GIS Based Bicycle & Pedestrian Demand Forecasting Techniques

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TMIP Webinar

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Fehr & Peers

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Objectives

- Why is Bike/Ped Forecasting Important?
- Overview of GIS Modeling Techniques
- Case Study of Locally Validated Model
  - Process of Constructing the Regression Model
  - Model Results & Validation
  - Model Applications

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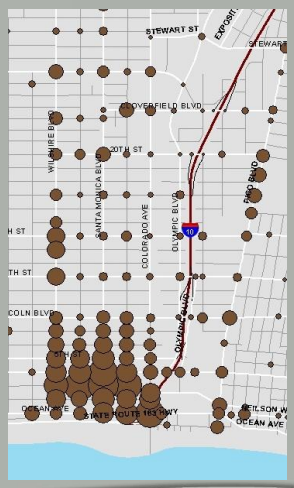
Why is Bike/Ped Forecasting Important?

- To evaluate: How many, where, when?
  - Determining need
  - Prioritizing improvements

Photo: Dan Burden



Why Types of Models Case Study

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Why is Bike/Ped Forecasting Important?

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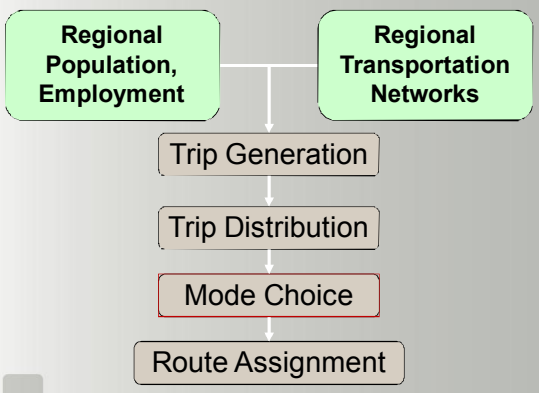
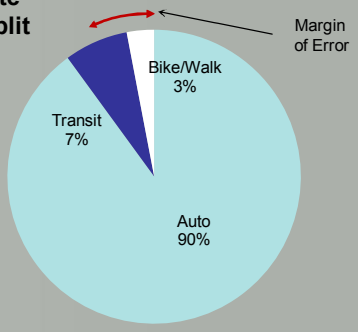
Types of Models: Travel Demand Models as Bike/Ped Forecasting Tools



Example Travel Demand Model Commute Mode Split



Why Types of Models Case Study

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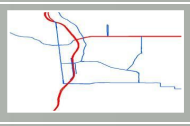
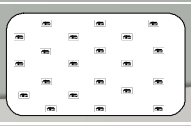
Typical Model "Blind Spots"

	Reality	Model's View
Circulation Network		
Walking Environment		
Density, Clustering		

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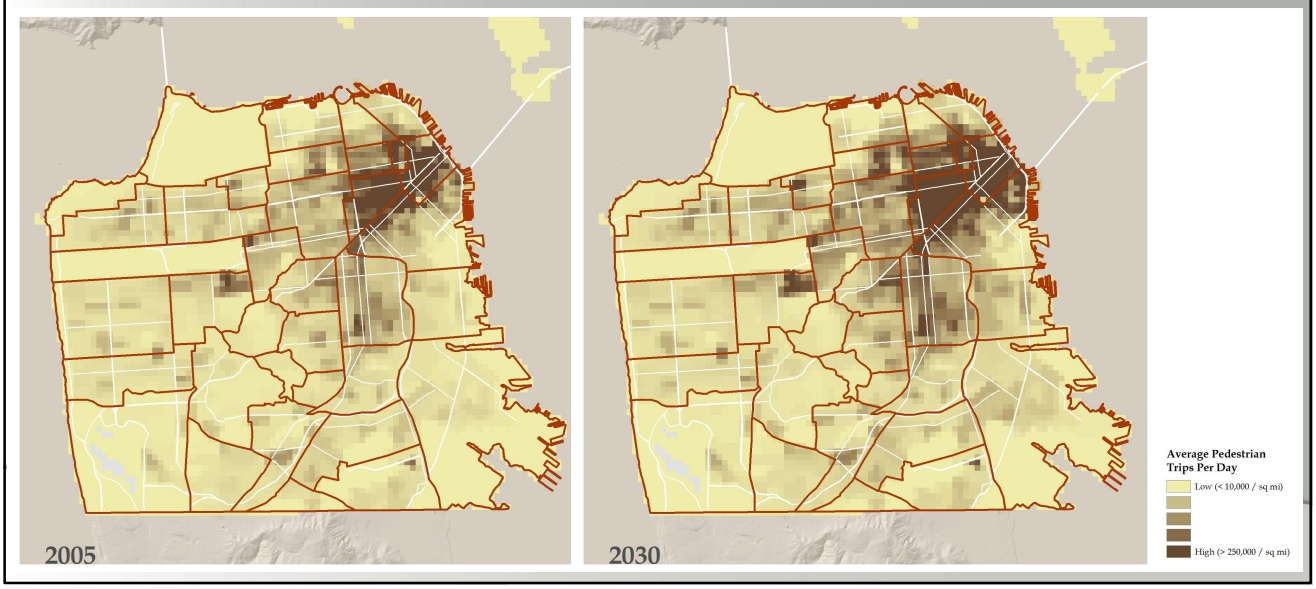
Travel Demand Models as Bike/Ped Forecasting Tools



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Types of Models: Dedicated GIS Bicycle/Pedestrian Demand Models

	Basic	Enhanced
Description	Latent Demand Forecasting	Bicycle/Pedestrian Demand Forecasting
Output	Bicycle/Pedestrian Demand Index	Intersection or Link Volumes
Inputs	"D" Factors – Density, Diversity, Design, Destinations, etc; Manually Assigned Weightings	"D" Factors – Only Statistically Significant Variables Selected
Key Advantages	Simple, Flexible, Rational	Output in Bikes/Pedestrians Volumes, Validated
Examples	Sacramento County, Ventura (CA), Seattle	Alameda County (CA), Santa Monica
		

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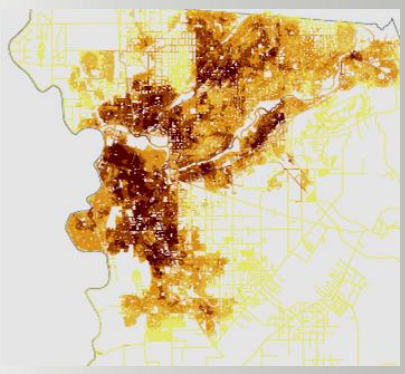
Latent Demand Models



Sacramento County, CA

Ventura, CA

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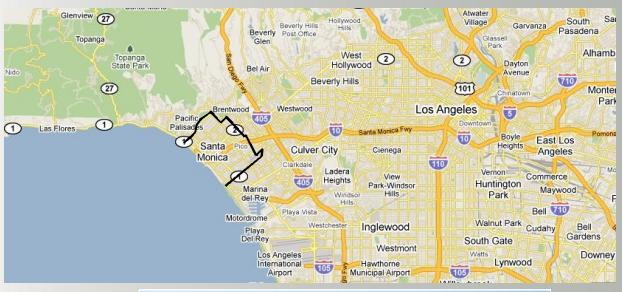
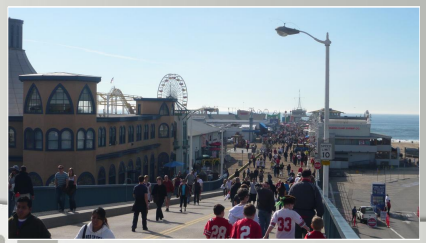
Case Study – Santa Monica Bicycle/Pedestrian Demand Model





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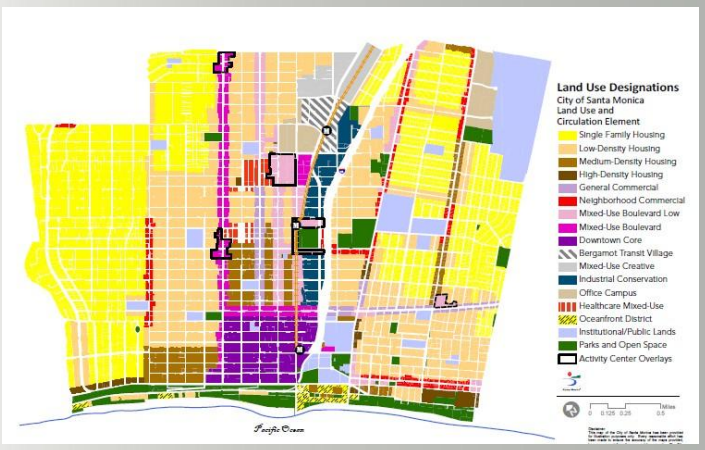
Case Study – Santa Monica Bicycle/Pedestrian Demand Model



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Case Study – Santa Monica Bicycle/Pedestrian Demand Modeling

- Goal
  - Selecting the Combination of Land Use factors that Best Describe Variation in Bicycle/Pedestrian Demand

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Dependent Variable – Bicycle & Pedestrian Volumes

- Approximately 200 Intersection Counts Collected in 2007 & 2009
- 4 Hours Counts – Used 5-6PM Peak Hour for Model Integration

Santa Monica 5-6 PM Bike Volumes

Santa Monica 5-6 PM Pedestrian Volumes

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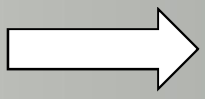
Process

Variable Selection

- Factors Rooted in the D's
  - Density
  - Diversity
  - Design
  - Destination Accessibility
  - Distance to Transit



- Population Density
- Employment Density
- Land Use Diversity
- Axial Map
- Roadway Speeds
- Adjacent Roadway Volumes
- Distance to Activity Centers
- Proximity to Ped/Bike Facilities

Tested Close to 20 Potential Variables

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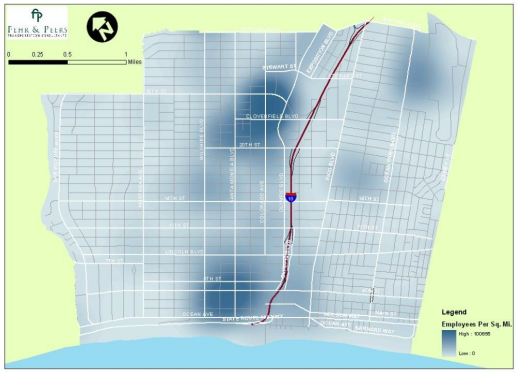
Population Density vs. Employment Density

Santa Monica Population Density



Santa Monica Employment Density

Density (and Demographics)

Why Types of Models Case Study

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Intersection Density

Santa Monica Intersection Density

Density (and Design)

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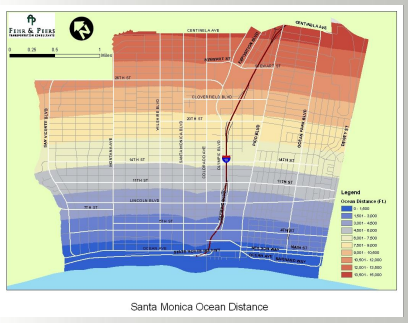
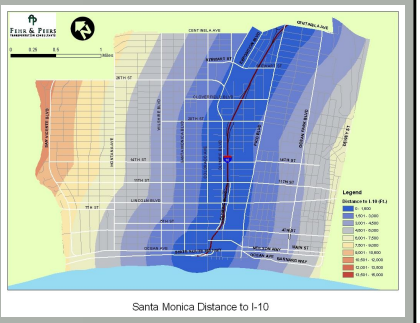
Destinations



Distance to Ocean

Distance to Parks



Distance to I-10

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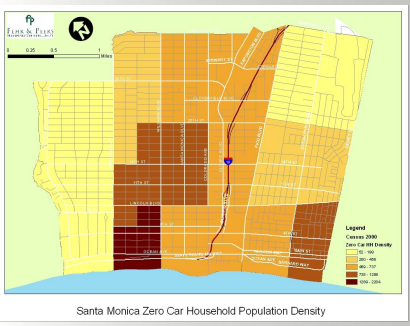
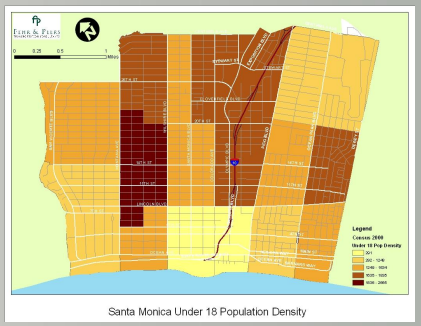
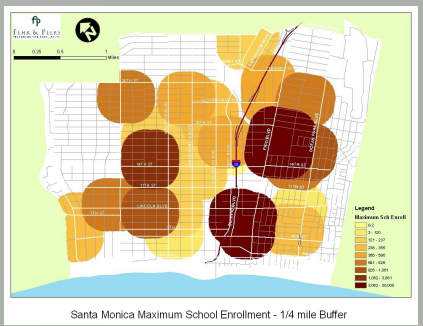
Demographic Factors



Zero Car Households



Under 18 Population



Maximum School Enrollment – ¼ Mile Buffer

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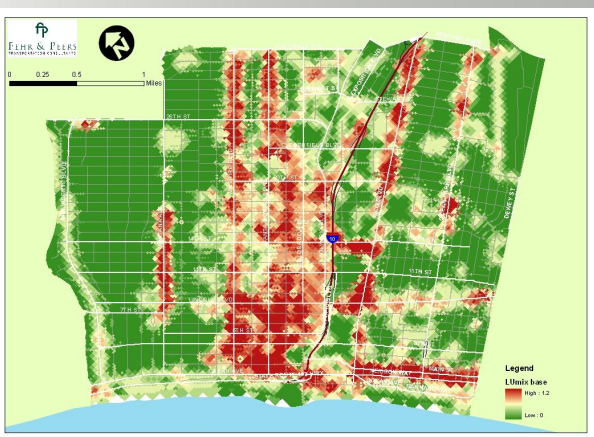
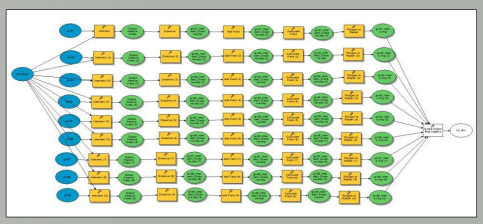
Land Use Mix



Santa Monica Land Use Mix



Diversity

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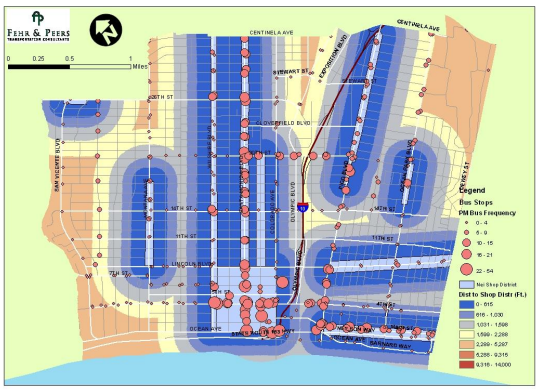
Proximity to Neighborhood Shopping Districts and Speed Limits



Santa Monica Bus Stops & Neighborhood Shopping Districts

Destinations

Santa Monica Speed Limits

Design

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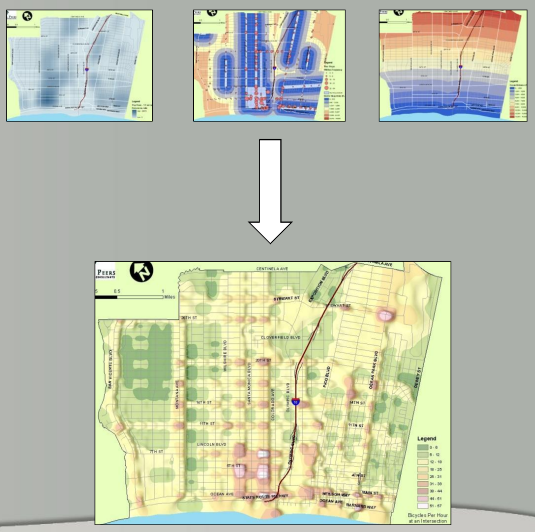
Process

- Goals
  - Elegant Model
    - Least Number of Significant Variables that Describe Behavior
  - Intuitive
  - Useful
  - Integrate with City's TDF Model (i.e. Peak Hour)



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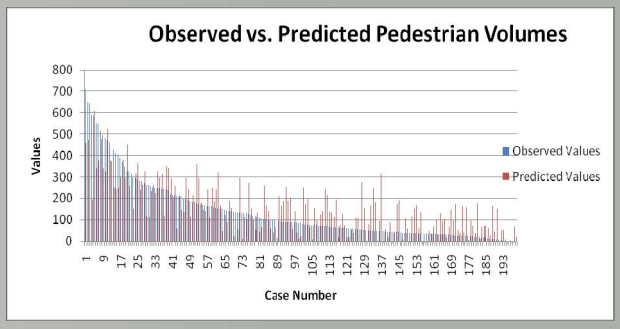
Results – Pedestrian Model

Variable	Significance	Coefficient Sign
Employment Density	0	+
PM Bus Frequency	0.001	+
Neighborhood Shopping District Proximity	0.002	+
Distance from the Ocean	0.043	-
Average Speed Limit of Approaches	0.123	-



- R-squared = 0.584

PM Peak Intersection Volume = 3.217×10^{-3} * Empl. Density + 3.675 * PM Bus Frequency + 82.695 * Nei. Shop Proximity – 6.855×10^{-3} * Ocean Distance – 5.699 * Ave. Speed Limit + 222.180

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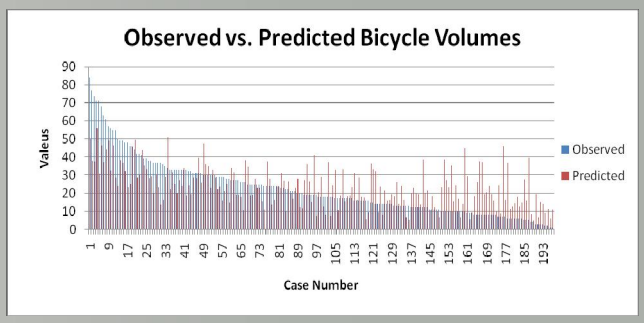
Results – Bicycle Model

Variable	Significance	Coefficient Sign
Land Use Mix	0.024	+
PM Bus Frequency	0.004	+
Population Density 18 and Under	0.025	-
Bike Network	0	+



- R-squared = 0.471

PM Peak Intersection Volume = 10.97 * LU Mix + 0.342 * PM Bus Frequency – 5.809 x 10^{-3} * Pop Dens Under 18 + 5.581 * Bike Network Score + 14.89

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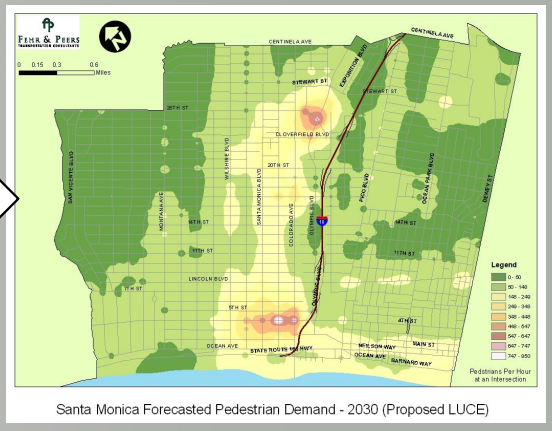
Forecasting Changes in Significant Variables

Santa Monica Growth in Retail Employment Existing - 2030 (LUCE09)



Santa Monica Forecasted Pedestrian Demand - 2030 (Proposed LUCE)

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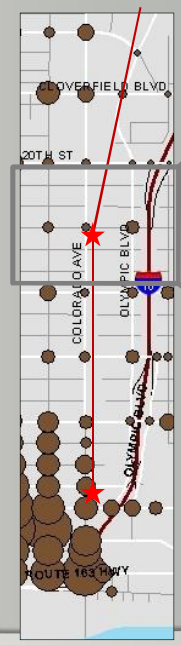
Additional Applications

- Intersection Volumes or Midblock
- Filling in Gaps in Data
  - Colorado Corridor



Existing Counts

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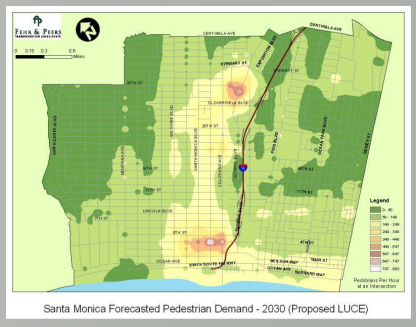
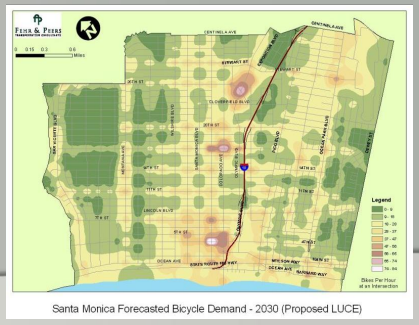
Results - Validation

- Enhancements
  - Expand From Peak Hour to Daily Volumes
  - Seasonal Factors
  - Land Use Factors
  - Network Variables
  - Avoid Multi-Collinearity
- Intuitive and Useful
- Validate D's



Santa Monica Forecasted Pedestrian Demand - 2030 (Proposed LUCE)



Santa Monica Forecasted Bicycle Demand - 2030 (Proposed LUCE)

Important Lessons

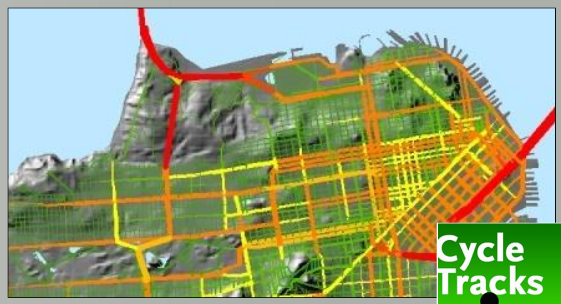
- Applications
  - Bicycle and Pedestrian Exposure
  - Filling in Gaps in Data
  - Prioritizing Improvements
- Importance of Data
  - Count Data
  - Variety of GIS Layers and Data Available

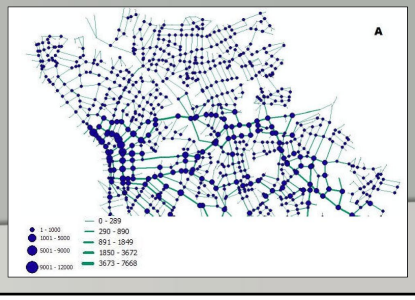
Santa Monica Forecasted Growth in Pedestrian Demand: Existing - 2030

Santa Monica Forecasted Growth in Bicycle Demand: Existing - 2030

TDF Model Integration

- Time Periods Measured – Peak Hour/Peak Period
- Appropriate for Mode Choice/Trip Generation Adjustments
- Enhancements
  - Route Choice/Assignment for Bicycles and Pedestrians
  - Origin/Destinations for Bicycles and Pedestrians





Next Steps – NCHRP 08-78 Study

- Objective – Provide National Best Practices Guide to Estimating Bicycling and Walking
  - Review Current Approaches and Techniques
  - Develop Transferable Methods for Estimating Walking and Bicycling
    - Practitioner's Guide to Bicycle and Pedestrian Model Development

Resources / Contact

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Questions?