



# Better Decisions Through Better Data

## The Impact of Big Data on Transportation Planning and Engineering

Mike Wallace, PTP

Jinghua Xu, Ph.D, PE

Jan 27, 2016

FEHR & PEERS



# BIG DATA



**Does Bigger Data  
Necessarily Mean  
Better Data?**

**A First Penguin Perspective**



# BIG DATA ■ Definition



**(1) Too big to fit into a spreadsheet.**

# BIG DATA ■ Need for Filtering





# BIG DATA ■ AirSage



[POPULATION ANALYTICS](#) [TECHNOLOGY](#) [NEWS](#) [ABOUT US](#) [CONTACT US](#)



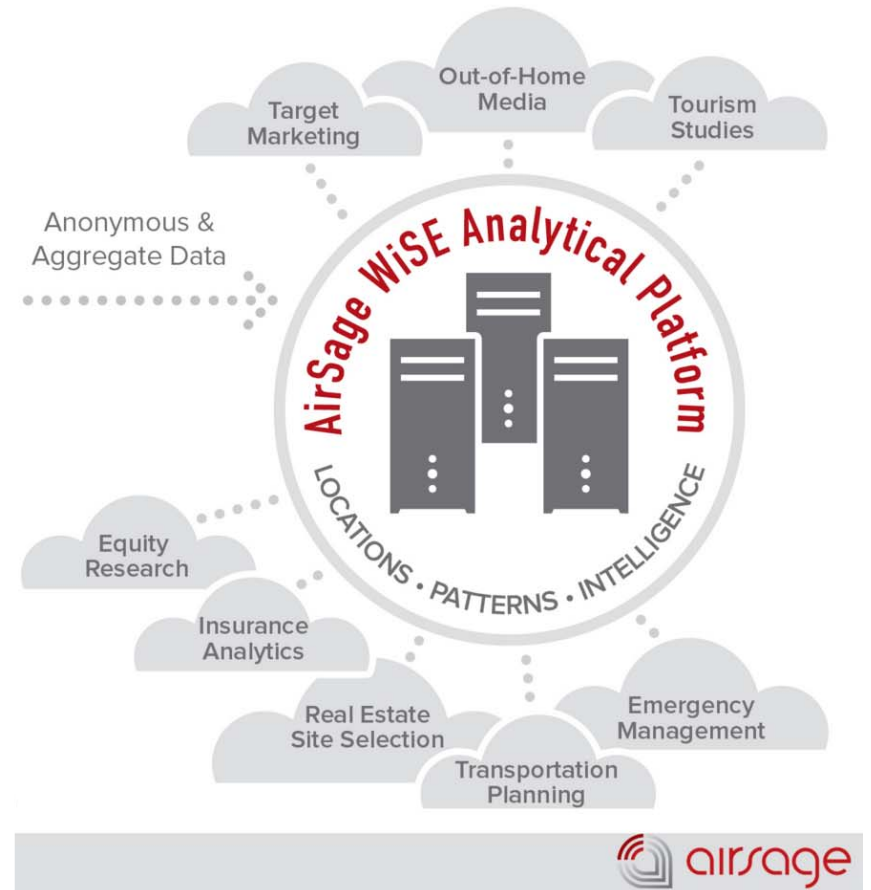
15 BILLION DATAPPOINTS EVERYDAY

00:03 00:53

CLOSE X

A video player interface showing a video with a network visualization background. The text '15 BILLION DATAPPOINTS EVERYDAY' is overlaid in large white font. The video progress bar shows 00:03 / 00:53. A 'CLOSE X' button is in the bottom right corner.

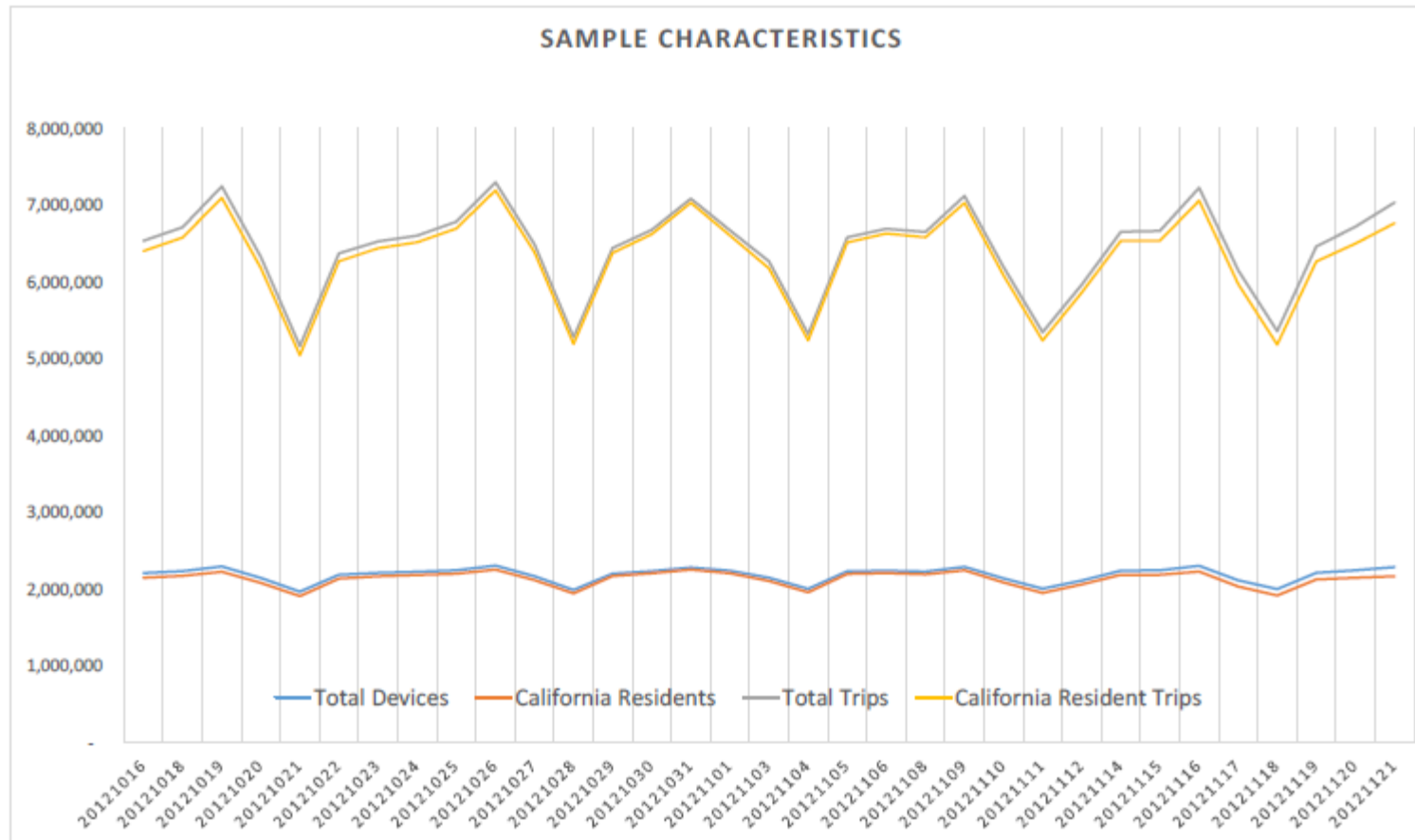
# BIG DATA ■ AirSage Filtering



# BIG DATA ■ Still a Sample



Figure 2 Sample Characteristics





# BIG DATA ■ The Challenge - CEQA



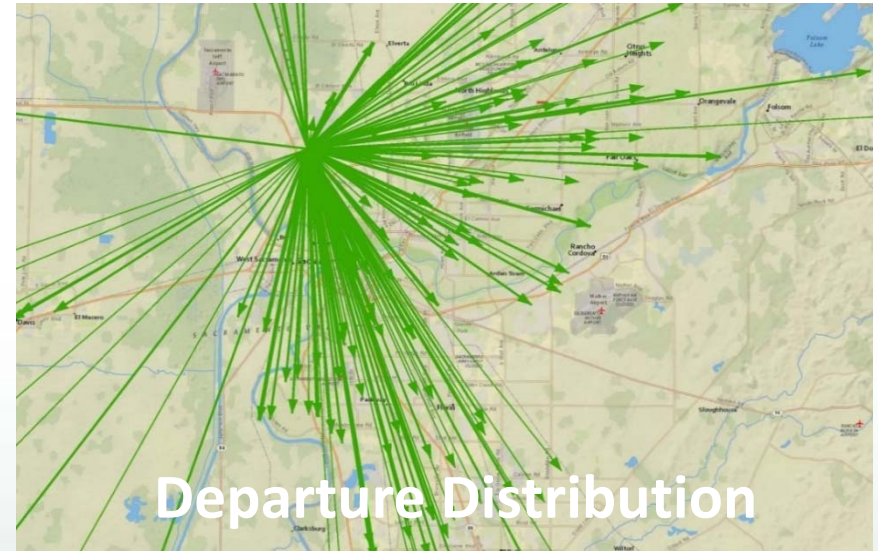
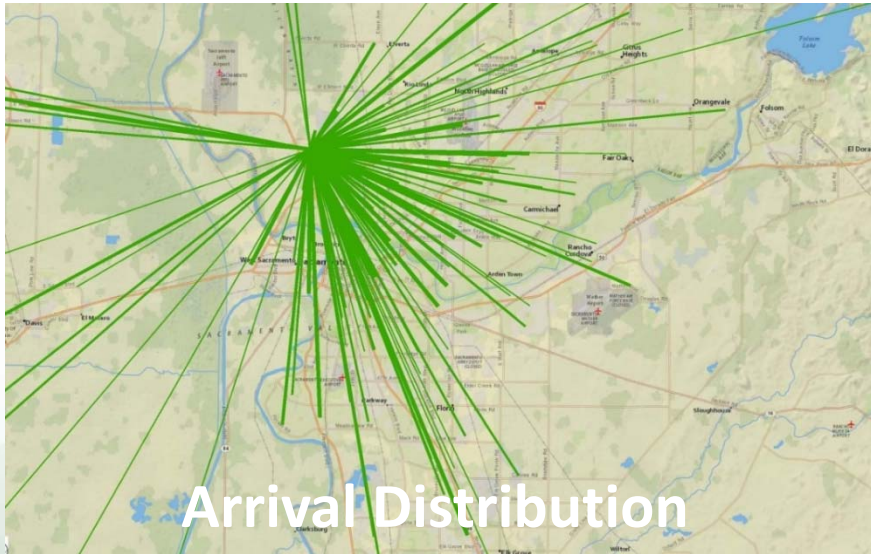
## Sacramento Kings

Create a **legally defensible** analysis that...

- Accurately identifies impacts
- Determines if new arena achieves VMT reduction targets

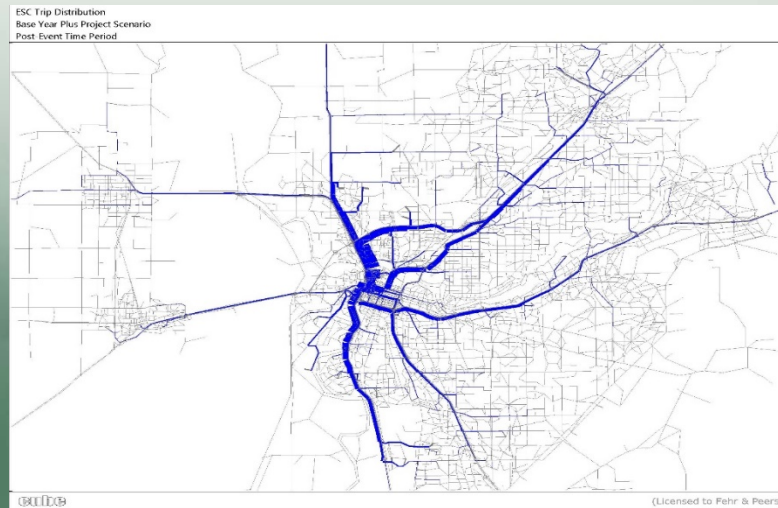
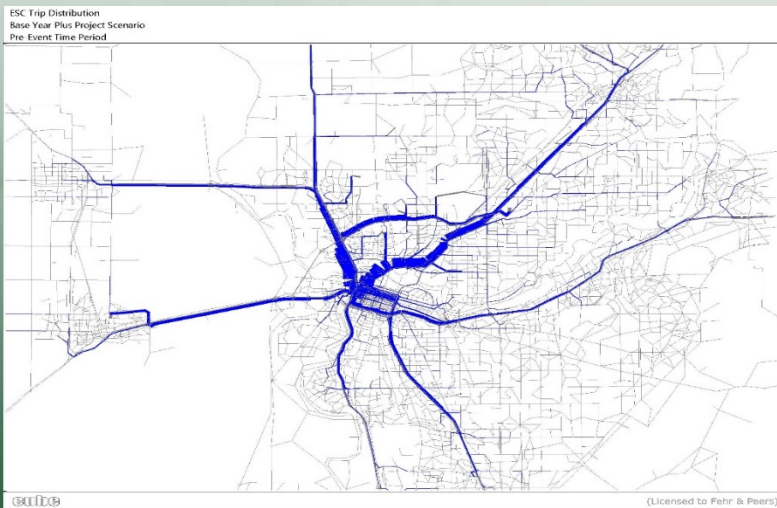


# BIG DATA ■ Pattern Visualization



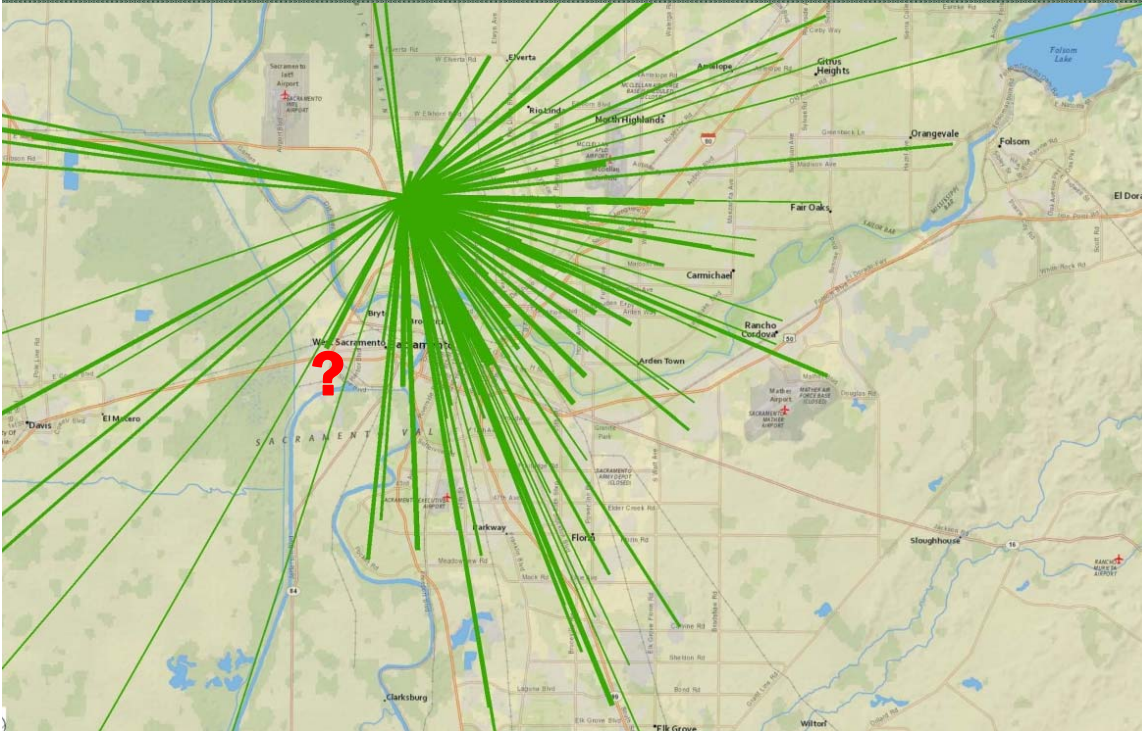
**Arrivals**

**Departures**





# BIG DATA ■ Sacramento KINGS



Origin of Airesage trips arriving at current project site: 3-7 PM		
Regional Analysis District	Trips	Percentage
Antelope	11.19	1%
Arden Arcade	133.36	9%
Auburn	1.96	0%
Cameron Park - Shingle Springs	2.72	0%
Carmichael	26	2%
Citrus Heights	22.42	1%
Colfax	0.21	0%
Coloma - Lotus	1.11	0%
Davis	23.66	2%
Delta	0.2	0%
Downtown	147.59	10%
East Placerville	0.82	0%
East Sacramento	137.17	9%
El Dorado High Country	0.3	0%
Vineyard	9.72	1%
<b>West Sacramento</b>	<b>119.25</b>	<b>8%</b>
Winters	2.64	0%
Woodland	62.53	4%
Yuba City	24.43	2%
<b>Total</b>	<b>1532.48</b>	<b>100%</b>

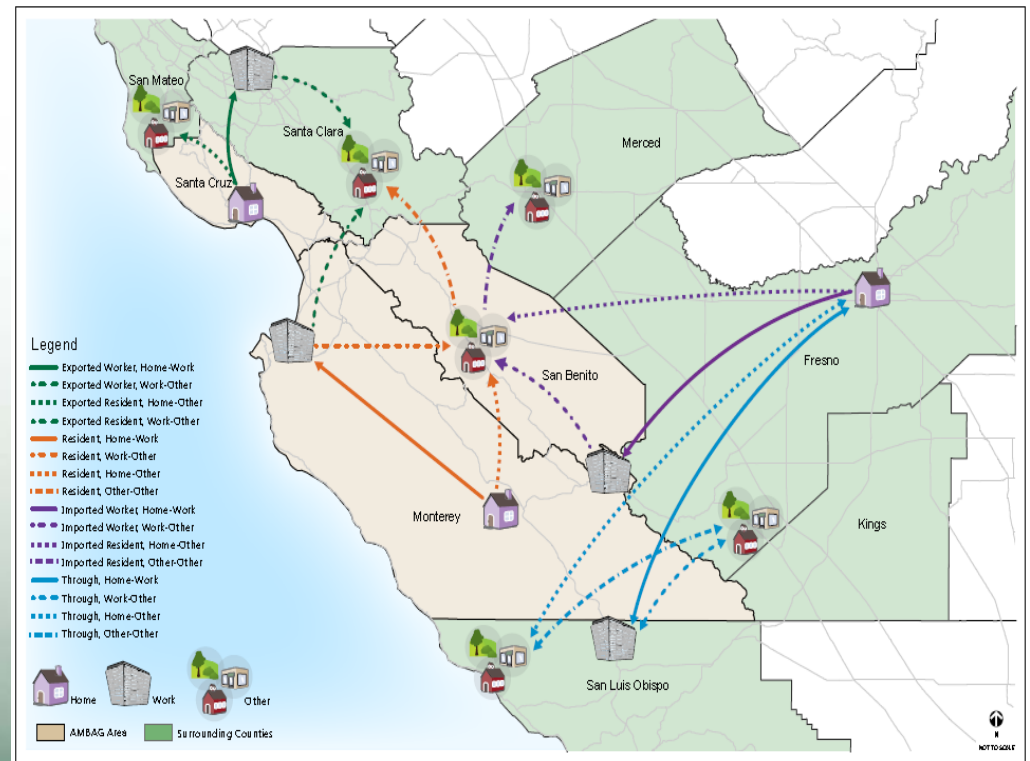


# NEEDS

## ■ For Practitioners



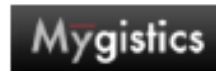
- A Common Lexicon
- Understanding of Data Filtering and Limitations
- Authoritative Guidance
- Recognition of Data Evolution



# BIG DATA



## County Level Experience



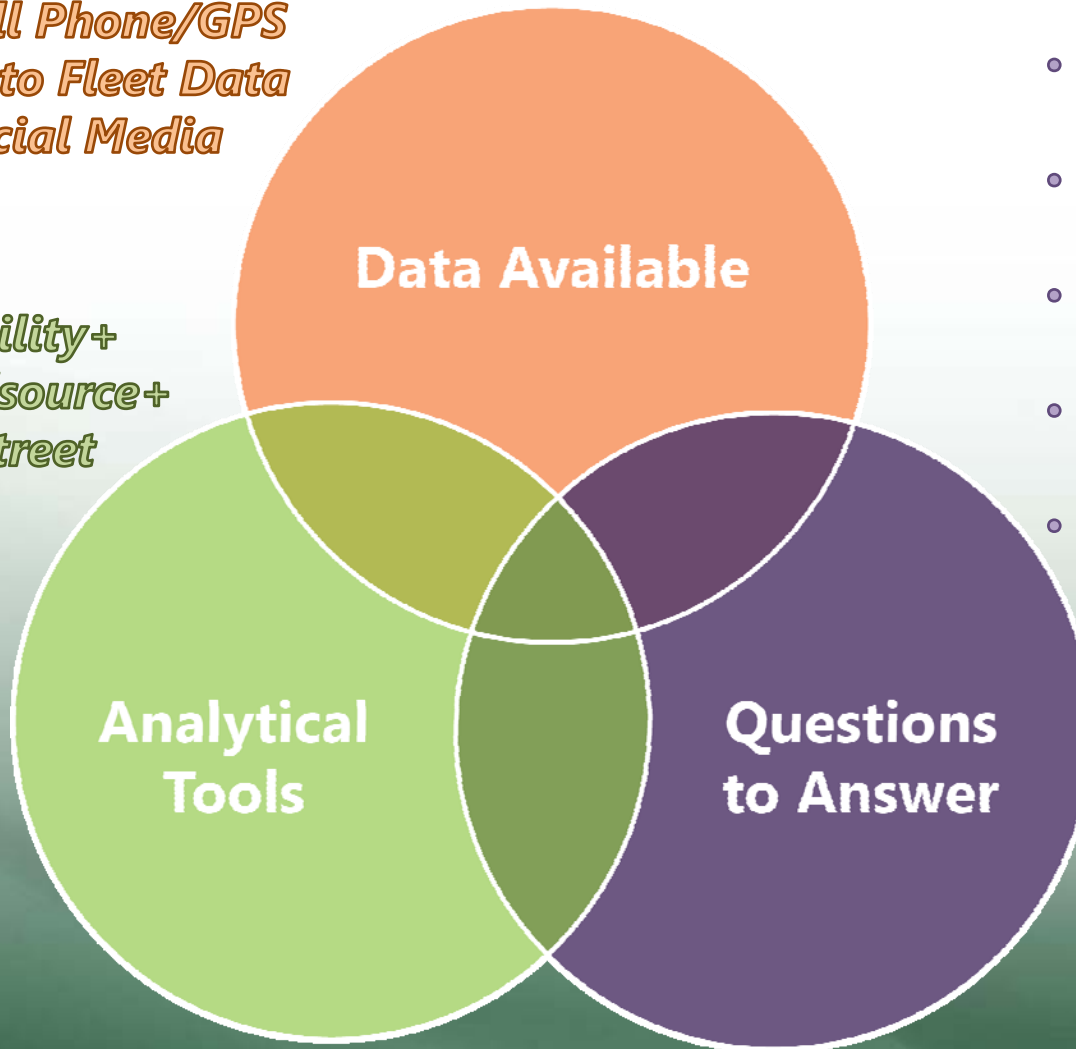


# BIG DATA



- *Transit AVL/APC*
- *Cell Phone/GPS*
- *Auto Fleet Data*
- *Social Media*

- *Reliability+*
- *Crowdsorce+*
- *Mainstreet*
- *TDM+*



- *When/where are issues occurring?*
- *How to prioritize investments?*
- *How to better engage the community?*
- *How effective is this treatment?*
- *How do pricing changes impact decisions?*
- *Other typical applications*

# BIG DATA ■ Reliability



## 5 Fulton Reliability

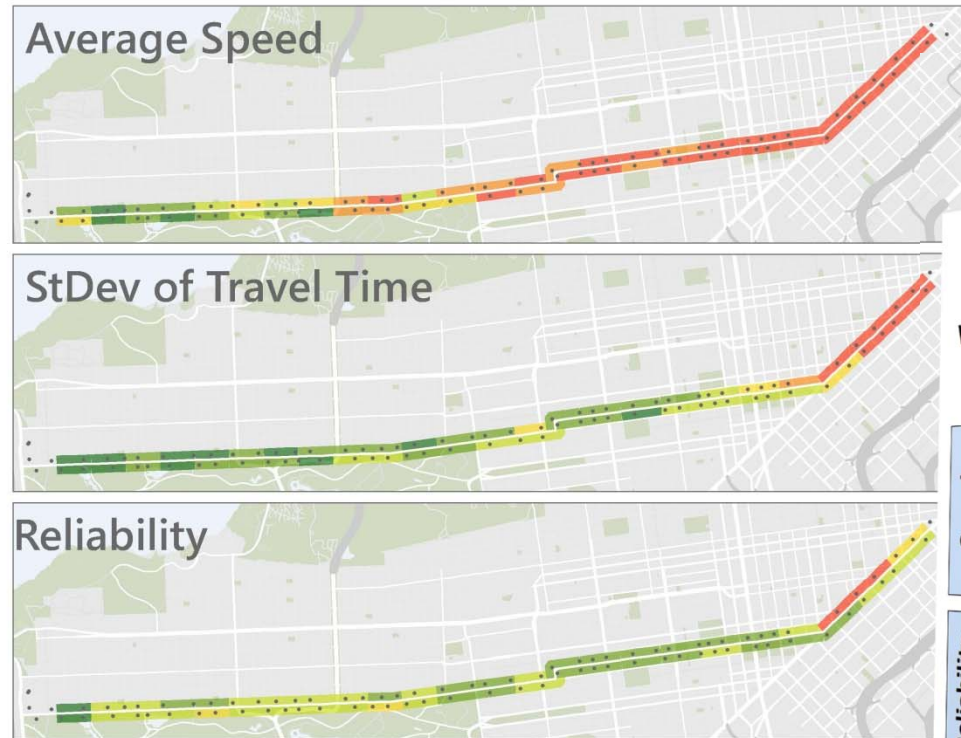
PM period (4 PM to 7 PM)

Source: SFMTA bus AVL data from May 2012. GIS analysis tool developed by Fehr & Peers

FEHR & PEERS



## SFMTA Reliability+ Tool



Westbound

	Fulton St											McAllister St				Market St								
	46th Ave	42nd Ave	38th Ave	34th Ave	30th Ave	26th Ave	22nd Ave	18th Ave	Park Presidio Blvd	10th Ave	6th Ave	2nd Ave	Stanyan St	Clayton St	Central Ave	Baker St	Scott St	Fillmore St	Laguna St	Franklin St	Larkin St	Jones St	5th St	3rd St
<b>Speed</b>																								
AM	21	25	20	22	22	18	21	18	15	11	20	14	12	11	12	11	10	13	11	7	8	8	8	6
Midday	20	22	19	21	19	16	18	16	12	9	18	12	11	9	11	10	9	13	10	6	7	7	7	6
School	21	20	18	21	18	14	16	15	11	8	17	12	11	9	11	9	9	13	9	6	6	7	7	6
PM	18	20	18	20	17	14	15	15	12	9	16	12	11	10	11	9	9	12	9	6	7	7	6	5
Evening	26	27	24	25	23	19	22	20	18	12	20	14	15	12	13	11	12	16	12	8	7	8	7	6
Night	24	23	22	23	21	18	20	17	17	11	19	14	13	11	13	10	11	15	11	8	8	10	9	7
<b>Reliability</b>																								
AM	0.3	0.3	0.4	0.3	0.4	0.4	0.4	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.3	0.4	0.2	0.2	0.4	0.3	1.0
Midday	0.7	0.4	0.5	0.3	0.4	0.4	0.4	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.2	0.2	0.3	1.5	0.3
School	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.4	0.3	0.2	0.2	0.3	0.3	0.2	0.2	0.3	1.5	0.3
PM	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.4	0.3	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.7	0.3
Evening	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.6	0.4	0.4	0.5	0.3	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.6	1.9	0.5
Night	0.3	0.3	0.4	0.4	0.3	0.4	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.3	0.3	0.4	0.6	1.6	0.9

Large sample sizes over multiple days offer increased **confidence** and understanding of **variability**.

Source: [Reliability+](#), [External ASAP Website Projects](#)





# BIG DATA

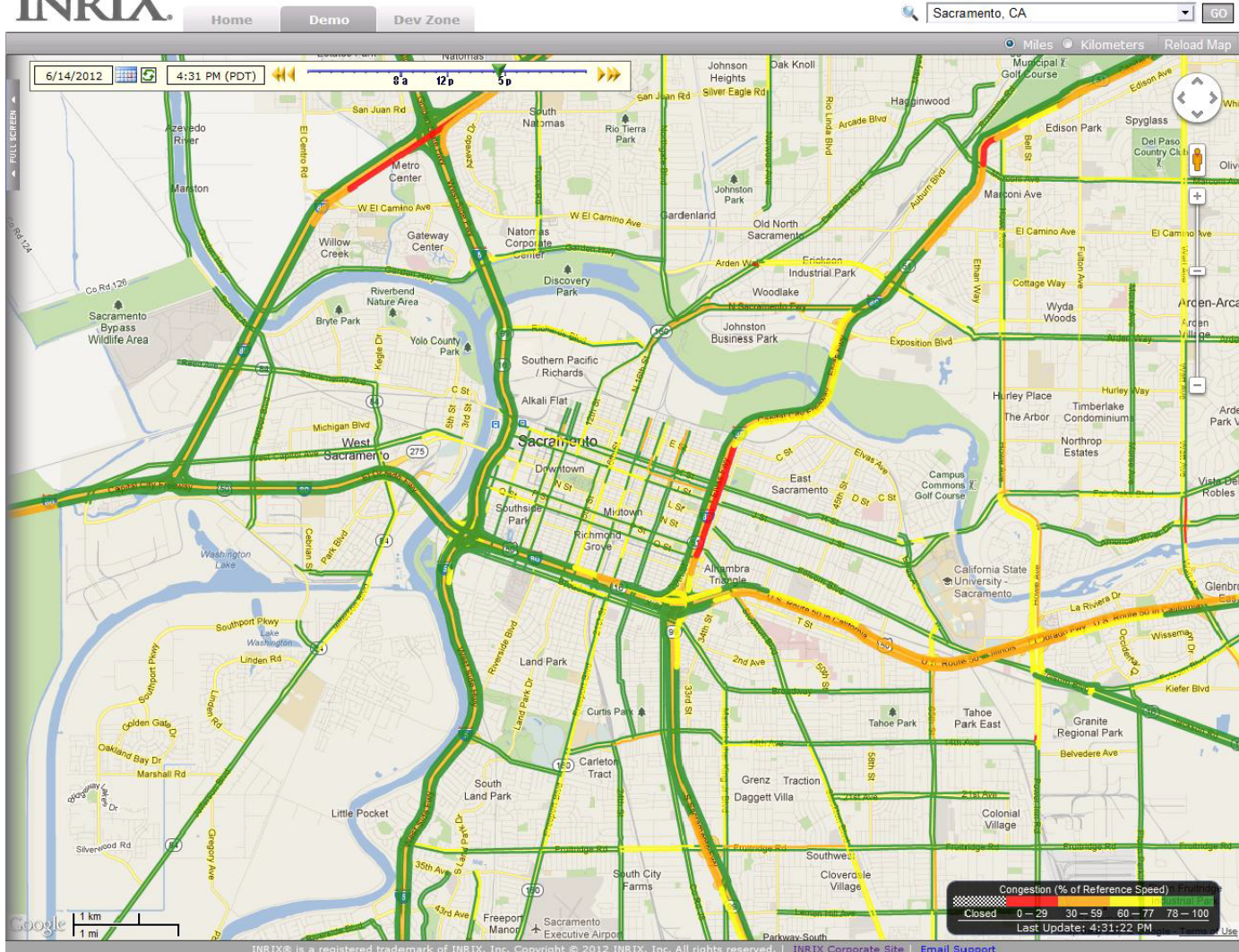
## Synthesizing Data from GPS, Cell, Detector, etc.



INRIX

Current Total Coverage: North America - 877,348 miles; Europe - 242,747 miles

Welcome, ted@inrix.com | My Account | Logout



# BIG DATA

## ■ Synthesizing Data from Social Media



Alright bus. Lets see if we can make it home some where near on time... Please?

Man on my bus: "I'm broke, I just got out of jail can I get a ride?" bus driver: "sure" me: so scared.



# BIG DATA ■ CrowdSources



## CrowdSource+

CrowdSource+ is our custom tool for empowering citizens to contribute their feedback for the improvement of their community, with commonly available technology.

We employ CrowdSource+ to host custom web-based mapping platforms and online surveying strategies that gather public comments, and can clearly communicate the analysis of that data. It also enables comment collection over a longer period of time than traditional in-person public meetings, and allows for sustained engagement from a wider sample of stakeholders.



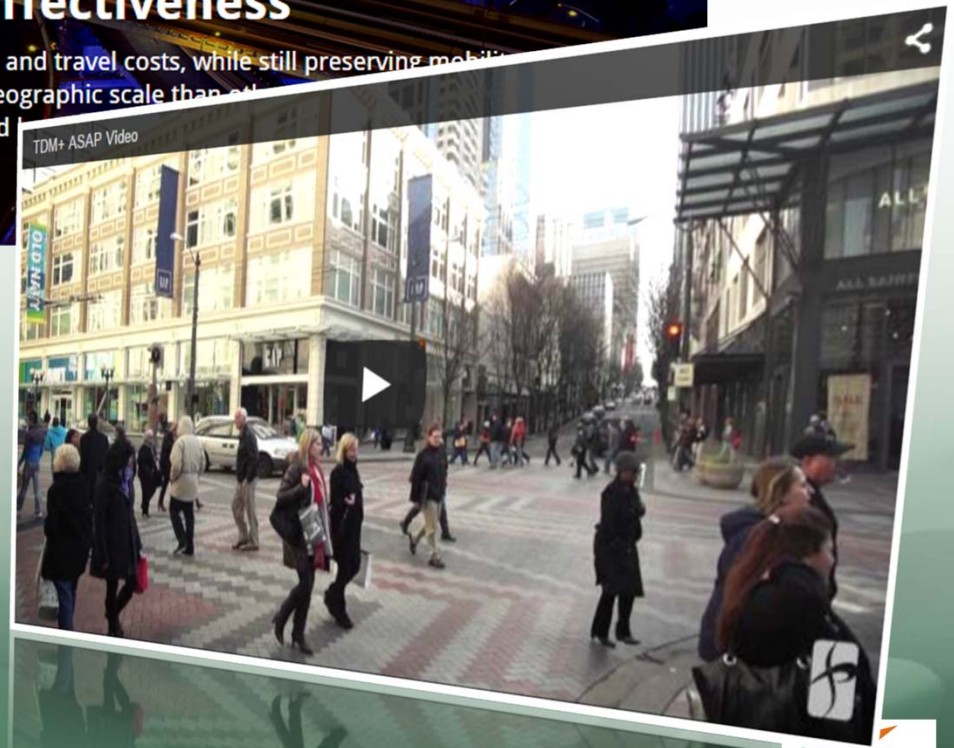
# BIG DATA ■ TDM+



# TDM+

## Quantify Demand Management Effectiveness

Reducing impacts on the transportation system, air quality, energy use, and travel costs, while still preserving mobility  
**TDM+** tool quantifies TDM effects in less time and for a more refined geographic scale than other  
TDM questions for an individual development site up to a neighborhood





# BIG DATA ■ Mainstreet



welcome to **MainStreet**

powered by:

MXD+

TDM+

RIDERSHIP+

PARKING+

FEHR PEERS

The screenshot displays the 'MainStreet' software interface. The top navigation bar includes 'Home', 'Project Information', 'Scenario Information', 'Trip Generation', and 'MCD Model Inputs'. The main content area is titled 'Scenario Information' and contains the following data:

Scenario Information	Scenario Creator
Project Name: 9453101	Scenario Creator
Scenario Name: E4076	Year of Analysis: 2015
Scenario Description: 945	Transit Available?: Yes
Developed Area (SQ Feet): 275,83	Located in CBD or TOD?: No
Developed Area (Lot Units): 275,83	Is this a Project Level or Program Level Scenario?: Project
Proportion of this within 1/4 mile of transit: 100	

Below the table is a 'Location' section with a map showing the project area in San Bernardino, California. The map includes labels for 'San Bernardino', 'Carnegie Blvd', 'Sancho Cordoba', and 'La Brea'. A red square on the map indicates the project location. The interface also features a 'Save & Continue' button at the bottom right.



# BIG DATA ■ WalkFirst SF

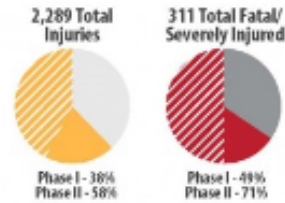


## 4 PRIORITY INJURY LOCATIONS top profiles per location

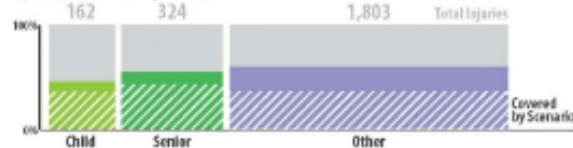
Phase I: cheap, effective    Phase II: comprehensive

	Phase I	Phase II
<b>Fatal/Severely Injured Covered</b>	<b>49%</b>	<b>71%</b>
Total Cost of Countermeasures	\$8.5M	\$74.4M
Average Cost/Intersection	\$62K	\$381K
Average Cost/Injury	\$931K	\$883K

Total Cost for Scenario 4 - \$82.8M  
Total Cost Across High Injury Network - \$212M



### Number of Citywide Injuries by Vulnerable Population

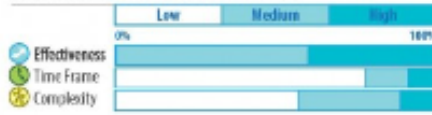


### Selected Countermeasures

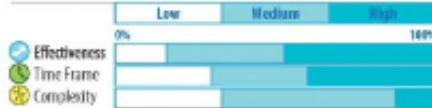
(Phase I, Phase I and II, Phase II only)  
\* Temporary in Phase I, permanent in Phase II

- Advance stop or yield lines
- Automated speed enforcement
- Chokers
- Continental crosswalks
- Corner bulbs\*
- Establish (mark) a new midblock crosswalk
- Flooding beacons
- Leading pedestrian intervals
- Mark an unmarked crosswalk
- Parking prohibitions (red visibility curbs)
- Pedestrian countdown signals
- Pedestrian detection to extend crossing time
- Pedestrian hybrid signal (HAWK)
- Pedestrian refuge islands\*
- Pedestrian scrambles
- Pedestrian warning signage
- Protected left turns
- Roller speed display signs / Portable speed trailer
- Raised crosswalks
- Reduced lane widths
- Road diets
- Roadway safety lighting
- Signal timing changes
- Speed humps
- Speed tables
- Traffic circles, roundabouts
- Turn prohibitions

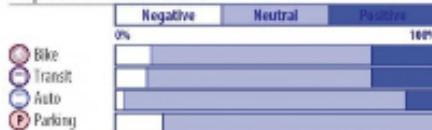
### Phase I Countermeasure Attributes



### Phase II Countermeasure Attributes

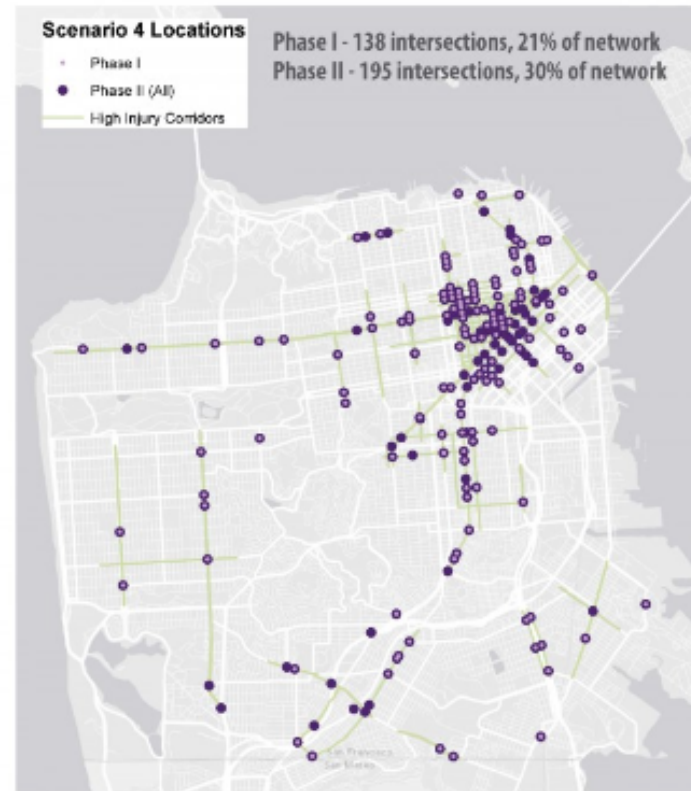


### Impacts to Other Modes



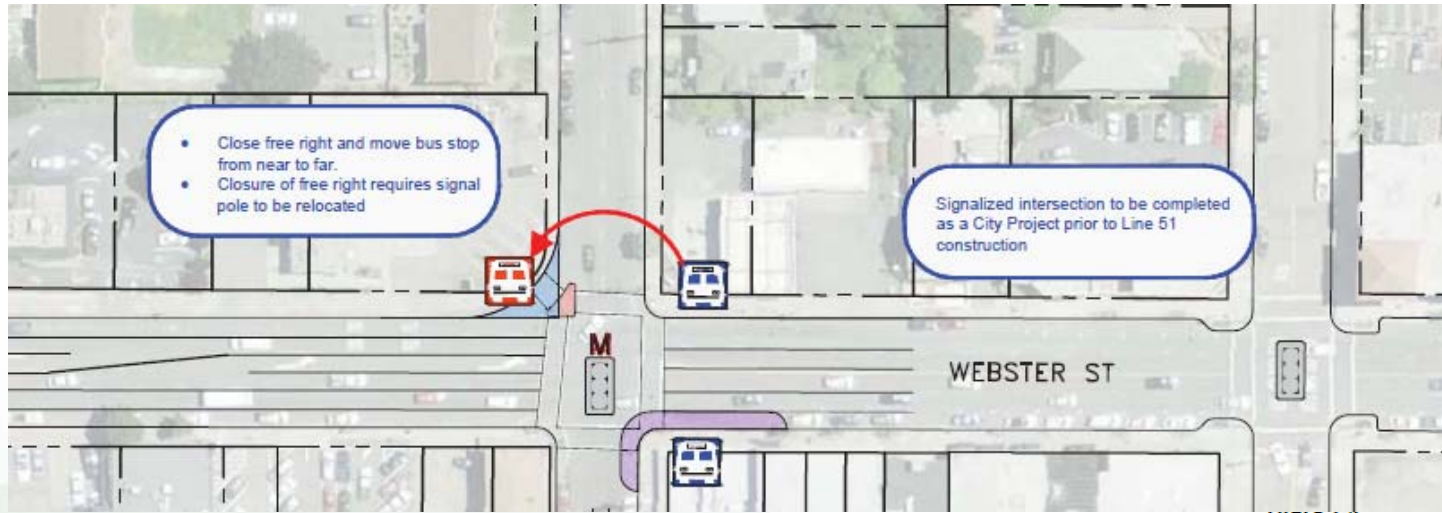
## 4 PRIORITY INJURY LOCATIONS top profiles per location

Phase I: cheap, effective    Phase II: comprehensive





# BIG DATA ■ Line 51 Study



FAR-SIDE STOP	
	Near-side In Lane to Far-side Stop
	15 – 25
	15 – 20
	10 – 15
	0 – 5
	0 – 5

TABLE 2-4  
TRANSIT TRAVEL TIME SAVINGS: QUEUE JUMP

Approach Volume (vphpl)	Near-side Curbside Stop	Near-side In Lane Stop
X > 630	40 – 50	25 – 30
630 > X > 550	20 – 25	15 – 20
550 > X > 400	15 – 20	10 – 15
400 > X > 300	5 – 10	0 – 5
X < 300	0 – 5	0 – 5

Fehr & Peers, 2013

TABLE 2-5  
TRANSIT TRAVEL TIME SAVINGS: TRANSIT SIGNAL PRIORITY (TSP)<sup>1</sup>

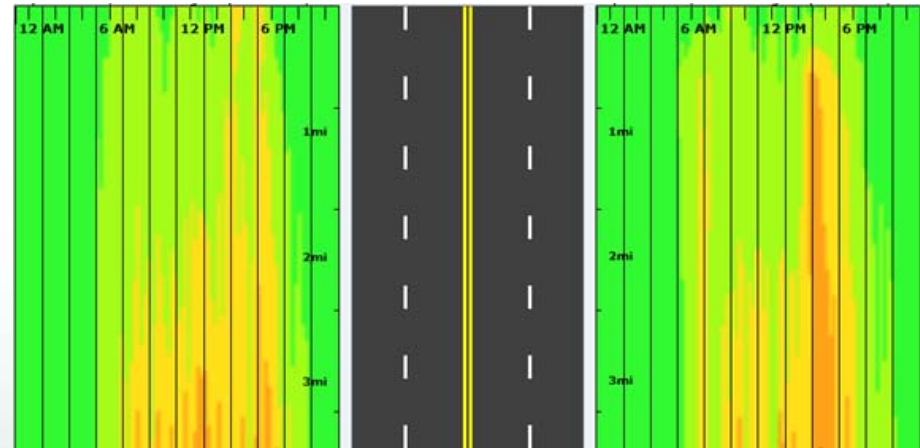
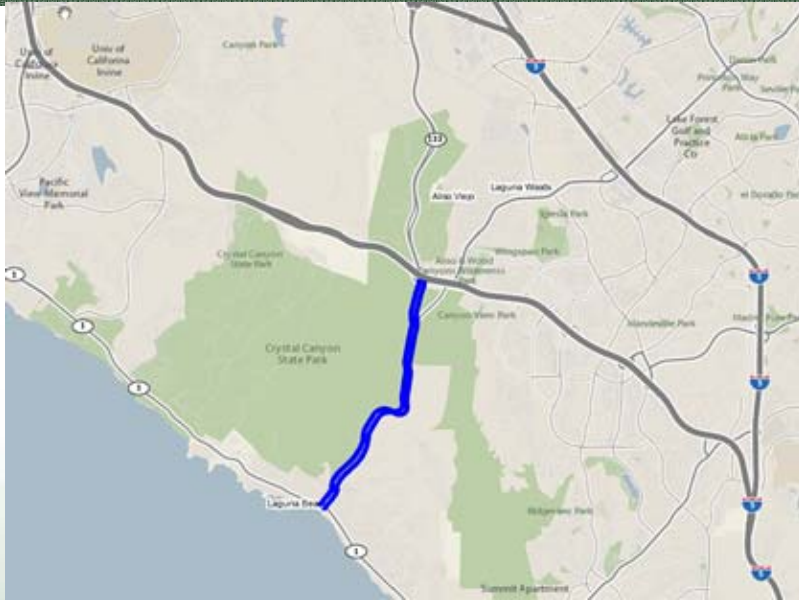
Approach Percent Green Time	Bus Time Savings (seconds)
40% Green Time	4 – 6
50% Green Time	3 – 4
60% Green Time	0 – 3

Notes:

1. TSP is not additive with queue jump savings, as the queue jump phase is typically not called until passengers have boarded and alighted. TSP can however be additive with queue bypass savings.

Fehr & Peers, 2013

# BIG DATA ■ HAWK Effectiveness



## Speed (mph)

	6:00 AM - 8:00 AM	4:00 PM - 6:00 PM
<b>Monday</b>	37.88	34.2
<b>Tuesday</b>	35.21	32.29
<b>Wednesday</b>	36.33	29.42
<b>Thursday</b>	35.68	32.48
<b>Friday</b>	36.65	26.2
<b>Saturday</b>	38.57	32.5
<b>Sunday</b>	38.34	35.2
<b>Weekends</b>	38.46	33.79
<b>Weekdays</b>	36.35	30.87
<b>All Days</b>	36.89	31.6

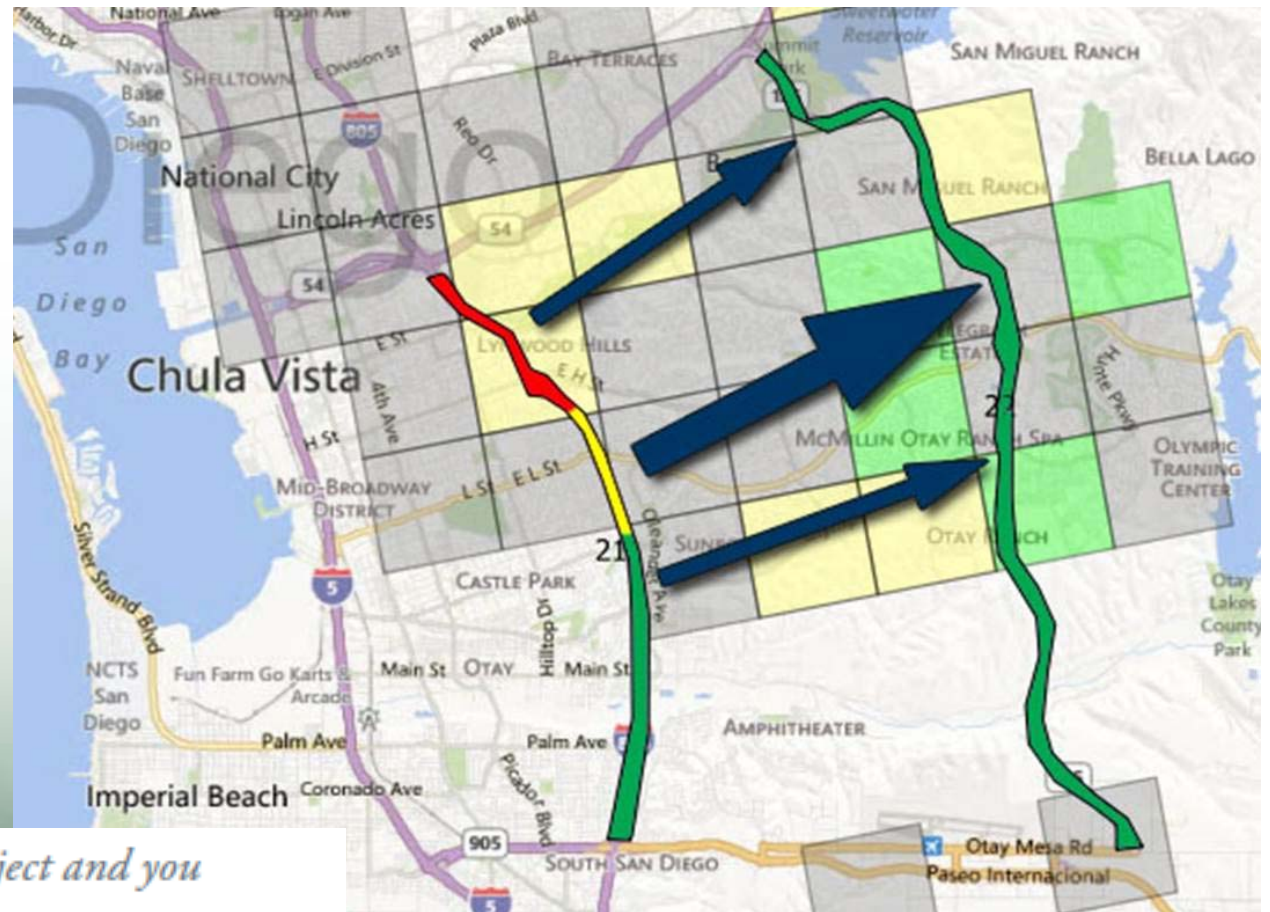
## Travel time (minutes)

	6:00 AM - 8:00 AM	4:00 PM - 6:00 PM
<b>Monday</b>	6.43	7.12
<b>Tuesday</b>	6.92	7.55
<b>Wednesday</b>	6.71	8.28
<b>Thursday</b>	6.83	7.5
<b>Friday</b>	6.65	9.3
<b>Saturday</b>	6.32	7.5
<b>Sunday</b>	6.36	6.92
<b>Weekends</b>	6.34	7.21
<b>Weekdays</b>	6.7	7.89
<b>All Days</b>	6.6	7.71

# BIG DATA



## SANDAG SR-125 before/after study



*"We know we gave you a tough project and you delivered. Thanks you!" – Clint Daniels, Manager of Regional Models and SANDAG SR 125 Before/After Project Manager*



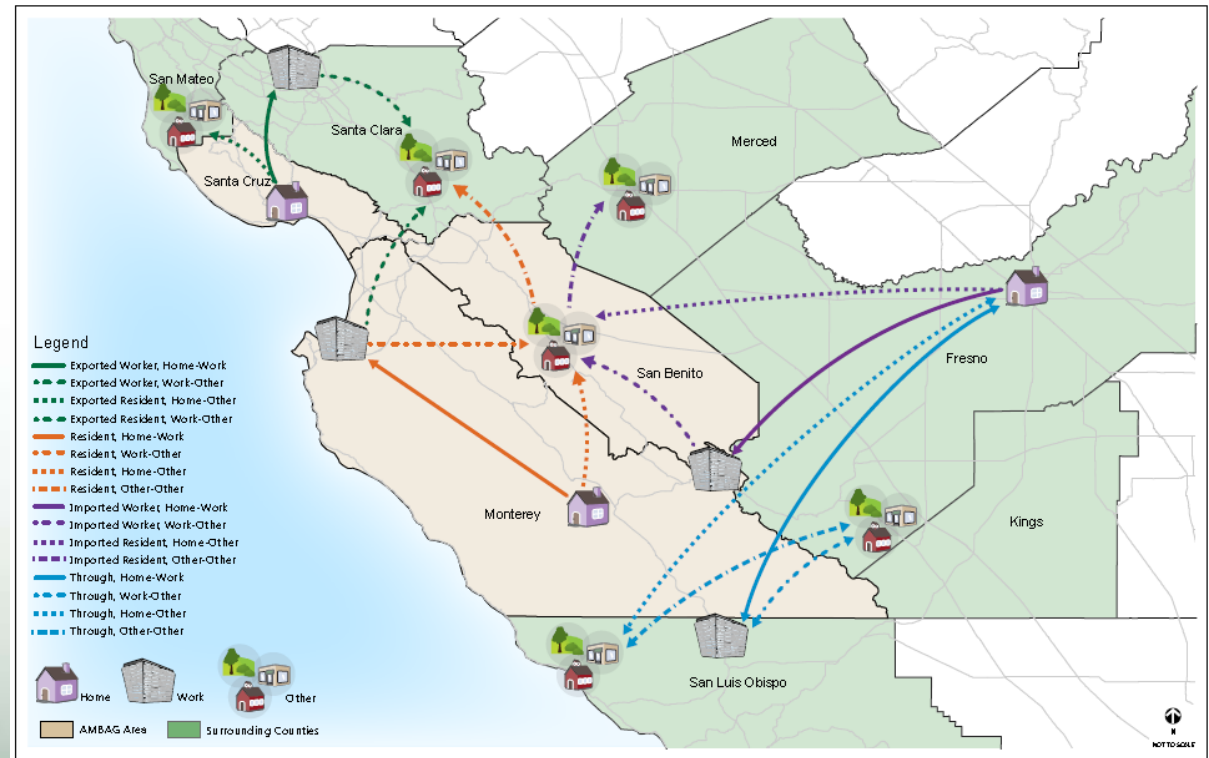


# BIG DATA



## Monterey Bay Road study

Combining Big and small data lead to understanding not only the **what** but also the **why** of travel behavior.



“The accuracy and additional data collected with the new license plate video technology alone increases the value of the survey. The ability to also collect cell phone data over 30 days and combine with Census data to infer the household demographics has great potential but has not yet been done. Combining both approaches on the same study is very exciting. We are looking forward to the advances the project can bring to data collection, travel modeling, and transportation planning.”

- Anita Schenk, Planner and AMBAG Project Manager

Source: [ASAP External Website, Projects](#)





# BIG DATA



## regional travel

Distribution **patterns** can be obtained in a more **cost effective** way than many other methods.



Percent Total Trips from Bakersfield  
Internal Trips Included

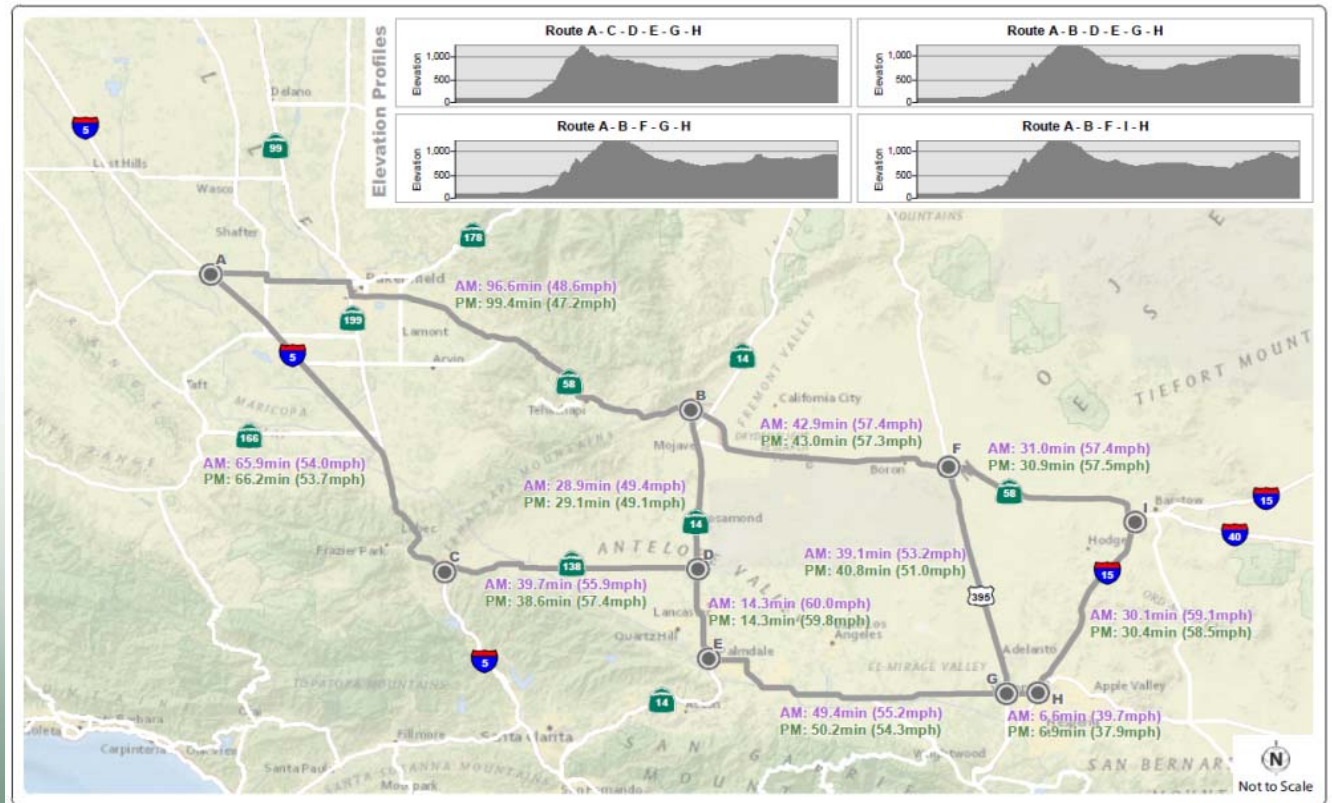
# BIG DATA



## gps speed

Roadway travel speed collected from in vehicle GPS devices or smart phone applications. The speed can be separated for **passenger** and **commercial vehicles**.

This example highlights the influence of **elevation** on **truck speeds**.



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Path: N:\Jobs\Active\25000\2500 - SR 138\Graphics\GIS\FromReserve\_8\_13\_13\GIS\MXD\ComparativeAnalysis.mxd

2013 Existing Conditions  
AM & PM Peak Hour Comparative Analysis:  
SR 138 and SR 58



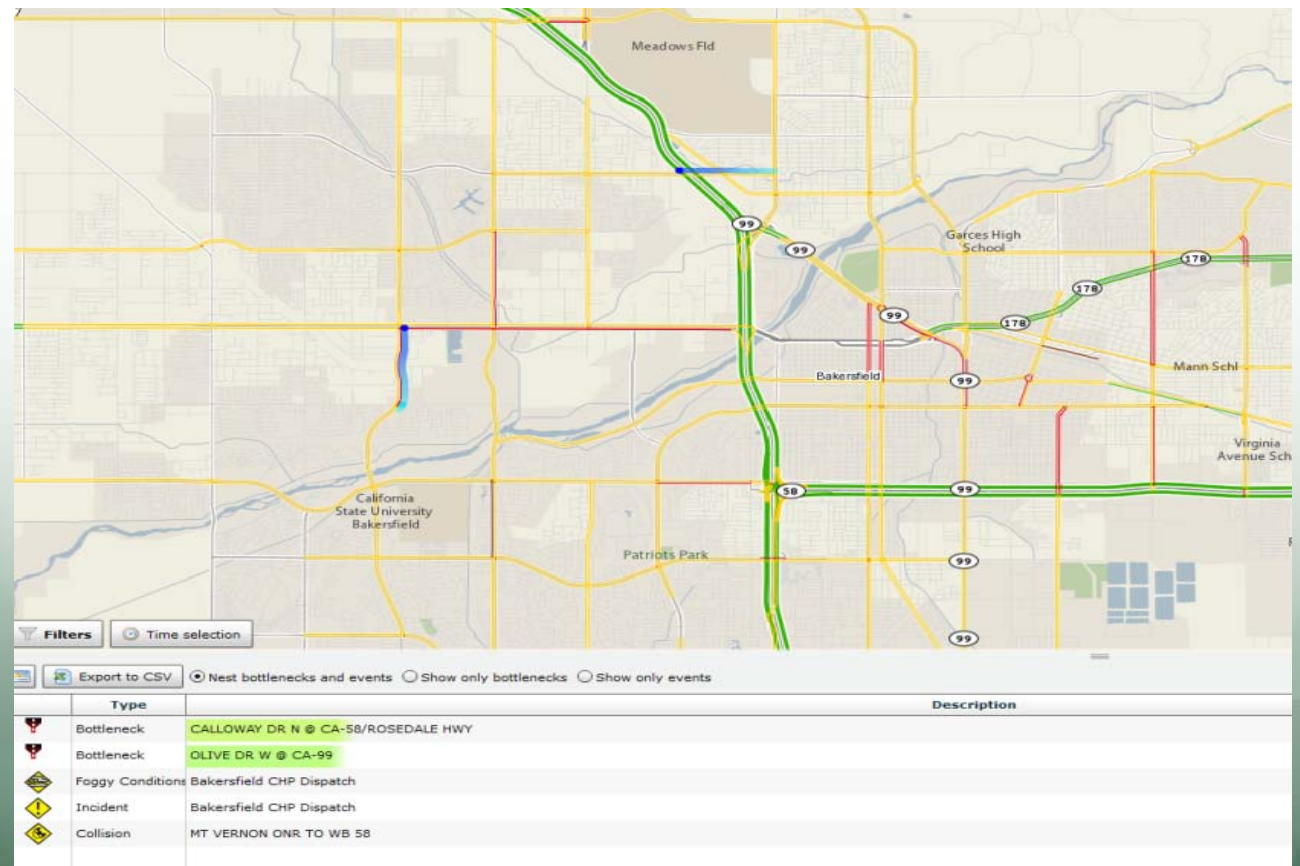
# BIG DATA



## gps traffic flow

**Bottlenecks** and other speed metrics can be viewed and summarized at the **segment** or **corridor** level.

Weather, collision, and construction notifications are also included so **non-recurring congestion** can be identified.



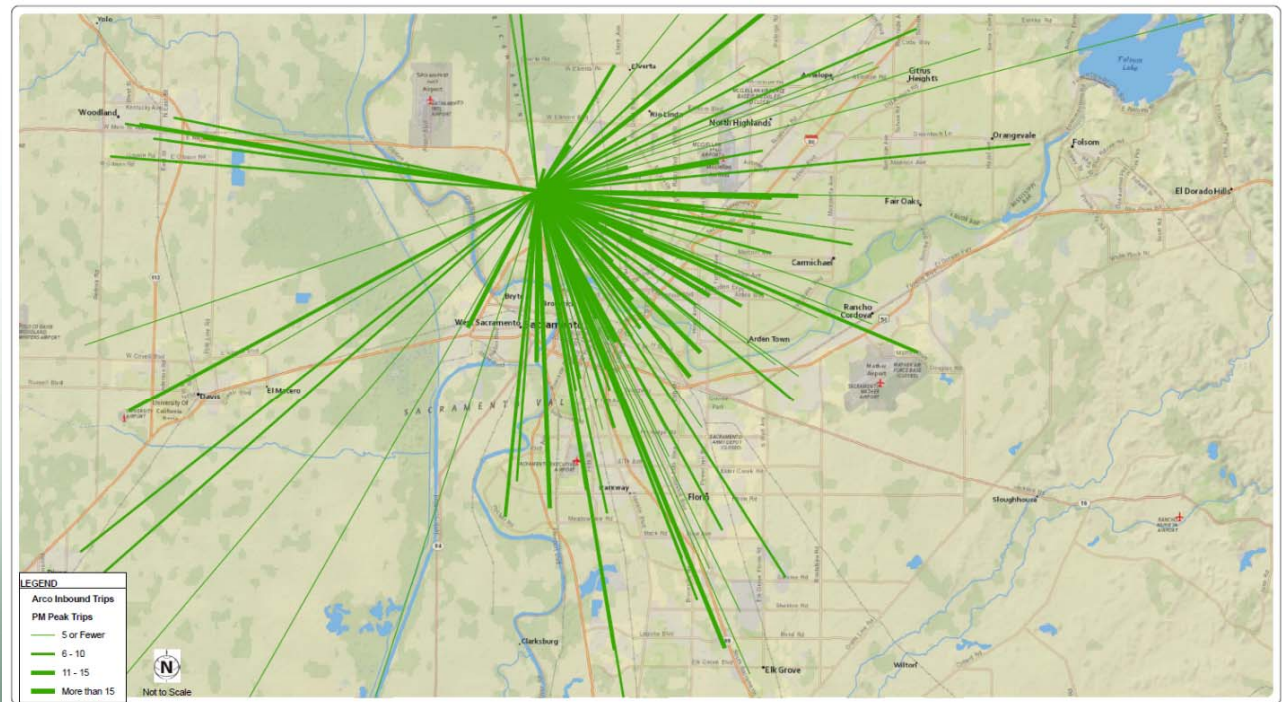


# BIG DATA



## project travel

Due to the geographic detail, GPS data can be used to identify project **distribution** and **routes**.



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ARCO WEEKDAY PM PEAK INBOUND TRIPS BY BLOCK GROUP  
FIGURE 1

Source: [Sacramento Kings Entertainment Sports & Complex, External ASAP website projects](#)



# BIG DATA



## walk access

Demand data were used to evaluate **overpass location scenarios** resulting in the **walkshed** maps.

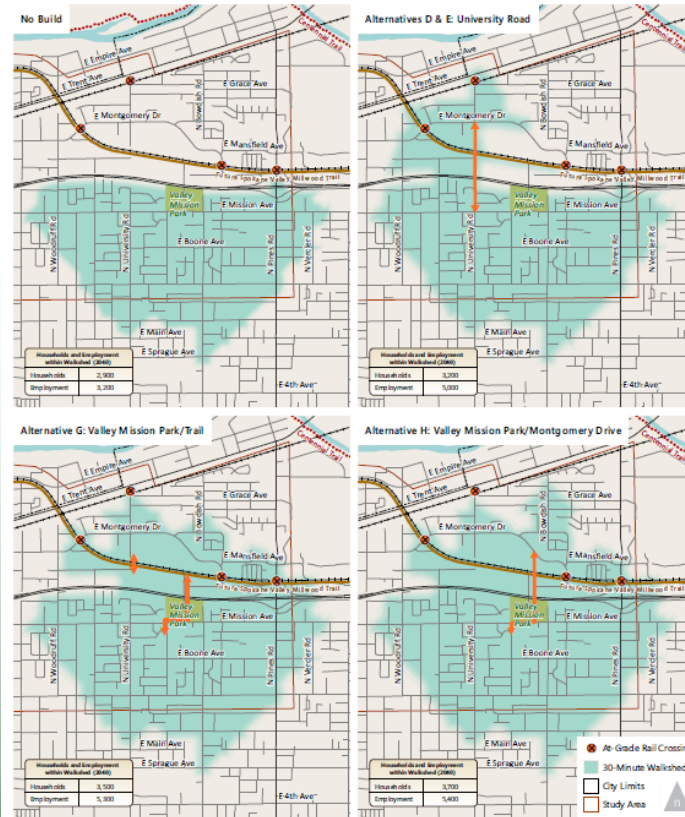


Figure 25.  
30-Minute Walkshed from Valley Mission Park

\\p003\p03e2\03\03\Projects\02-10-2012\_University\_Rd\_Overpass\Graphics\Draft\018\MXD\September2013\Fig25\_Walk30.mxd





# Data Sharing ■ GIS Application



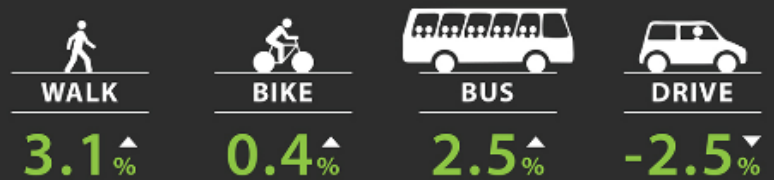
## web-based mapping and data sharing

### SAFE ROUTES 2 TRANSIT

THE TRANSPORTATION TRIFECTA

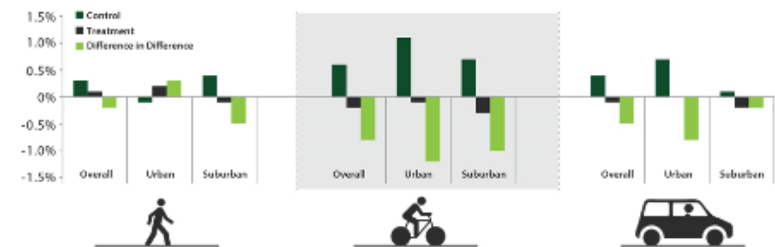
#### MORE WALKING, BIKING & TRANSIT

Walking and bicycling, whether as the sole access to transit or as part of a multi-modal trip to access the various stations, increased from the pre- to the post-period at the treatment sites.



#### INCREASED SENSE OF SAFETY

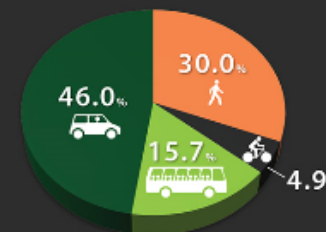
Perceived traffic risk decreased significantly among cyclists and drivers.



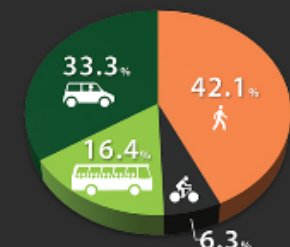
#### IMPROVED LOCAL ECONOMY

While walking and biking trips represent 35% of transit access trips at study sites, they represent almost 50% of transit access trips that stopped for food and drink.

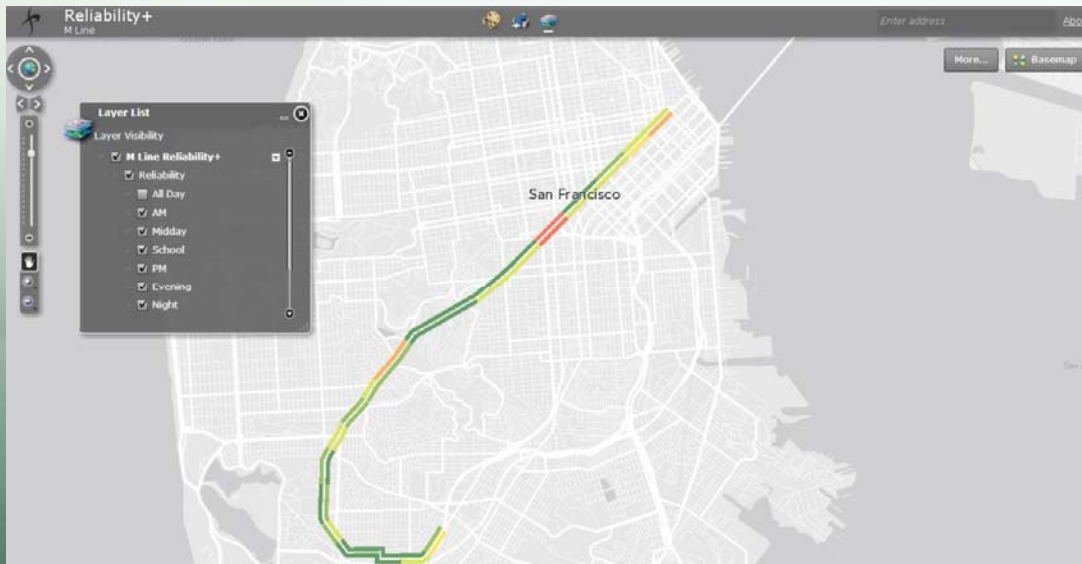
OVERALL MAIN MODE SHARES



STOPPED ON THE WAY FOR FOOD/DRINK



Source: [External FP VisCom website](#)



**Mike Wallace, PTP**

**M.Wallace@fehrrandpeers.com**

**925-930-7100**

**Jinghua Xu, Ph.D, PE**

**J.Xu@fehrrandpeers.com**

**714-941-8774**



**FEHR & PEERS**

