

METRO **EXPRESSLANES**

Automated Occupancy Detection
October 2015 (Phase I) Demonstration Results
Presented by Kathy McCune



2016 TRB Managed Lanes Conference
May 5th, Session 6



Presentation Outline

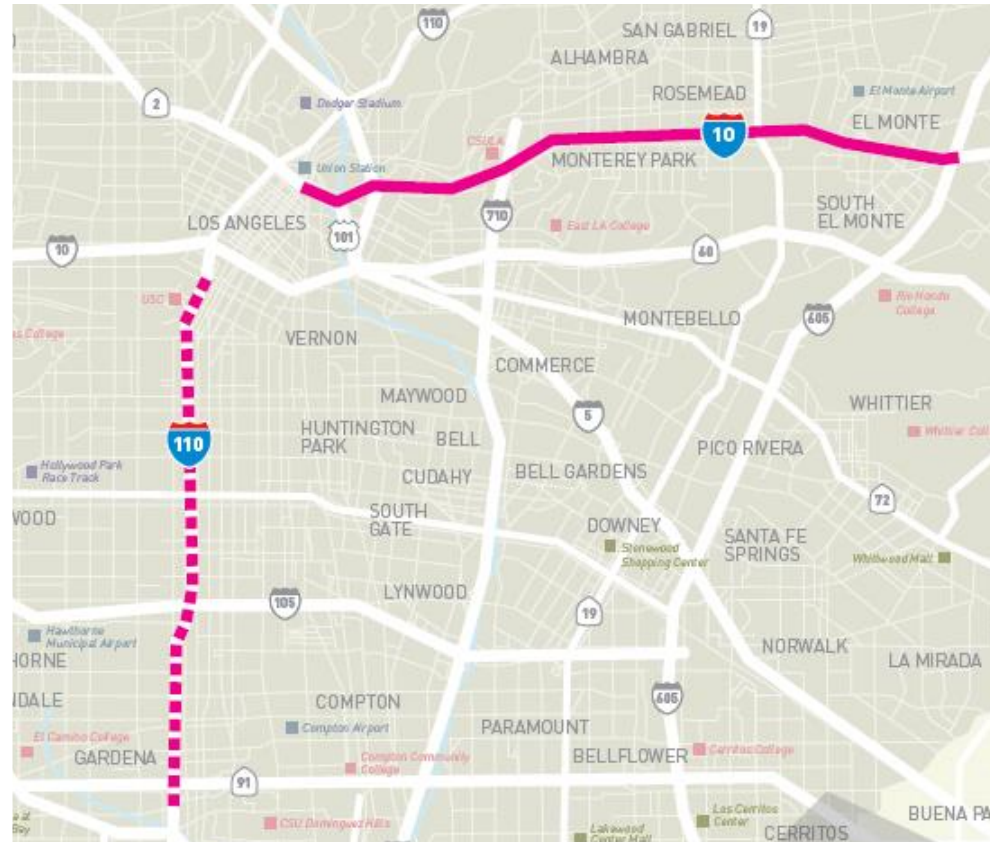


- Background/Business Rules
- Issue – I-110 Northbound AM Peak
 - Trips
 - Violations/Citations
 - HOV Only
- Self Declaration
 - Manual Observation
 - Automated Observation
- Summary
- Next Steps

Background



- Converted 47 center line miles of HOV Lanes to HOT
- Two of the most congested corridors in LA County
- I-110 ExpressLanes opened 11/10/12
- I-10 ExpressLanes opened 2/23/13
- I-110 Geometric Issues
 - Single Lane (3 Miles)
 - Dual Lane (8 Miles)
 - Merge back into GP Lanes
 - Ramp to Adams Blvd



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Business Rules



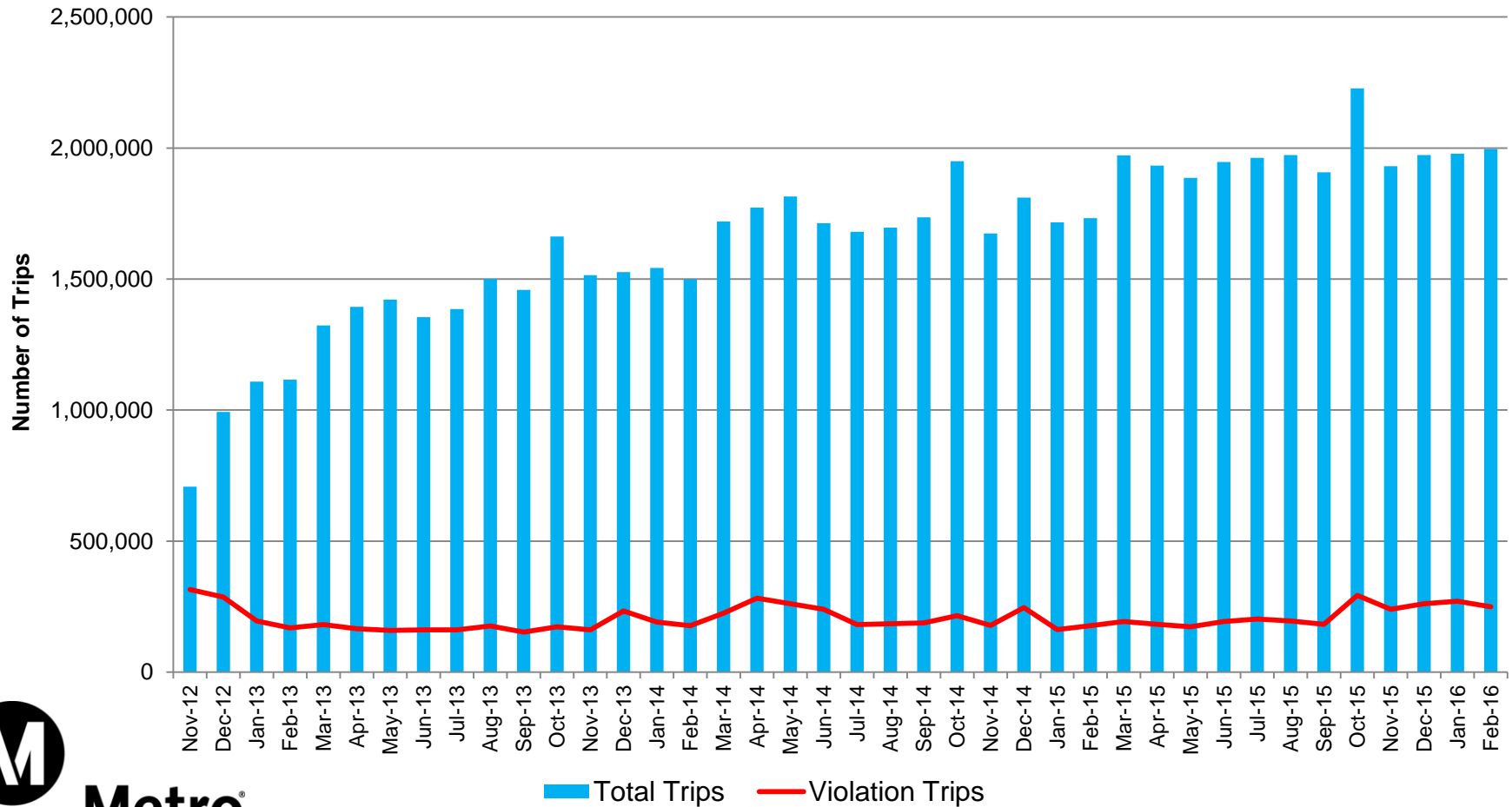
- All vehicles (except buses, motorcycles, & emergency responders) required to have a FasTrak[®]
- FasTrak Flex[®] for carpools
- 24/7 tolling operation
- Dynamically priced - \$0.10 to \$1.40 per mile
- I-10 - HOV 3+ Toll-free peak hours; HOV 2 off-peak
- I-110 - HOV 2+ Toll-free at all times
- SOV Pay Toll at all times
- Transponder can be used in multiple vehicles



Monthly Trips and Violations



I-110 Trips and Violations by Month



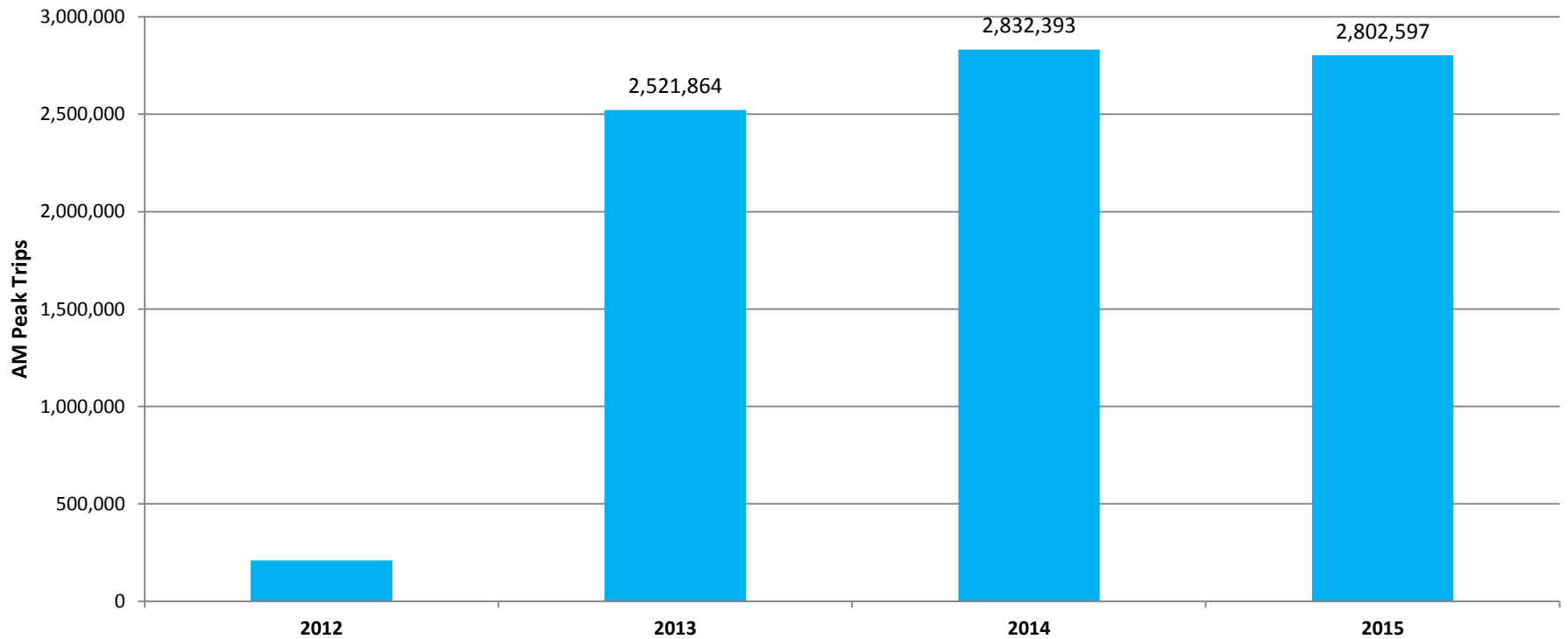
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■ Total Trips — Violation Trips

Annual AM Peak Trips



I-110 Northbound AM Peak Trips: 5 – 9 AM

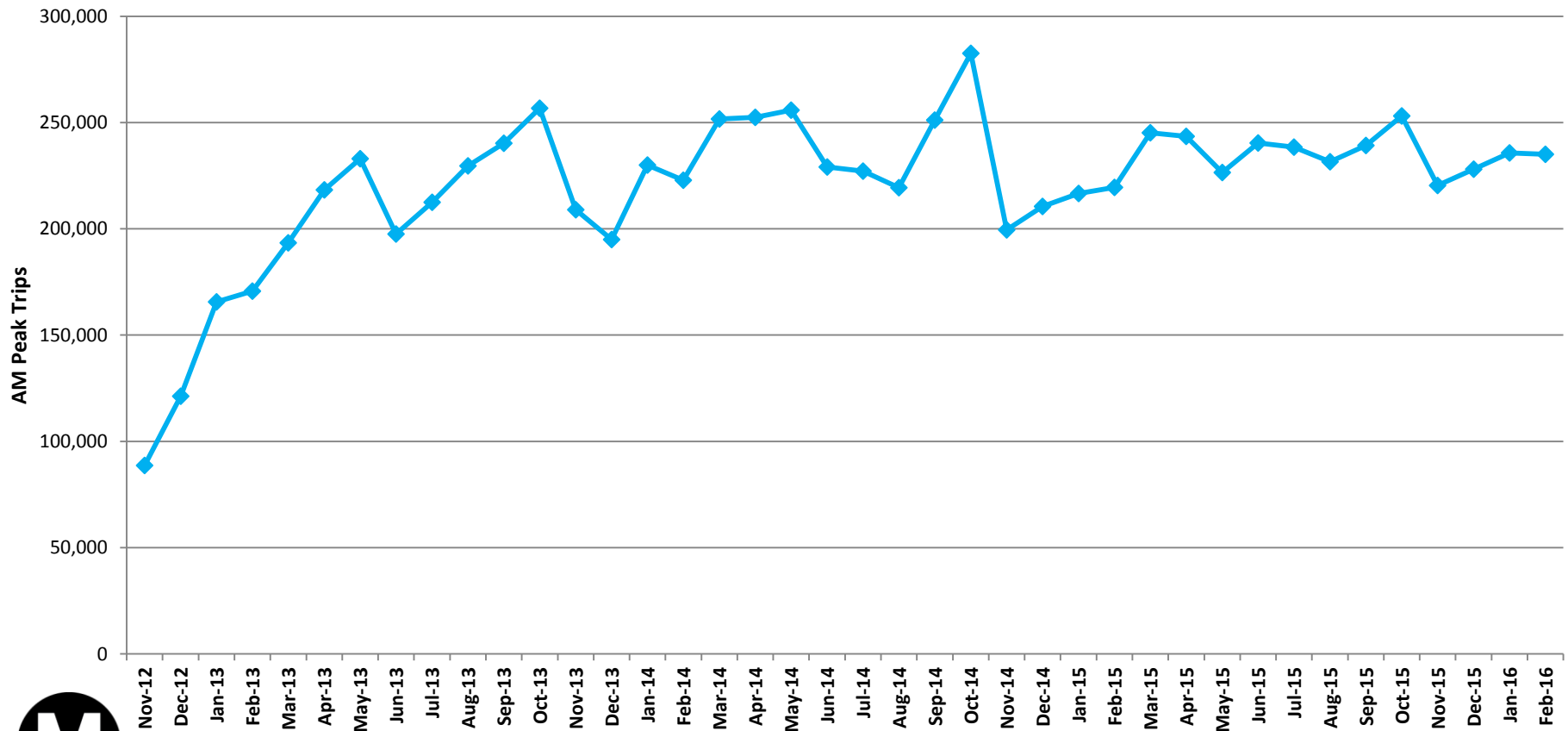


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Monthly AM Peak Trips



I-110 Northbound AM Peak Trips

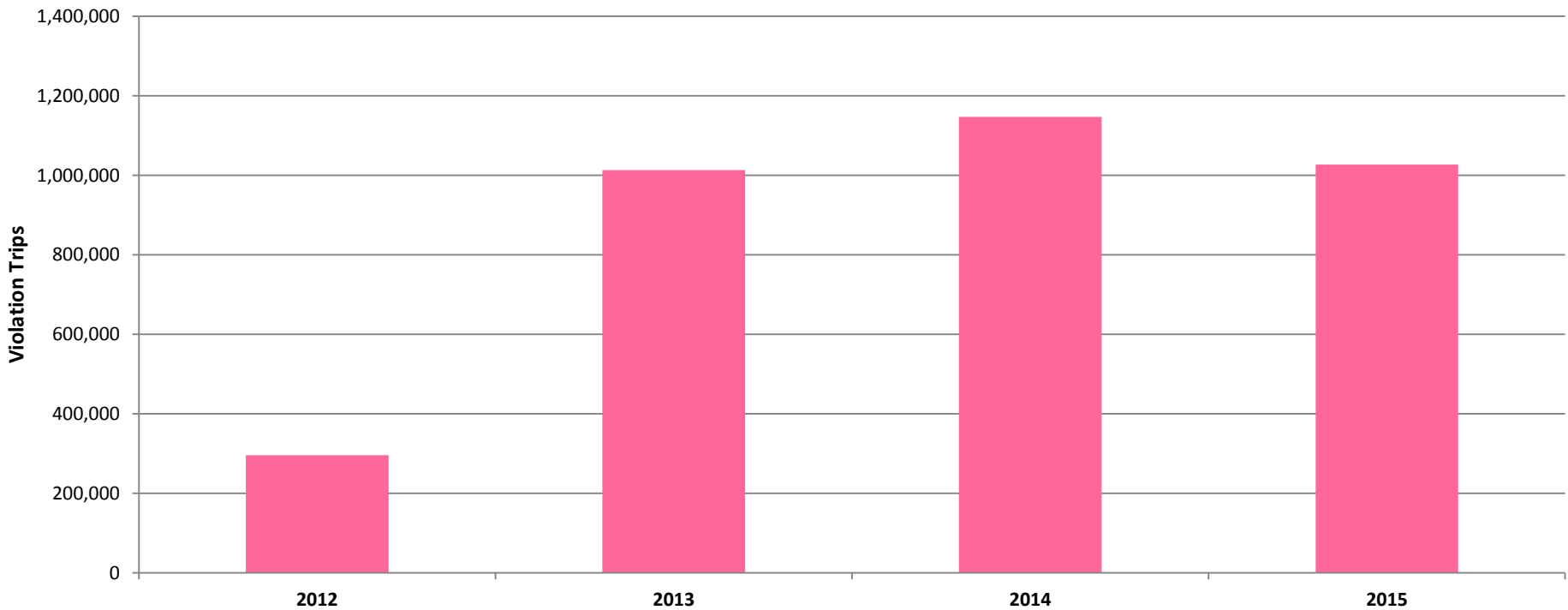


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Annual Violation Trips



I-110 Northbound Violation Trips

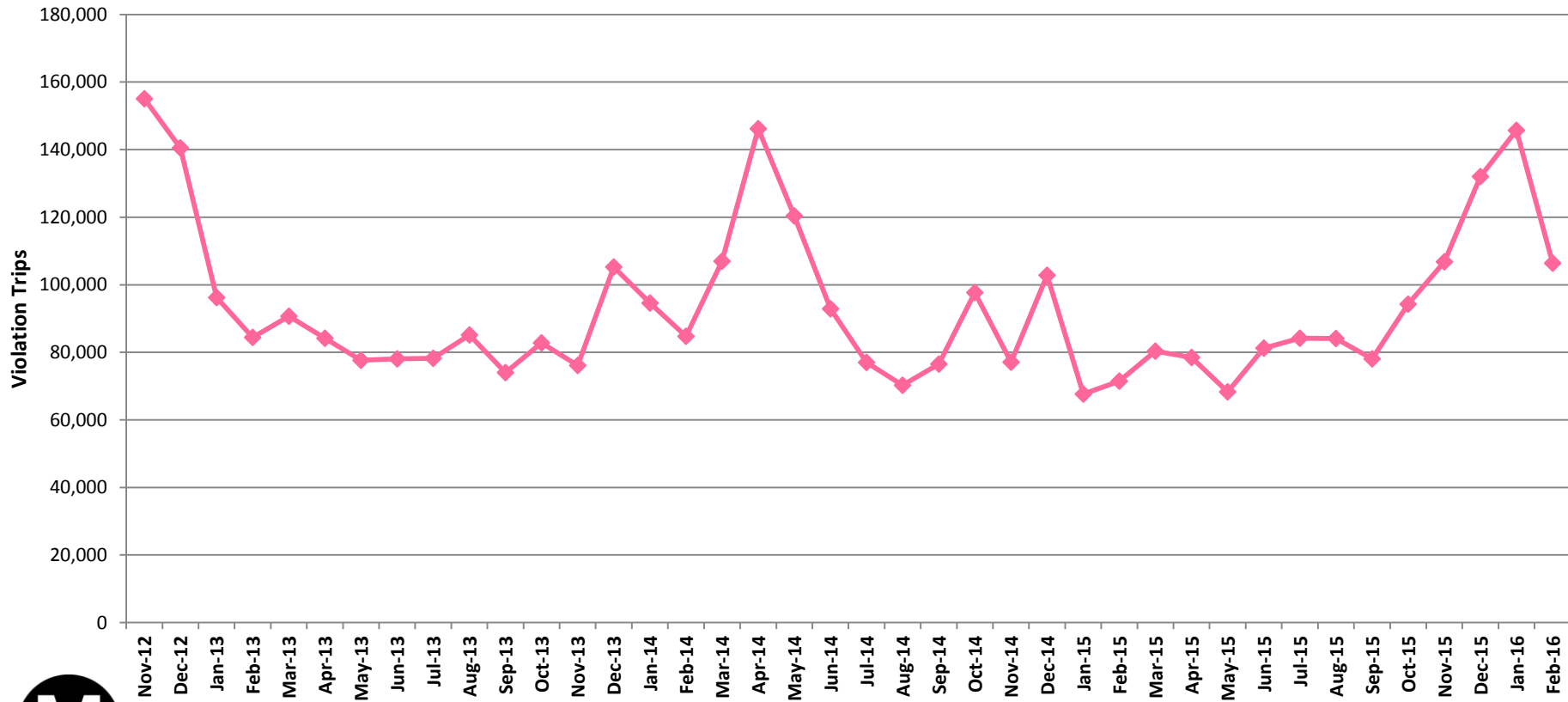


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Monthly Violation Trips



I-110 Northbound Violation Trips

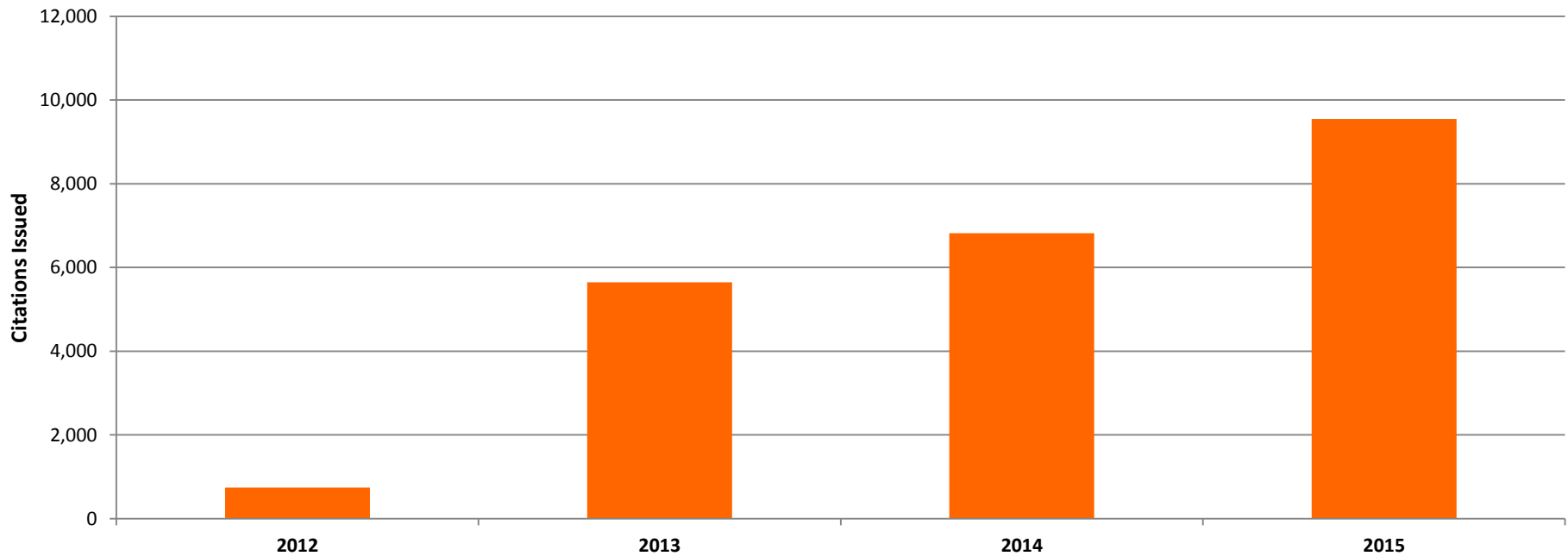


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Annual Citations Issued



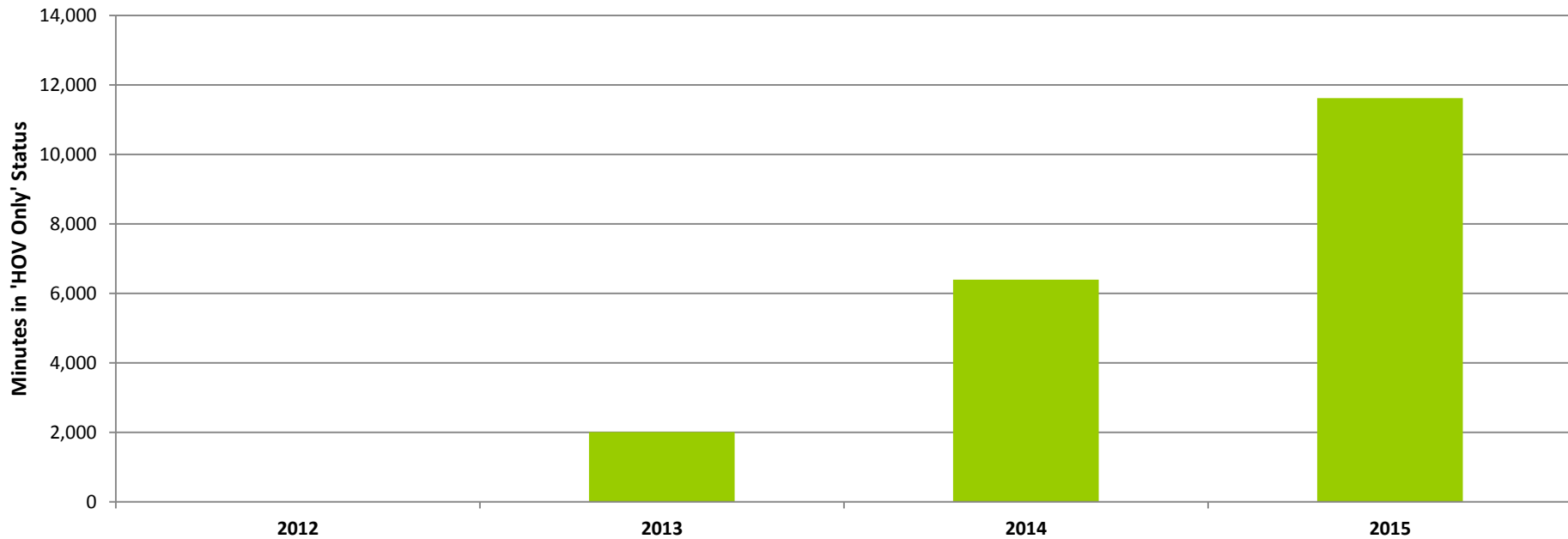
I-110 CHP Citations Issued - AM & PM Peak



Minutes in HOV Only Status by Year



I-110 Northbound 'HOV Only' Minutes

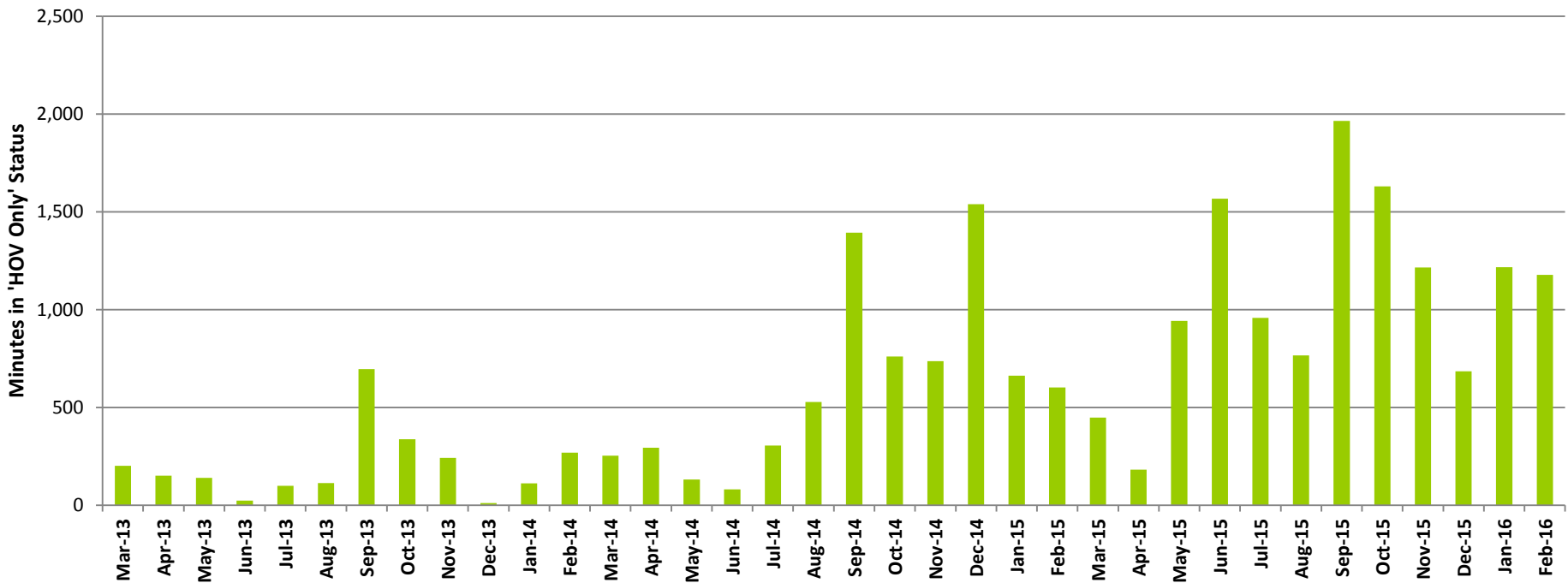


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Minutes in HOV Only Status by Month



I-110 Northbound 'HOV Only' Minutes



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Manual Occupancy Counts (Segment 4) (7 am – 10 am)



Methodology

- Situated to see occupants and Beacon lights
- AM of July 14, 2015
- 2, 2-person teams:
 - Team 1 - verbally state occupancy, other records
 - Team 2 – verbally state enforcement beacon, other records
- Performed in blocks of 30 vehicles
- Able to observe 61.3% of all vehicles
- Did one lane at a time (since in a 2 lane segment)
- Totals were compared and switch setting error rate determined
- Lane transaction data obtained and compared to enforcement beacon data to validate field observations

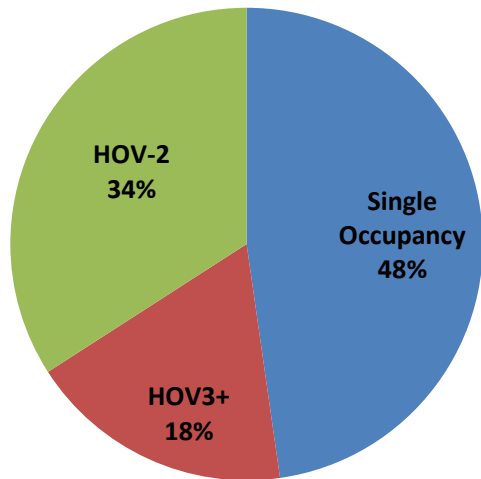


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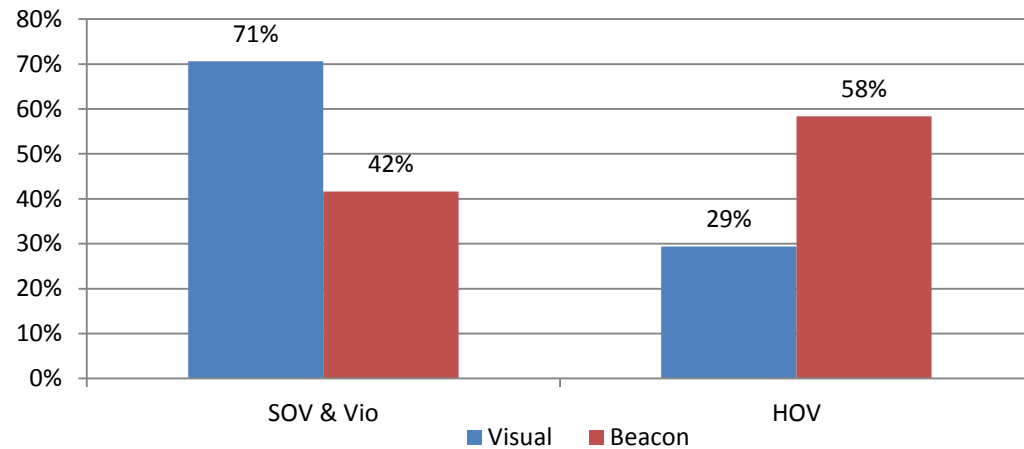
Manual Occupancy Counts (Segment 4) (7 am – 10 am)



I-110 Northbound Vehicle Occupancy - Toll System



Visual Occupancy Compared to Switch Setting as a % of Transactions



All Vehicle Trips -March 2015 thru February 2016

Demo for Automated Occupancy Counts



Objective

- 1) Establish approach to matching Xerox Vehicle Passenger Detection System (XVPDS) and Metro ExpressLanes toll transactions
- 2) Determine accuracy of XVPDS versus Manual Review
- 3) Determine Violation Rate for lane under evaluation

Test Approach and Process



1. Installation of Equipment
2. Training Data Collection
 - 24 hours of data from September 3-4
3. Model Creation
 - Development of XVPDS Model by Manual Scoring from Training Data
 - September 7-17: 17,000 Vehicles
4. Develop Process For Matching XVPDS Data to Tag Setting Data
 - September 15- October 5
 - Confirmation of Approach: October 5 - 20
5. Data Analysis for October 8: ~14,000 Vehicles
 - Manual Image Review To Establish Accuracy: Oct 28- Nov 8
 - Tag Setting Comparison to XVPDS Output: October 29



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Equipment Installation



Front Camera and Illuminator



Rear Camera and Illuminator plus Laser Trigger



Front and Side Images (1)



20151008_063007.113_0_Lane1.Frontview.tif



Specify Passenger Occupancy

Front Seat	Rear Seat
<input type="button" value="Occupied"/>	<input type="button" value="Occupied"/>
<input type="button" value="Empty"/>	<input type="button" value="Empty"/>
<input type="button" value="Skip"/>	<input type="button" value="Skip"/>

Total Passengers:

Front Statistics	Side Statistics
Accuracy:	Accuracy:
Skip Rate: 1.0000	Skip Rate: 1.0000
File Count: 2	File Count: 2

20151008_063007.104_0_Lane1.Sideview.tif



Front Unoccupied, Rear Unoccupied - XVPDS Correct

Front and Side Images (2)



20151008_130028.065_0_Lane1.Frontview.tif



Specify Passenger Occupancy

Front Seat

Occupied

Empty

Skip

Rear Seat

Occupied

Empty

Skip

Total Passengers:

Front Statistics

Accuracy:

Skip Rate: 1.0000

File Count: 6

Side Statistics

Accuracy:

Skip Rate: 1.0000

File Count: 6

20151008_130028.054_0_Lane1.Sideview.tif



Front Occupied, Rear Unoccupied – XVPDS Correct



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Xerox VPDS Model



➤ 24 hour period to establish XVPDS Model

- Captures varying light conditions, varying traffic conditions,

➤ Images captured

- ~14,093 Front Images
- ~14,093 Rear Images

➤ Images were scored for Occupancy by Manual Image Review

- Front Seat: Occupied or Not Occupied
- Rear Seat: Occupied or Not Occupied
- Data is then combined to determine: Single Occupant Vehicle or High Occupancy Vehicle
- This process creates the XVPDS Model and the system is trained or “learns” what is an Occupied Vehicle and what is Not.



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Preliminary Analysis – Phase I Demo



- October 8 Data Analyzed 14,093 vehicles over 24 hours
- Compare tag declarations against XVPDS output based on time stamp

		Total=	14093
SOV Mode or HOT Mode	Occupancy Declared By User		
Occupancy as Declared by XVPDS		SOV	HOV2/3
	SOV	32.3%	12.7%
	HOV2/3	21.8%	33.1%

Summary



- Manual Occupancy violator rates - 29% (71% SOV; 29% HOV)
- XVPDS – 21.8% Violation Rate (54% SOV; 45% HOV)
- Accuracy (i.e. when XVPDS declares the vehicle is an SOV and the vehicle is an SOV) was 94.1%
- When augmented with Manual Image Review, could be improved to 99.9% accuracy
- Pilot installation where XVPDS was not directly tied to the Toll Collection System
- Matching was based on XVPDS and Toll System time stamps
- With additional integration, tuning, and calibration the results would be improved



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Next Steps



- Xerox currently testing the occlusion rate in 2nd lane (Phase II of Demo)
- Once rate is determined Metro will make a decision whether to move forward or not
- If decide to move forward, a Concept of Operations will be prepared
- Present to Metro Board for approval
- Begin installation on I-110 and I-10



For more Information:
Kathy McCune
213-922-7241
mccunek@metro.net