off and picks up ([Google Maps](#))

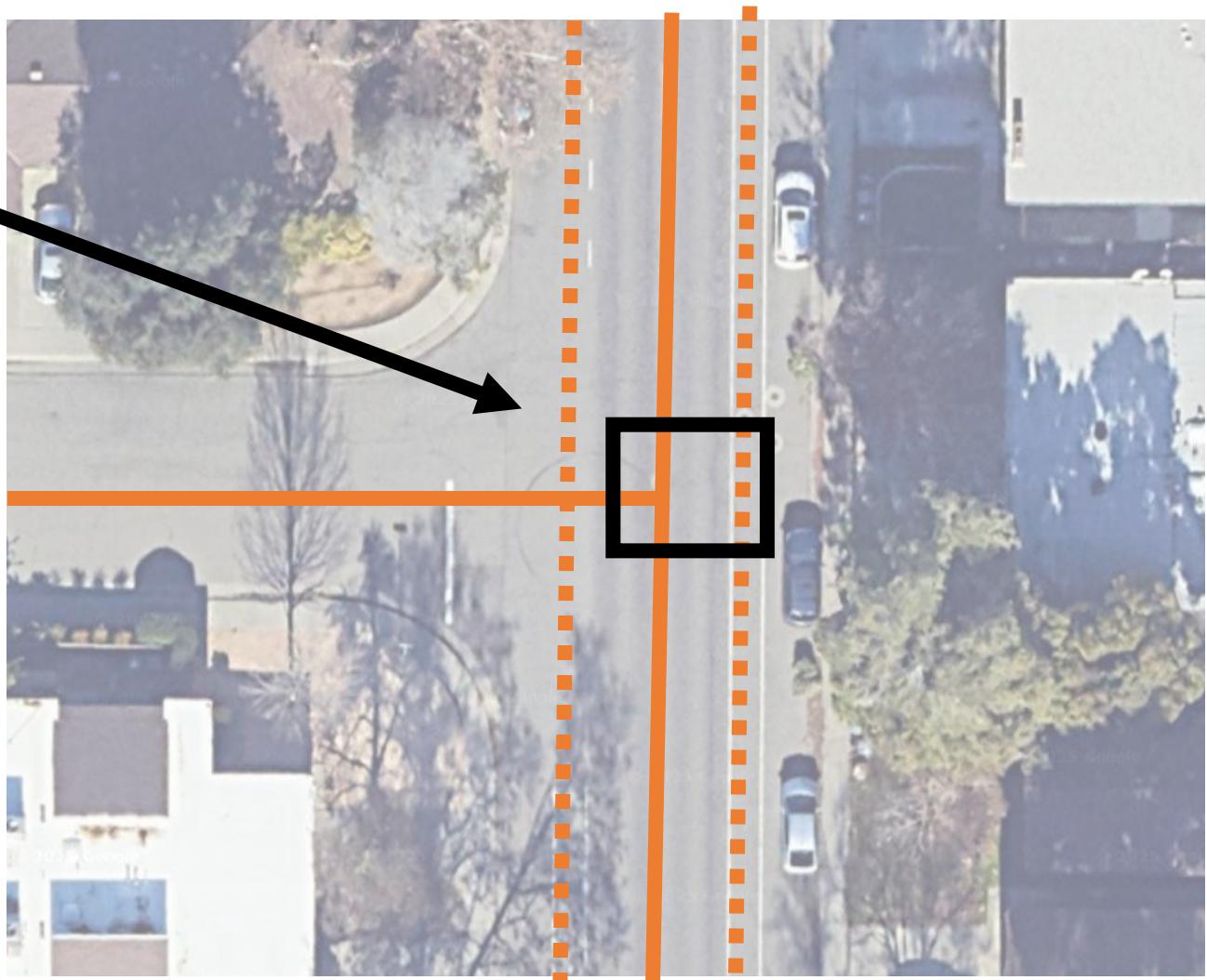
Challenges of network
representation for bicycle lanes

Challenges of network representation for bicycle lanes

- Cyclists are often expected to use the road like a vehicle
- Cyclist frequently transfer between dedicated bicycle facilities and the roadway
 - When the bike lane ends
 - When making left turns
- Separate features for bike lanes implies that the bike facility is “separate” from the road when this really isn’t the case

Challenges of network representation for bicycle lanes

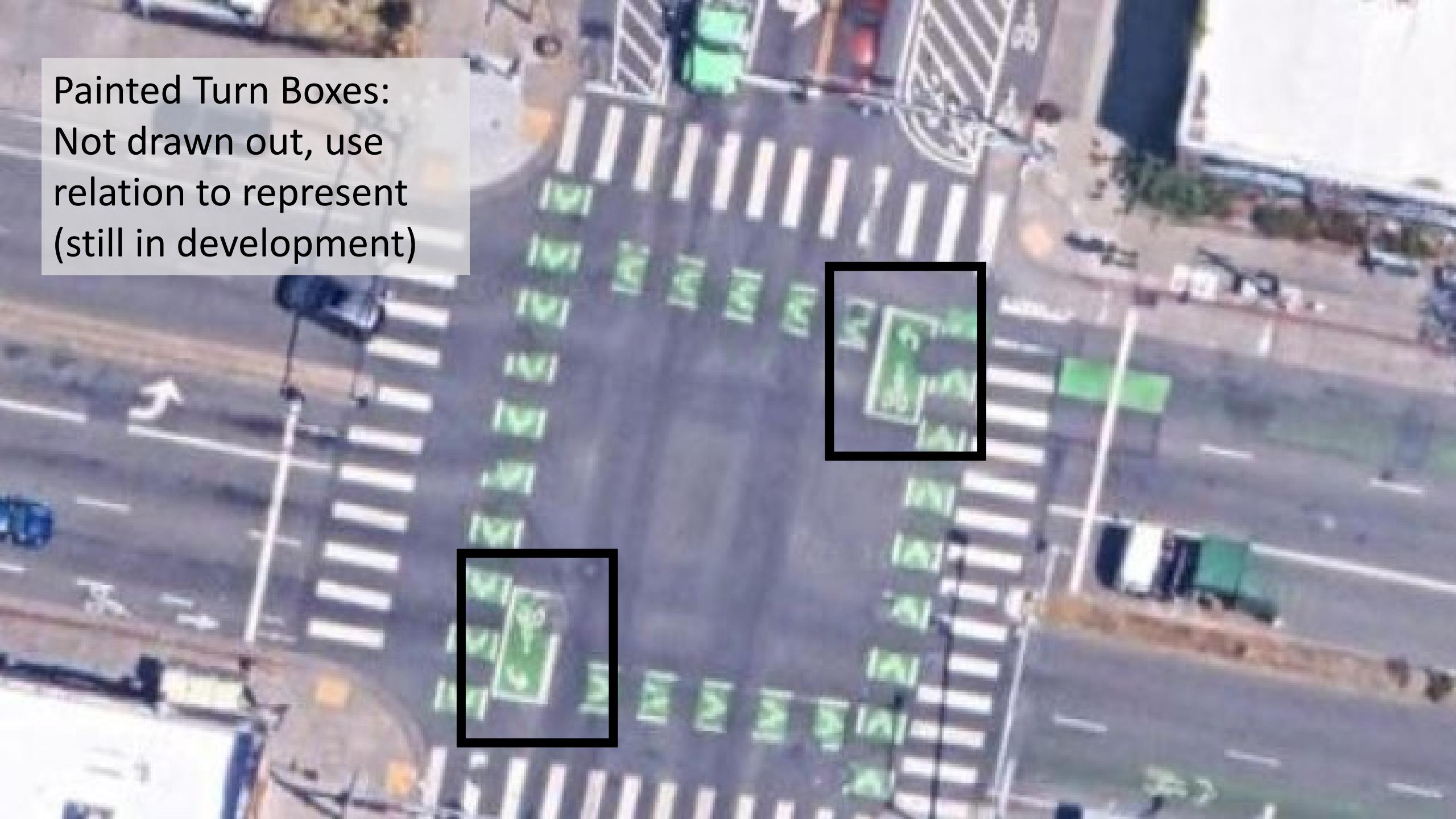
- Disconnects at intersections makes routing more challenging
- If reference to road not included, analysts lose the road attributes that matter for Level of Traffic Stress safety analyses



Intersection where North/South road has a bike lane and intersecting West/East road does not

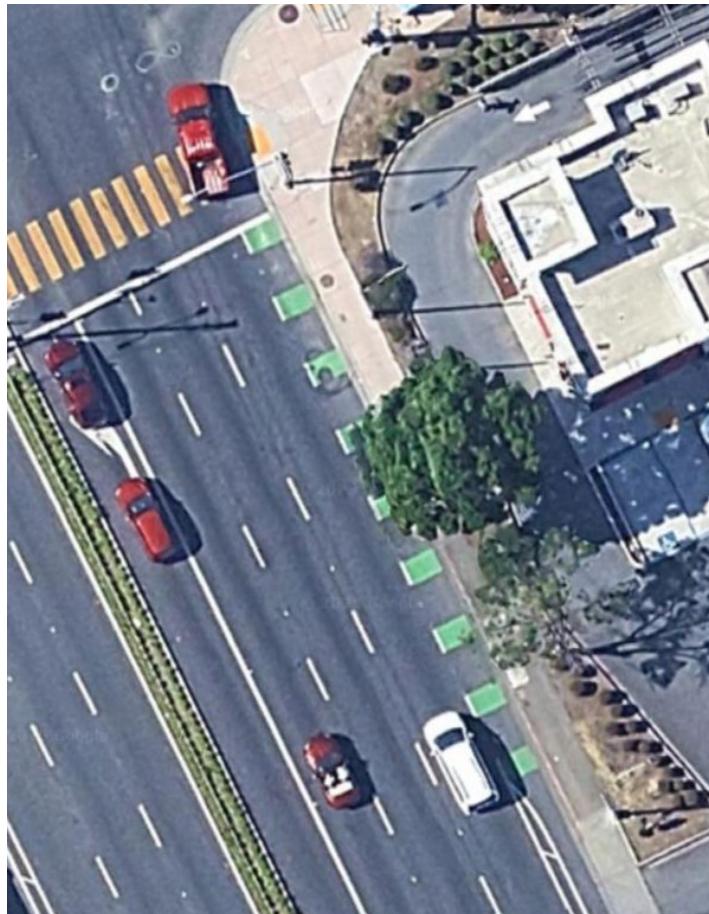
Edge cases

Painted Turn Boxes:
Not drawn out, use
relation to represent
(still in development)



Merging/mixing areas and pocket lanes

- Not currently accommodated in the spec
- Treat like a painted bike lane
- When modeling intersections, pocket lane data on the edges can be used to determine intersection approach bike lane type



Bike lane with merging area
(Google Maps)

Figure 9C-1. Example of Intersection Pavement Markings—Designated Bicycle Lane with Left-Turn Area, Heavy Turn Volumes, Parking, One-Way Traffic, or Divided Highway

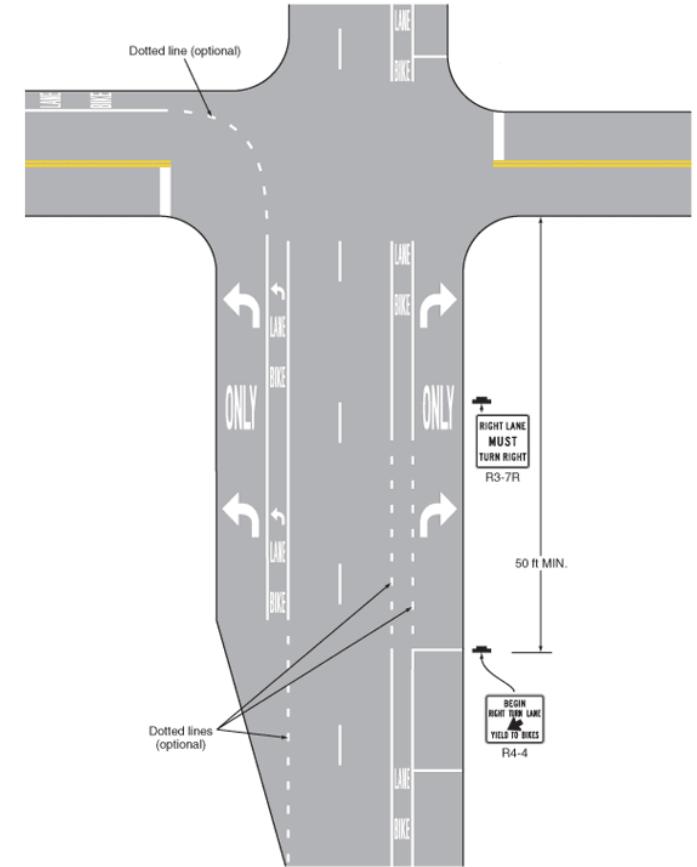


Figure 9C-1 (MUTCD)
<https://mutcd.fhwa.dot.gov/htm/2009/part9/part9c.htm>

Center-running bike lanes

- Use network representation
- Left/right tags don't apply
- A center tag wouldn't tell you "where" in the center



Washington, DC



San Francisco, CA ([Mission Local](#))

Roundabouts

Bike lane turns into sidewalk before the roundabout

Map bike lane on road
and indicate where
bike lane leaves road

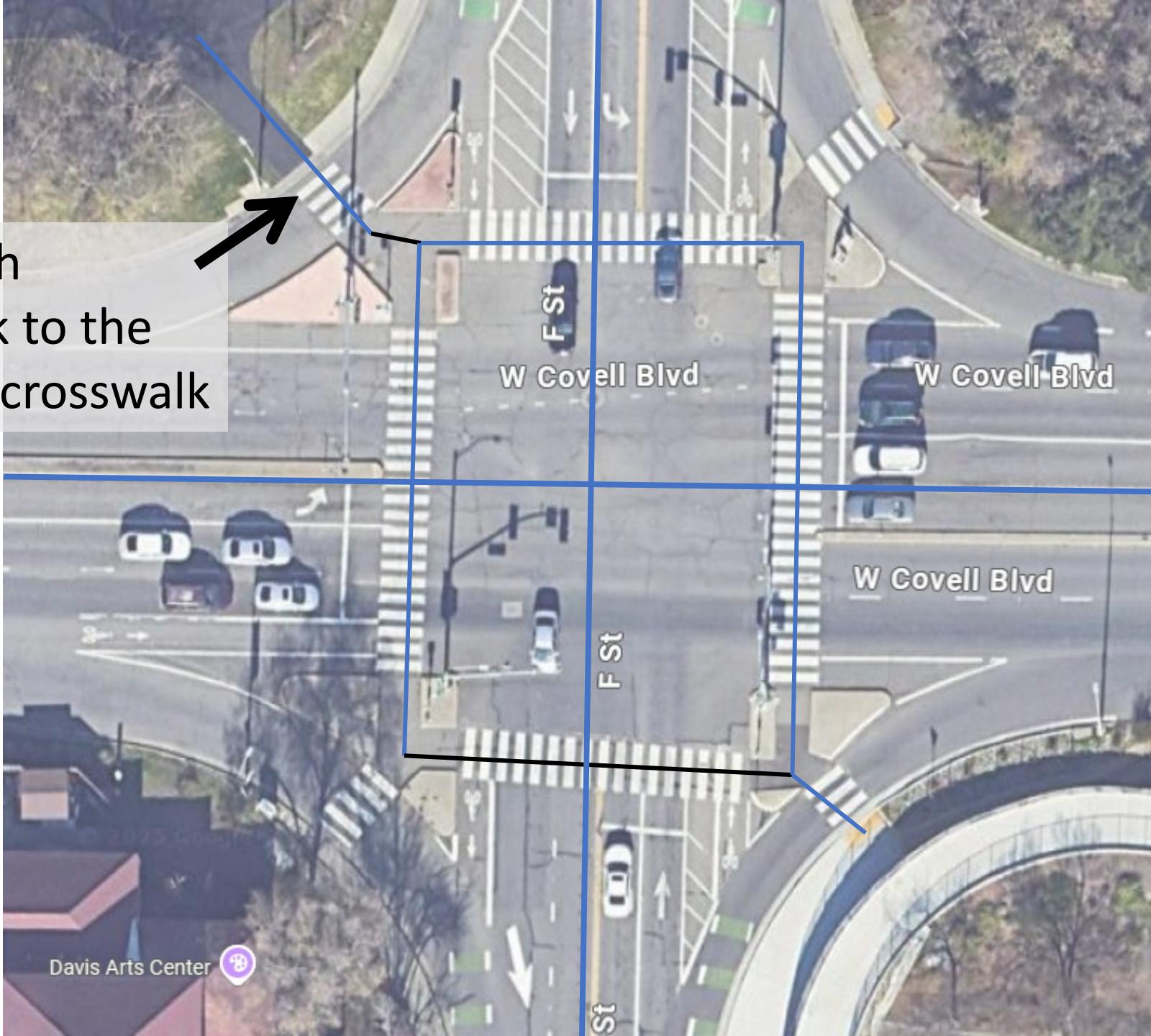


Multi-use trail to road connections

- Occurs when a multi-use path ends at a road intersection
- Need connecting edges to facilitate routing
- Use existing crossings/footpaths

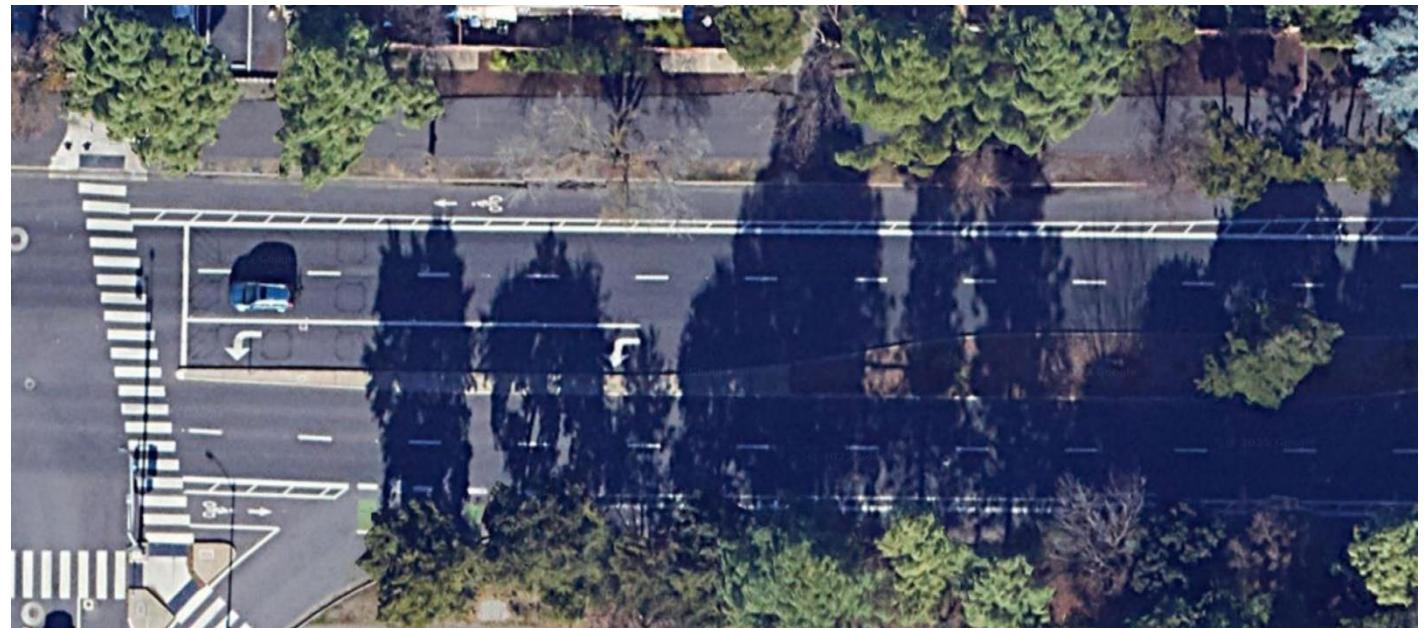


Multi-use path
connects back to the
road through crosswalk



Redundant bicycle facilities

- Sometimes there will be a bike lane on the road and multi-use path next to each other
- Bike lane is mapped as part of the road, multi-use path is mapped separately



Miscellaneous

ESRI Character Restrictions

- Some GATIS attributes use more than 10 characters
- Some illegal characters like ":" used
- Conversion tools could facilitate this:
 - Could use "_" for ":"
 - ESRI Shapefile compliant alias for all attributes
 - JSON arrays represented as text