

Temporal and Spatial Freeway Work Zone Delay Estimation Using Probe-vehicle Data

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Outline

- Background
- Model Development
- Case Study
- Conclusions
- Future Enhancements



Background

- Accurate and reliable estimates of traffic impacts associated with work zone lane closures
- Issues in traditional volume/capacity formulae and deterministic traffic queuing method
- Integration of probe-vehicle data into the traffic impact analysis model
- Development of **W**ork zone **I**nteractive **M**anagement **A**Pplication-**P**lanning (**WIMAP-P**) model and software

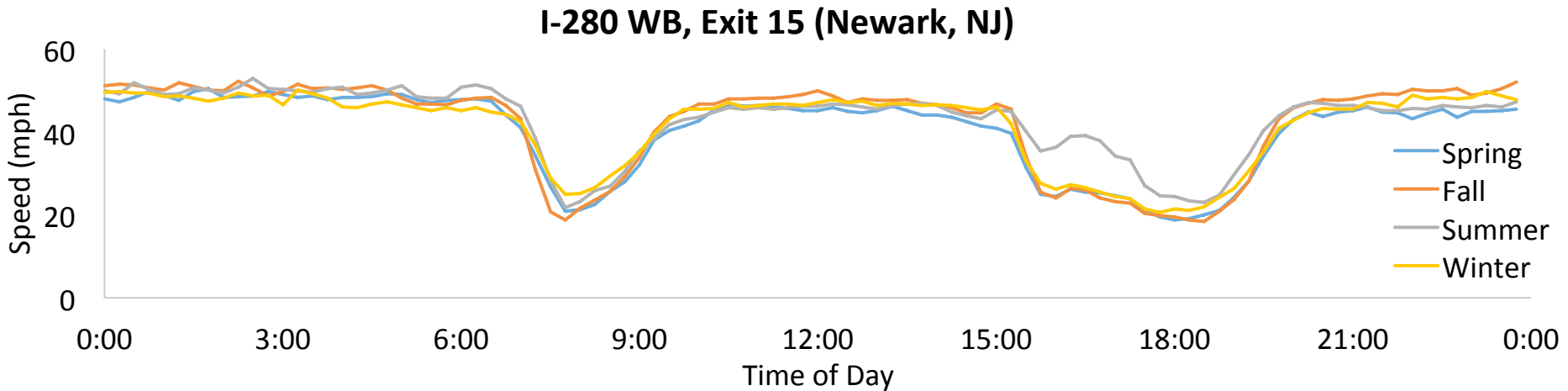
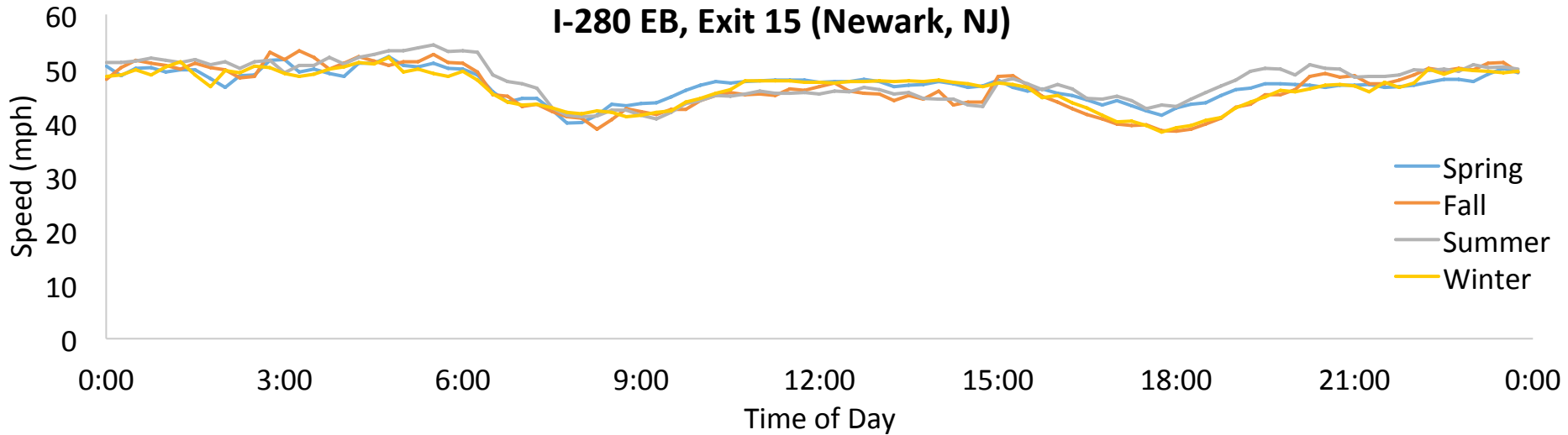


Work Zone Delay Estimation Approaches

Approaches	Detailed Information	Selected References
Parametric Approach	Deterministic queuing theory	Abraham et al. (1981); Dudek and Richards (1982); Chien and Schonfeld (2001)
	Shockwave theory	Lighthill and Whitham (1955); Richards (1956); Wirasinghe (1978)
Non-parametric Approach	ANN (Artificial Neural Network)	Karim Adeli (2003); Jiang and Adeli (2003); Ghosh-Dastidar and Adeli (2006)
Simulation Approach	VISSIM, CORSIM	Chien et al. (2002); Chitturi et al. (2004); Edara et al. (2013)



Seasonal Average Speeds (I-280, Exit 15)

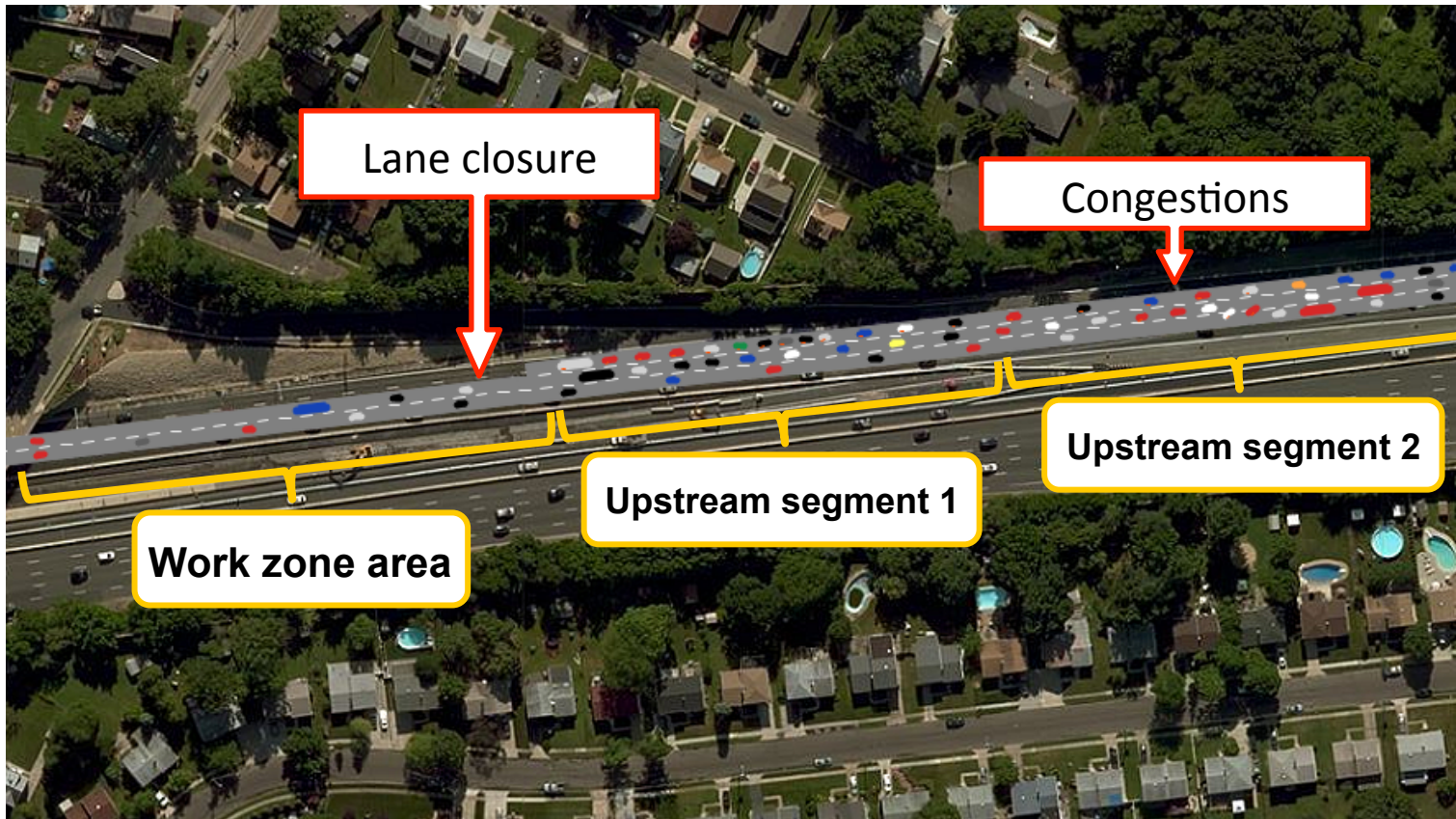


(Speed data source: INRIX)

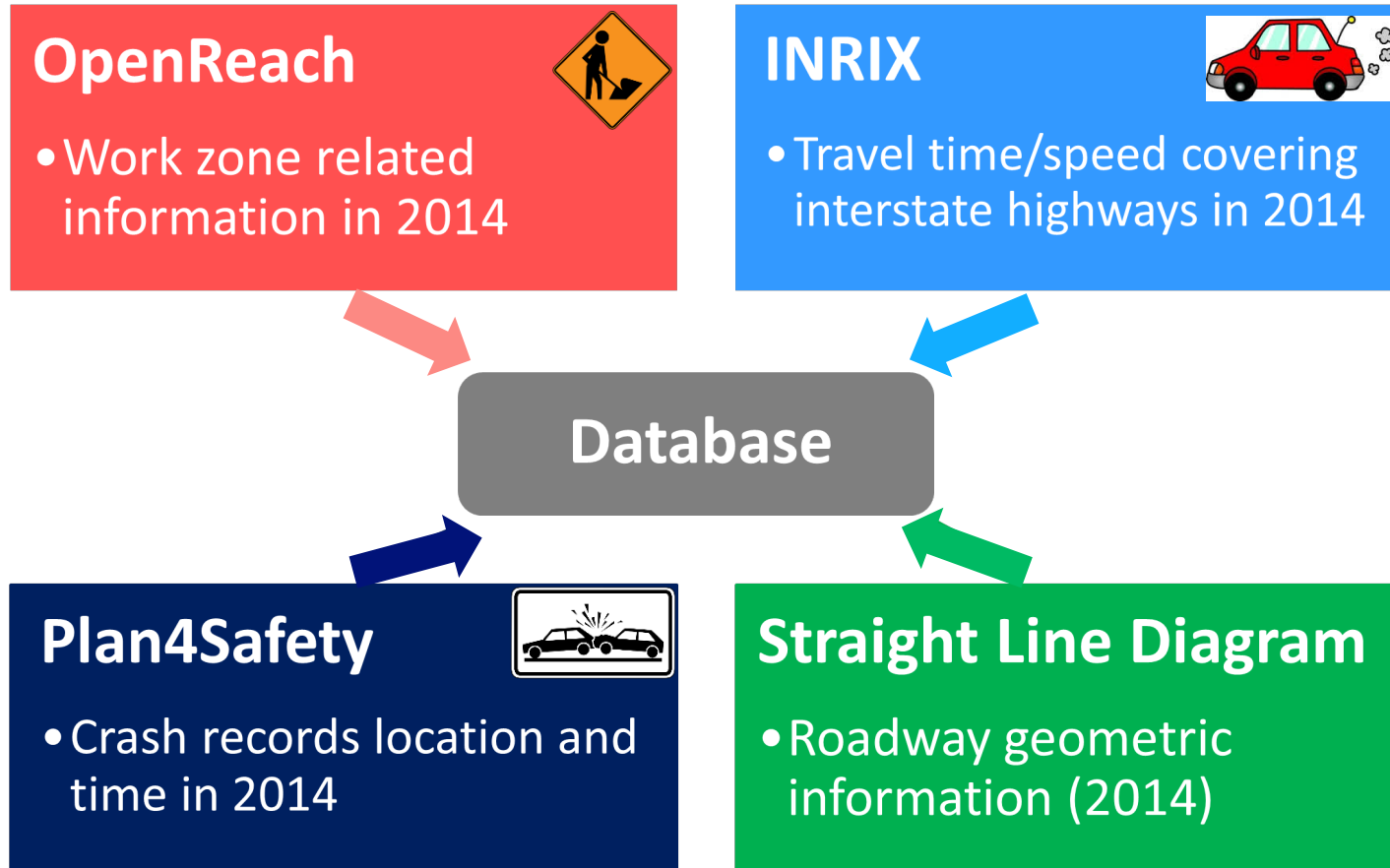


Artificial Neural Network (ANN)

- Analyze transportation data and recognize patterns
- Classify transportation data with proper boundaries



Data Collection



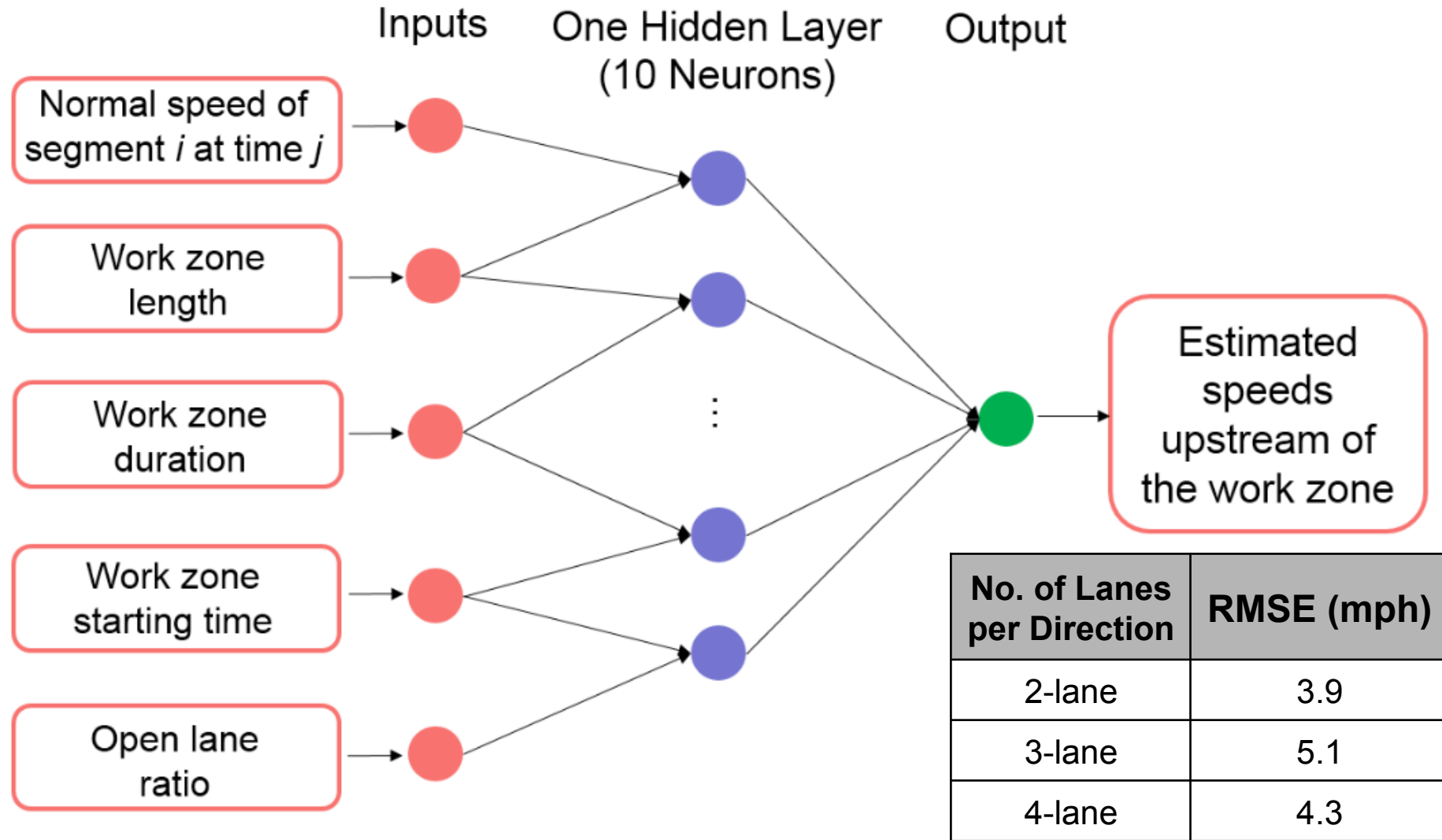
Data Collection (cont'd)

- Qualified historical work zones on New Jersey Interstate Highways in 2014 for model development

		Types of Lane Closures		
		Shoulder Closure	1-lane Closure	2-lane Closure
No. of Lanes per Direction	2	10	177	31
	3	35	108	32
	4 and more	7	20	10



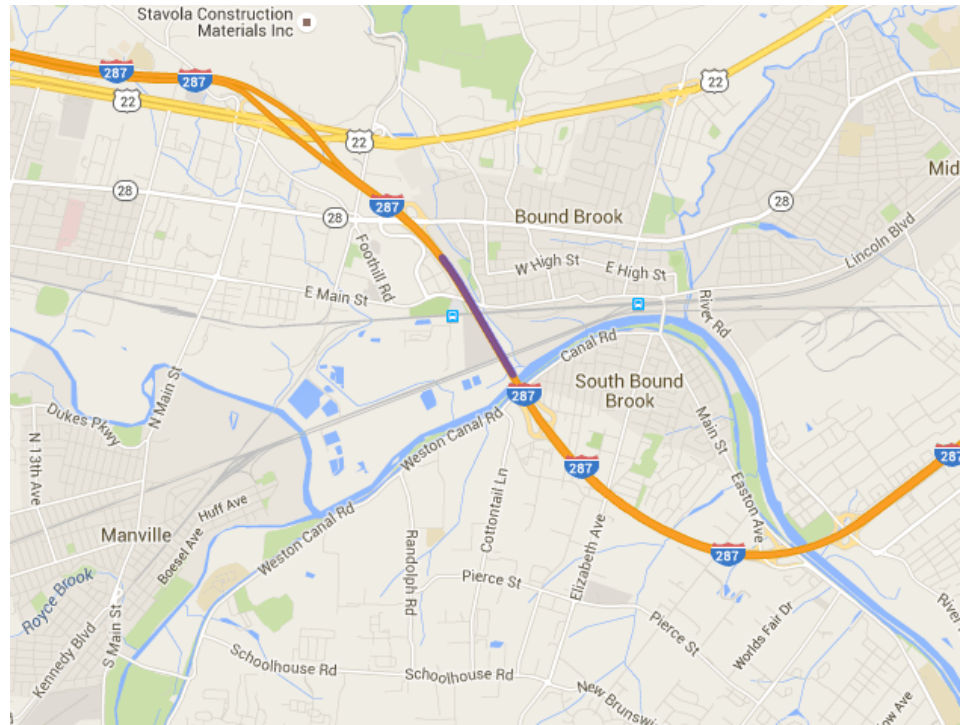
Configuration of WIMAP-P ANN Model



No. of Lanes per Direction	RMSE (mph)
2-lane	3.9
3-lane	5.1
4-lane	4.3

Case Study

- Work zone location: I-287 Northbound MP 12.5 ~ 13.1
- Total number of lanes: 3
- Number of closed lanes: 1
- Date/time:
June 19, 2014
from 10:30 am to 1:30 pm



Freeway Work Zone Planning

Parameter Inputs:

Route Name:

Start & End Milepost Range: to

Starting Milepost:

Ending Milepost:

Direction:

Number of Total Lanes:

Number of Closed Lanes:

Expected Start Date:

Expected Start Time:

Expected End Date:

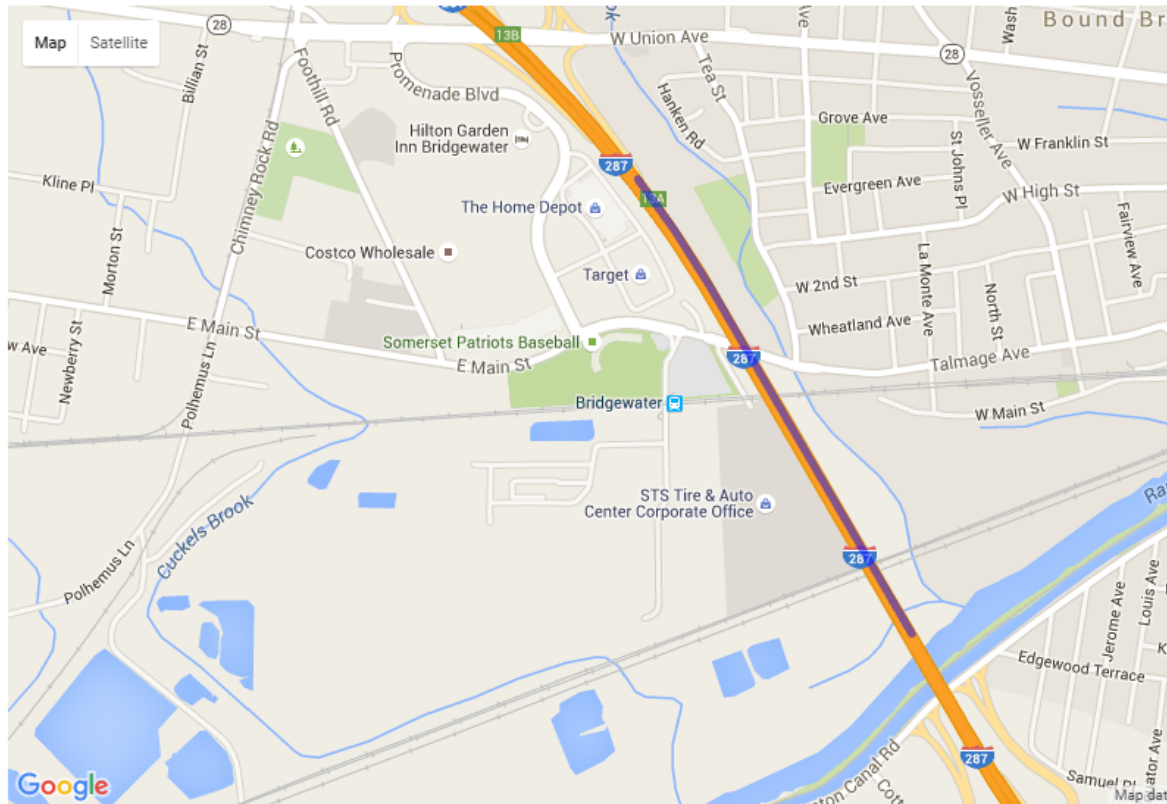
Expected End Time:

Value of Passenger Car Time (\$/veh-hr):

Value of Truck Time (\$/veh-hr):

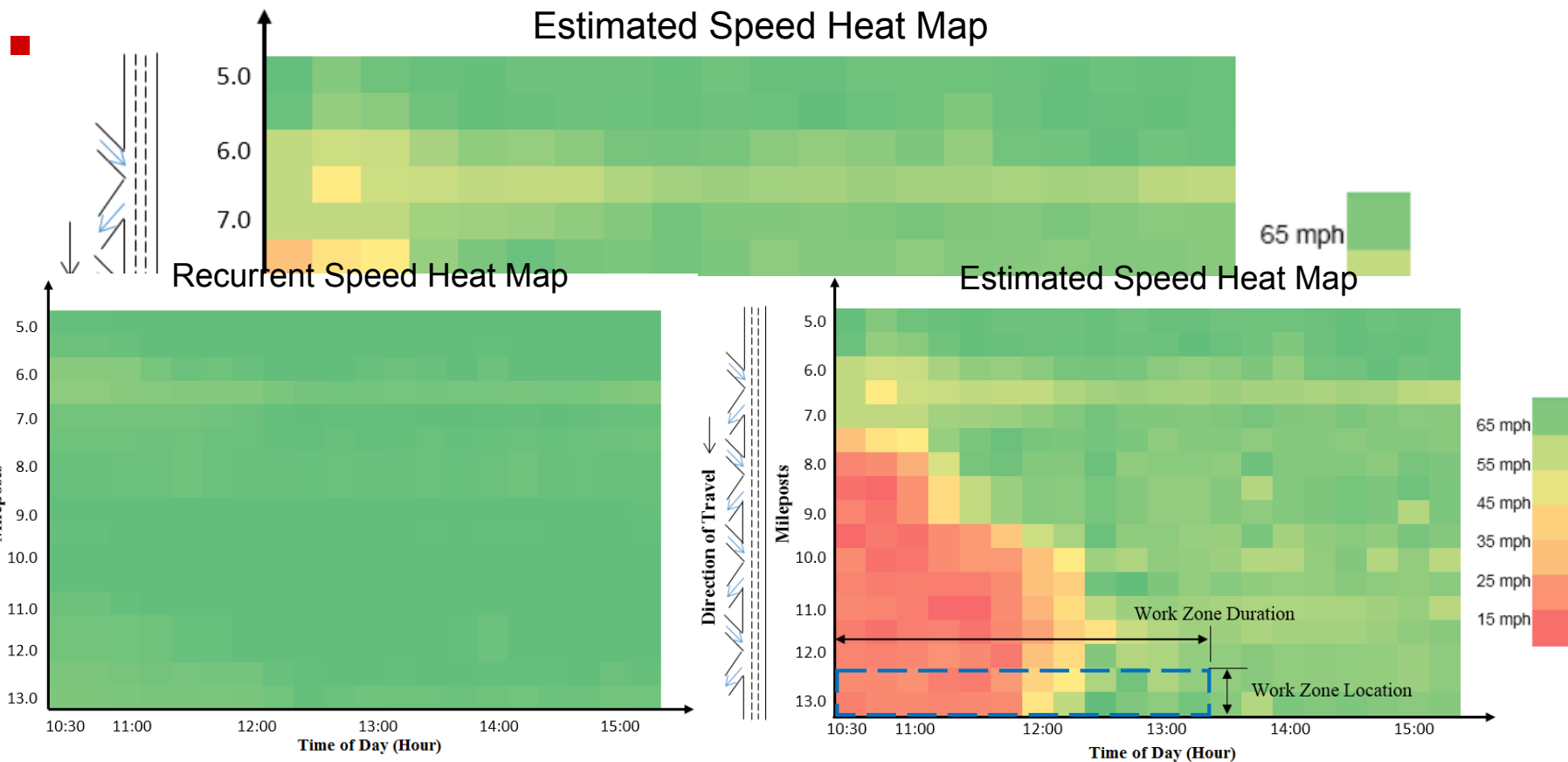
[Show Result](#)

[Show Report](#)



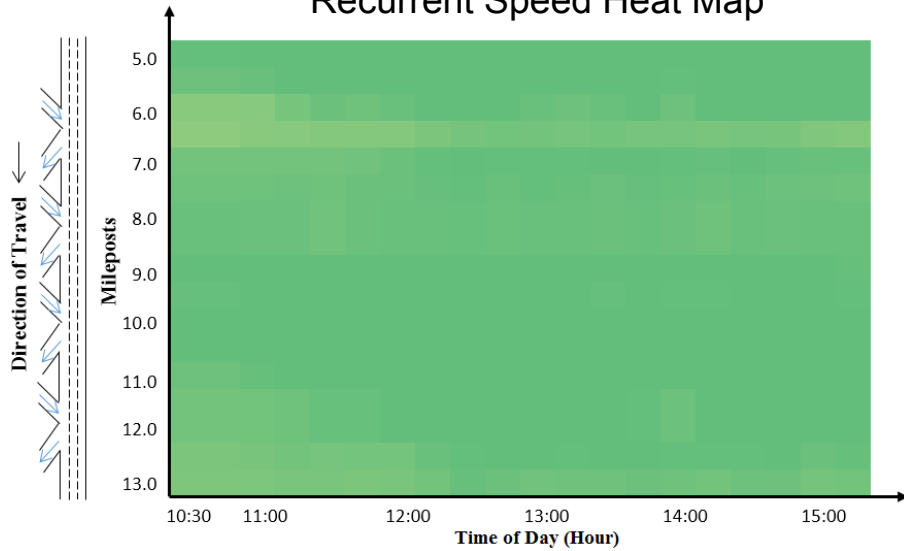
Case Study

- Determine and display the spatial and temporal speeds of an expected lane closure activity;

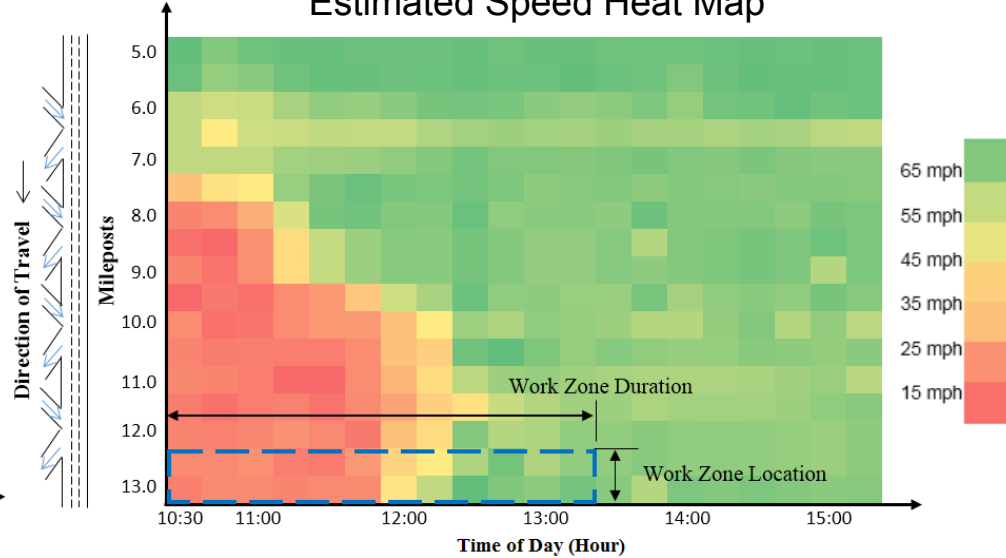


Case Study

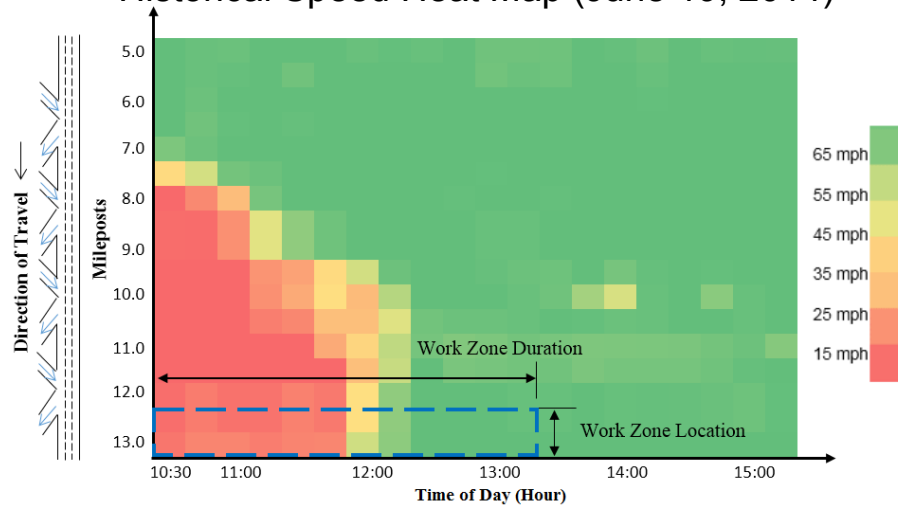
Recurrent Speed Heat Map



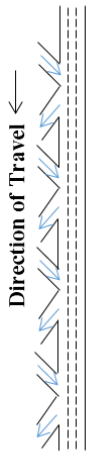
Estimated Speed Heat Map



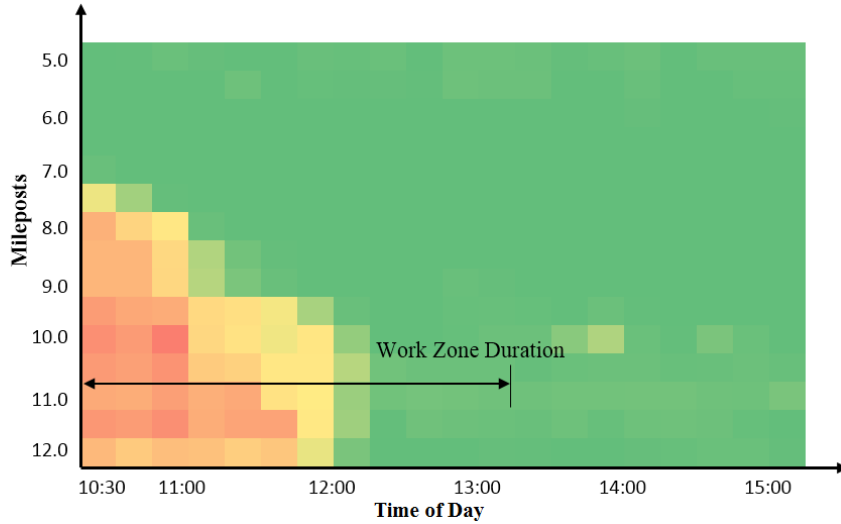
Historical Speed Heat Map (June 19, 2014)



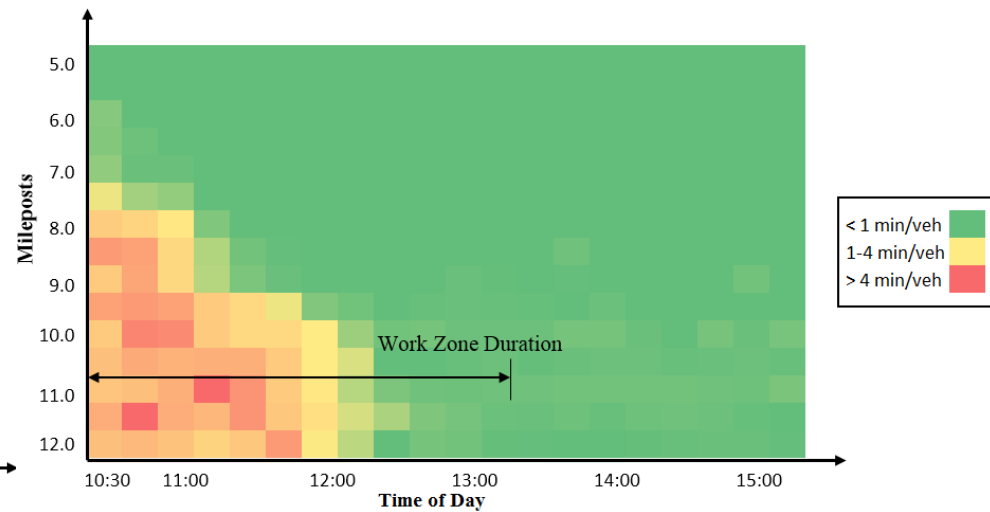
Case Study



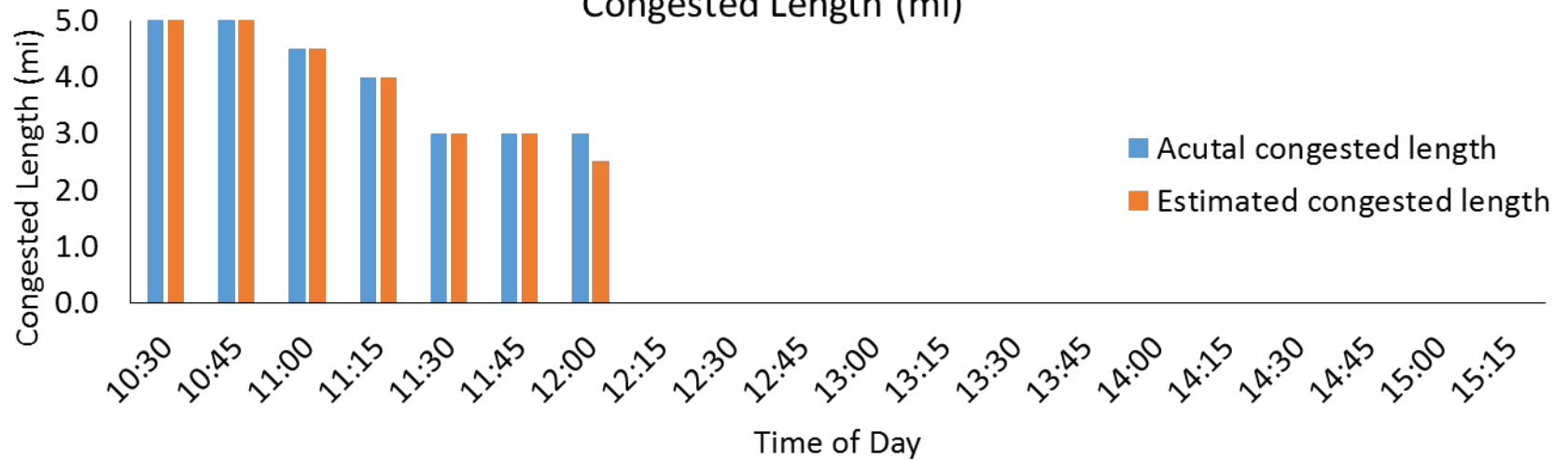
Historical Average Upstream Delay (min/veh)



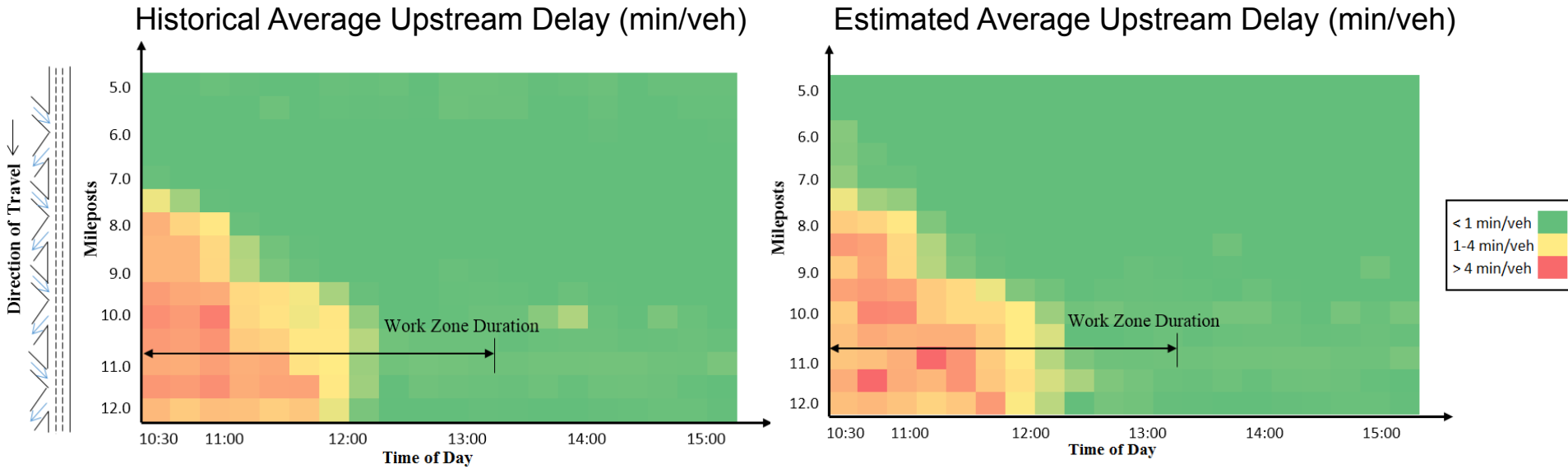
Estimated Average Upstream Delay (min/veh)



Congested Length (mi)



Case Study



- If the volume counts at the work zone are available, we can also estimate:
 - Vehicle emission cost
 - Road user cost

Conclusions

- The WIMAP-P ANN model developed utilizing probe-vehicle speed data to estimate the upstream speeds and delay under planned work zone lane closure conditions
- The main data used are: OpenReach, INRIX, Plan4Safety, and SLD
- In addition, the model can assist transportation engineers
 - To evaluate congestion impacts by planned work zones
 - To develop traffic management plans mitigating congestion
 - To facilitate work zone sketch planning and scheduling
 - To determine lane rental charges



Future Enhancements

- Incorporate traffic flow data where available
- Develop an innovative Big Data management framework to cover wide range of data sources
- Estimate emission and road user costs
- Develop a corridor-based model



Q&A

