



CENTRAL TEXAS
Regional Mobility Authority

***183A Toll Road
2009 Vehicle Emissions Study***

October 16, 2009

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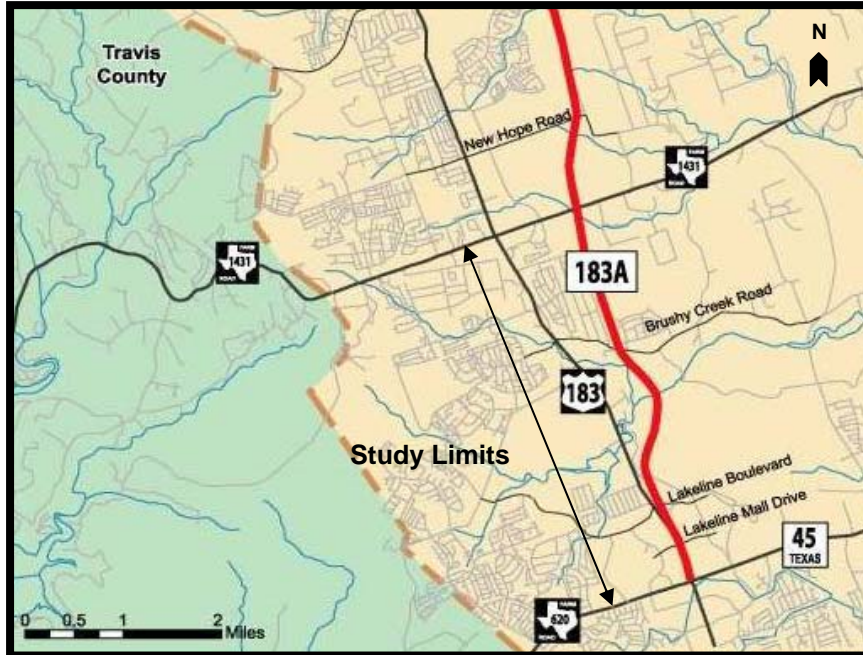
1. Executive Summary

In June, 2009, a vehicle emissions study was conducted and constrained to only evaluate the differences in fuel usage, emissions and travel time between the parallel facilities of US 183 and the 183A Toll Road. The study area was bounded to the south by RM 620 and FM 1431 to the north. The vehicle emission study process consisted of a series of trial runs using two test vehicles under actual traffic conditions; including both AM and PM peak periods. The test vehicles consisted of a standard sedan and an SUV. Each vehicle was equipped with special emissions testing equipment.

Based on data obtained from the vehicle emissions study, current traffic counts and previous time travel analysis, the following observations are noted and conclusions can be made for motorists traveling the 183A Toll Road as compared to traveling on US 183:

- Average travel time was reduced by approximately 6-7 minutes
- Compared to US 183 prior to construction of 183A Toll Road, average time travel was reduced by approximately 15 minutes; a time reduction of over 75%
- All emissions were reduced for both peak and off-peak hours
- Fuel consumption was reduced for both peak and off-peak hours
- Estimated annual fuel savings per vehicle of 108 gallons with an annual cost savings of \$281
- Total estimated annual fuel savings of 664,723 gallons with cost savings of \$1,728,280
- Data indicates that for every vehicle that uses the 183A Toll Road, there is significant reduction in overall emissions within the study area when compared to all vehicles using US 183 only
- Although the total life cycle analysis of the carbon footprint was not evaluated as part of this study, the study demonstrates a reduction of vehicle carbon footprint for the 183A Toll Road through a reduction of vehicle emissions as seen in the CO₂ and CO calculated annual reductions
- Annual reduction in emissions and fuel consumption was calculated to be:
 - Carbon Dioxide (CO₂) emissions reduced by 28% (7,231.9 Tons/Yr)
 - Carbon Monoxide (CO) emissions reduced by 47% (21.8 Tons/Yr)
 - Nitrogen Oxides (NO_x) reduced by 56%
 - Total Hydrocarbon (THC) emissions reduced by 37%
 - Fuel consumption reduced by 26%

Location Map



2. Background

In June, 2009, a vehicle emissions study was conducted and constrained to only evaluate the differences in fuel usage, emissions and travel time between the parallel facilities of US 183 and the 183A Toll Road. US 183 is a four-lane undivided highway with signalized at-grade intersections and many driveway accesses. The 183A Toll Road is a limited access highway class road. Two different vehicles, a small sedan and a large SUV, were used for the study to capture data from vehicles generally representative of size class vehicles that utilize the two roads. Both vehicles made several laps on US 183 and 183A Toll Road, between RM 620 and FM 1431, during peak and off-peak hours. Traffic counts were taken at US 183 and 183A Toll Road during the study to ensure average traffic conditions were being represented and to discount any anomalies such as a traffic accident on the road.

3. Analysis Process and Assumptions

Two vehicles, a sedan and an SUV, were analyzed as part of the Emissions Study. Each vehicle made passes along both corridors, US 183 and 183A Toll Road, during peak and off-peak times. During each pass, vehicle emissions, travel times, and fuel efficiencies were recorded. The emissions testing equipment consisted of SEMTECH-DS and EFM 2 Units to measure the emissions via a sampler manifold connected to the exhaust pipe. Field data from the emissions study and the following basic assumptions and approach that was utilized in developing the analysis for the study were as follows:

- Two different types of representative test vehicles, traveling both US 183 and 183A Toll Road within the limits of RM 620 and FM 1431, were utilized
- Traffic was assumed to consist of 57% sedans and 43% SUVs based on the 2002 Texas Transportation Profile produced by U.S. Department of Transportation
- Daily traffic counts over a period from January 2009 to June 2009 from the Park Street Mainlane toll gantry on 183A Toll Road were used to estimate the peak, off-peak, and yearly traffic volumes on the 183A Toll Road
- Annual per vehicle emissions and fuel efficiencies are based on commuter traffic (5 weekday roundtrips during peak hours)
- Per vehicle emissions and fuel efficiencies were calculated using an average 183A Toll Road traffic count and measurement data from both the sedan and SUV study vehicles
- The measured emissions rates and fuel efficiencies for US 183 were compared to the 183A Toll Road emissions rates and fuel efficiencies
- Total life cycle emissions analysis comparison of the two facilities was beyond the scope of this study. The study was constrained to the contrast of vehicle emissions between free flow 183A Toll Road and obstructed flow US 183 facilities

4. Discussion

During the study period, vehicles traveling the 183A Toll Road experienced lower levels of gas emissions and greater fuel efficiency when compared to those traveling on US 183. The reductions in emissions by vehicles traveling on the 183A Toll Road as compared to those traveling US 183 were greatest during peak hour traffic. The following tables compare the emissions and fuel efficiencies of actual traffic on the 183A Toll Road to emissions levels that those same vehicles would have experienced traveling on US 183.

Southbound vehicles traveling between FM 1431 and RM 620 during the morning peak hour (7am-8am) experienced the following reductions:

Table 1. Measured Time/Fuel/Emissions Comparison Southbound AM Peak Hours (per vehicle)

	Units	US 183	183A Toll Road	Reduction
Time	Min.	9.84	4.07	5.77
*Fuel	Gal.	0.2285	0.1734	24%
CO₂	Lbs.	4.6691	3.4810	25%
CO	Lbs.	8.229197E-03	5.123952E-03	38%
NOX	Lbs.	3.273296E-04	1.893608E-04	42%
kNOX	Lbs.	3.398273E-04	1.971510E-04	42%
THC	Lbs.	5.734488E-05	3.961251E-05	31%

In 2004, prior to the construction and operation of 183A Toll Road, the CTRMA General Engineering Consultant conducted a limited southbound travel time analysis on US 183 during morning peak hours between FM 1431 and RM 620. This analysis indicated a travel time of approximately 19 minutes. Compared to the travel times recorded during the study of US 183, the travel time savings on 183A Toll Road is approximately 15 minutes; a time reduction of over 75%.

Table 2. Calculated Time/Fuel/Emissions Comparison Southbound AM Peak Hours (All Traffic)

	Units	US 183	183A Toll Road	Reduction
Time	Hrs.	3,483	1,440	2,043
*Fuel	Gal.	485	368	24%
CO₂	Lbs.	9,912	7,390	25%
CO	Lbs.	17.47	10.88	38%
NOX	Lbs.	0.69	0.40	42%
kNOX	Lbs.	0.72	0.42	42%
THC	Lbs.	0.12	0.08	31%

Northbound vehicles traveling between RM 620 and FM 1431 during the afternoon peak hour (5pm-6pm) experienced the following reductions:

Table 3. Measured Time/Fuel/Emissions Comparisons Northbound PM Peak Hours (per vehicle)

	Units	US 183	183A Toll Road	Reduction
Time	Min.	10.87	3.86	7.01
*Fuel	Gal.	0.3001	0.1924	36%
CO ₂	Lbs.	6.0441	2.3797	61%
CO	Lbs.	1.615052E-02	6.231098E-03	61%
NOX	Lbs.	4.176683E-04	8.978536E-05	79%
kNOX	Lbs.	4.152233E-04	2.179590E-04	48%
THC	Lbs.	5.610619E-05	4.051608E-05	28%

Table 4. Calculated Time/Fuel/Emissions Comparisons Northbound PM Peak Hours (All Traffic)

	Units	US 183	183A Toll Road	Reduction
Time	Hrs.	3,984	1,414	2,570
*Fuel	Gal.	660	423	36%
CO ₂	Lbs.	13,297	5,235	61%
CO	Lbs.	35.53	13.71	61%
NOX	Lbs.	0.92	0.20	79%
kNOX	Lbs.	0.91	0.48	48%
THC	Lbs.	0.12	0.09	28%

Based on the results of the emissions study data obtained, it is estimated that drivers traveling between RM 620 and FM 1431 could experience the following annual reductions in emissions and fuel consumption by using the 183A Toll Road instead of US 183:

Table 5. Average Annual Emissions and Fuels Consumption (per vehicle)

	Units	US 183	183A Toll Road	Reduction
*Fuel	Gal.	367.08	258.92	29%
CO ₂	Lbs.	7,426.60	4,438.28	40%
CO	Lbs.	1.588782E+01	7.656118E+00	52%
NOX	Lbs.	5.949743E-01	2.386315E-01	60%
kNOX	Lbs.	6.086185E-01	3.136078E-01	48%
THC	Lbs.	8.533804E-02	5.784640E-02	32%

Table 5. Average Annual Emissions and Fuels Consumption (per vehicle)

	Units	US 183	183A Toll Road	Reduction
*Fuel	Gal.	367.08	258.92	29%
CO₂	Lbs.	7,426.60	4,438.28	40%
CO	Lbs.	1.588782E+01	7.656118E+00	52%
NOX	Lbs.	5.949743E-01	2.386315E-01	60%
kNOX	Lbs.	6.086185E-01	3.136078E-01	48%
THC	Lbs.	8.533804E-02	5.784640E-02	32%

Table 6. Total Annual Emissions and Fuel Consumption (All Traffic - peak and off-peak)

	Units	US 183	183A Toll Road	Reduction	
*Fuel	Gal.	2,519,161	1,854,438	26%	664,723 Gal./Yr
CO₂	Lbs.	50,753,389	36,289,591	28%	7,231.9 Tons/Yr
CO	Lbs.	92,488	48,846	47%	21.8 Tons/Yr
NOX	Lbs.	5,328	2,351	56%	1.5 Tons/Yr
kNOX	Lbs.	5,528	2,557	54%	1.5 Tons/Yr
THC	Lbs.	690	432	37%	0.1 Tons/Yr

Based on the fuel calculations, it is estimated that drivers traveling between RM 620 and FM 1431 could experience the following annual fuel and cost savings by using the 183A Toll Road instead of US 183.

Table 7. Estimated Fuel and Cost Savings Per Year Comparisons

	Units	US 183	183A Toll Road	183A Toll Road Fuel Savings	183A Toll Road Cost Savings at \$2.60/gal.
Per Vehicle	Gal.	367.08	258.92	108.16	\$281.22
**Total Annual	Gal.	2,519,161	1,854,438	664,723	\$1,728,279.80

* Fuel consumption calculations are determined from the exhaust mass flow rate and the calculated air/fuel mass fraction. Fuel economy is computed for a test period by summing the fuel consumed and dividing by the distance traveled.

**Based on an annual average traffic count of 9,865,830 vehicles; from CTRMA Toll Data.

5. Study Observations / Conclusions

Based on data obtained from the emissions study, current traffic counts, and previous time travel analysis, the following observations are noted and conclusions can be made for motorists traveling the 183A Toll Road as compared to traveling on US 183 (refer to the Appendices A and B for additional supportive detail):

- Average travel time was reduced by approximately 6-7 minutes
- Compared to US 183 prior to construction of 183A Toll Road, average time travel was reduced by approximately 15 minutes; a time reduction of over 75%
- All emissions were reduced for both peak and off-peak hours
- Fuel consumption was reduced for both peak and off-peak hours
- Estimated annual fuel savings per vehicle of 108 gallons with cost savings of \$281
- Total estimated annual fuel savings of 664,723 gallons with an annual cost savings of \$1,728,280
- Data indicates that for every vehicle that uses the 183A Toll Road, there is significant reduction in overall emissions within the study area when compared to all vehicles using US 183 only
- Although the total life cycle analysis of the carbon footprint was not evaluated as part of this study, the study demonstrates a reduction of vehicle carbon footprint for the 183A Toll Road through a reduction of vehicle emissions as seen in the CO₂ and CO calculated annual reductions
- Annual reduction in emissions and fuel consumption was calculated to be:
 - Carbon Dioxide (CO₂) emissions reduced by 28% (7,231.9 Tons/Yr)
 - Carbon Monoxide (CO) emissions reduced by 47% (21.8 Tons/Yr)
 - Nitrogen Oxides (NO_x) reduced by 56%
 - Total Hydrocarbon (THC) emissions reduced by 37%
 - Fuel consumption reduced by 26%



Appendix A

Supporting Calculations

Appendix A - Supporting Calculations

Travel Analysis - AM Peak

		Sedans						
		Field Data (per vehicle)			Traffic Count		Total	
Time/Fuel/Emissions Comparison Southbound AM Peak Hours	US 183	Seconds	564.00					
		Distance	4.15					
		MPG	24.31	0.17 gal/car	1210 Sedans	206.53 gals		
		CO2	380.88 g/mi/car	3.48 lbs/car	1210 Sedans	4216.29 lbs		
		CO	0.22150 g/mi/car	0.00203 lbs/car	1210 Sedans	2.45 lbs		
		NOX	0.03025 g/mi/car	0.00028 lbs/car	1210 Sedans	0.33 lbs		
		kNOX	0.03125 g/mi/car	0.00029 lbs/car	1210 Sedans	0.35 lbs		
		THC	0.01000 g/mi/car	0.00009 lbs/car	1210 Sedans	0.11 lbs		
	183A Toll Road	Seconds	236.25					
		Distance	4.29					
		MPG	33.64	0.13 gal/car	1210 Sedans	154.47 gals		
		CO2	270.36 g/mi/car	2.56 lbs/car	1210 Sedans	3096.86 lbs		
		CO	0.19975 g/mi/car	0.00189 lbs/car	1210 Sedans	2.29 lbs		
		NOX	0.01500 g/mi/car	0.00014 lbs/car	1210 Sedans	0.17 lbs		
		kNOX	0.01525 g/mi/car	0.00014 lbs/car	1210 Sedans	0.17 lbs		
		THC	0.00575 g/mi/car	0.00005 lbs/car	1210 Sedans	0.07 lbs		

		SUVs						
		Field Data (per vehicle)			Traffic Count		Total	
		Seconds	617.25					
		Distance	4.39					
		MPG	14.39	0.31 gal/car	913 SUVs	278.49 gals		
		CO2	644.68 g/mi/car	6.24 lbs/car	913 SUVs	5,696.21 lbs		
		CO	1.69975 g/mi/car	0.01645 lbs/car	913 SUVs	15.02 lbs		
		NOX	0.04075 g/mi/car	0.00039 lbs/car	913 SUVs	0.36 lbs		
		kNOX	0.04250 g/mi/car	0.00041 lbs/car	913 SUVs	0.38 lbs		
		THC	0.00125 g/mi/car	0.00001 lbs/car	913 SUVs	0.01 lbs		
		Seconds	252.00					
		Distance	4.53					
		MPG	19.36	0.23 gal/car	913 SUVs	213.56 gals		
		CO2	470.94 g/mi/car	4.70 lbs/car	913 SUVs	4,293.40 lbs		
		CO	0.94225 g/mi/car	0.00941 lbs/car	913 SUVs	8.59 lbs		
		NOX	0.02525 g/mi/car	0.00025 lbs/car	913 SUVs	0.23 lbs		
		kNOX	0.02675 g/mi/car	0.00027 lbs/car	913 SUVs	0.24 lbs		
		THC	0.00200 g/mi/car	0.00002 lbs/car	913 SUVs	0.02 lbs		

		Sedans						
		Field Data (per vehicle)			Traffic Count		Total	
AM Non - Peak Flow Direction (Northbound)	US 183	Seconds	564.00					
		Distance	4.15					
		MPG	24.31	0.17 gal/car	369 Sedans	62.98 gals		
		CO2	380.88 g/mi/car	3.48 lbs/car	369 Sedans	1285.79 lbs		
		CO	0.22150 g/mi/car	0.00203 lbs/car	369 Sedans	0.75 lbs		
		NOX	0.03025 g/mi/car	0.00028 lbs/car	369 Sedans	0.10 lbs		
		kNOX	0.03125 g/mi/car	0.00029 lbs/car	369 Sedans	0.11 lbs		
		THC	0.01000 g/mi/car	0.00009 lbs/car	369 Sedans	0.03 lbs		
	183A Toll Road	Seconds	236.25					
		Distance	4.29					
		MPG	33.64	0.13 gal/car	369 Sedans	47.11 gals		
		CO2	270.36 g/mi/car	2.56 lbs/car	369 Sedans	944.41 lbs		
		CO	0.19975 g/mi/car	0.00189 lbs/car	369 Sedans	0.70 lbs		
		NOX	0.01500 g/mi/car	0.00014 lbs/car	369 Sedans	0.05 lbs		
		kNOX	0.01525 g/mi/car	0.00014 lbs/car	369 Sedans	0.05 lbs		
		THC	0.00575 g/mi/car	0.00005 lbs/car	369 Sedans	0.02 lbs		

		SUVs						
		Field Data (per vehicle)			Traffic Count		Total	
		Seconds	617.25					
		Distance	4.39					
		MPG	14.39	0.31 gal/car	278 SUVs	84.80 gals		
		CO2	644.68 g/mi/car	6.24 lbs/car	278 SUVs	1,734.44 lbs		
		CO	1.69975 g/mi/car	0.01645 lbs/car	278 SUVs	4.57 lbs		
		NOX	0.04075 g/mi/car	0.00039 lbs/car	278 SUVs	0.11 lbs		
		kNOX	0.04250 g/mi/car	0.00041 lbs/car	278 SUVs	0.11 lbs		
		THC	0.00125 g/mi/car	0.00001 lbs/car	278 SUVs	0.00 lbs		
		Seconds	252.00					
		Distance	4.53					
		MPG	19.36	0.23 gal/car	278 SUVs	65.03 gals		
		CO2	470.94 g/mi/car	4.70 lbs/car	278 SUVs	1,307.30 lbs		
		CO	0.94225 g/mi/car	0.00941 lbs/car	278 SUVs	2.62 lbs		
		NOX	0.02525 g/mi/car	0.00025 lbs/car	278 SUVs	0.07 lbs		
		kNOX	0.02675 g/mi/car	0.00027 lbs/car	278 SUVs	0.07 lbs		
		THC	0.00200 g/mi/car	0.00002 lbs/car	278 SUVs	0.01 lbs		

Appendix A - Supporting Calculations

Travel Analysis - Non-Peak

Sedans

		Field Data (per vehicle)				Traffic Count		Total	
Off Peak Flow Weekday (NON DIRECTIONAL)	US 183	Seconds	561.00						
		Distance	4.18						
		MPG	22.56		0.19 gal/car	13497	Sedans	2497.96	gal
		CO2	407.99	g/mi/car	3.76 lbs/car	13497	Sedans	50684.57	lbs
		CO	0.26263	g/mi/car	0.00242 lbs/car	13497	Sedans	32.63	lbs
		NOX	0.04600	g/mi/car	0.00042 lbs/car	13497	Sedans	5.71	lbs
		kNOX	0.04788	g/mi/car	0.00044 lbs/car	13497	Sedans	5.95	lbs
		THC	0.01063	g/mi/car	0.00010 lbs/car	13497	Sedans	1.32	lbs
	183A Toll Road	Seconds	231.00						
		Distance	4.27						
		MPG	30.47		0.14 gal/car	13497	Sedans	1892.85	gal
		CO2	303.37	g/mi/car	2.86 lbs/car	13497	Sedans	38579.30	lbs
		CO	0.19463	g/mi/car	0.00183 lbs/car	13497	Sedans	24.75	lbs
		NOX	0.02713	g/mi/car	0.00026 lbs/car	13497	Sedans	3.45	lbs
		kNOX	0.02788	g/mi/car	0.00026 lbs/car	13497	Sedans	3.54	lbs
		THC	0.00538	g/mi/car	0.00005 lbs/car	13497	Sedans	0.68	lbs

SUVs

		Field Data (per vehicle)				Traffic Count		Total	
Off Peak Flow Weekday (NON DIRECTIONAL)	US 183	Seconds	580.20						
		Distance	4.38						
		MPG	12.74		0.34 gal/car	10182	SUVs	3,500.88	gal
		CO2	712.32	g/mi/car	6.88 lbs/car	10182	SUVs	70,044.63	lbs
		CO	1.79200	g/mi/car	0.01731 lbs/car	10182	SUVs	176.21	lbs
		NOX	0.07920	g/mi/car	0.00076 lbs/car	10182	SUVs	7.79	lbs
		kNOX	0.08240	g/mi/car	0.00080 lbs/car	10182	SUVs	8.10	lbs
		THC	0.00400	g/mi/car	0.00004 lbs/car	10182	SUVs	0.39	lbs
	183A Toll Road	Seconds	238.40						
		Distance	4.32						
		MPG	17.08		0.25 gal/car	10182	SUVs	2,577.67	gal
		CO2	534.66	g/mi/car	5.10 lbs/car	10182	SUVs	51,888.81	lbs
		CO	0.91920	g/mi/car	0.00876 lbs/car	10182	SUVs	89.21	lbs
		NOX	0.02820	g/mi/car	0.00026 lbs/car	10182	SUVs	2.63	lbs
		kNOX	0.02900	g/mi/car	0.00028 lbs/car	10182	SUVs	2.81	lbs
		THC	0.00380	g/mi/car	0.00004 lbs/car	10182	SUVs	0.37	lbs

Sedans

		Field Data (per vehicle)				Traffic Count		Total	
Off Peak Flow Weekend (NON DIRECTIONAL)	US 183	Seconds	561.00						
		Distance	4.18						
		MPG	22.56		0.19 gal/car	11972	Sedans	2215.72	gal
		CO2	407.99	g/mi/car	3.76 lbs/car	11972	Sedans	44957.82	lbs
		CO	0.26263	g/mi/car	0.00242 lbs/car	11972	Sedans	28.94	lbs
		NOX	0.04600	g/mi/car	0.00042 lbs/car	11972	Sedans	5.07	lbs
		kNOX	0.04788	g/mi/car	0.00044 lbs/car	11972	Sedans	5.28	lbs
		THC	0.01063	g/mi/car	0.00010 lbs/car	11972	Sedans	1.17	lbs
	183A Toll Road	Seconds	231.00						
		Distance	4.27						
		MPG	30.47		0.14 gal/car	11972	Sedans	1678.98	gal
		CO2	303.37	g/mi/car	2.86 lbs/car	11972	Sedans	34220.30	lbs
		CO	0.19463	g/mi/car	0.00183 lbs/car	11972	Sedans	21.95	lbs
		NOX	0.02713	g/mi/car	0.00026 lbs/car	11972	Sedans	3.06	lbs
		kNOX	0.02788	g/mi/car	0.00026 lbs/car	11972	Sedans	3.14	lbs
		THC	0.00538	g/mi/car	0.00005 lbs/car	11972	Sedans	0.61	lbs

SUVs

		Field Data (per vehicle)				Traffic Count		Total	
Off Peak Flow Weekend (NON DIRECTIONAL)	US 183	Seconds	580.20						
		Distance	4.38						
		MPG	12.74		0.34 gal/car	9032	SUVs	3,105.47	gal
		CO2	712.32	g/mi/car	6.88 lbs/car	9032	SUVs	62,133.48	lbs
		CO	1.79200	g/mi/car	0.01731 lbs/car	9032	SUVs	156.31	lbs
		NOX	0.07920	g/mi/car	0.00076 lbs/car	9032	SUVs	6.91	lbs
		kNOX	0.08240	g/mi/car	0.00080 lbs/car	9032	SUVs	7.19	lbs
		THC	0.00400	g/mi/car	0.00004 lbs/car	9032	SUVs	0.35	lbs
	183A Toll Road	Seconds	238.40						
		Distance	4.32						
		MPG	17.08		0.25 gal/car	9032	SUVs	2,286.53	gal
		CO2	534.66	g/mi/car	5.10 lbs/car	9032	SUVs	46,028.26	lbs
		CO	0.92	g/mi/car	0.00876 lbs/car	9032	SUVs	79.13	lbs
		NOX	0.02820	g/mi/car	0.00026 lbs/car	9032	SUVs	2.34	lbs
		kNOX	0.02900	g/mi/car	0.00028 lbs/car	9032	SUVs	2.50	lbs
		THC	0.00380	g/mi/car	0.00004 lbs/car	9032	SUVs	0.33	lbs

Appendix A - Supporting Calculations

Travel Analysis - PM Peak

		Sedans					
		Field Data (per vehicle)			Traffic Count		Total
PM Non-Peak Direction (Southbound)	US 183	Seconds	666.25				
		Distance	4.28				
		MPG	18.40	0.233 gal/car	510 Sedans	118.62 gal	
		CO2	497.23 g/mi/car	4.691 lbs/car	510 Sedans	2392.66 lbs	
		CO	0.22375 g/mi/car	0.00211 lbs/car	510 Sedans	1.08 lbs	
		NOX	0.02250 g/mi/car	0.00021 lbs/car	510 Sedans	0.11 lbs	
		kNOX	0.02250 g/mi/car	0.00021 lbs/car	510 Sedans	0.11 lbs	
		THC	0.00725 g/mi/car	0.00007 lbs/car	510 Sedans	0.03 lbs	
	183A Toll Road	Seconds	231.25				
		Distance	4.22				
		MPG	29.32	0.14 gal/car	510 Sedans	73.38 gal	
		CO2	311.89 g/mi/car	0.27 lbs/car	510 Sedans	139.02 lbs	
		CO	0.21900 g/mi/car	0.00204 lbs/car	510 Sedans	1.04 lbs	
		NOX	0.01675 g/mi/car	0.00016 lbs/car	510 Sedans	0.08 lbs	
kNOX		0.01675 g/mi/car	0.00016 lbs/car	510 Sedans	0.08 lbs		
THC		0.00475 g/mi/car	0.00004 lbs/car	510 Sedans	0.02 lbs		

		SUVs					
		Field Data (per vehicle)			Traffic Count		Total
		Seconds	637.60				
		Distance	4.30				
		MPG	11.03	0.39 gal/car	385 SUVs	150.03 gal	
		CO2	826.97 g/mi/car	7.84 lbs/car	385 SUVs	3,017.26 lbs	
		CO	3.67 g/mi/car	0.03476 lbs/car	385 SUVs	13.38 lbs	
		NOX	0.07280 g/mi/car	0.00069 lbs/car	385 SUVs	0.27 lbs	
		kNOX	0.07220 g/mi/car	0.00068 lbs/car	385 SUVs	0.26 lbs	
		THC	0.00420 g/mi/car	0.00004 lbs/car	385 SUVs	0.02 lbs	
		Seconds	231.40				
		Distance	4.26				
		MPG	16.58	0.26 gal/car	385 SUVs	98.86 gal	
		CO2	550.99 g/mi/car	5.17 lbs/car	385 SUVs	1,991.53 lbs	
		CO	1.26 g/mi/car	0.01179 lbs/car	385 SUVs	4.54 lbs	
		NOX	0.03260 g/mi/car	0.00000 lbs/car	385 SUVs	0.00 lbs	
kNOX		0.03200 g/mi/car	0.00030 lbs/car	385 SUVs	0.12 lbs		
THC		0.00380 g/mi/car	0.00004 lbs/car	385 SUVs	0.01 lbs		

		Sedans					
		Field Data (per vehicle)			Traffic Count		Total
Time/Fuel/Emissions Comparisons Northbound PM Peak Hours	US 183	Seconds	666.25				
		Distance	4.28				
		MPG	18.40	0.233 gal/car	1254 Sedans	291.67 gal	
		CO2	497.23 g/mi/car	4.691 lbs/car	1254 Sedans	5883.12 lbs	
		CO	0.22375 g/mi/car	0.00211 lbs/car	1254 Sedans	2.65 lbs	
		NOX	0.02250 g/mi/car	0.00021 lbs/car	1254 Sedans	0.27 lbs	
		kNOX	0.02250 g/mi/car	0.00021 lbs/car	1254 Sedans	0.27 lbs	
		THC	0.00725 g/mi/car	0.00007 lbs/car	1254 Sedans	0.09 lbs	
	183A Toll Road	Seconds	231.25				
		Distance	4.22				
		MPG	29.32	0.14 gal/car	1254 Sedans	180.42 gal	
		CO2	311.89 g/mi/car	0.27 lbs/car	1254 Sedans	341.83 lbs	
		CO	0.21900 g/mi/car	0.00204 lbs/car	1254 Sedans	2.55 lbs	
		NOX	0.01675 g/mi/car	0.00016 lbs/car	1254 Sedans	0.20 lbs	
kNOX		0.01675 g/mi/car	0.00016 lbs/car	1254 Sedans	0.20 lbs		
THC		0.00475 g/mi/car	0.00004 lbs/car	1254 Sedans	0.06 lbs		

		SUVs					
		Field Data (per vehicle)			Traffic Count		Total
		Seconds	637.60				
		Distance	4.30				
		MPG	11.03	0.39 gal/car	946 SUVs	368.65 gal	
		CO2	826.97 g/mi/car	7.84 lbs/car	946 SUVs	7,413.85 lbs	
		CO	3.67 g/mi/car	0.03476 lbs/car	946 SUVs	32.88 lbs	
		NOX	0.07280 g/mi/car	0.00069 lbs/car	946 SUVs	0.65 lbs	
		kNOX	0.07220 g/mi/car	0.00068 lbs/car	946 SUVs	0.65 lbs	
		THC	0.00420 g/mi/car	0.00004 lbs/car	946 SUVs	0.04 lbs	
		Seconds	231.40				
		Distance	4.26				
		MPG	16.58	0.26 gal/car	946 SUVs	242.91 gal	
		CO2	550.99 g/mi/car	5.17 lbs/car	946 SUVs	4,893.47 lbs	
		CO	1.26 g/mi/car	0.01179 lbs/car	946 SUVs	11.15 lbs	
		NOX	0.03260 g/mi/car	0.00000 lbs/car	946 SUVs	0.00 lbs	
kNOX		0.03200 g/mi/car	0.00030 lbs/car	946 SUVs	0.28 lbs		
THC		0.00380 g/mi/car	0.00004 lbs/car	946 SUVs	0.03 lbs		

Appendix A - Supporting Calculations

Summary Tabulation

US 183		
AM Rush totals		
Fuel	Gal.	633
CO2	Lbs.	12933
CO	Lbs.	23.00
NOX	Lbs.	0.91
kNOX	Lbs.	0.94
THC	Lbs.	0.16
Off peak (weekdays)		
Fuel	Gal.	5999
CO2	Lbs.	120729
CO	Lbs.	208.84
NOX	Lbs.	13.50
kNOX	Lbs.	14.05
THC	Lbs.	1.71
Off peak (weekends)		
Fuel	Gal.	5321
CO2	Lbs.	107091
CO	Lbs.	185.25
NOX	Lbs.	11.98
kNOX	Lbs.	12.46
THC	Lbs.	1.52
PM Rush Totals		
Fuel	Gal.	929
CO2	Lbs.	18707
CO	Lbs.	49.99
NOX	Lbs.	1.29
kNOX	Lbs.	1.29
THC	Lbs.	0.17
Daily Totals (Weekdays)		
Fuel	Gal.	7561
CO2	Lbs.	152369
CO	Lbs.	281.62
NOX	Lbs.	15.70
kNOX	Lbs.	16.28
THC	Lbs.	2.05
Daily Totals (Weekends)		
Fuel	Gal.	5321
CO2	Lbs.	107091
CO	Lbs.	185.25
NOX	Lbs.	11.98
kNOX	Lbs.	12.46
THC	Lbs.	1.52
Yearly Totals		
Fuel	Gal.	2519161
CO2	Lbs.	50753389
CO	Lbs.	92488
NOX	Lbs.	5328

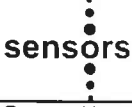
183A Toll Road		
AM Rush totals		
Fuel	Gal.	480
CO2	Lbs.	9642
CO	Lbs.	14.19
NOX	Lbs.	0.52
kNOX	Lbs.	0.55
THC	Lbs.	0.11
Off peak (weekdays)		
Fuel	Gal.	4471
CO2	Lbs.	90468
CO	Lbs.	114.00
NOX	Lbs.	6.08
kNOX	Lbs.	6.36
THC	Lbs.	1.05
Off peak (weekends)		
Fuel	Gal.	3966
CO2	Lbs.	80249
CO	Lbs.	101.00
NOX	Lbs.	5.39
kNOX	Lbs.	5.64
THC	Lbs.	0.93
PM Rush Totals		
Fuel	Gal.	596
CO2	Lbs.	7366
CO	Lbs.	19.00
NOX	Lbs.	0.28
kNOX	Lbs.	0.67
THC	Lbs.	0.13
Daily Totals (Weekdays)		
Fuel	Gal.	5546
CO2	Lbs.	107476
CO	Lbs.	147.44
NOX	Lbs.	6.88
kNOX	Lbs.	7.58
THC	Lbs.	1.29
Daily Totals (Weekends)		
Fuel	Gal.	3966
CO2	Lbs.	80249
CO	Lbs.	101.00
NOX	Lbs.	5.39
kNOX	Lbs.	5.64
THC	Lbs.	0.93
Yearly Totals		
Fuel	Gal.	1854438
CO2	Lbs.	36289591
CO	Lbs.	48846
NOX	Lbs.	2351



CENTRAL TEXAS
Regional Mobility Authority

Appendix B

Vehicle Emissions Study Field Report

 Prepared by P. Clark	Test Report CTRMA/ HTNB Road Test	Customer HTNB (Austin, TX)	Page 1 of 36
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TEST SUMMARY

Fuel Economy and Carbon Footprint are concerns of the government for the past decade. Finding improvements can help the environment and secure a better future. This test compares the difference in environmental impact of vehicles traveling two different roads. The roads in comparison are State 183 and the toll road State 183A.

The test was conducted over three days and data was recorded of the vehicle emissions and fuel economy of both vehicles. It was found that there was a fuel saving of approximately 39% in both vehicles using the toll road. The carbon dioxide showed a significant change of approximately of approximately 40% reduction. The other gases show no significant change, however the average was lower in all cases for 183A.

RESULTS SUMMARY

The data below shows the average values for each road for each of the test vehicles.

	183			183A	
	Car	SUV		Car	SUV
Gallons Consumed	0.191047	0.345505	Gallons Consumed	0.137687	0.248312
CO2 (g)	1776.621	3195.52	CO2 (g)	1267.7	2276.662
CO (g)	1.017782	10.60462	CO (g)	0.861492	4.559825
NOX (g)	0.151802	0.287048	NOX (g)	0.091693	0.1261
kNOX (g)	0.156783	0.293268	kNOX (g)	0.093559	0.128279
THC (g)	0.040376	0.014306	THC (g)	0.022657	0.014322

The average time savings was 364 seconds or just over six minutes.

BACKGROUND / OBJECTIVE

CTRMA has built a parallel road to 183 called 183A. This toll road was made to ease congestion and give an alternate route to its counterpart. This test was designed to show if there are any improvements in fuel economy or emissions

The test consisted of several laps during peak traffic hours in the morning and afternoon along with non-peak time data. The primary goal is to demonstrate if one road reduces fuel consumption and emissions over the other road in a series of tests.

EQUIPMENT

Vehicle Information:


2009 Ford Expedition (Eddie Bauer Edition) VIN # 1FMFK17509EA71061

2008 Ford Fusion Sedan VIN# 3FAHPU7168R172550

Emissions Testing Equipment:

SEMTECH-DS Units: I06-SDS01, C07-SDS05 (measures CO, CO2, NOx, and THC)

EFM 2 Units: 3" Flowmeter, H05-SE06; 2.5" Flowmeter, B07-SE02 (measures mass flow of exhaust)

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TEST METHOD

Calibration


EFM2 Flowmeters were calibrated and certified using a LFE flowstand at Sensors Inc. prior to arrival. SEMTECH-DS units were calibrated on location using independently certified gases.

Procedure

The vehicles were instrumented by employees of Sensors Inc. and the measurement devices were calibrated at the beginning of each day. The instrumentation was zeroed between every lap to minimize any variance due to instrumentation drift.

Morning rush tests consisted of traveling southbound on State 183 and then turning around and re-traveling southbound on State 183A. This cycle will continue until the rush traffic had dissipated. Mid -Day data consisted of both north and southbound runs. The afternoon rush tests were conducted in a similar fashion to the morning rush except traveling northbound.

The data marked main crossroads, although this report focuses on the points between 620 and 1431.

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RESULTS

The data is separated into three categories; These are Morning Rush, Mid-Day, and Afternoon Rush. Each of these will have data from both the car and the SUV described in the Equipment section of this document.

CAR DATA:

MORNING RUSH

Series 1 Data:

183 Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.138
Total Fuel Consumed (gal)	0.202
Overall Fuel Economy (mpg)	20.451

Overall Emissions (Distance Specific):

CO2 (g/mi)	443.447
CO (g/mi)	0.226
NOx (g/mi)	0.033
kNOx (g/mi) (corrected NOx)	0.034
THC (g/mi)	0.011

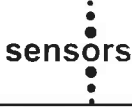
183A Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.254
Total Fuel Consumed (gal)	0.137
Overall Fuel Economy (mpg)	31.155

Overall Emissions (Distance Specific):

CO2 (g/mi)	290.91
CO (g/mi)	0.284
NOx (g/mi)	0.021
kNOx (g/mi) (corrected NOx)	0.022
THC (g/mi)	0.008

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Series 2 Data:

183 Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.17
Total Fuel Consumed (gal)	0.161
Overall Fuel Economy (mpg)	25.964

Overall Emissions (Distance Specific):

CO2 (g/mi)	349.277
CO (g/mi)	0.157
NOx (g/mi)	0.037
kNOx (g/mi) (corrected NOx)	0.038
THC (g/mi)	0.006


183A Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.263
Total Fuel Consumed (gal)	0.129
Overall Fuel Economy (mpg)	33.137

Overall Emissions (Distance Specific):

CO2 (g/mi)	273.593
CO (g/mi)	0.205
NOx (g/mi)	0.026
kNOx (g/mi) (corrected NOx)	0.026
THC (g/mi)	0.006

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Series 3 Data:

183 Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.157
Total Fuel Consumed (gal)	0.142
Overall Fuel Economy (mpg)	29.312

Overall Emissions (Distance Specific):

CO2 (g/mi)	309.482
CO (g/mi)	0.186
NOx (g/mi)	0.018
kNOx (g/mi) (corrected NOx)	0.019
THC (g/mi)	0.007


183A Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.273
Total Fuel Consumed (gal)	0.118
Overall Fuel Economy (mpg)	36.185

Overall Emissions (Distance Specific):

CO2 (g/mi)	250.544
CO (g/mi)	0.213
NOx (g/mi)	0.007
kNOx (g/mi) (corrected NOx)	0.007
THC (g/mi)	0.007

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Series 4 Data:

183 Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.134
Total Fuel Consumed (gal)	0.192
Overall Fuel Economy (mpg)	21.521

Overall Emissions (Distance Specific):

CO2 (g/mi)	421.316
CO (g/mi)	0.317
NOx (g/mi)	0.033
kNOx (g/mi) (corrected NOx)	0.034
THC (g/mi)	0.016


183A Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.386
Total Fuel Consumed (gal)	0.129
Overall Fuel Economy (mpg)	34.066

Overall Emissions (Distance Specific):

CO2 (g/mi)	266.386
CO (g/mi)	0.097
NOx (g/mi)	0.006
kNOx (g/mi) (corrected NOx)	0.006
THC (g/mi)	0.002

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MID-DAY TRAFFIC

Series 1 Data:

183 Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.151
Total Fuel Consumed (gal)	0.202
Overall Fuel Economy (mpg)	20.506

Overall Emissions (Distance Specific):

CO2 (g/mi)	441.494
CO (g/mi)	0.362
NOx (g/mi)	0.05
kNOx (g/mi) (corrected NOx)	0.054
THC (g/mi)	0.017


183A Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.208
Total Fuel Consumed (gal)	0.143
Overall Fuel Economy (mpg)	29.463

Overall Emissions (Distance Specific):

CO2 (g/mi)	307.577
CO (g/mi)	0.209
NOx (g/mi)	0.02
kNOx (g/mi) (corrected NOx)	0.022
THC (g/mi)	0.007

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Series 2 Data:

183 Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.139
Total Fuel Consumed (gal)	0.21
Overall Fuel Economy (mpg)	19.746

Overall Emissions (Distance Specific):

CO2 (g/mi)	459.166
CO (g/mi)	0.35
NOx (g/mi)	0.077
kNOx (g/mi) (corrected NOx)	0.082
THC (g/mi)	0.017


183A Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.294
Total Fuel Consumed (gal)	0.141
Overall Fuel Economy (mpg)	30.36

Overall Emissions (Distance Specific):

CO2 (g/mi)	298.88
CO (g/mi)	0.178
NOx (g/mi)	0.025
kNOx (g/mi) (corrected NOx)	0.026
THC (g/mi)	0.003

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Series 3 Data:

183 Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.298
Total Fuel Consumed (gal)	0.233
Overall Fuel Economy (mpg)	18.445

Overall Emissions (Distance Specific):

CO2 (g/mi)	493.27
CO (g/mi)	0.299
NOx (g/mi)	0.098
kNOx (g/mi) (corrected NOx)	0.101
THC (g/mi)	0.012


183A Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.21
Total Fuel Consumed (gal)	0.129
Overall Fuel Economy (mpg)	32.699

Overall Emissions (Distance Specific):

CO2 (g/mi)	278.417
CO (g/mi)	0.098
NOx (g/mi)	0.035
kNOx (g/mi) (corrected NOx)	0.036
THC (g/mi)	0.002

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Series 4 Data:

183 Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.159
Total Fuel Consumed (gal)	0.171
Overall Fuel Economy (mpg)	24.291

Overall Emissions (Distance Specific):

CO2 (g/mi)	373.223
CO (g/mi)	0.301
NOx (g/mi)	0.033
kNOx (g/mi) (corrected NOx)	0.034
THC (g/mi)	0.011


183A Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.262
Total Fuel Consumed (gal)	0.135
Overall Fuel Economy (mpg)	31.682

Overall Emissions (Distance Specific):

CO2 (g/mi)	285.976
CO (g/mi)	0.246
NOx (g/mi)	0.033
kNOx (g/mi) (corrected NOx)	0.034
THC (g/mi)	0.007

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Series 5 Data:

183 Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.145
Total Fuel Consumed (gal)	0.184
Overall Fuel Economy (mpg)	22.52

Overall Emissions (Distance Specific):

CO2 (g/mi)	402.804
CO (g/mi)	0.203
NOx (g/mi)	0.031
kNOx (g/mi) (corrected NOx)	0.032
THC (g/mi)	0.008


183A Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.256
Total Fuel Consumed (gal)	0.135
Overall Fuel Economy (mpg)	31.454

Overall Emissions (Distance Specific):

CO2 (g/mi)	288.406
CO (g/mi)	0.195
NOx (g/mi)	0.021
kNOx (g/mi) (corrected NOx)	0.022
THC (g/mi)	0.004

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Series 6 Data:

183 Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.165
Total Fuel Consumed (gal)	0.173
Overall Fuel Economy (mpg)	24.045

Overall Emissions (Distance Specific):

CO2 (g/mi)	377.69
CO (g/mi)	0.18
NOx (g/mi)	0.046
kNOx (g/mi) (corrected NOx)	0.047
THC (g/mi)	0.006


183A Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.249
Total Fuel Consumed (gal)	0.125
Overall Fuel Economy (mpg)	34.056

Overall Emissions (Distance Specific):

CO2 (g/mi)	266.358
CO (g/mi)	0.156
NOx (g/mi)	0.009
kNOx (g/mi) (corrected NOx)	0.009
THC (g/mi)	0.003

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Series 7 Data:

183 Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.134
Total Fuel Consumed (gal)	0.172
Overall Fuel Economy (mpg)	24.014

Overall Emissions (Distance Specific):

CO2 (g/mi)	378.461
CO (g/mi)	0.152
NOx (g/mi)	0.009
kNOx (g/mi) (corrected NOx)	0.009
THC (g/mi)	0.006


183A Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.287
Total Fuel Consumed (gal)	0.132
Overall Fuel Economy (mpg)	32.507

Overall Emissions (Distance Specific):

CO2 (g/mi)	279.853
CO (g/mi)	0.154
NOx (g/mi)	0.007
kNOx (g/mi) (corrected NOx)	0.007
THC (g/mi)	0.003

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Series 8 Data:

183 Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.209
Total Fuel Consumed (gal)	0.156
Overall Fuel Economy (mpg)	26.9

Overall Emissions (Distance Specific):

CO2 (g/mi)	337.799
CO (g/mi)	0.254
NOx (g/mi)	0.024
kNOx (g/mi) (corrected NOx)	0.024
THC (g/mi)	0.008


183A Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.424
Total Fuel Consumed (gal)	0.205
Overall Fuel Economy (mpg)	21.571

Overall Emissions (Distance Specific):

CO2 (g/mi)	421.499
CO (g/mi)	0.321
NOx (g/mi)	0.067
kNOx (g/mi) (corrected NOx)	0.067
THC (g/mi)	0.014

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AFTERNOON RUSH

Series 1 Data:

183 Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.284
Total Fuel Consumed (gal)	0.237
Overall Fuel Economy (mpg)	18.105

Overall Emissions (Distance Specific):

CO2 (g/mi)	502.701
CO (g/mi)	0.213
NOx (g/mi)	0.003
kNOx (g/mi) (corrected NOx)	0.003
THC (g/mi)	0.005


183A Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.22
Total Fuel Consumed (gal)	0.129
Overall Fuel Economy (mpg)	32.706

Overall Emissions (Distance Specific):

CO2 (g/mi)	278.324
CO (g/mi)	0.087
NOx (g/mi)	0.011
kNOx (g/mi) (corrected NOx)	0.012
THC (g/mi)	0.001

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Series 2 Data:

183 Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.268
Total Fuel Consumed (gal)	0.228
Overall Fuel Economy (mpg)	18.692

Overall Emissions (Distance Specific):

CO2 (g/mi)	485.462
CO (g/mi)	0.152
NOx (g/mi)	0.003
kNOx (g/mi) (corrected NOx)	0.004
THC (g/mi)	0.005


183A Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.218
Total Fuel Consumed (gal)	0.151
Overall Fuel Economy (mpg)	27.887

Overall Emissions (Distance Specific):

CO2 (g/mi)	325.969
CO (g/mi)	0.246
NOx (g/mi)	0.012
kNOx (g/mi) (corrected NOx)	0.012
THC (g/mi)	0.007

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Series 3 Data:

183 Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.284
Total Fuel Consumed (gal)	0.259
Overall Fuel Economy (mpg)	16.542

Overall Emissions (Distance Specific):

CO2 (g/mi)	550.46
CO (g/mi)	0.393
NOx (g/mi)	0.08
kNOx (g/mi) (corrected NOx)	0.079
THC (g/mi)	0.015


183A Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.214
Total Fuel Consumed (gal)	0.146
Overall Fuel Economy (mpg)	28.791

Overall Emissions (Distance Specific):

CO2 (g/mi)	316.428
CO (g/mi)	0.303
NOx (g/mi)	0.017
kNOx (g/mi) (corrected NOx)	0.017
THC (g/mi)	0.006

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Series 4 Data:

183 Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.283
Total Fuel Consumed (gal)	0.211
Overall Fuel Economy (mpg)	20.263

Overall Emissions (Distance Specific):

CO2 (g/mi)	450.298
CO (g/mi)	0.137
NOx (g/mi)	0.004
kNOx (g/mi) (corrected NOx)	0.004
THC (g/mi)	0.004


183A Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.219
Total Fuel Consumed (gal)	0.151
Overall Fuel Economy (mpg)	27.877

Overall Emissions (Distance Specific):

CO2 (g/mi)	326.82
CO (g/mi)	0.24
NOx (g/mi)	0.027
kNOx (g/mi) (corrected NOx)	0.026
THC (g/mi)	0.005

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SUV DATA:

MORNING RUSH

Series 1 Data:

183 Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.146
Total Fuel Consumed (gal)	0.33
Overall Fuel Economy (mpg)	12.56

Overall Emissions (Distance Specific):

CO2 (g/mi)	719.39
CO (g/mi)	2.415
NOx (g/mi)	0.029
kNOx (g/mi) (corrected NOx)	0.031
THC (g/mi)	0.003


183A Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.845
Total Fuel Consumed (gal)	0.266
Overall Fuel Economy (mpg)	18.246

Overall Emissions (Distance Specific):

CO2 (g/mi)	495.876
CO (g/mi)	1.087
NOx (g/mi)	0.035
kNOx (g/mi) (corrected NOx)	0.038
THC (g/mi)	0.005

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Series 2 Data:

183 Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.139
Total Fuel Consumed (gal)	0.329
Overall Fuel Economy (mpg)	12.596

Overall Emissions (Distance Specific):

CO2 (g/mi)	721.497
CO (g/mi)	0.757
NOx (g/mi)	0.049
kNOx (g/mi) (corrected NOx)	0.051
THC (g/mi)	0.001


183A Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.213
Total Fuel Consumed (gal)	0.233
Overall Fuel Economy (mpg)	18.053

Overall Emissions (Distance Specific):

CO2 (g/mi)	502.979
CO (g/mi)	0.808
NOx (g/mi)	0.026
kNOx (g/mi) (corrected NOx)	0.027
THC (g/mi)	0.001

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Series 3 Data:

183 Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.639
Total Fuel Consumed (gal)	0.253
Overall Fuel Economy (mpg)	18.364

Overall Emissions (Distance Specific):

CO2 (g/mi)	491.342
CO (g/mi)	2.552
NOx (g/mi)	0.048
kNOx (g/mi) (corrected NOx)	0.05
THC (g/mi)	0


183A Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.542
Total Fuel Consumed (gal)	0.208
Overall Fuel Economy (mpg)	21.802

Overall Emissions (Distance Specific):

CO2 (g/mi)	416.469
CO (g/mi)	0.571
NOx (g/mi)	0.018
kNOx (g/mi) (corrected NOx)	0.019
THC (g/mi)	0.001

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Series 4 Data:

183 Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.635
Total Fuel Consumed (gal)	0.33
Overall Fuel Economy (mpg)	14.046

Overall Emissions (Distance Specific):

CO2 (g/mi)	646.472
CO (g/mi)	1.075
NOx (g/mi)	0.037
kNOx (g/mi) (corrected NOx)	0.038
THC (g/mi)	0.001


183A Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.517
Total Fuel Consumed (gal)	0.233
Overall Fuel Economy (mpg)	19.352

Overall Emissions (Distance Specific):

CO2 (g/mi)	468.454
CO (g/mi)	1.303
NOx (g/mi)	0.022
kNOx (g/mi) (corrected NOx)	0.023
THC (g/mi)	0.001

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MID-DAY TRAFFIC

Series 1 Data:

183 Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.179
Total Fuel Consumed (gal)	0.319
Overall Fuel Economy (mpg)	13.091

Overall Emissions (Distance Specific):

CO2 (g/mi)	691.418
CO (g/mi)	1.671
NOx (g/mi)	0.054
kNOx (g/mi) (corrected NOx)	0.058
THC (g/mi)	0.003


183A Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.672
Total Fuel Consumed (gal)	0.261
Overall Fuel Economy (mpg)	17.907

Overall Emissions (Distance Specific):

CO2 (g/mi)	506.086
CO (g/mi)	0.903
NOx (g/mi)	0.024
kNOx (g/mi) (corrected NOx)	0.025
THC (g/mi)	0.007

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Series 2 Data:

183 Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.551
Total Fuel Consumed (gal)	0.367
Overall Fuel Economy (mpg)	12.405

Overall Emissions (Distance Specific):

CO2 (g/mi)	728.787
CO (g/mi)	2.474
NOx (g/mi)	0.093
kNOx (g/mi) (corrected NOx)	0.099
THC (g/mi)	0.009


183A Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.134
Total Fuel Consumed (gal)	0.234
Overall Fuel Economy (mpg)	17.663

Overall Emissions (Distance Specific):

CO2 (g/mi)	512.833
CO (g/mi)	1.172
NOx (g/mi)	0.028
kNOx (g/mi) (corrected NOx)	0.03
THC (g/mi)	0.003

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Series 3 Data:

183 Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.575
Total Fuel Consumed (gal)	0.349
Overall Fuel Economy (mpg)	13.122

Overall Emissions (Distance Specific):

CO2 (g/mi)	691.438
CO (g/mi)	1.574
NOx (g/mi)	0.14
kNOx (g/mi) (corrected NOx)	0.145
THC (g/mi)	0.003


183A Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.772
Total Fuel Consumed (gal)	0.255
Overall Fuel Economy (mpg)	18.698

Overall Emissions (Distance Specific):

CO2 (g/mi)	485.938
CO (g/mi)	0.553
NOx (g/mi)	0.027
kNOx (g/mi) (corrected NOx)	0.028
THC (g/mi)	0.003

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Series 4 Data:

183 Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.276
Total Fuel Consumed (gal)	0.328
Overall Fuel Economy (mpg)	13.034

Overall Emissions (Distance Specific):

CO2 (g/mi)	695.573
CO (g/mi)	1.797
NOx (g/mi)	0.05
kNOx (g/mi) (corrected NOx)	0.051
THC (g/mi)	0


183A Southbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.172
Total Fuel Consumed (gal)	0.268
Overall Fuel Economy (mpg)	15.595

Overall Emissions (Distance Specific):

CO2 (g/mi)	582.684
CO (g/mi)	0.861
NOx (g/mi)	0.029
kNOx (g/mi) (corrected NOx)	0.029
THC (g/mi)	0.005

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Series 5 Data:

183 Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.322
Total Fuel Consumed (gal)	0.359
Overall Fuel Economy (mpg)	12.051

Overall Emissions (Distance Specific):

CO ₂ (g/mi)	754.374
CO (g/mi)	1.444
NO _x (g/mi)	0.059
kNO _x (g/mi) (corrected NO _x)	0.059
THC (g/mi)	0.005


183A Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	3.867
Total Fuel Consumed (gal)	0.249
Overall Fuel Economy (mpg)	15.526

Overall Emissions (Distance Specific):

CO ₂ (g/mi)	585.779
CO (g/mi)	1.107
NO _x (g/mi)	0.033
kNO _x (g/mi) (corrected NO _x)	0.033
THC (g/mi)	0.01

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AFTERNOON RUSH

Series 1 Data:

183 Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.272
Total Fuel Consumed (gal)	0.398
Overall Fuel Economy (mpg)	10.724

Overall Emissions (Distance Specific):

CO2 (g/mi)	847.604
CO (g/mi)	1.421
NOx (g/mi)	0.077
kNOx (g/mi) (corrected NOx)	0.079
THC (g/mi)	0.003


183A Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.212
Total Fuel Consumed (gal)	0.224
Overall Fuel Economy (mpg)	18.846

Overall Emissions (Distance Specific):

CO2 (g/mi)	481.795
CO (g/mi)	1.316
NOx (g/mi)	0.036
kNOx (g/mi) (corrected NOx)	0.036
THC (g/mi)	0.006

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Series 2 Data:

183 Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.321
Total Fuel Consumed (gal)	0.393
Overall Fuel Economy (mpg)	10.985

Overall Emissions (Distance Specific):

CO2 (g/mi)	825.201
CO (g/mi)	1.961
NOx (g/mi)	0.04
kNOx (g/mi) (corrected NOx)	0.042
THC (g/mi)	0.001


183A Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.262
Total Fuel Consumed (gal)	0.273
Overall Fuel Economy (mpg)	15.638

Overall Emissions (Distance Specific):

CO2 (g/mi)	581.115
CO (g/mi)	0.849
NOx (g/mi)	0.024
kNOx (g/mi) (corrected NOx)	0.025
THC (g/mi)	0.003

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Series 3 Data:

183 Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.303
Total Fuel Consumed (gal)	0.449
Overall Fuel Economy (mpg)	9.588

Overall Emissions (Distance Specific):

CO2 (g/mi)	944.727
CO (g/mi)	4.468
NOx (g/mi)	0.086
kNOx (g/mi) (corrected NOx)	0.085
THC (g/mi)	0.006


183A Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.226
Total Fuel Consumed (gal)	0.264
Overall Fuel Economy (mpg)	16.016

Overall Emissions (Distance Specific):

CO2 (g/mi)	567.513
CO (g/mi)	1.682
NOx (g/mi)	0.039
kNOx (g/mi) (corrected NOx)	0.038
THC (g/mi)	0.003

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Series 4 Data:

183 Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.311
Total Fuel Consumed (gal)	0.377
Overall Fuel Economy (mpg)	11.447

Overall Emissions (Distance Specific):

CO2 (g/mi)	789.422
CO (g/mi)	5.318
NOx (g/mi)	0.104
kNOx (g/mi) (corrected NOx)	0.1
THC (g/mi)	0.005


183A Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.362
Total Fuel Consumed (gal)	0.275
Overall Fuel Economy (mpg)	15.853

Overall Emissions (Distance Specific):

CO2 (g/mi)	574.416
CO (g/mi)	1.286
NOx (g/mi)	0.031
kNOx (g/mi) (corrected NOx)	0.03
THC (g/mi)	0.005

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Series 5 Data:

183 Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.286
Total Fuel Consumed (gal)	0.345
Overall Fuel Economy (mpg)	12.41

Overall Emissions (Distance Specific):

CO2 (g/mi)	727.909
CO (g/mi)	5.172
NOx (g/mi)	0.057
kNOx (g/mi) (corrected NOx)	0.055
THC (g/mi)	0.006


183A Northbound Data

Overall Test Results:

Total Distance Traveled (mi)	4.23
Total Fuel Consumed (gal)	0.255
Overall Fuel Economy (mpg)	16.568

Overall Emissions (Distance Specific):

CO2 (g/mi)	550.122
CO (g/mi)	1.147
NOx (g/mi)	0.033
kNOx (g/mi) (corrected NOx)	0.031
THC (g/mi)	0.002

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COMPARISON DATA: Note: All pollutant values are in grams per mile unless otherwise stated.

MORNING RUSH DATA

2008 Ford Fusion Sedan Summary

183

	Series1	Series2	Series3	Series4	Average
Distance	4.138	4.17	4.157	4.134	4.14975
MPG	20.451	25.964	29.312	21.521	24.312
CO2	443.447	349.277	309.482	421.316	380.8805
CO	0.226	0.157	0.186	0.317	0.2215
NOX	0.033	0.037	0.018	0.033	0.03025
KNOX	0.034	0.038	0.019	0.034	0.03125
THC	0.011	0.006	0.007	0.016	0.01

183A

	Series1	Series2	Series3	Series4	Average
Distance	4.254	4.263	4.273	4.386	4.294
MPG	31.155	33.137	36.185	34.066	33.63575
CO2	290.91	273.593	250.544	266.386	270.3583
CO	0.284	0.205	0.213	0.097	0.19975
NOX	0.021	0.026	0.007	0.006	0.015
KNOX	0.022	0.026	0.007	0.006	0.01525
THC	0.008	0.006	0.007	0.002	0.00575

2009 Ford Expedition Summary

183

	Series1	Series2	Series3	Series4	Average
Distance	4.146	4.139	4.639	4.635	4.38975
MPG	12.56	12.596	18.364	14.046	14.3915
CO2	719.39	721.497	491.342	646.472	644.6753
CO	2.415	0.757	2.552	1.075	1.69975
NOX	0.029	0.049	0.048	0.037	0.04075
KNOX	0.031	0.051	0.05	0.038	0.0425
THC	0.003	0.001	0	0.001	0.00125

183A

	Series1	Series2	Series3	Series4	Average
Distance	4.845	4.213	4.542	4.517	4.52925
MPG	18.246	18.053	21.802	19.352	19.36325
CO2	495.876	502.979	416.469	468.454	470.9445
CO	1.087	0.808	0.571	1.303	0.94225
NOX	0.035	0.026	0.018	0.022	0.02525
KNOX	0.038	0.027	0.019	0.023	0.02675
THC	0.005	0.001	0.001	0.001	0.002



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MID-DAY DATA

2008 Ford Fusion Sedan Summary

183

	Series1	Series2	Series3	Series4	Series5	Series 6	Series7	Series8	Average
Distance	4.151	4.139	4.298	4.159	4.145	4.165	4.134	4.209	4.175
MPG	20.506	19.746	18.445	24.291	22.52	24.045	24.014	26.9	22.55838
CO2	441.494	459.166	493.27	373.223	402.804	377.69	378.461	337.799	407.9884
CO	0.362	0.35	0.299	0.301	0.203	0.18	0.152	0.254	0.262625
NOX	0.05	0.077	0.098	0.033	0.031	0.046	0.009	0.024	0.046
KNOX	0.054	0.082	0.101	0.034	0.032	0.047	0.009	0.024	0.047875
THC	0.017	0.017	0.012	0.011	0.008	0.006	0.006	0.008	0.010625

183A

	Series1	Series2	Series3	Series4	Series5	Series 6	Series7	Series8	Average
Distance	4.208	4.294	4.21	4.262	4.256	4.249	4.287	4.424	4.27375
MPG	29.463	30.36	32.699	31.682	31.454	34.056	32.507	21.571	30.474
CO2	307.577	298.88	278.417	285.976	288.406	266.358	279.853	421.499	303.3708
CO	0.209	0.178	0.098	0.246	0.195	0.156	0.154	0.321	0.194625
NOX	0.02	0.025	0.035	0.033	0.021	0.009	0.007	0.067	0.027125
KNOX	0.022	0.026	0.036	0.034	0.022	0.009	0.007	0.067	0.027875
THC	0.007	0.003	0.002	0.007	0.004	0.003	0.003	0.014	0.005375


2009 Ford Expedition Summary

183

	Series1	Series2	Series3	Series4	Series 5	Average
Distance	4.179	4.551	4.575	4.276	4.322	4.3806
MPG	13.091	12.405	13.122	13.034	12.051	12.7406
CO2	691.418	728.787	691.438	695.573	754.374	712.318
CO	1.671	2.474	1.574	1.797	1.444	1.792
NOX	0.054	0.093	0.14	0.05	0.059	0.0792
KNOX	0.058	0.099	0.145	0.051	0.059	0.0824
THC	0.003	0.009	0.003	0	0.005	0.004

183A

	Series1	Series2	Series3	Series4	Series 5	Average
Distance	4.672	4.134	4.772	4.172	3.867	4.3234
MPG	17.907	17.663	18.698	15.595	15.526	17.0778
CO2	506.086	512.833	485.938	582.684	585.779	534.664
CO	0.903	1.172	0.553	0.861	1.107	0.9192
NOX	0.024	0.028	0.027	0.029	0.033	0.0282
KNOX	0.025	0.03	0.028	0.029	0.033	0.029
THC	0.007	0.003	0.003	0.005	0.001	0.0038

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AFTERNOON RUSH DATA

2008 Ford Fusion Sedan Summary

183

	Series1	Series2	Series3	Series4	Average
Distance	4.284	4.268	4.284	4.283	4.27975
MPG	18.105	18.692	16.542	20.263	18.4005
CO2	502.701	485.462	550.46	450.298	497.2303
CO	0.213	0.152	0.393	0.137	0.22375
NOX	0.003	0.003	0.08	0.004	0.0225
kNOX	0.003	0.004	0.079	0.004	0.0225
THC	0.005	0.005	0.015	0.004	0.00725

183A

	Series1	Series2	Series3	Series4	Average
Distance	4.22	4.218	4.214	4.219	4.21775
MPG	32.706	27.887	28.791	27.877	29.31525
CO2	278.324	325.969	316.428	326.82	311.8853
CO	0.087	0.246	0.303	0.24	0.219
NOX	0.011	0.012	0.017	0.027	0.01675
kNOX	0.012	0.012	0.017	0.026	0.01675
THC	0.001	0.007	0.006	0.005	0.00475


2009 Ford Expedition Summary

183

	Series1	Series2	Series3	Series4	Series5	Average
Distance	4.272	4.321	4.303	4.311	4.286	4.2986
MPG	10.724	10.985	9.588	11.447	12.41	11.0308
CO2	847.604	825.201	944.727	789.422	727.909	826.9726
CO	1.421	1.961	4.468	5.318	5.172	3.668
NOX	0.077	0.04	0.086	0.104	0.057	0.0728
kNOX	0.079	0.042	0.085	0.1	0.055	0.0722
THC	0.003	0.001	0.006	0.005	0.006	0.0042

183A

	Series1	Series2	Series3	Series4	Series5	Average
Distance	4.212	4.262	4.226	4.362	4.23	4.2584
MPG	18.846	15.638	16.016	15.853	16.568	16.5842
CO2	481.795	581.115	567.513	574.416	550.122	550.9922
CO	1.316	0.849	1.682	1.286	1.147	1.256
NOX	0.036	0.024	0.039	0.031	0.033	0.0326
kNOX	0.036	0.025	0.038	0.03	0.031	0.032
THC	0.006	0.003	0.003	0.005	0.002	0.0038

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TOTAL TESTING AVERAGE

183			183A		
	Car	SUV		Car	SUV
Distance	4.194875	4.353929	Distance	4.264813	4.359
MPG	21.95731	12.60164	MPG	30.97475	17.5545
CO2	423.5219	733.9396	CO2	297.2463	522.2899
CO	0.242625	2.435643	CO	0.202	1.046071
NOX	0.036188	0.065929	NOX	0.0215	0.028929
kNOX	0.037375	0.067357	kNOX	0.021938	0.029429
THC	0.009625	0.003286	THC	0.005313	0.003286

Emissions and Fuel Consumption Data:

183			183A		
	Car	SUV		Car	SUV
Gallons Consumed	0.191047	0.345505	Gallons Consumed	0.137687	0.248312
CO2 (g)	1776.621	3195.52	CO2 (g)	1267.7	2276.662
CO (g)	1.017782	10.60462	CO (g)	0.861492	4.559825
NOX (g)	0.151802	0.287048	NOX (g)	0.091693	0.1261
kNOX (g)	0.156783	0.293268	kNOX (g)	0.093559	0.128279
THC (g)	0.040376	0.014306	THC (g)	0.022657	0.014322

Average Time Data:

	183	183A	Difference
Car	588 sec	232 sec	356 sec
SUV	611 sec	240 sec	371 sec

CONCLUSIONS/RECOMMENDATIONS

It was found that there was a fuel saving of approximately 39% in both vehicles using the toll road. The carbon dioxide showed a significant change of approximately of approximately 40% reduction. The other gases show no significant change, however the average was lower in all cases for 183A.

It was found that using the toll road will save approximately six minutes on average.