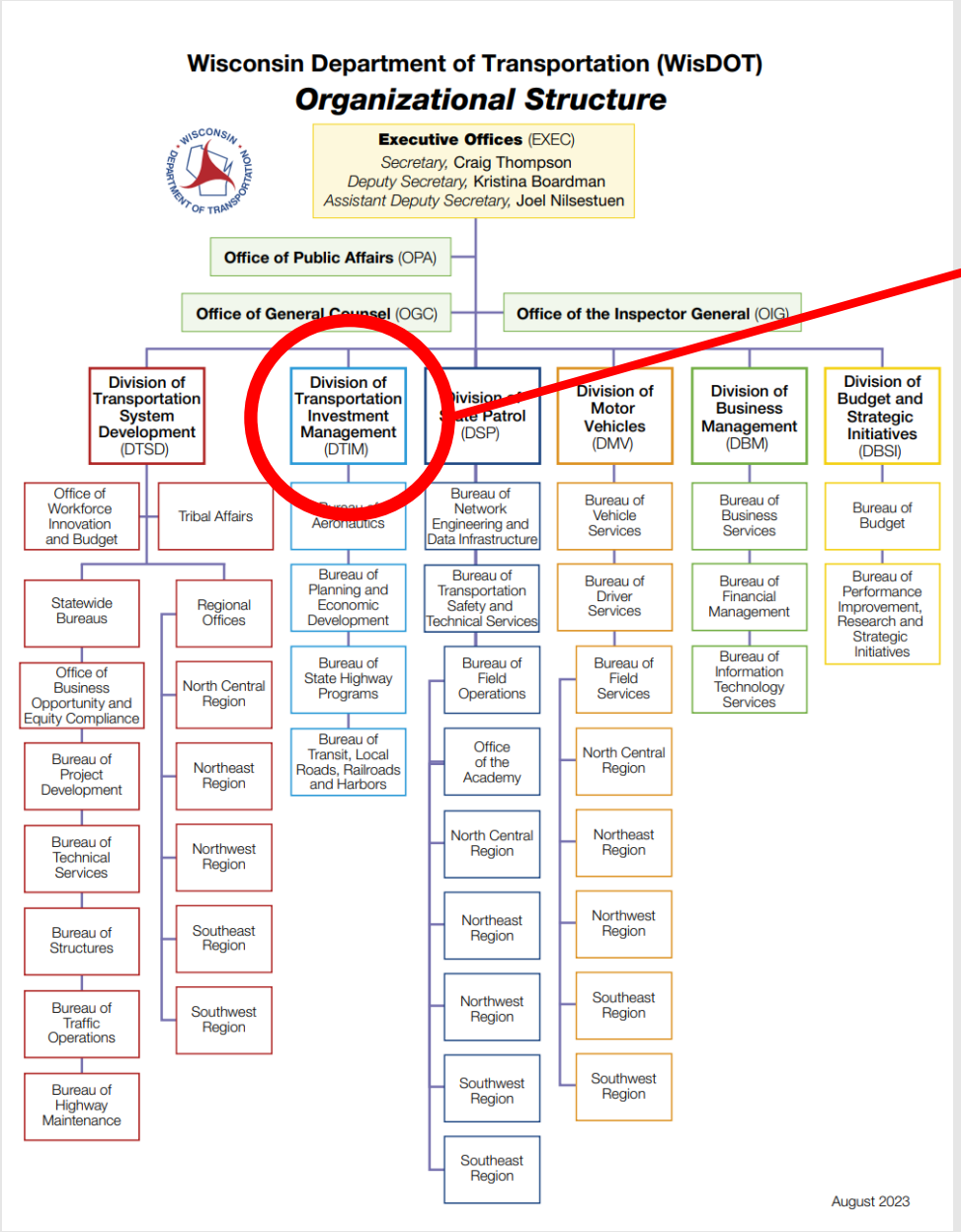
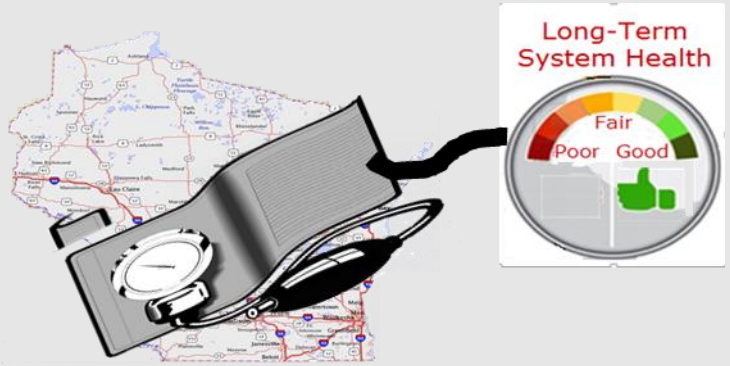
Bicycle & Pedestrian Project Analysis Support System (BiPASS)

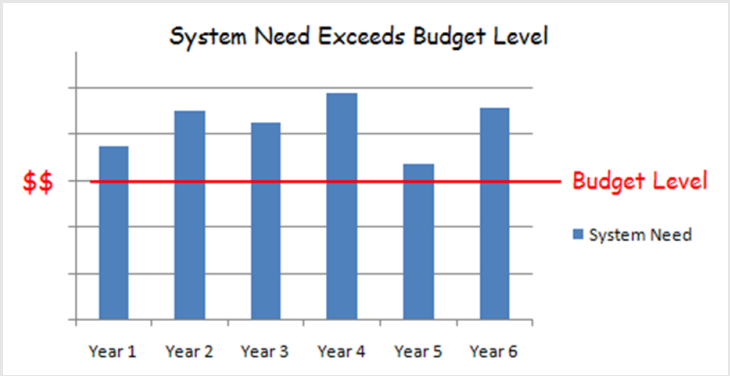
Performance-Based Design for Rehabilitation Projects



Office of Asset and Performance Management

Using advanced data analytics and performance-based analysis to optimize statewide system conditions





Bicycle and Pedestrian Project Considerations Beyond Reconstruction and New Construction

Rehabilitation Projects

- Bicycle and Pedestrian Facilities are Transportation Assets
- What to build for bicycle and pedestrian project considerations for rehabilitation projects (resurface to pavement replacement)?
  - Address Safety Issues
  - Address Critical Connectivity Issues
  - Data supports decision-making (performance-based)

Current Practices

- Safety
  - Safety Certification Process – Requires 1 bike/ped crash triggering evaluation requirements (**Reactive**)
- Mobility
  - Qualitative
  - Partial Counts

NEW Practices (Pilot)

- Safety
  - Output from a new crash prediction model (**Proactive**) + Evaluate HSM version 2.0
- Mobility
  - Output from a new bicycle/pedestrian link-volume prediction model (**Novel Approach**)

NOTE: From NCHRP 17-84 Bicycle and Pedestrian Crash Prediction Regression models were developed for various roadway segment and intersection types to estimate the potential of a pedestrian or bicycle crash occurring in the absence of having pedestrian or bicycle exposure data. *Final Report Complete Not Approved*

BiPASS Process

Improvement Project
- Rehabilitation

Mobility Analysis
- Developments
- Alternatives
- Volumes

Safety Analysis
- Alternatives
- Volumes
- Crashes

Project Evaluation
- Alternatives
- Fundable Benefit
- Crash Reduction
- Cost
- B/C Ratio

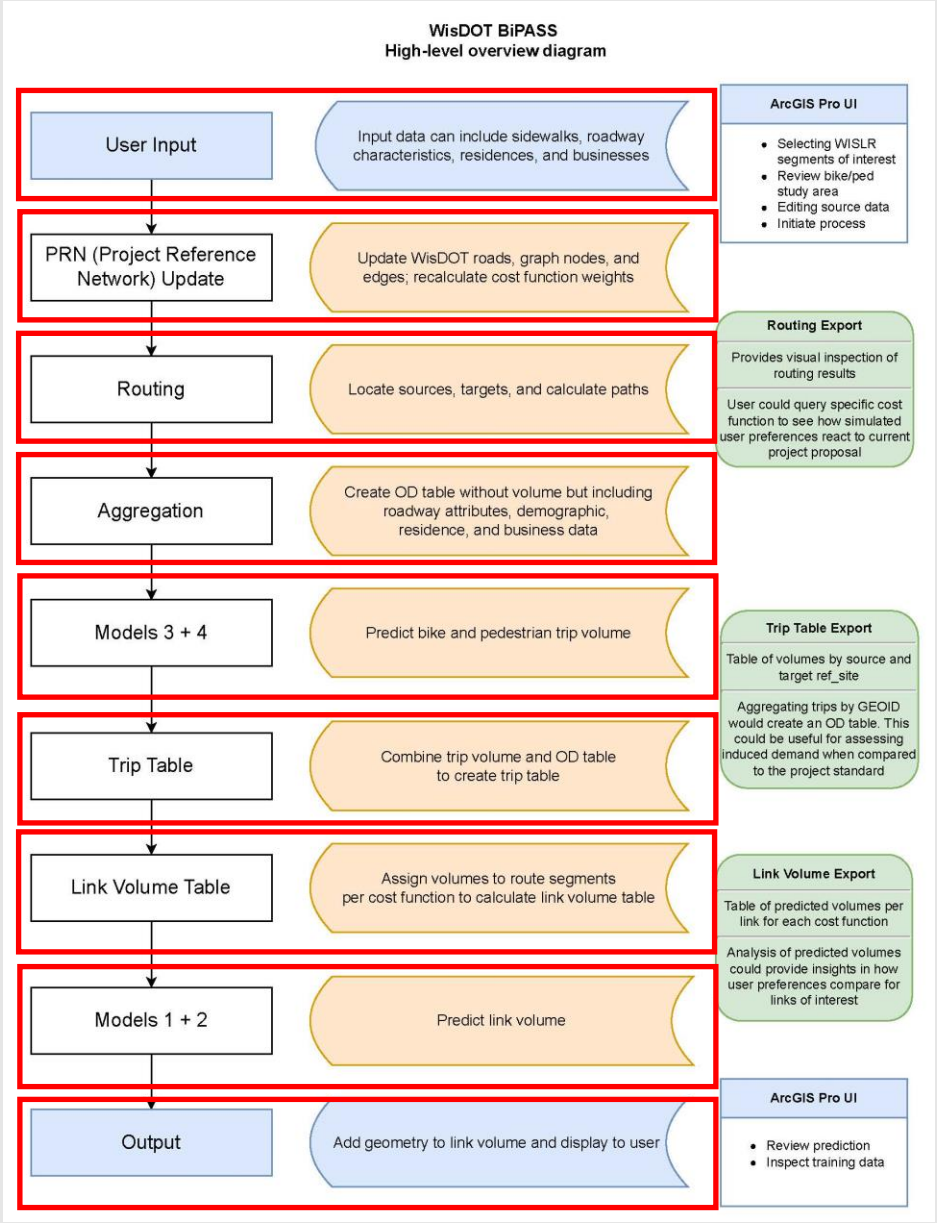
BiPASS
Mobility Analysis

Convert from GIS format for processing + ML modeling

For each OD pair, describe Origin & Destination demographics + routes from Origin to Destination

Total trips from each Origin to each Destination (separate bike & ped trip volumes)

Predict total bike/ped volume on segments of interest based on possible volumes and trip-maker demographics
(Used 3rd party volume data to train models)



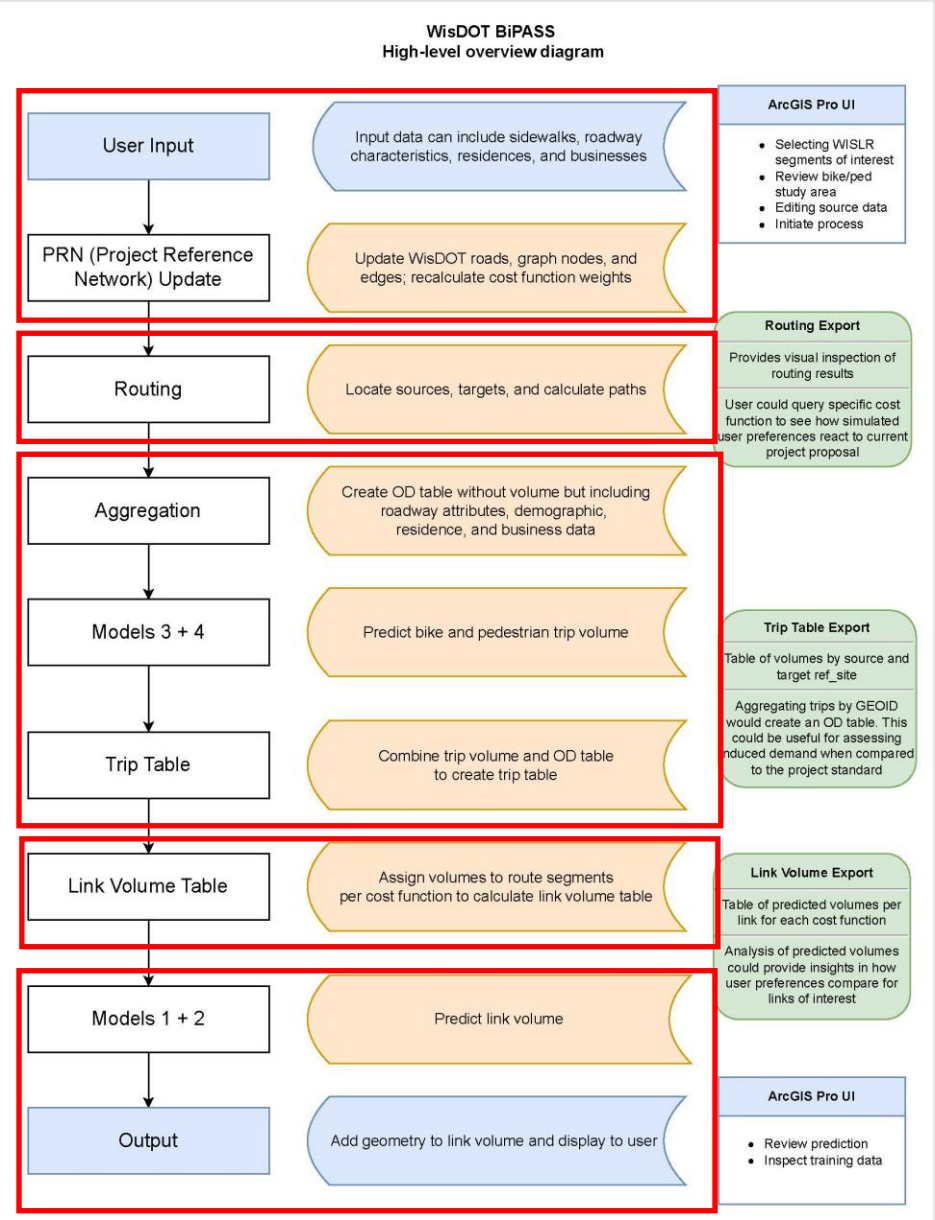
Project alternatives + anticipated/proposed developments

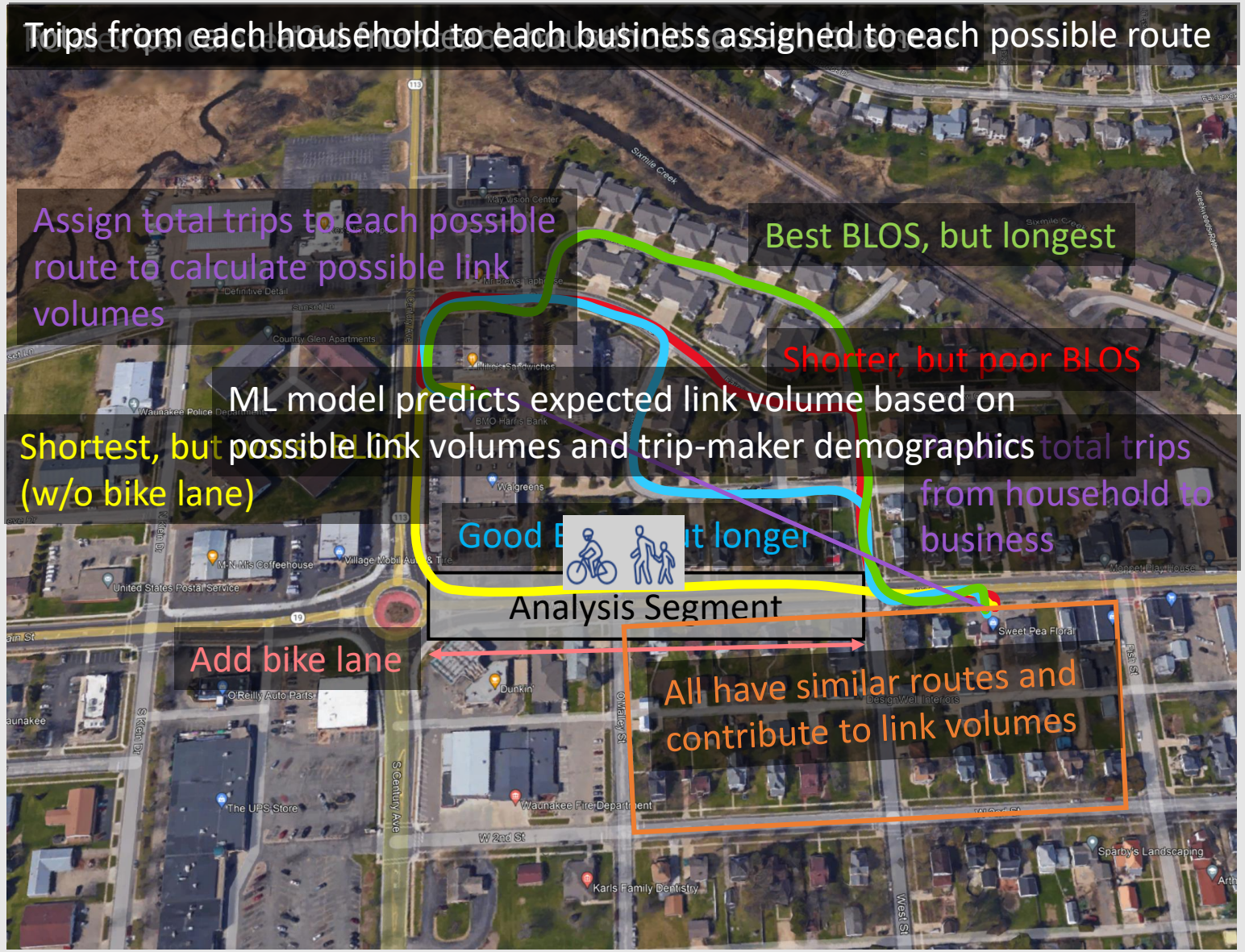
Calculate possible routes between Origins & Destinations based on BLOS, sidewalk presence, and distance

Predict total trips from each Origin to each Destination based on data from previous step (Used 3rd party trip data to train models)

Assign trips to each possible route calculated in Routing step

Convert to GIS format for display


WisDOT BiPASS
High-level overview diagram
User Input
Input data can include sidewalks, roadway characteristics, residences, and businesses
ArcGIS Pro UI
Selecting WISLR segments of interest
Review bike/ped study area
Editing source data
Initiate process
PRN (Project Reference Network) Update
Update WisDOT roads, graph nodes, and edges; recalculate cost function weights
Routing
Locate sources, targets, and calculate paths
Routing Export
Provides visual inspection of routing results
User could query specific cost function to see how simulated user preferences react to current project proposal
Aggregation
Create OD table without volume but including roadway attributes, demographic, residence, and business data
Models 3 + 4
Predict bike and pedestrian trip volume
Trip Table Export
Table of volumes by source and target ref_site
Aggregating trips by GEOID would create an OD table. This could be useful for assessing induced demand when compared to the project standard
Trip Table
Combine trip volume and OD table to create trip table
Link Volume Table
Assign volumes to route segments per cost function to calculate link volume table
Link Volume Export
Table of predicted volumes per link for each cost function
Analysis of predicted volumes could provide insights in how user preferences compare for links of interest
Models 1 + 2
Predict link volume
Output
Add geometry to link volume and display to user
ArcGIS Pro UI
Review prediction
Inspect training data


Trips from each household to each business assigned to each possible route
Assign total trips to each possible route to calculate possible link volumes
Best BLOS, but longest
Shorter, but poor BLOS
ML model predicts expected link volume based on possible link volumes and trip-maker demographics
Shortest, but poor BLOS (w/o bike lane)
total trips from household to business
Good B t longer
Analysis Segment
Add bike lane
All have similar routes and contribute to link volumes
Waunakee Police Department
BMO Harris Bank
Walgreens
M-N-Ms Coffeehouse
United States Postal Service
Village Mobil
O'Reilly Auto Parts
Dunkin'
The UPS Store
Waunakee Fire Department
Karls Family Dentistry
Sweet Pea Floral
Sparby's Landscaping
S Century Ave
W 2nd St
S Main St
O'Malley St
West St
First St

What Makes BiPASS Mobility Analysis Different From Traditional Four Step TDM?

- Does not assume any theoretical mathematical models
- Combines Trip Generation, Trip Distribution, & Mode Choice steps
  - Can predict more trips as a result of network changes → induced demand
- Uses multiple cost functions and ML models for enhanced volume prediction beyond traditional Route Assignment step

BiPASS Safety Analysis

- Uses ML models to predict intersection and segment crashes for bicycles and pedestrians based on roadway attributes, auto volumes, and bike/ped volumes predicted by Mobility Analysis

- Why ML models?
  - Compared HSM methodology (Negative Binomial Regression) to ML models and found ML models have more accurate prediction of crash volumes

BiPASS ML Model Technical Details

BiPASS Component	Model Type	Mode	Candidate Algorithm
Mobility Analysis	Trip Volume	Bicycle	Ensemble (Tree/Linear)
		Pedestrian	Ensemble (Tree/Linear)
	Link Volume	Bicycle	Ensemble (Tree/Linear)
		Pedestrian	Ensemble (Tree/Linear)
Safety Analysis	Segment	Bicycle	XG Boost
		Pedestrian	XG Boost
	Intersection	Bicycle	XG Boost
		Pedestrian	XG Boost

BiPASS Project Evaluation

- Conducts a benefit-cost analysis based on
  - economic value of bike/ped trips – assigning cost/user (NEW)
  - public benefit of bike/ped crash reduction
  - cost of bike/ped improvements

Next Steps

- Continuous improvement
  - Validation data
  - Model retraining
- Enhancements
  - Data integration & feature engineering
    - More detailed demographics and access to destination variables

Question/Answer