

# USING PeMS DATA TO EMPIRICALLY DIAGNOSE FREEWAY BOTTLENECK LOCATIONS IN ORANGE COUNTY, CALIFORNIA



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# Objectives

- Identify Freeflow  $\Leftrightarrow$  Congested Conditions
- Determine Bottleneck Locations
- Measure Queue Discharge Features
- Conclusions

# Background

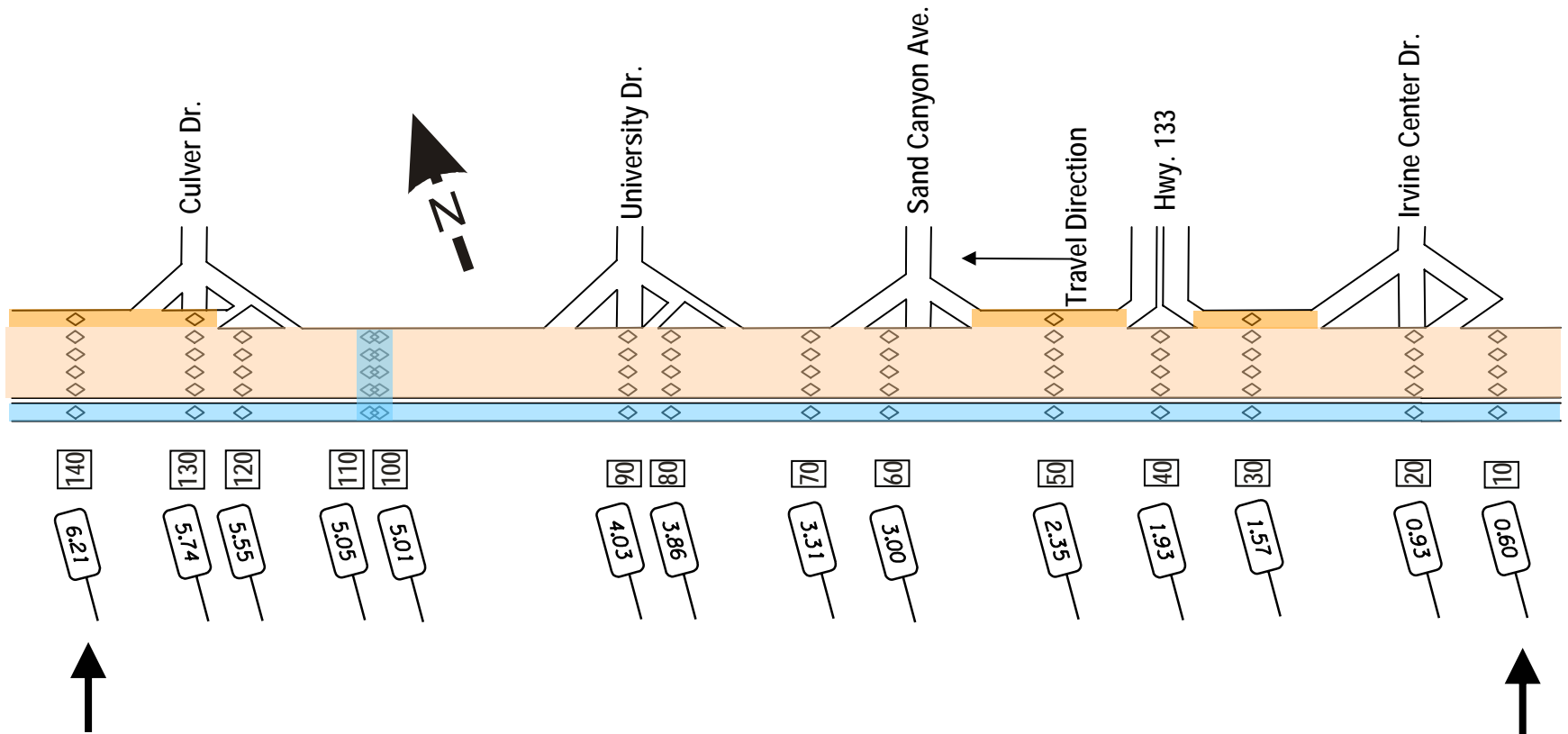
- Foundation for Understanding Freeway Operations
- Queues Cause Delays
- Loop Detectors Good Data Source
- Previous Studies
  - Throughput Increase 2-5% Prior To Queue
  - Diverge Bottleneck Identified
- PeMS Provides Opportunity for Detailed Data Analysis

# Site Map

- Four Northbound Lanes
- One Northbound HOV Lane
- Freeway Ramps Between Stations, Except 100/110

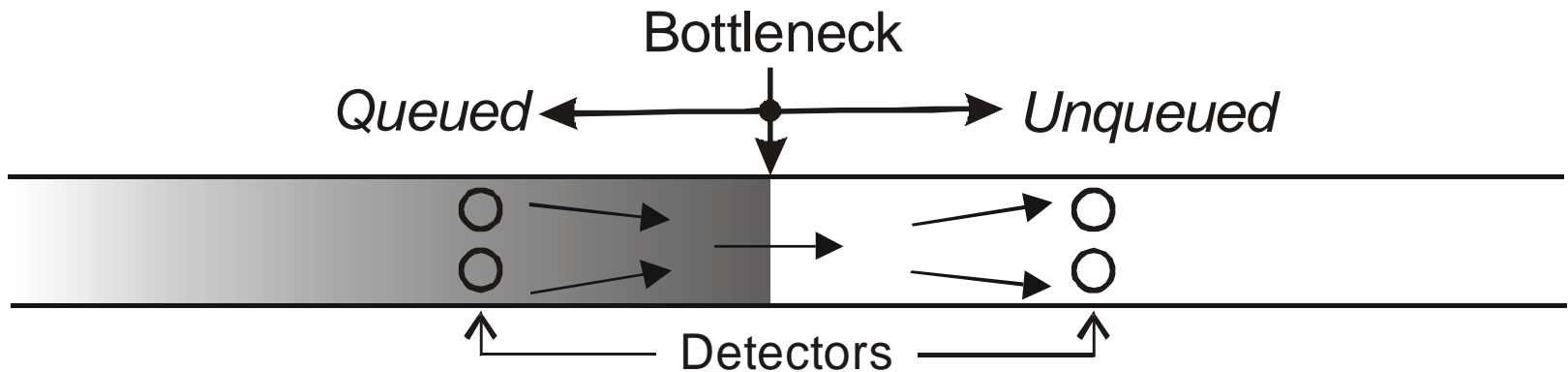
## LEGEND

- ◇ Loop Detector
- 110 Station Number
- 5.05 Post-mile



# Bottleneck Definition

- Queue upstream
- Freely-flowing traffic downstream
- Temporally and spatially variable

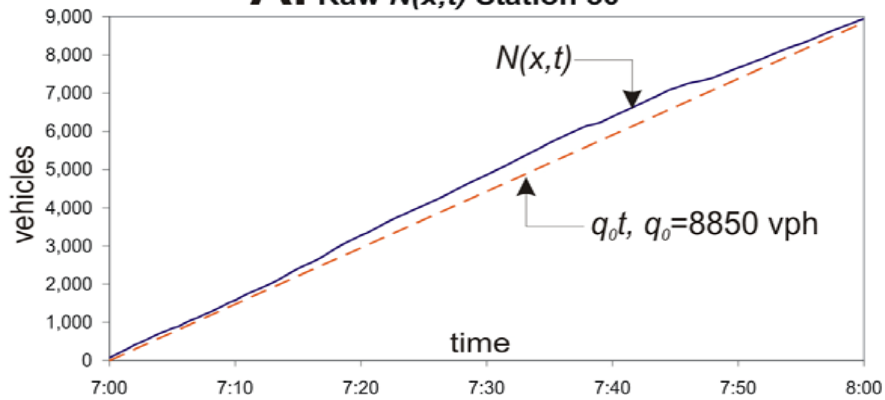
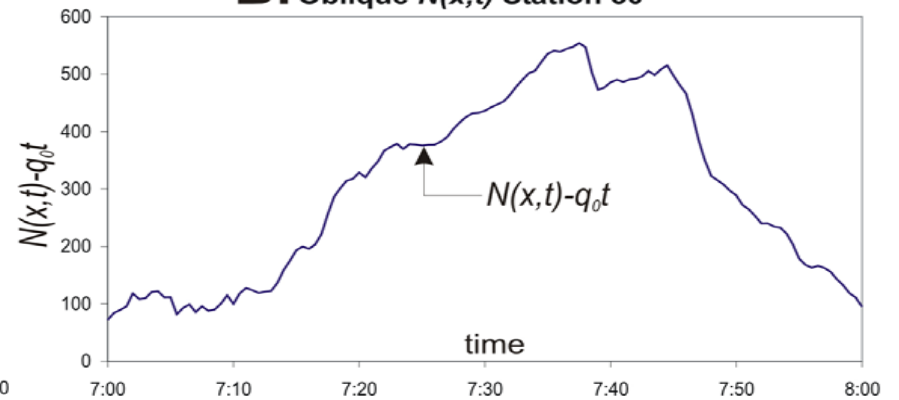
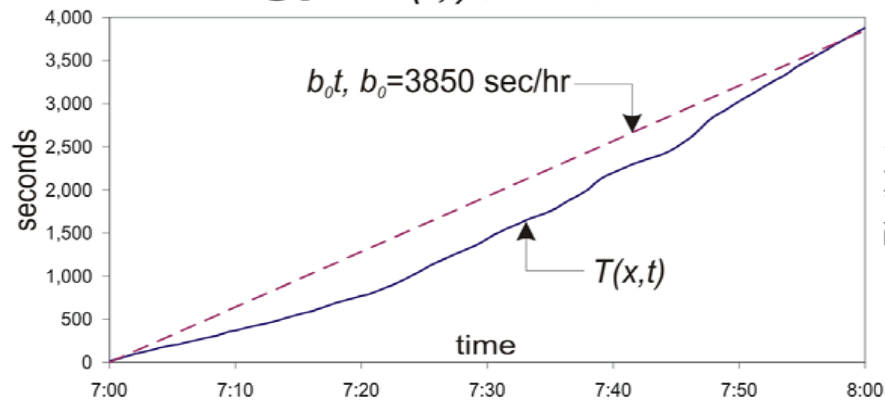
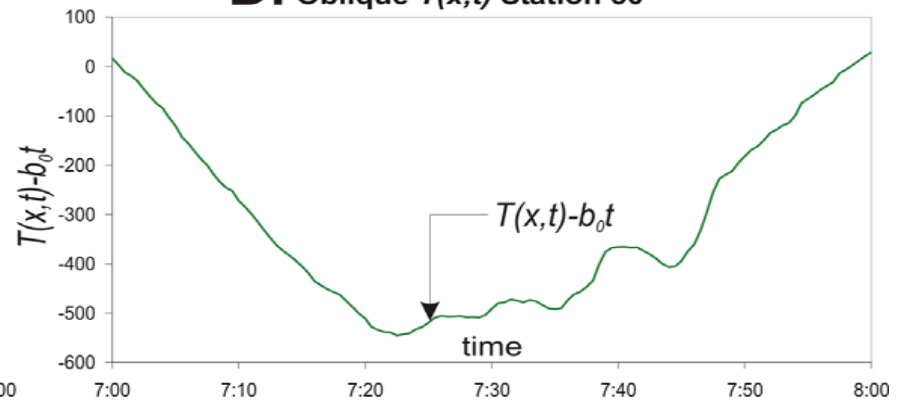
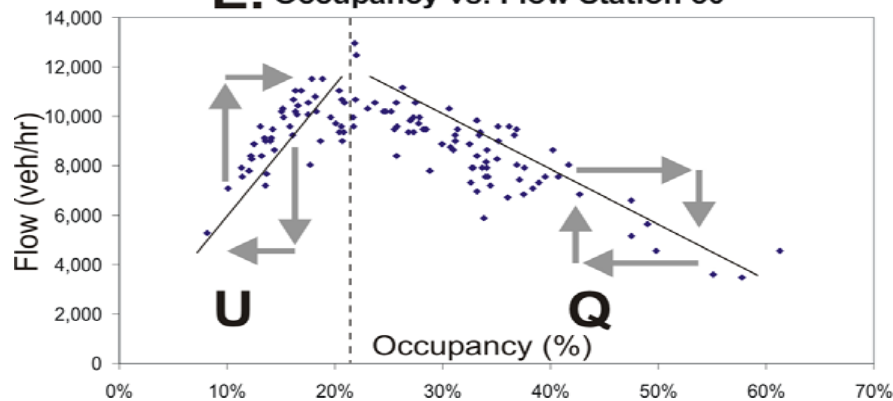


# Data

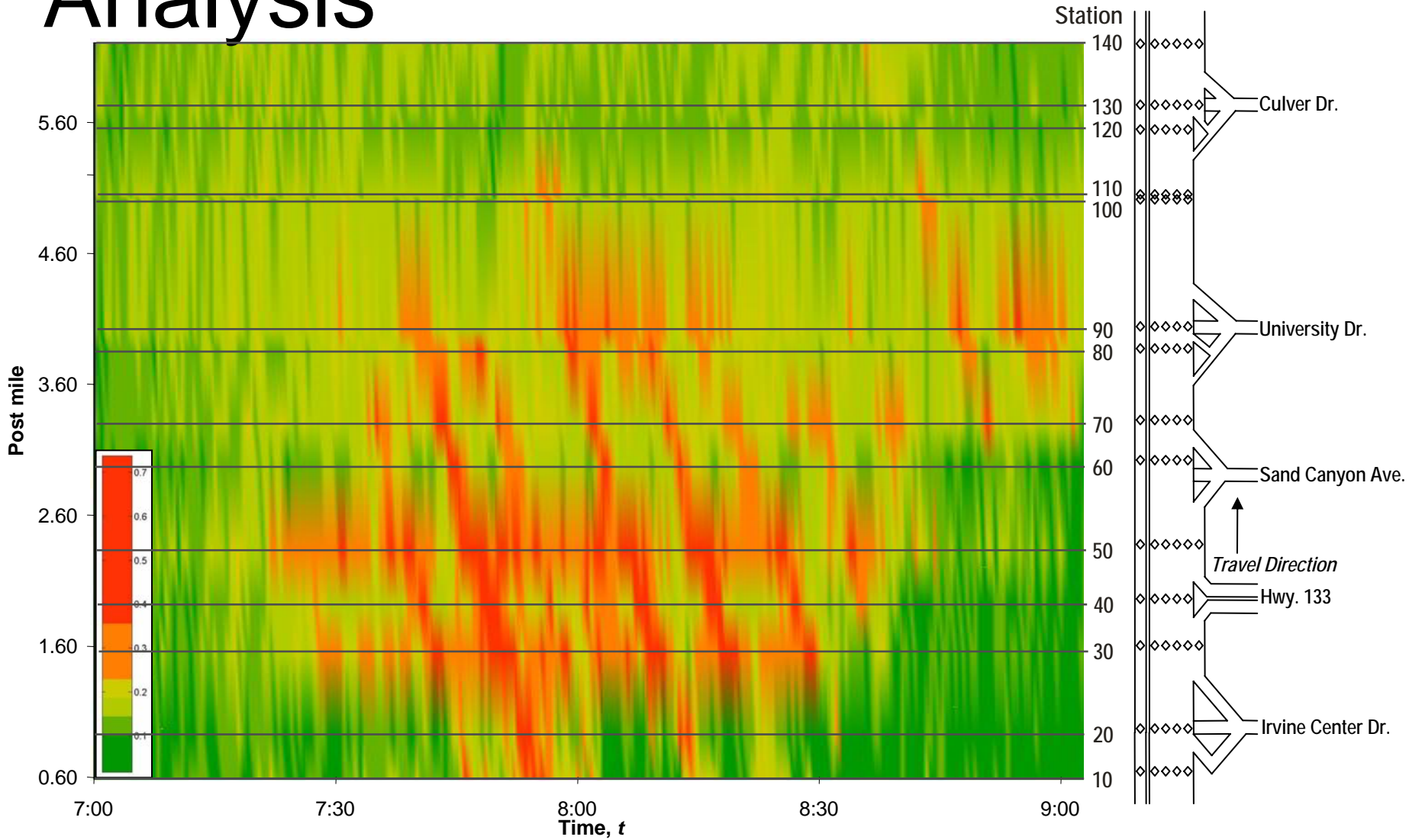
- Freeway Performance Monitoring System (PeMS)
  - <http://pems.eecs.berkeley.edu/Public>
- Single Inductive Loops
- Vehicle Occupancy and Count
- Data Aggregated in 30-sec. Intervals
- On-Ramp/Off-Ramp Data Not Available
- Monday June 1, 1998

# Methodology

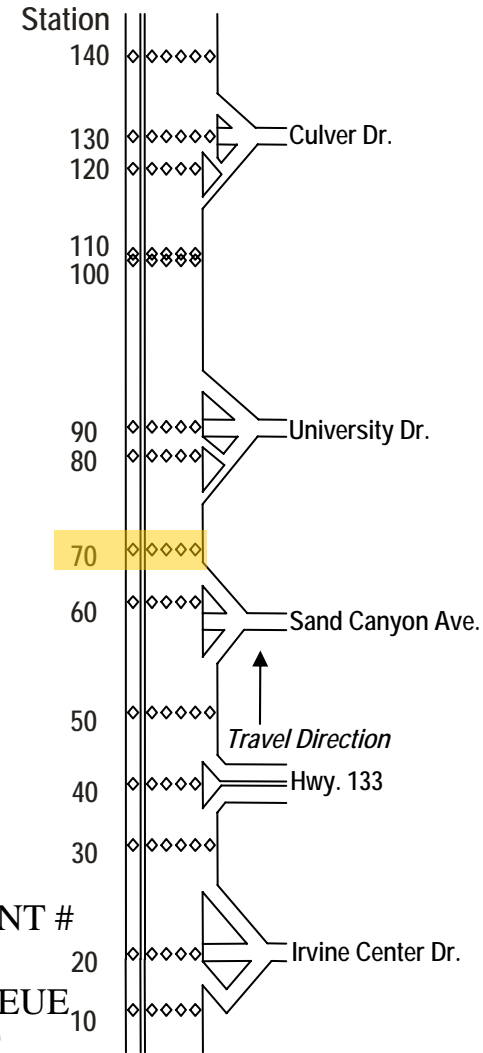
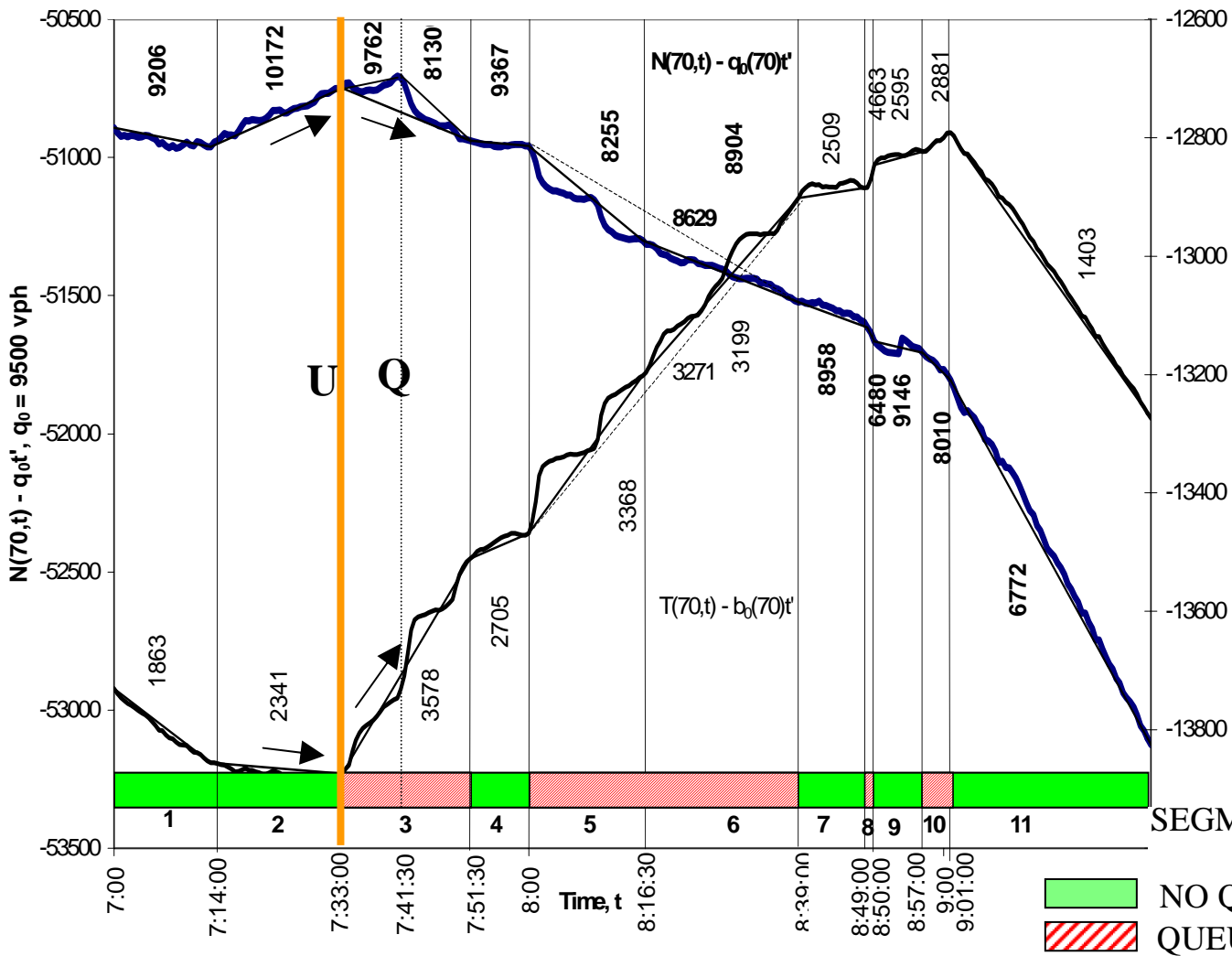
- Cumulative Curves – Vehicle Count & Occupancy
- Oblique Plots N and T

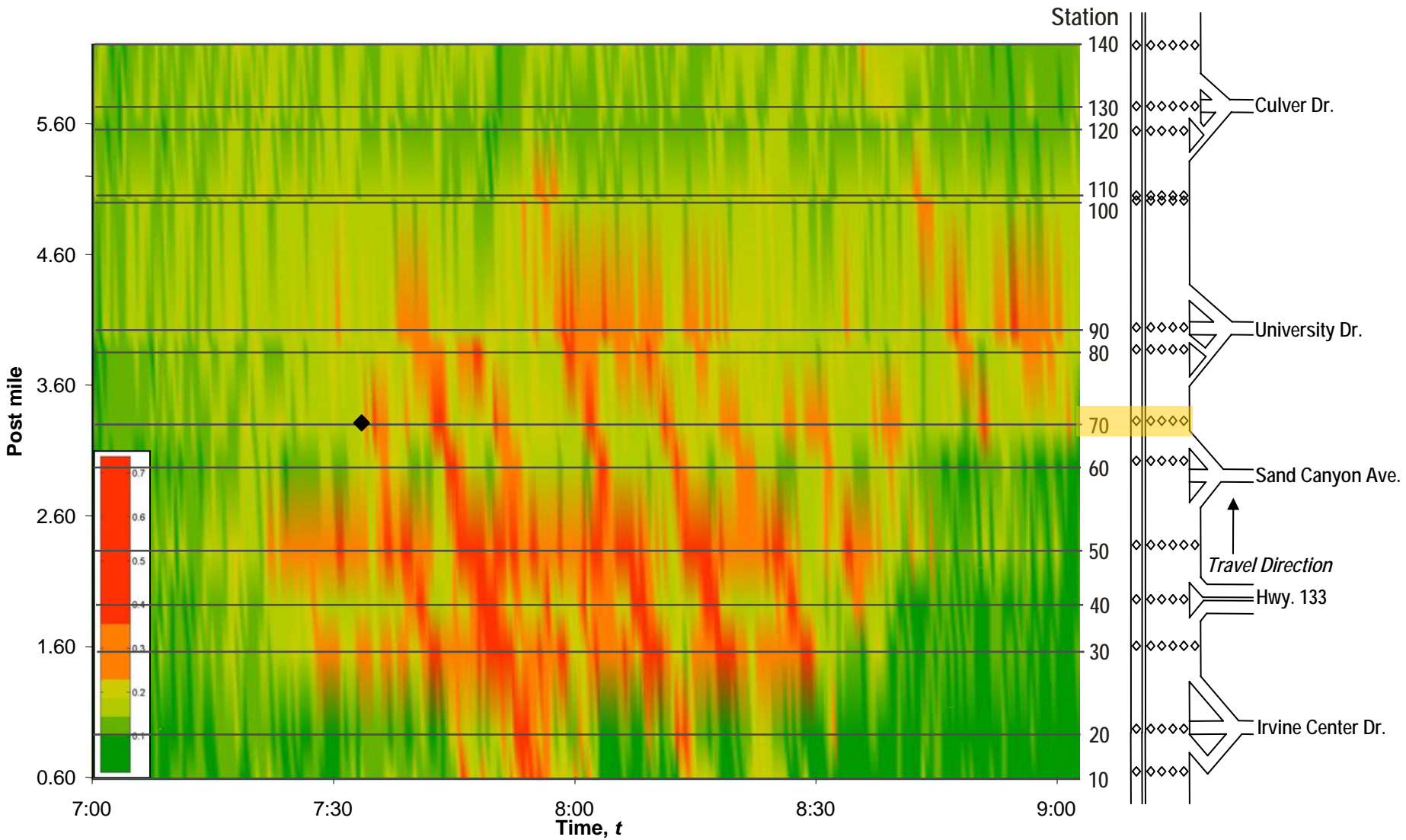
**A. Raw  $N(x,t)$  Station 50****B. Oblique  $N(x,t)$  Station 50****C. Raw  $T(x,t)$  Station 50****D. Oblique  $T(x,t)$  Station 50****E. Occupancy vs. Flow Station 50**

# Analysis

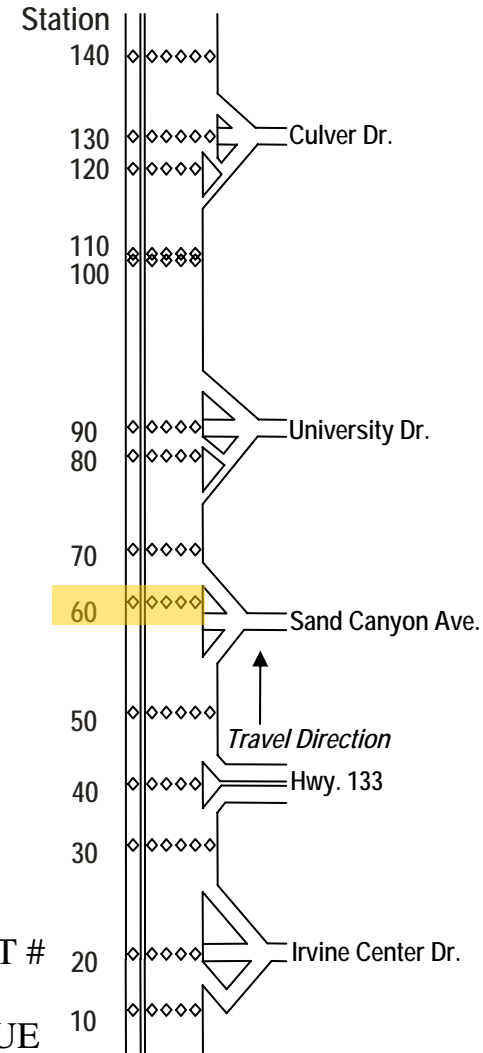
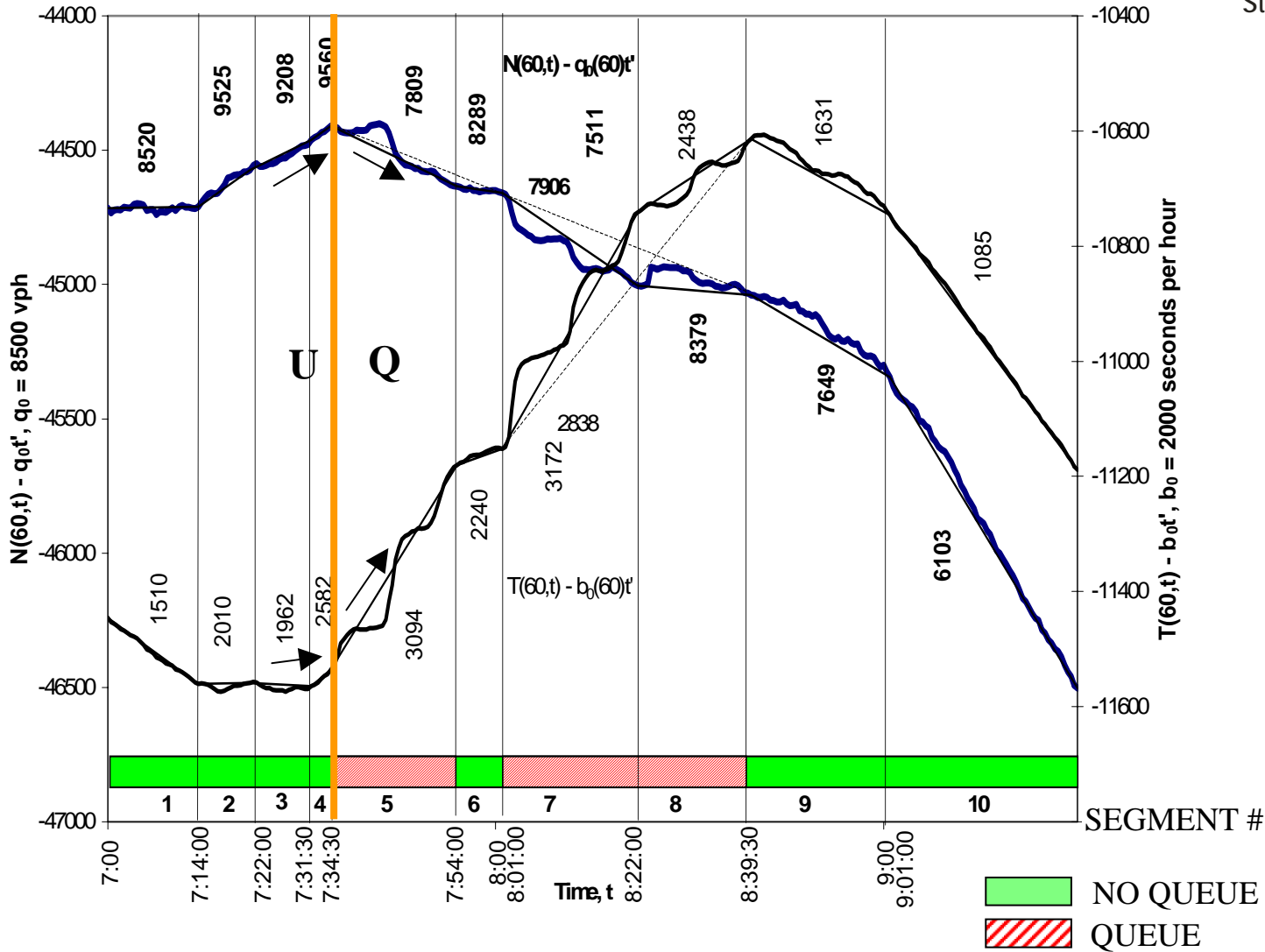


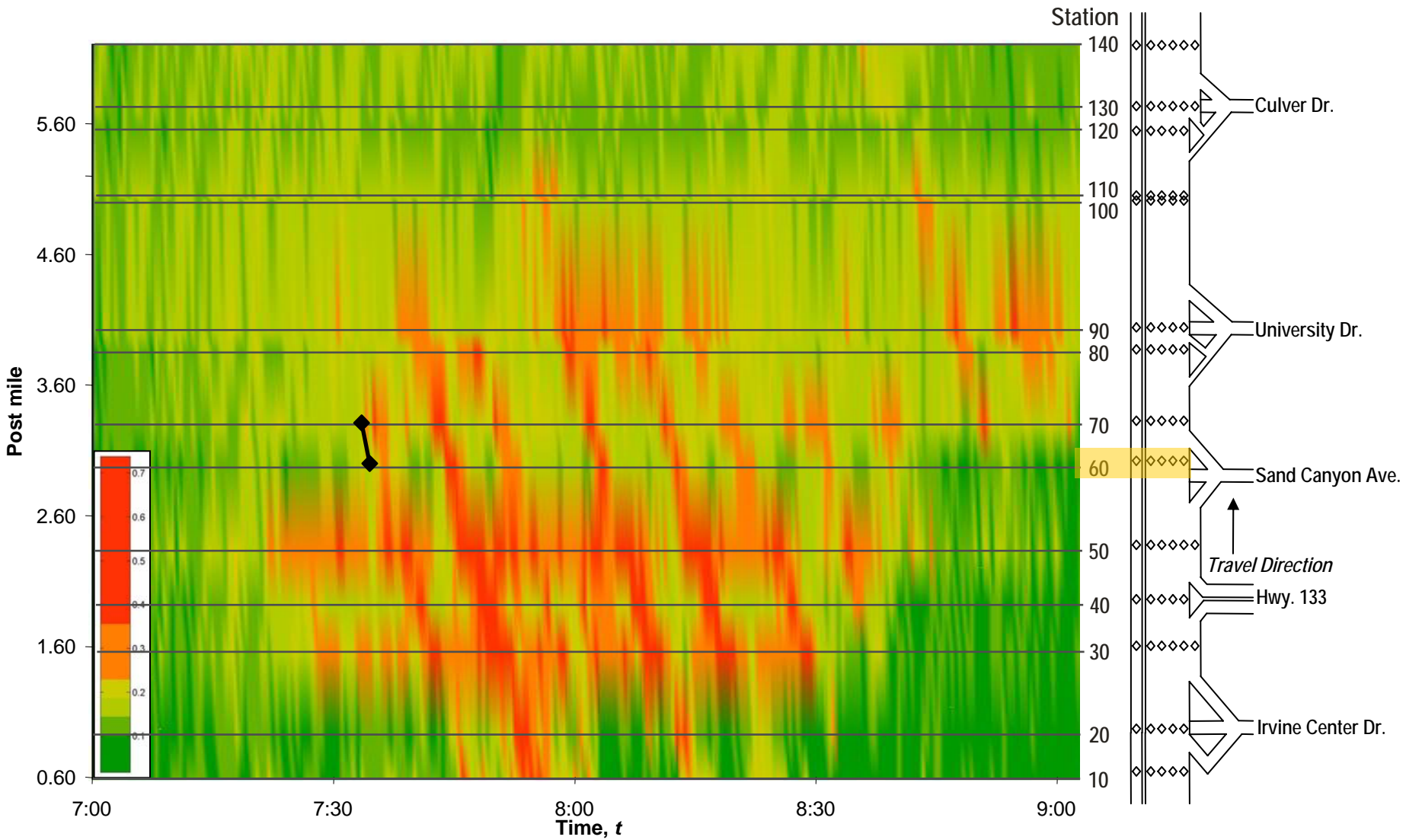
# Station 70 – Loops 1-4 Oblique N and T

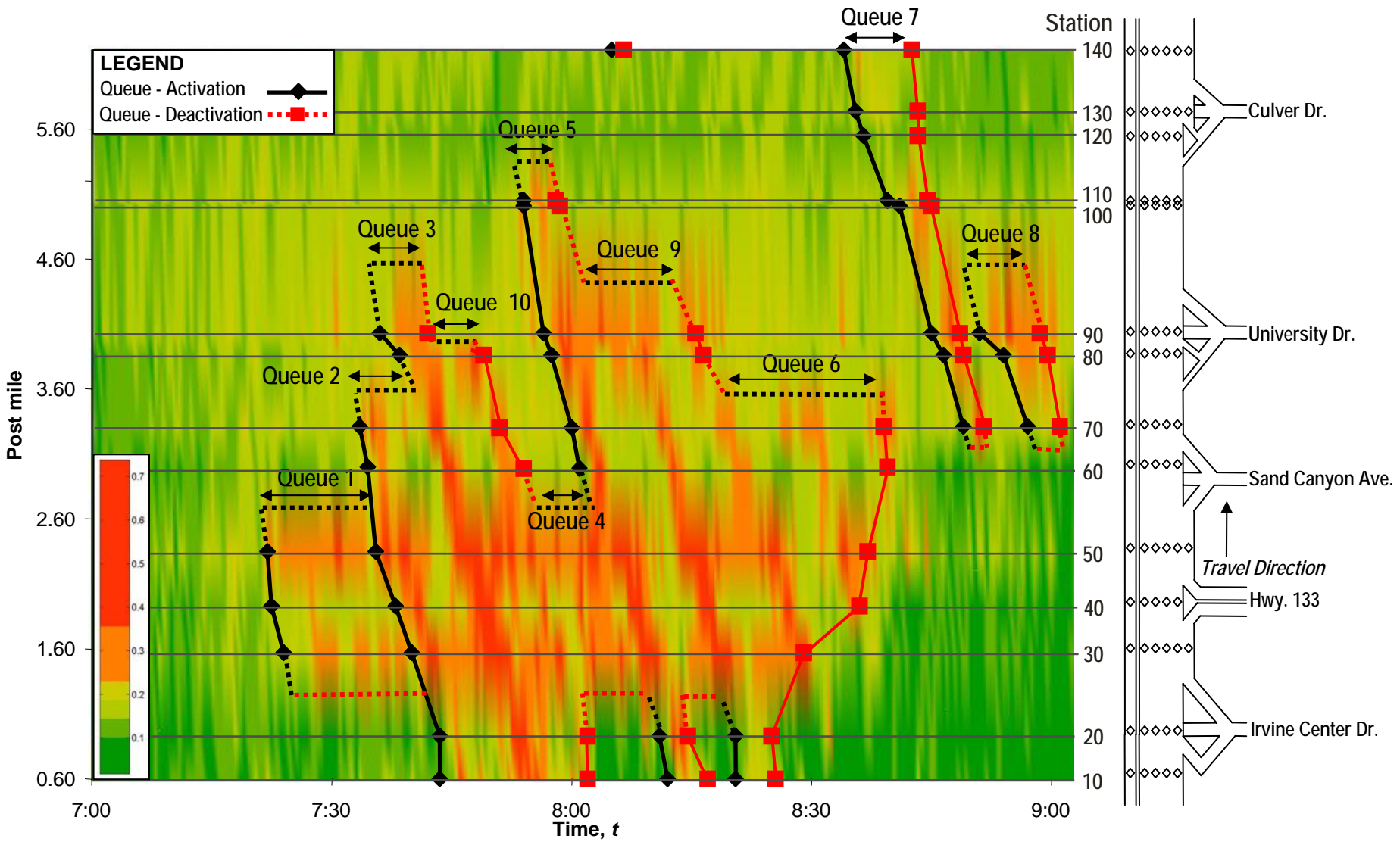




# Station 60 – Loops 1-4, Oblique N and T







# Results

Queue	Input Station	Outflow Station	Pre-Queue Flow		Bottleneck Flow		Difference (%)
			Flow vph	Duration mm:ss	Flow vph	Duration mm:ss	
1	50	'	10500	9:00	9600	13:30	8.2
		60	' 9500	8:00	9200	9:00	3.3

# Results

Queue	Input Station	Outflow Station	Pre-Queue Flow		Bottleneck Flow		Difference (%)
			Flow vph	Duration mm:ss	Flow vph	Duration mm:ss	
1	50		10500	9:00	9600	13:30	8.2
		60	9500	8:00	9200	9:00	3.3
2	70		10200	19:00	9762	8:30	4.3
		80	9100	6:30	8800	5:00	3.7
3	90		9300	7:00	8700	6:00	6.8
		100	10200	27:00	9600	5:00	6.2
4	50				7400	7:00	
		60			8300	7:00	
5	110		10200	3:30	8700	4:00	14.6
		120	9200	2:30	8500	4:00	7.3
6	70				8900	22:30	
		80			8100	22:30	
7	140				10100	8:00	
8	90		7600	2:30	7300	7:30	4.5
		100	8300	2:00	8200	7:00	1.2
9	90				8200	12:30	
		100			9200	16:00	
10	80				8700	12:30	
		90			8100	7:30	

# Conclusions

- Ten Queues Formed at Five Locations
- Flow Reduction of 3-15%
- No Queue in HOV Lanes
- Bottlenecks Typically Activated Near Ramps
- No Speed Threshold Needed

# Future Research

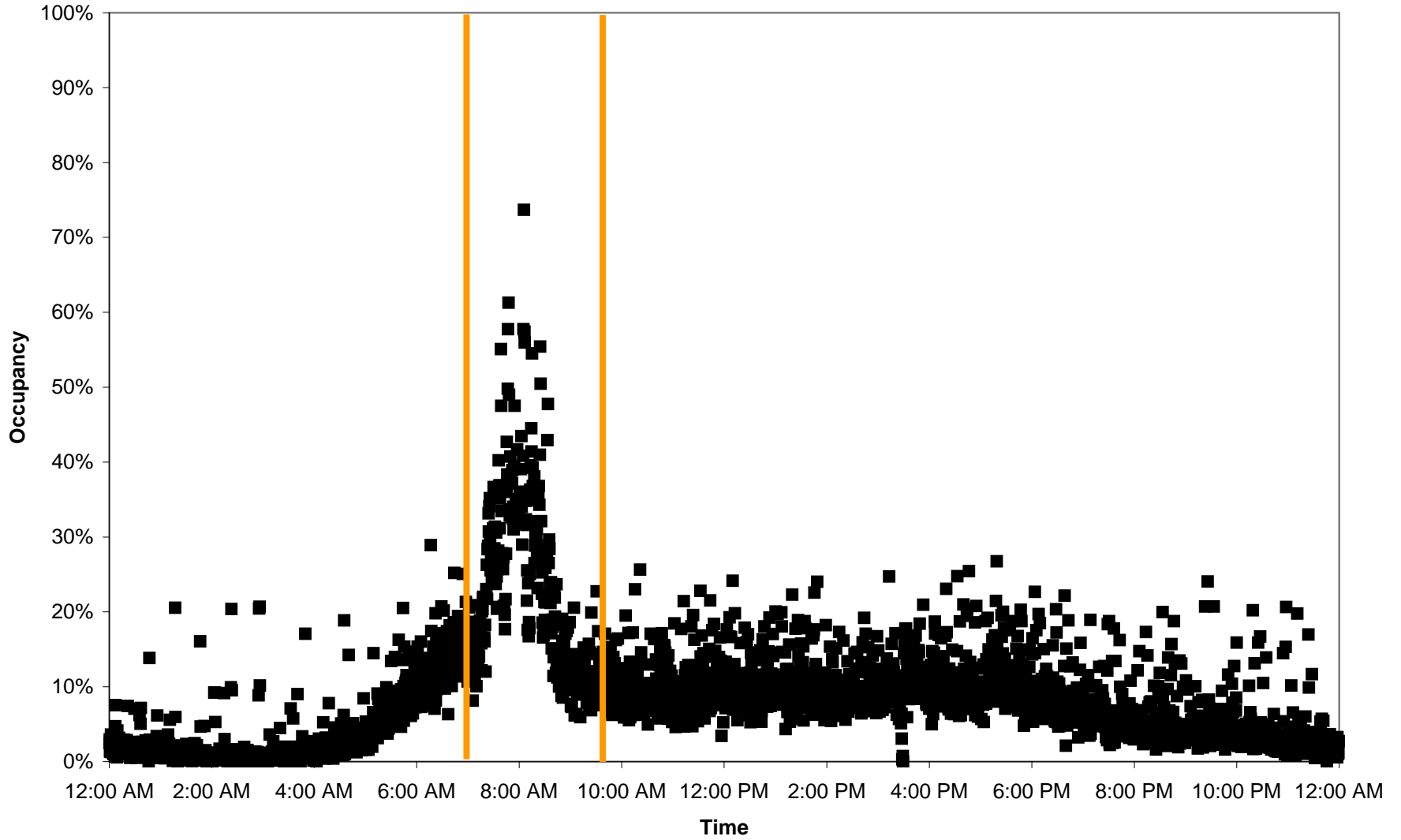
- Study site on different days
- Manual replication of procedure
- Develop semi-automated method

# Acknowledgements

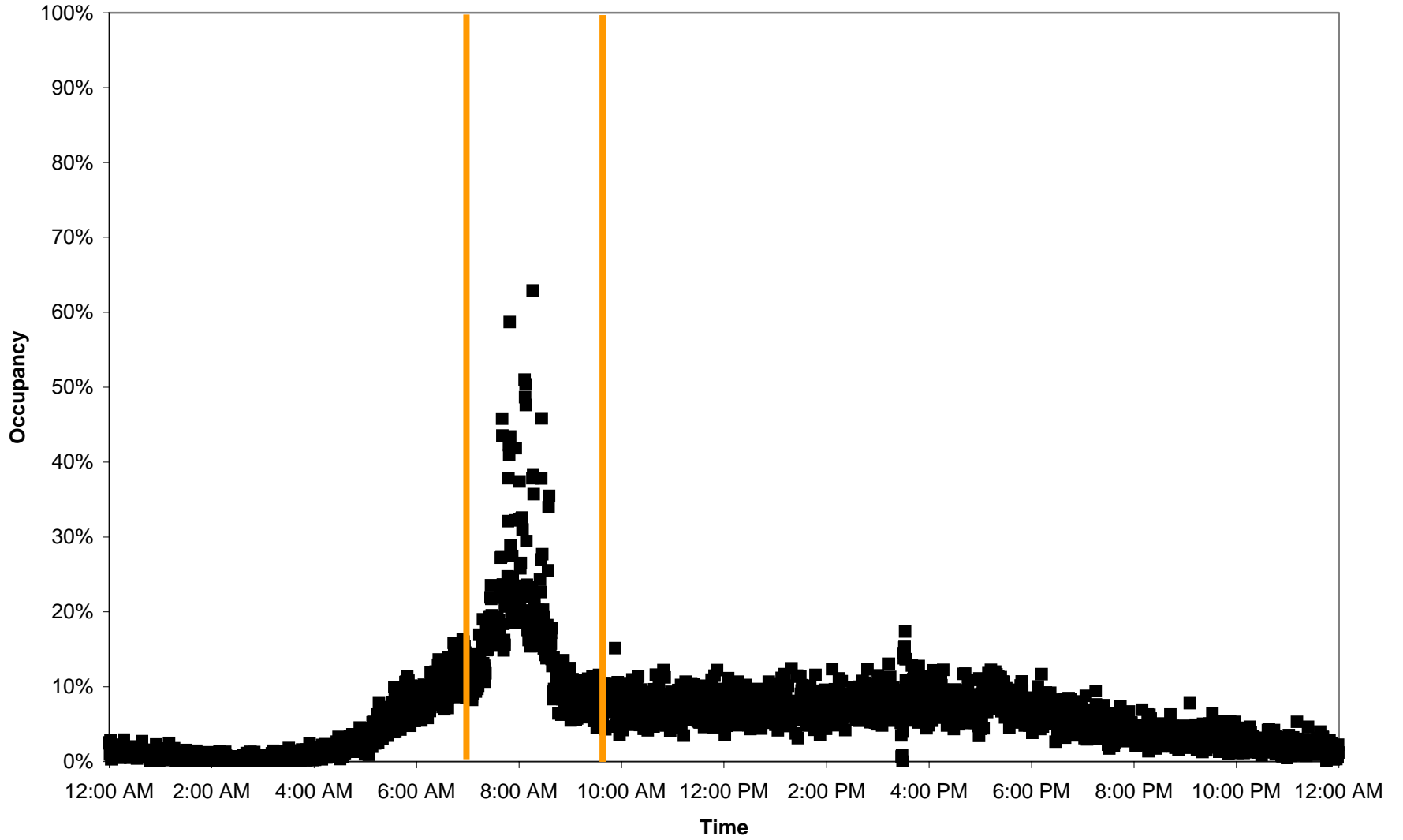
- Prof. Pravin Varaiya and Prof. Alexander Skabardonis, U.C. Berkeley
- Dr. Karl Petty, Berkeley Transportation Systems
- Pherak Hay, Vu Mai, and Roger Lindgren



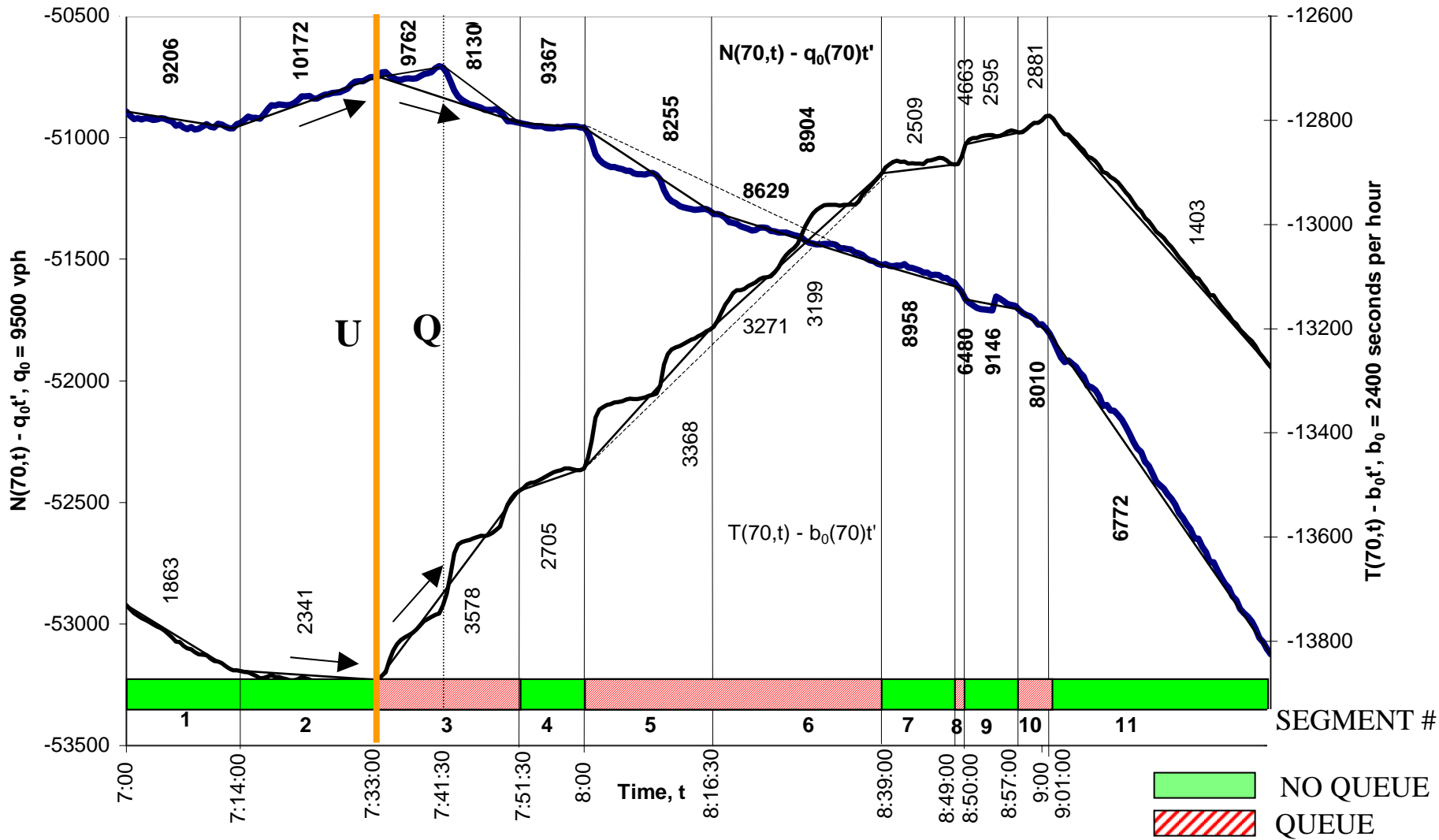
# Station 50, Occupancy



# Station 40, Occupancy



# Station 70 – Loops 1-4 Oblique N and T



# Station 60 – Loops 1-4, Oblique N and T

