Microsimulation Model Design in Lower Manhattan: A Street Management Approach

Transportation Research Board Session 278

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Trent Lethco, Arup

Varanesh Singh, Arup

S. Brian Huey, Arup

Peter Dunn, Arup

Suchi Sanagavarapu, New York City DOT

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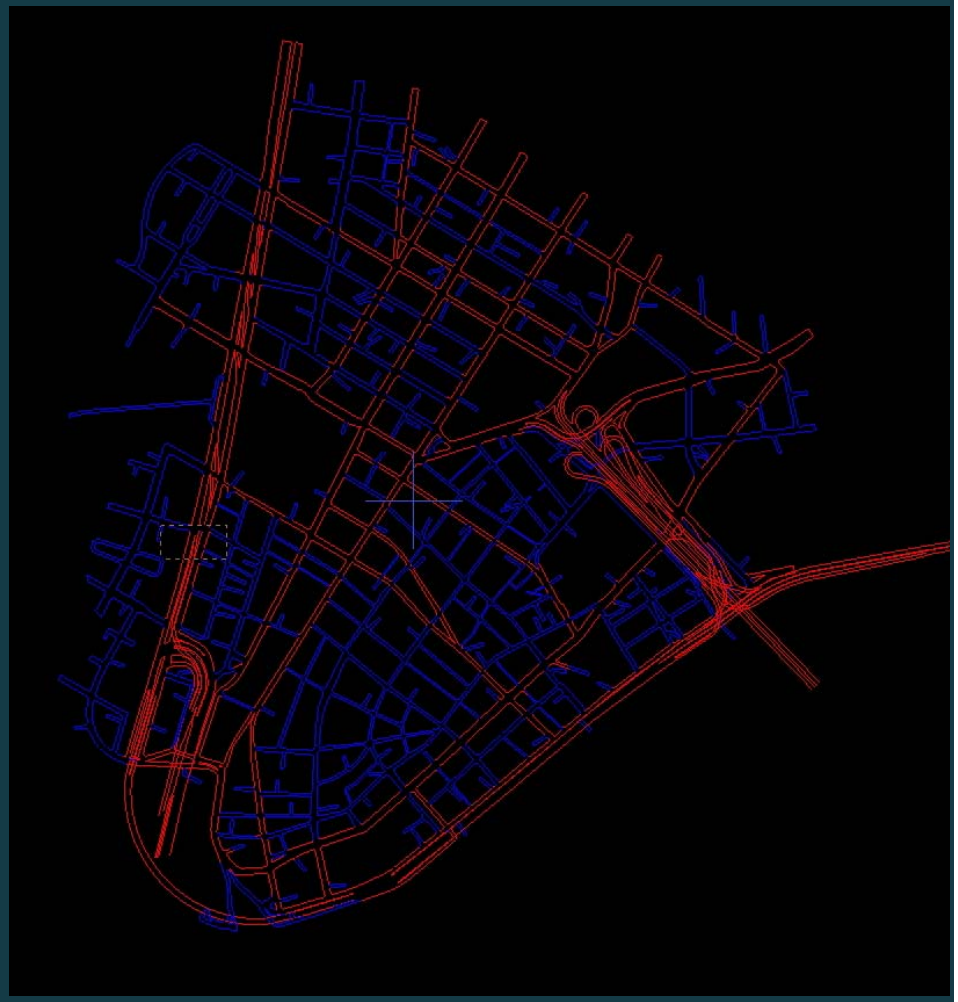

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Introduction

- Lower Manhattan Street Management Project
  - Multi-year, transportation planning services contract with NYCDOT and NYCEDC
- Scope of work includes:
  - Traffic Simulation Model
  - Placard Parking Analysis
  - Bus Management Analysis
  - Other Traffic Analyses

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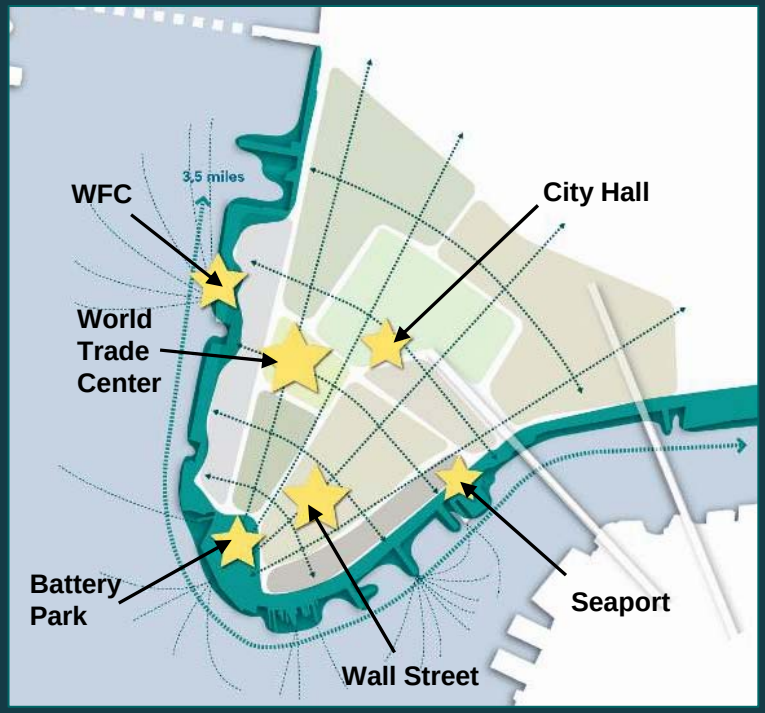
Lower Manhattan at a Glance



- 1 sq mile dense urban neighborhood
- Fourth largest central business district in America
- Over 318,000 employees
- 145% increase in residential population since 2001
- Over 8 million annual visitors

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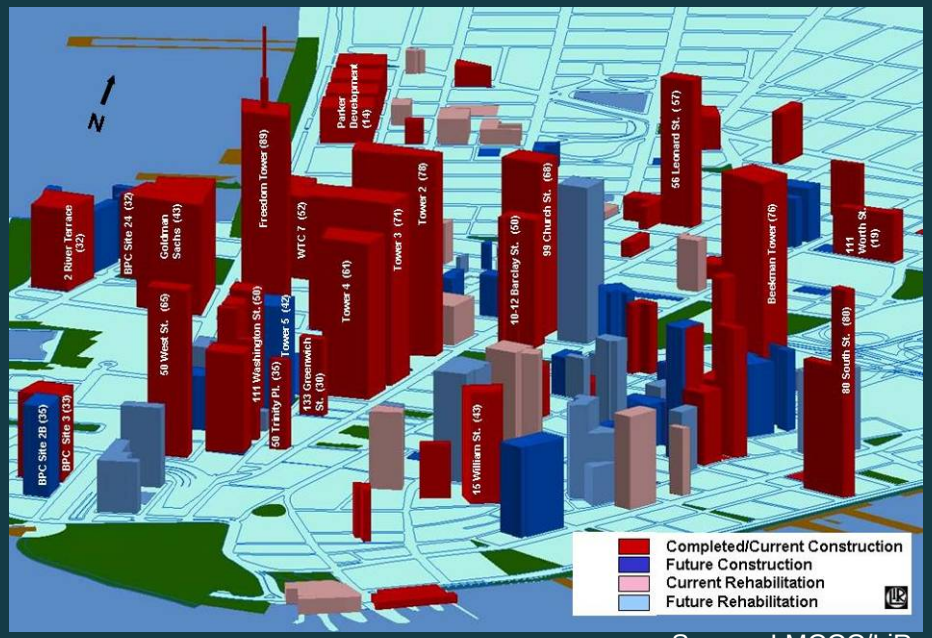
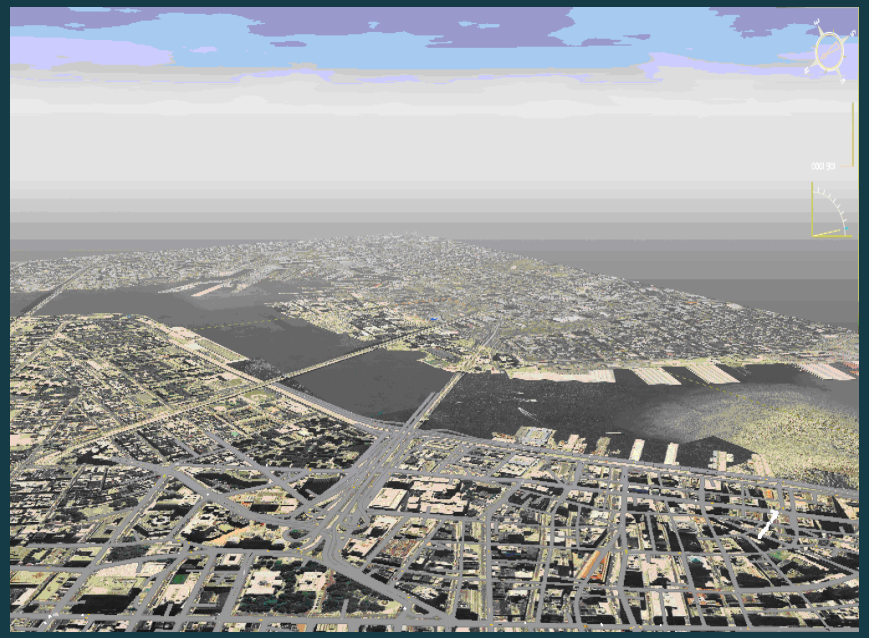
Model Purpose

- Comprehensive, detailed traffic model
- Appropriate for technical and non-technical audience
- Manage street operations resulting from:
  - Construction closures
  - Network changes
  - Planning and security scenarios





Source: LMCCC/LiRo

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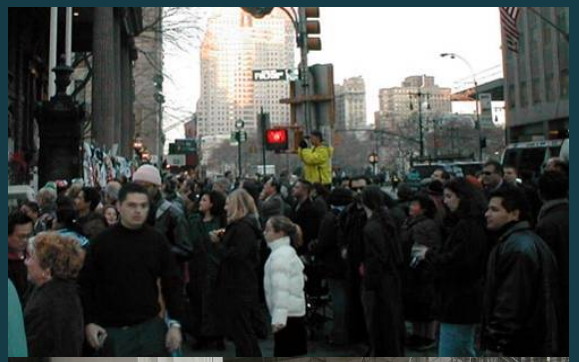
Modeling Challenges

- Large, dense urban study area
- Pedestrian/vehicular interactions
- Curbside activity
- Bus activity on streets
- Taxis and livery vehicles
- Variation in traffic flow



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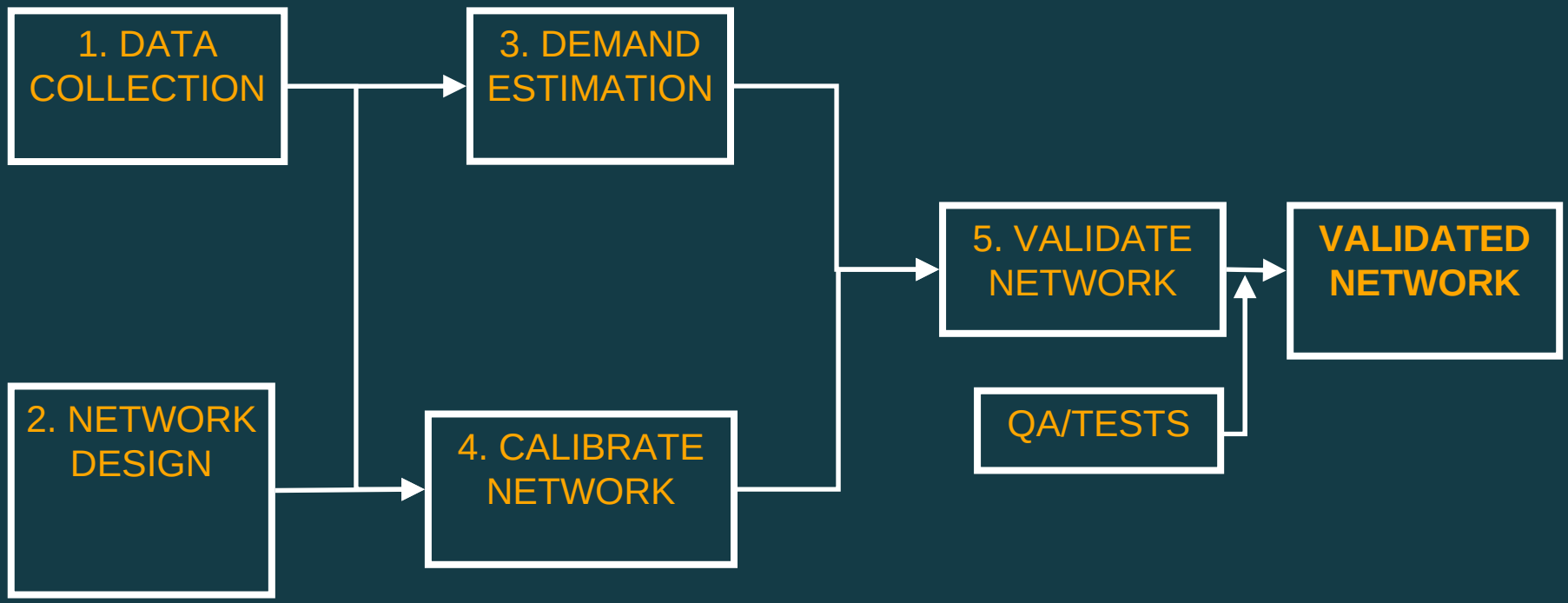
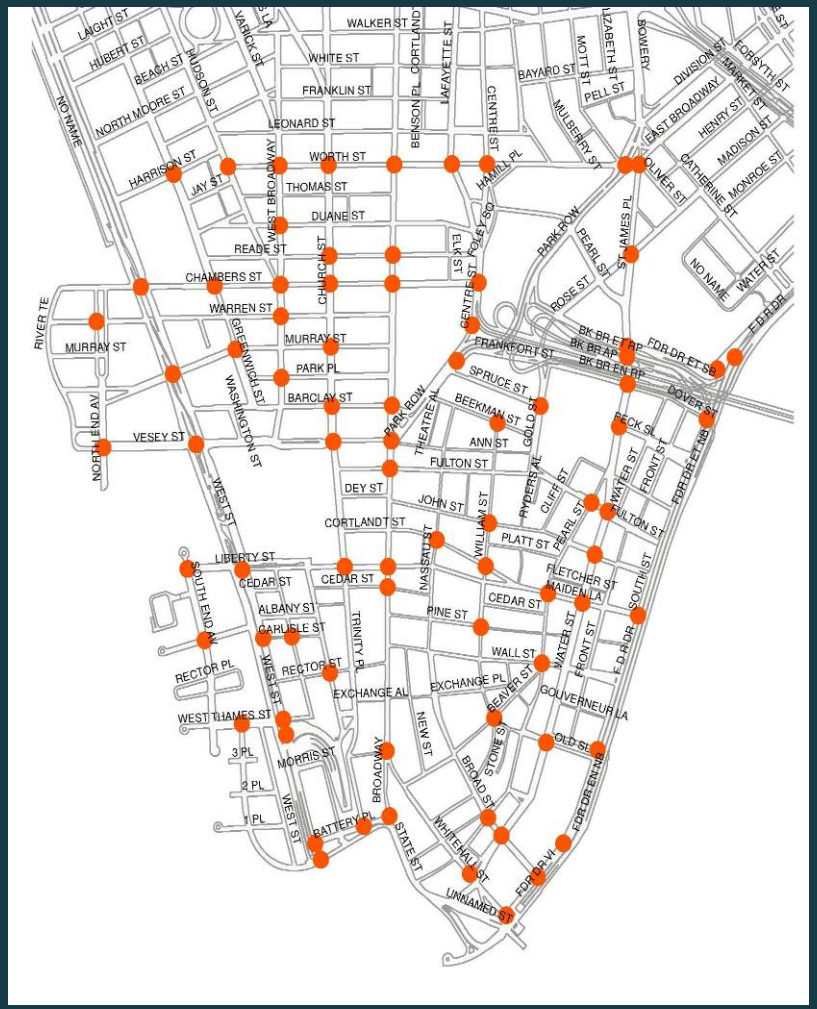
Model Development Process



1. Data Collection

- Surveys
  - Vehicle and pedestrian counts
  - Parking (on and off street)
  - Travel time
- Existing data sources
  - BPM
  - 2000 Census (JTW)
  - Brooklyn Bridge counts
- Network configuration
  - Aerial photography
  - Site visits/photos



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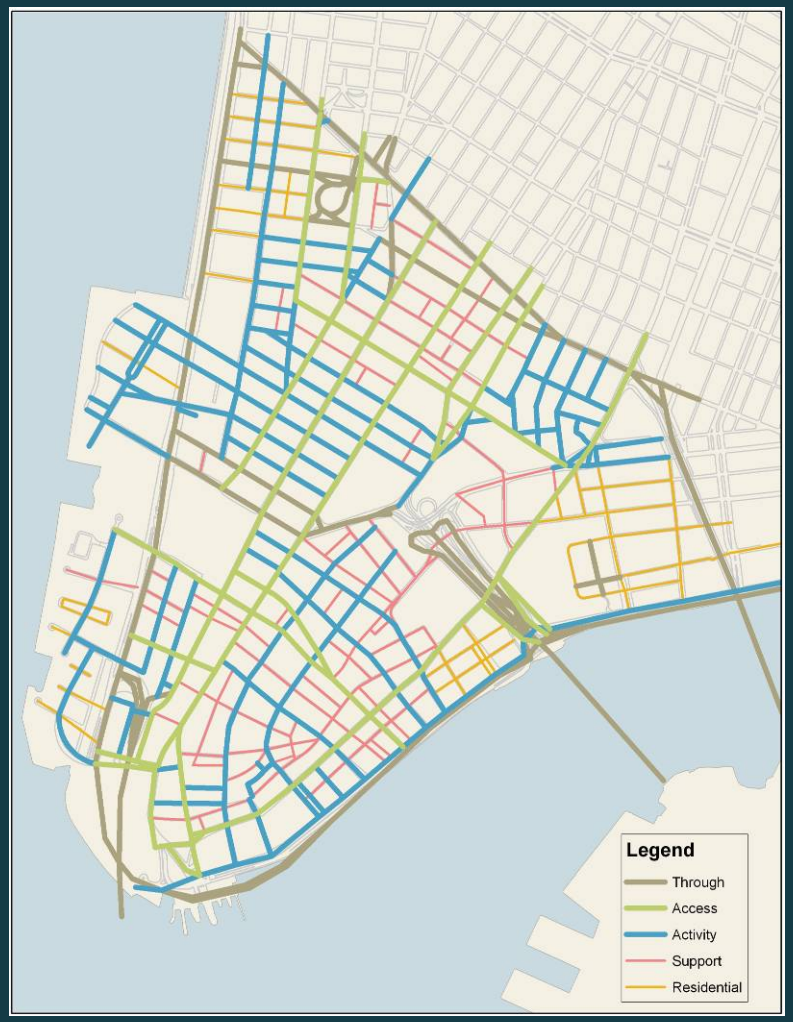
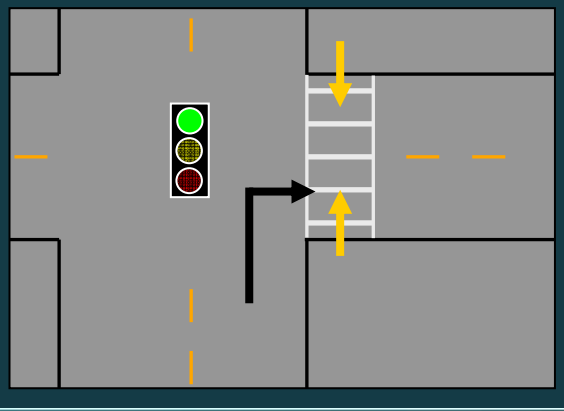
2. Network Design – Link Categories

- Systematic and functional approach to categorization
- Guided by LM Street Management Framework
- Informed major/minor designation, speed, widths and cost factors



2. Network Design – Pedestrians

- Vehicle-pedestrian conflict
  - Based on HCM methodology
  - Calculates amount of time pedestrians are in intersection
  - “Dummy” phasing simulates vehicle-ped conflict by reducing green time.
- Not applied to prohibited crossings or all pedestrian phases
- Turning movements at uncontrolled crossings were designated as minor to mimic stopping



3. Demand Estimation

- Pattern matrix based on regional model demands
- 159 Zones, > 25,000 possible O/D pairs
- 8 O-D matrices – separated by vehicle and trip type
- Hierarchical estimation process
  1. External cordons
  2. Off Street destinations
  3. On street parking
  4. Screenline traffic
  5. Turns
  6. Vehicle types

4. Calibration

- *Calibration* ensures that the model adequately reflects the observed traffic behavior, volume and travel times:
  - Physical network (stop lines, curbs, junctions)
  - Link costs
  - Assignment parameters
  - Visual calibration based on site visits
    - Allowance for prohibited movements

- *Validation* is an independent check of the calibrated model to assess its accuracy and confirm that the model is fit for purpose

5. Validation

- Performance criteria adopted from US and International guidelines
  - GEH – applied to link and turn flows
  - R squared – applied to link and turn flows
  - Percent Difference – applied to screenline and travel time
- Four criteria:
  - Screenlines
  - Individual Link Flows
  - Turning Movements
  - Travel Times

$$GEH = \sqrt{\frac{2(M-C)^2}{M+C}}$$

where

M = modeled volume

C = observed volume

5. Validation

Criteria	Targets	Comments
Screenline Flows		
Percentage difference	5 - 10%	Outliers may be accepted depending on confidence of counts and other validation criteria.
Individual link flows		
R2	0.85 – 0.95	Correlation between measured and modeled flows should tend toward 0.9.
GEH<5	75% - 80% of counts	Small difference between modeled and observed links.
GEH<10	95% of counts	No significant outliers, unless justification provided.
Turn Flows		
R2	0.85 – 0.95	Correlation of all measured to modeled turn flows should tend toward 0.85.
GEH<5	65% - 75% of counts	Small difference between modeled and observed for most turns
GEH<10	90% of counts	A small number of significant outliers allowed that are shown not to significantly impact on the model's operation.
Travel time		
Mean difference <15%	85% of routes	Difficult to achieve due to the small sample of observed travel time information along each route.
Average modeled travel time within range of observed times	95% of routes	Difficult to achieve given small sample.

Results

Criteria	Targets	Achieved AM	Achieved PM	Comments
Screenline Flows				
Percent difference	5 – 10%	**All <6%**	**All <7%**	Acceptable
Individual Link Flows				
R2	0.85 – 0.95	**0.99**	**0.99**	Acceptable
GEH<5	75% - 80% of counts	**74%**	**84%**	Acceptable – AM slightly low
GEH<10	95% of counts	**96%**	**98%**	Acceptable
Turn Flows				
R2	0.85 – 0.95	**0.95**	**0.98**	Acceptable
GEH<5	65% - 75% of counts	**63%**	**70%**	Acceptable – AM slightly low
GEH<10	90% of counts	**91%**	**94%**	Acceptable
Travel Time				
Mean difference <15%	85% of routes	**50%**	**11%**	Doesn't achieve targets
Average modeled travel time within range of observed times	95% of routes	**22%**	**6%**	Doesn't achieve targets

Lessons Learned

- Client collaboration is essential
- Data collection is important
- Few urban microsimulation standards and guidelines
- Travel times are variable requiring careful attention

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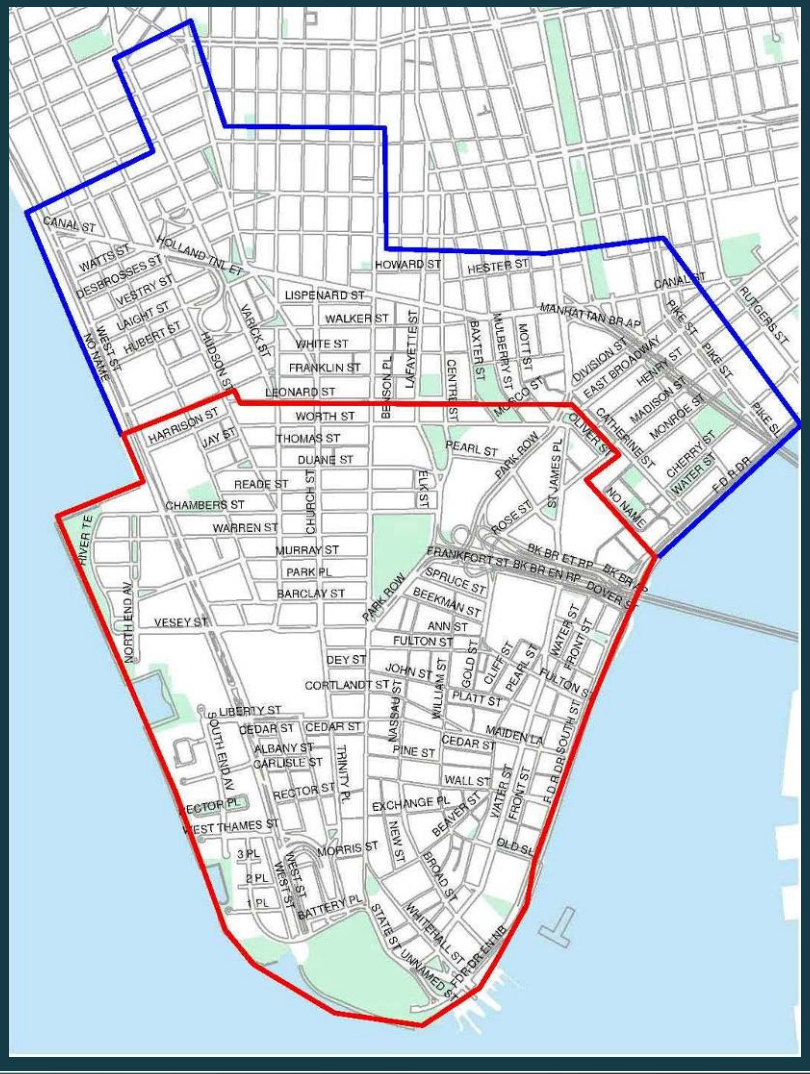
Current Work

- Model expansion
- Agent-based pedestrian simulation
- Additional data collection
- Seamless linkage to regional model



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