



Estimation and Effects of Vehicle Mix on On-road Emissions Estimates

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2005 Emissions Inventory

Las Vegas, Nevada

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Vehicle Mix: Largest Uncertainty in NO_x and PM On-Road Emissions Modeling?

- **Total VMT relatively well understood**
- **Heavy-duty vehicles produce 10 – 100 times the emissions per vehicle mile as light-duty vehicles**
- **Fraction of vehicles that meet HDV emission standards not well understood with most link level modeling**
- **Fraction of HDV vehicles varies dramatically**
 - Temporally primarily by time of day and day of week
 - Spatially determined from road type designation



How to Determine Mix (Counting Cars & Trucks)

- **Automatic Traffic Recorders (ATR)**
 - Tubes, Loops, Weigh-in-motion
 - Number of axles
 - Axle spacing
- **ATR data from FHWA VTRIS Database**
- **General FHWA vehicle classification**
- **EPA vehicle classification**

FHWA Classification

(Too general to be useful)



Rural		Urban	
Code	Classification Description	Code	Classification Description
1	Principal Arterial – Interstate	11	Principal Arterial – Interstate
2	Principal Arterial – Other	12	Principal Arterial – Freeways
6	Minor Arterial	14	Principal Arterial – Other
7	Major Collector	16	Minor Arterial
8	Minor Collector	17	Collector
9	Local System	19	Local System

FHWA Class	VTRIS Vehicle Type
1	Motorcycle
2	Passenger cars
3	Other 2-axle, 4-tire single unit vehicles
4	Buses
5	2-axle, 6-tire single-unit vehicles
6	3-axle, 6-tire single-unit vehicles
7	4+ axle single-unit vehicles
8	4 or less axle combination vehicles
9	5-axle combination vehicles
10	6+ axle combination vehicles
11	5-axle multitrailer vehicles
12	6-axle multitrailer vehicles
13	7+ axle multi-trailer vehicles
14	Unclassified
15	Unclassifiable

Easton Chain Up Area WSDOT ©



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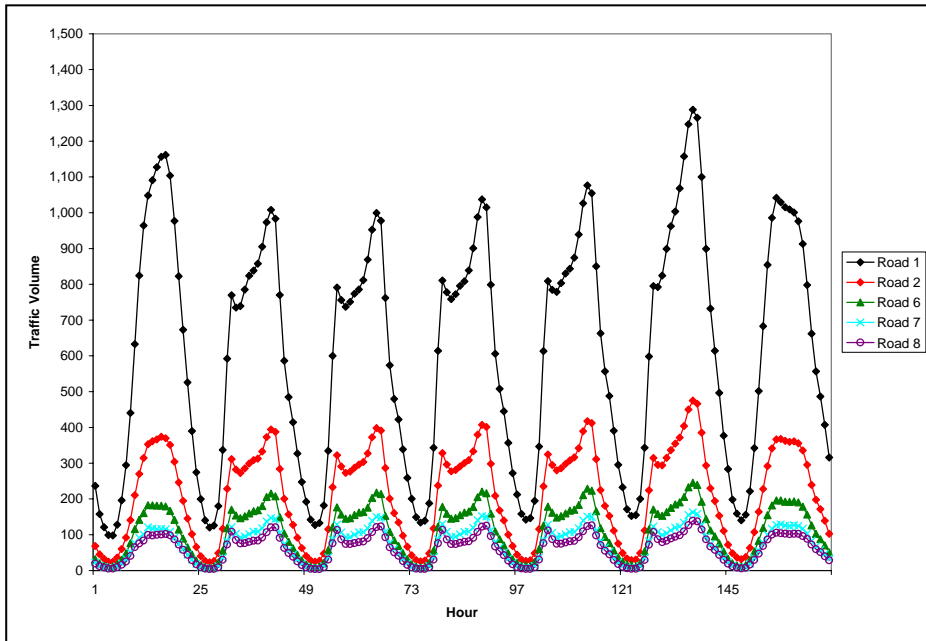
EPA Classification (from NEI) (Tricky Business; What's a Truck?)

MOBILE Weight Ratings/FHWA Types	Passenger Car FHWA #2 ¹	Other 2-axle 4-tire, FHWA #3	Single-Unit Trucks, FHWA #5-7	Combination Trucks, FHWA #8-13
LDV	52.3%	98.3% (0.524% Class 2b)	0%	0%
6,000 lbs or less LDGT1 & LDGT2	35.4%		24%	0%
6001 –10,000 ² LDGT3, LDGT4, Class 2b	12.3% (0% Class 2b)		21%	0.77%
10,001 – 14,000 Class 3	0	0.44	12	0.61
14,001 –16,000 Class 4	0	0.14	5.0	0.65
- 19,500 Class 5	0	0.13	4.8	0.64
- 26,000 Class 6	0	0.24	12	3.3
- 33,000 Class 7	0	0.12	6.8	3.7
- 60,000 Class 8a	0	0.05	11	28
>60,000 Class 8b	0	0.006	2.5	62

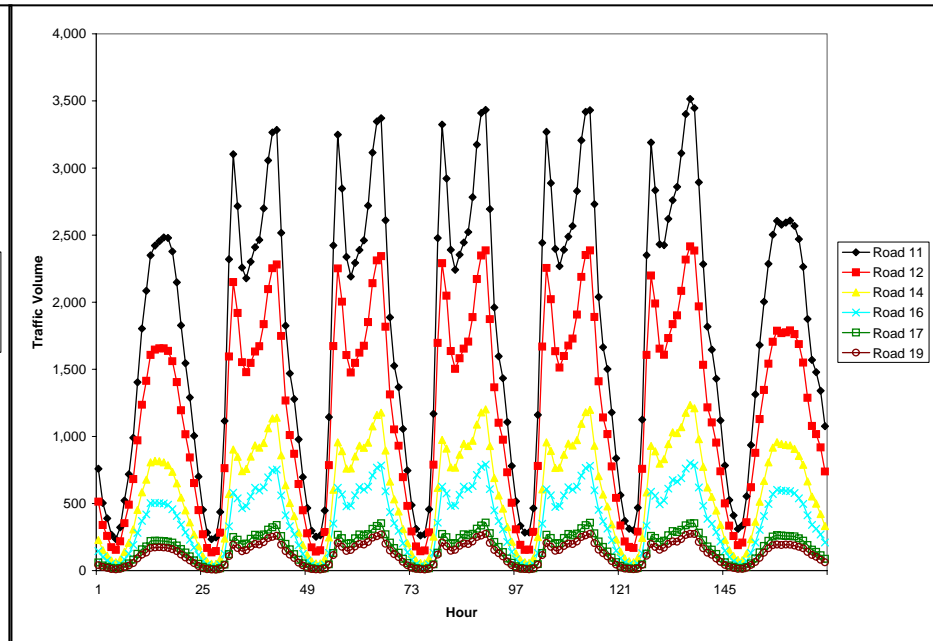


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Total Traffic Volume (Sunday – Saturday Hourly)



Rural

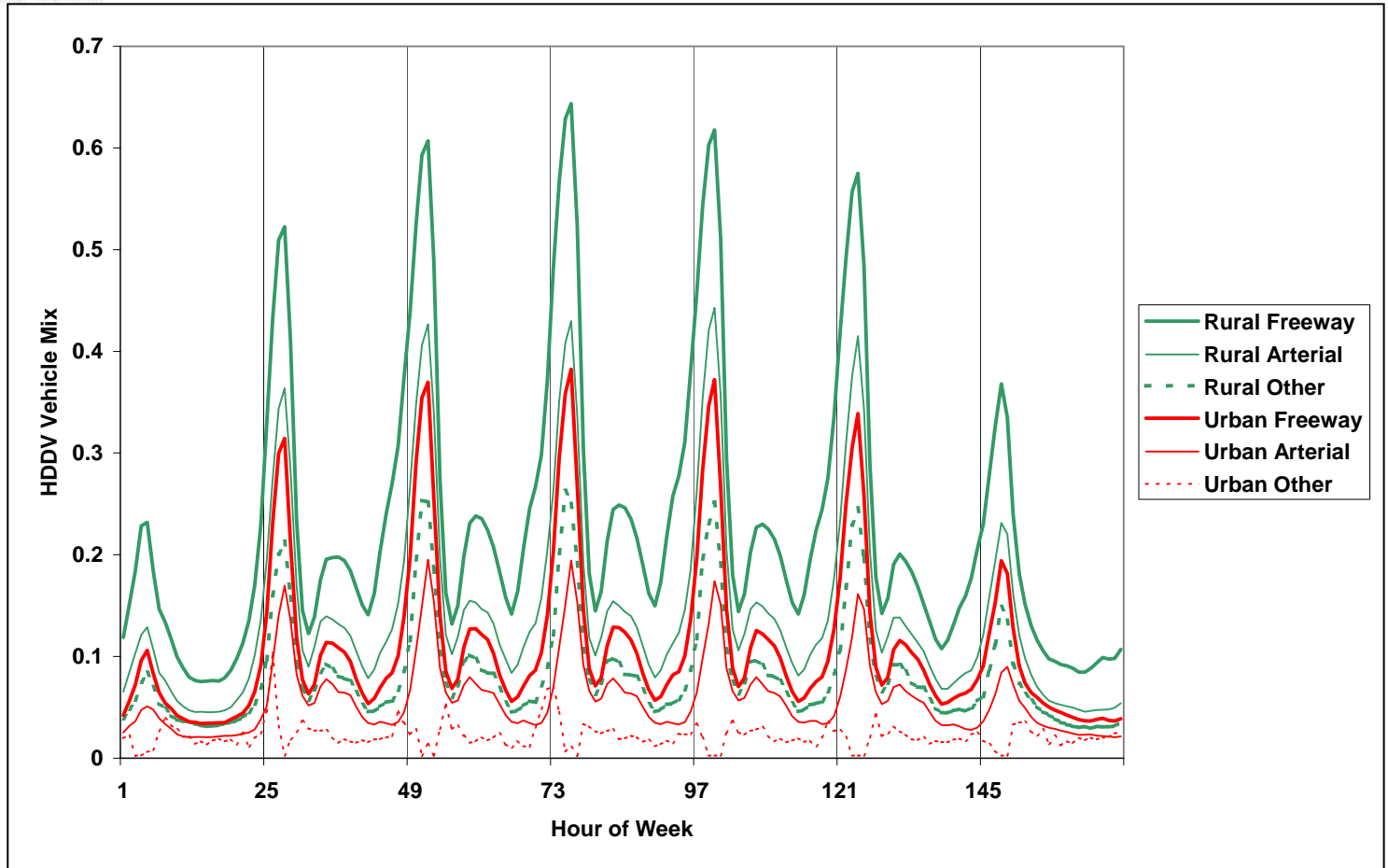


Urban



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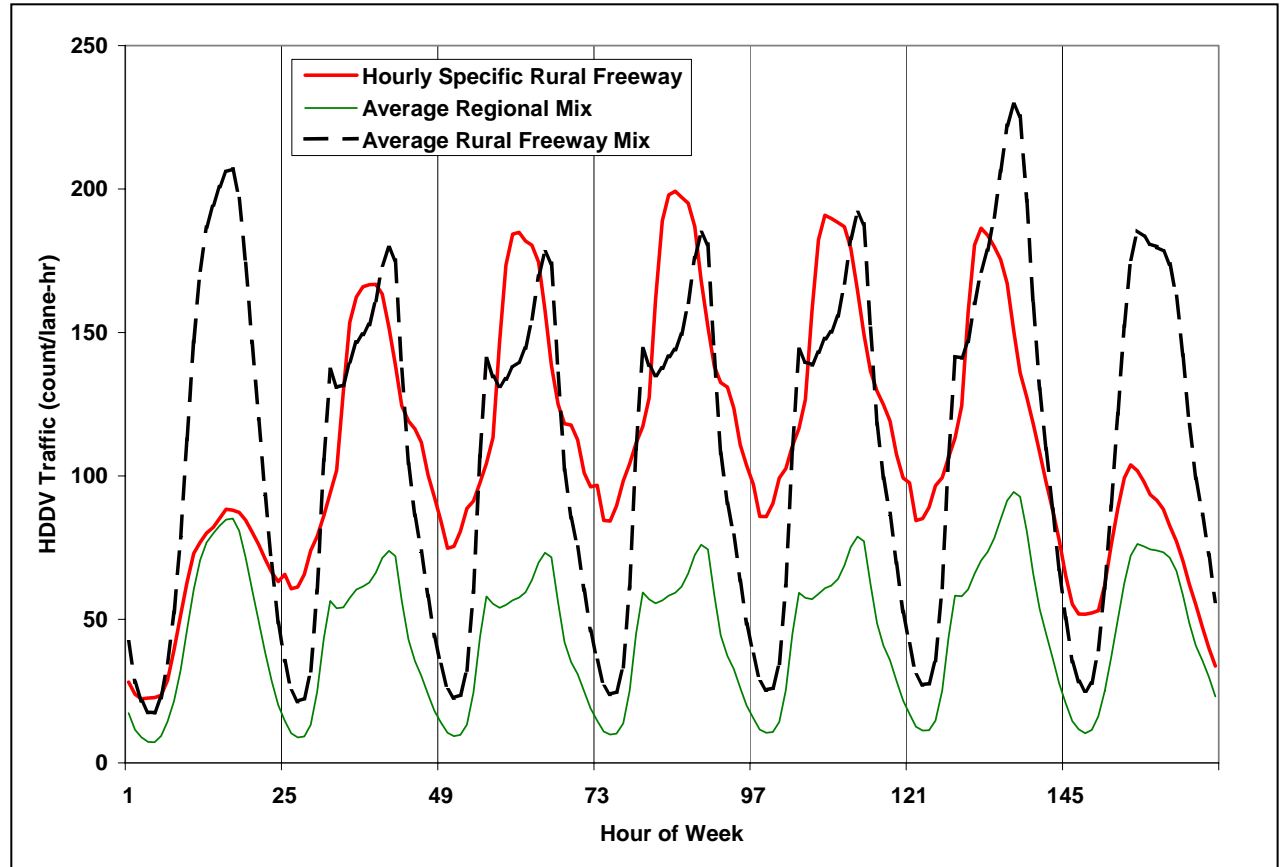
HDDV Vehicle Mix (Fraction of Total VMT)



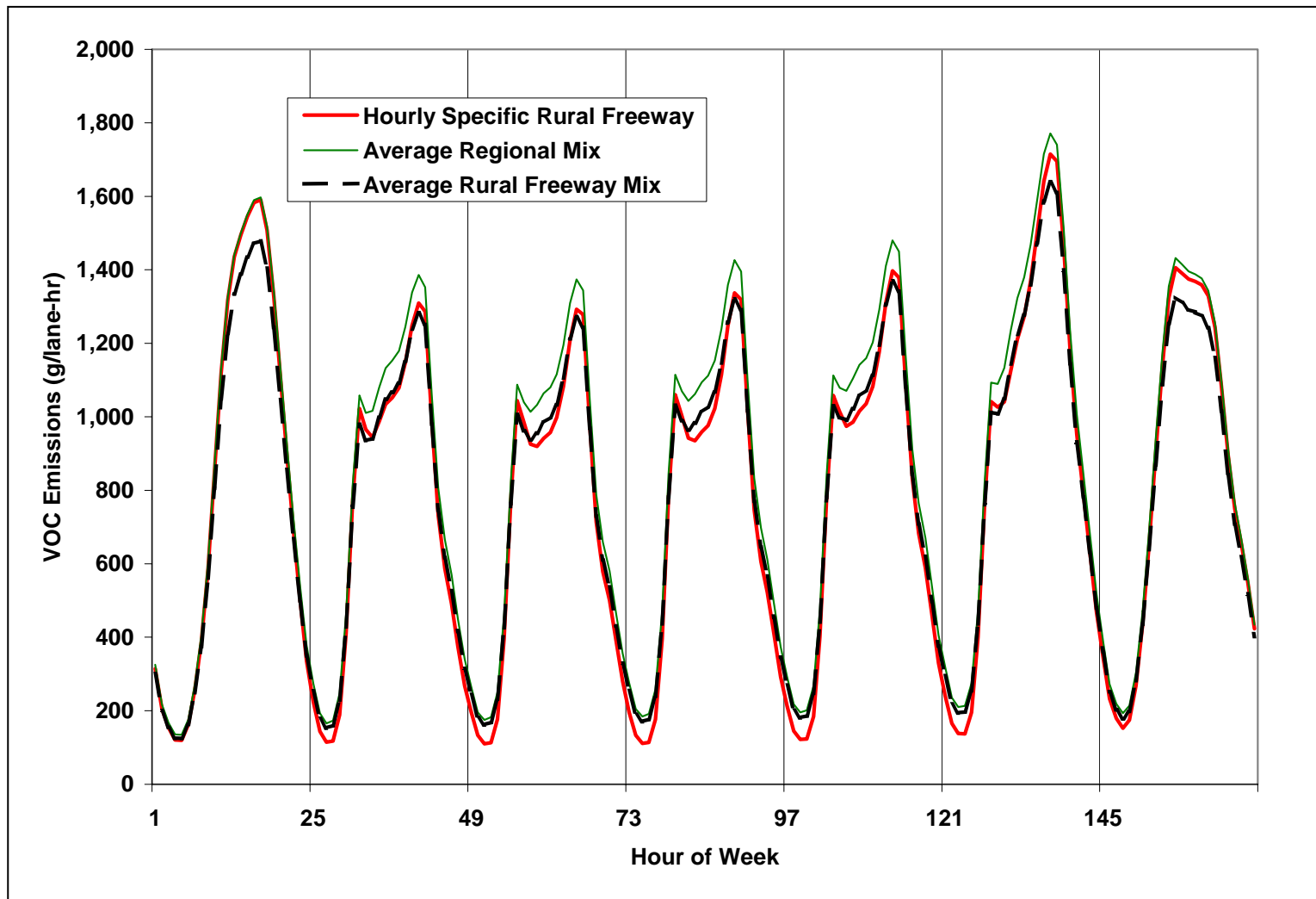


Vehicle Mix Choices

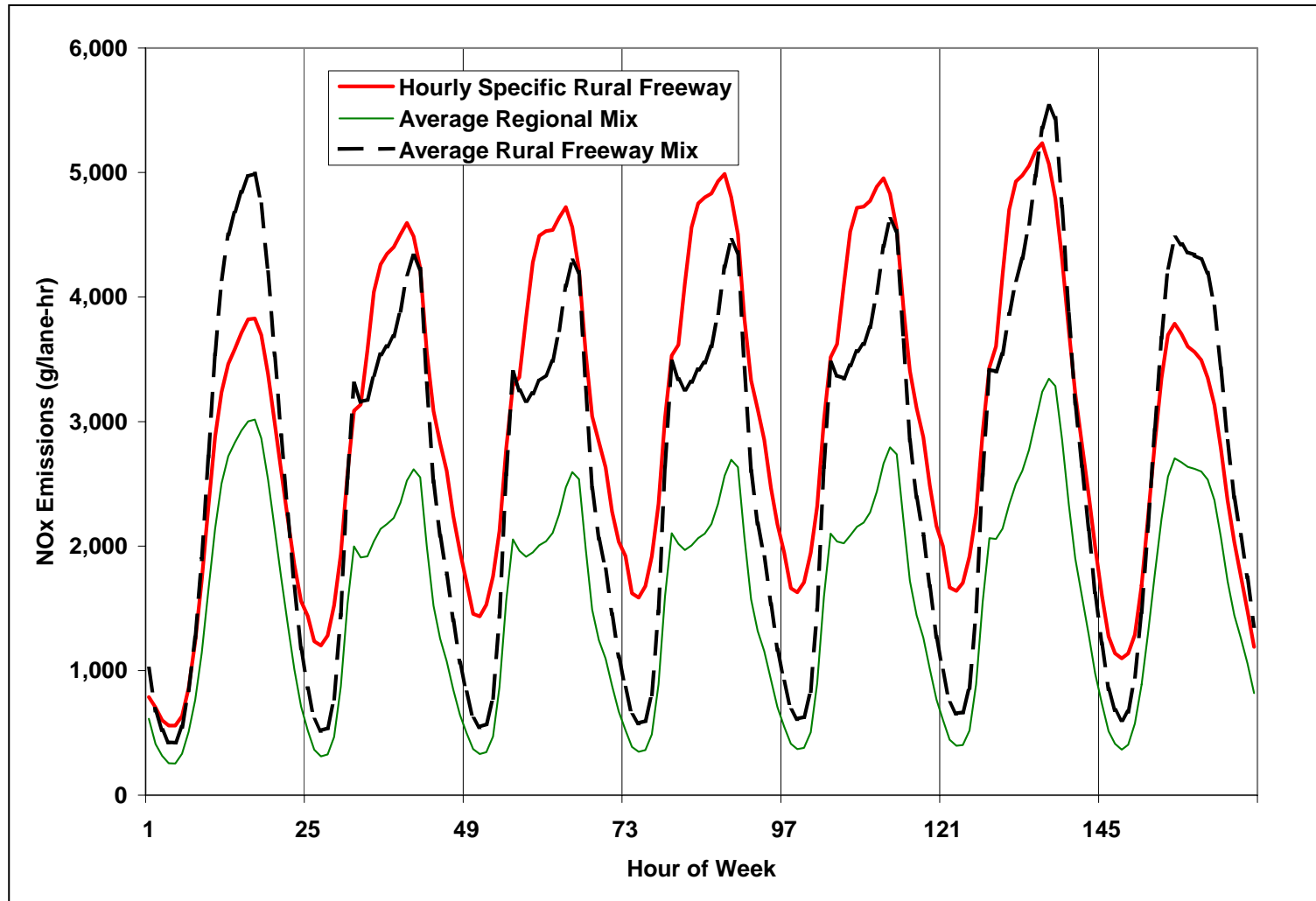
- **Apply 3 mixes**
 - Temporal and Spatial
 - Spatial
 - General
- **Total HDDV Traffic Volume Estimates**



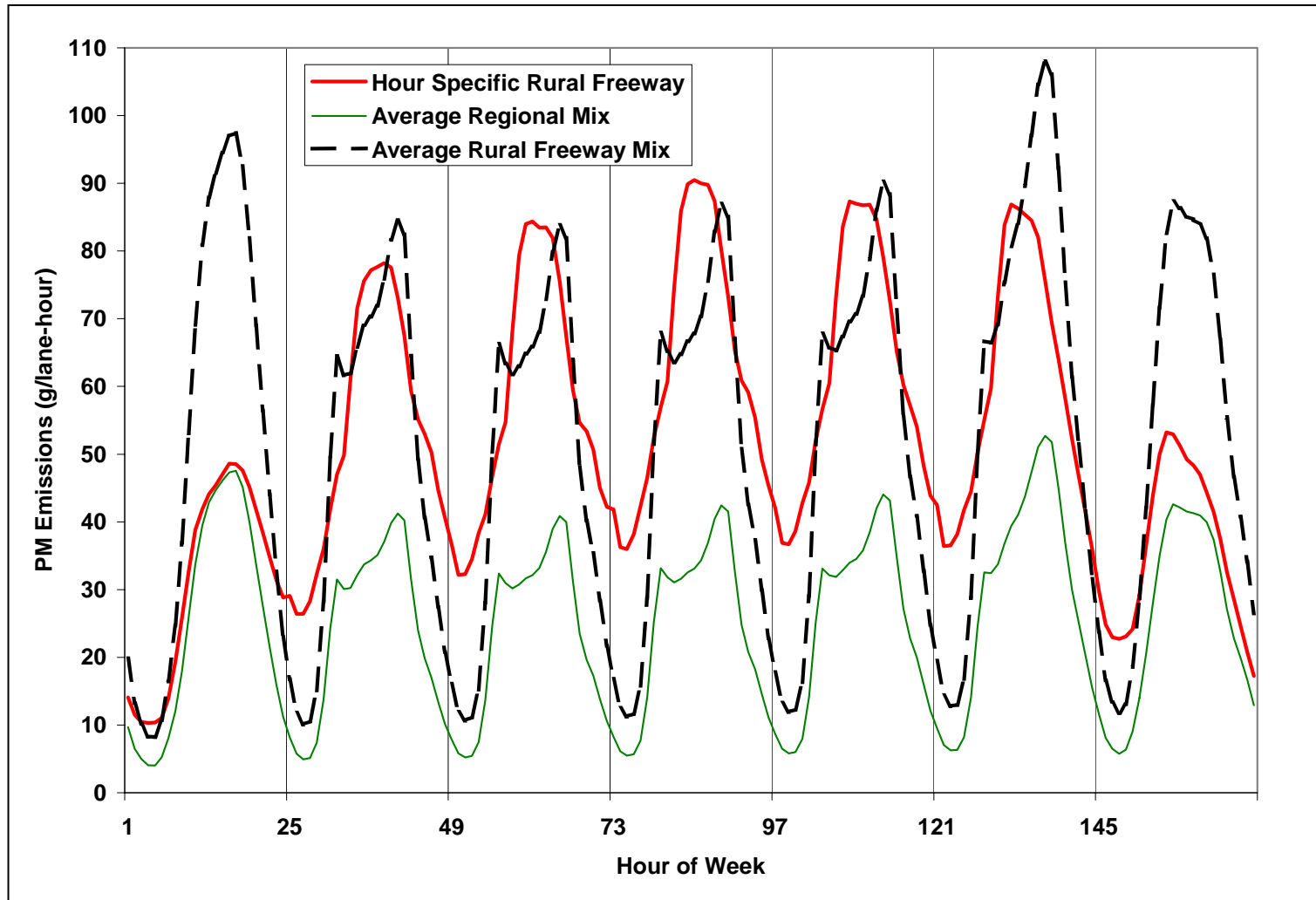
VOC Emission Effects



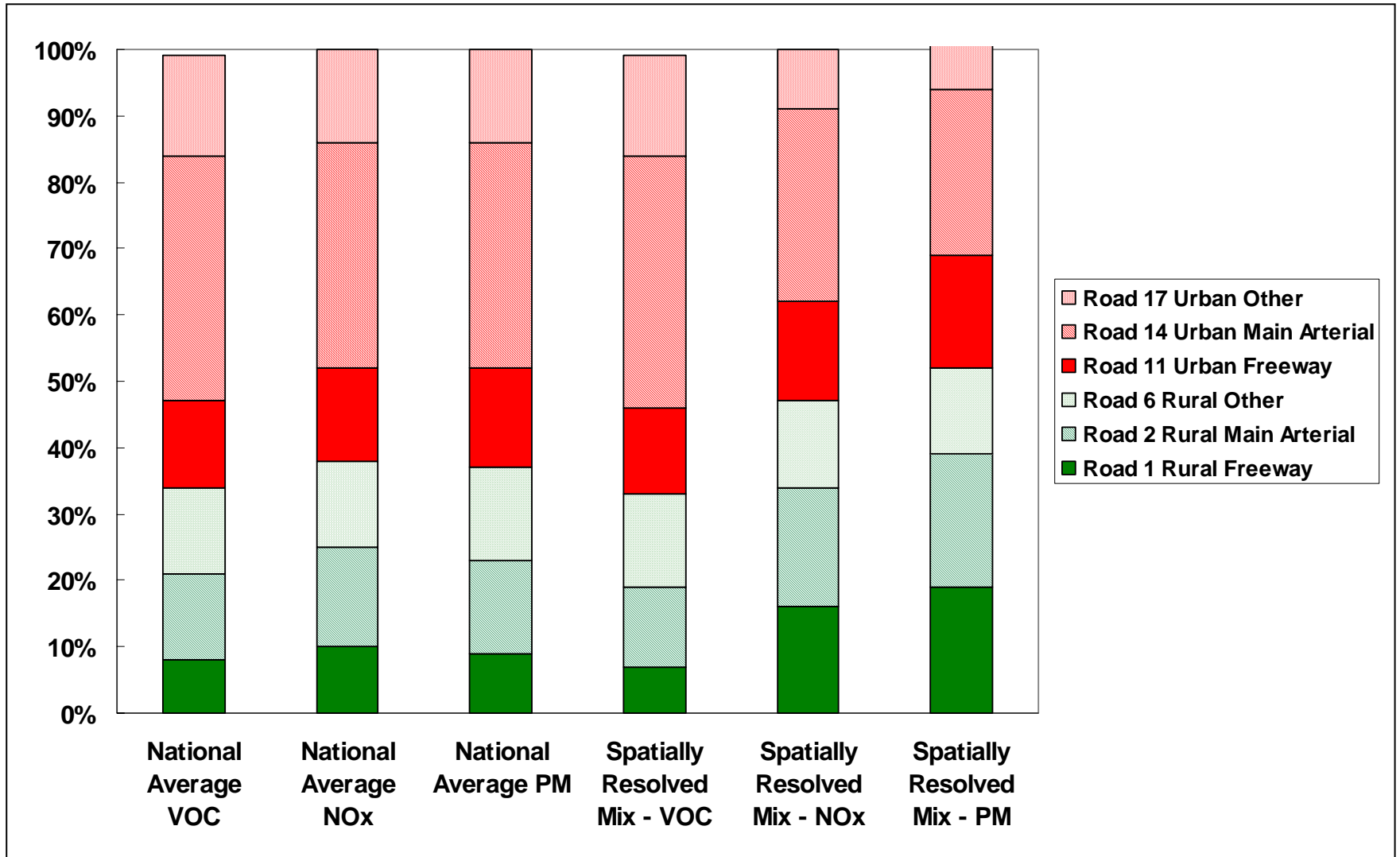
NOx Emission Effect



PM Emission Effects



Spatial Resolution





Considerations

- **FHWA and EPA vehicle classification**
 - State registrations
 - Out of state/area or through traffic
 - Weight designation mismatch
 - Weigh in motion refinement
- **Site Selection Bias**
 - Travel demand model refinement for trucks
 - Regional zones (industrial districts or intermodal zones for ports/rail/truck)
 - Insufficient sample sizes for less traveled roads



Conclusions (Easy or Difficult?)

- Rural roadways have higher fractions of HDDV
- Higher volume roads (freeways) have higher HDDV mix
- Higher HDDV mix overnight and during the week
- Higher HDDV translates to higher NO_x and PM
- Affects the overall estimates, and spatial and temporal distribution of the NO_x and PM emissions

Acknowledgements

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- **Other similar support by LADCO**
- **And WSDOT for the pictures**