COMMONWEALTH OF VIRGINIA
STATE AIR POLLUTION CONTROL BOARD

OZONE ADVANCE ACTION PLAN
RICHMOND-PETERSBURG, VIRGINIA

Appendix C: CMAQ Emission Reduction Estimates

RICHMOND AREA MPO

CMAQ PROJECT ALLOCATIONS BY YEAR

FEDERAL AND STATE MATCH FUNDS FOR FY 10 THRU FY 18

($000)

12/3/12

Jurisdiction/ Route	UPC #	Location	Type	Actual Allocation (Fed+State Match)					Projected Allocation (Fed+State Match)					Actual+ Projected	Emissions Reduction Analsis (ERA)		Comments
				FY10	FY11	FY12	FY13	Actual Total (FY10+FY13)	FY14	FY15	FY16	FY17	FY18	Total (FY10 to FY18)	VOC/HC (Kg/day)	NOx (Kg/day)	
Ashland																	
Rt 1/54	13463	Rt 1/54	Right turn lanes				2,204.0	2,204.0	1,096.0					3,300.0	2.31	-	
Chesterfield																	
Rt 10	102957	4 locations (Chester)	Pedestrian improv				200.0	200.0						200.0	0.07	0.21	
Rt 60	103576	Branchway Rd & Mall Dr	Intersections and mall access improv				500.0	500.0						500.0	2.30	1.07	
Rt 288	90349	At Chester Rd	Interchange Improvements	1,500.0				1,500.0						1,500.0	1.14	0.65	
Rt 653	67967	0.5 MN At 360	SB right turn relief			847.9	452.1	1,300.0						1,300.0	7.84 (kg/hr)	1.31 (kg/hr)	
Sub-Total				1,500.0		847.9	1,152.1	3,500.0						**3,500.0**			
Hanover																	
Rt 33	56181	At Ashland Rd	Intersection improvements			5.8		5.8		1,918.1	1,475.0			3,398.9	0.30	0.13	
Rt 360	13551	At Lee Davis Rd	Intersection improvement							3,040.0				3,040.0	9.06	4.11	
Rt 615 (Creighton)	81667	At Cold Harbor Rd	Intersection improvements	1,250.0	1,421.1	1,836.0	258.5	4,765.6	1,344.4					6,110.0	0.20	0.11	
Rt 627 (Pole Green)	97686	At Rural Point Rd	Intersection improvements		254.0		95.0	349.0						349.0	0.42	0.20	
Rt 627 (Pole Green)	97685	At Walnut Grove Rd	Intersection improvements			500.0	201.0	701.0						701.0	0.05	0.03	
Sub-Total				1,250.0	1675.1	2,341.8	554.5	5,821.4	1,344.4	4,958.1	1,475.0			**13,598.9**			
Henrico																	
Rt 250	77074	At Parham Rd	Turn lanes	252.7				252.7						252.7	129 (g/hr)	108 (g/hr)	
Countywide	T11908	Countywide	ATMS (automated traffic manage. system) phase 2						1,197.6	1,197.6	1,360.9	2,257.0	2,000.0	8,013.1	46.72	(5.44)	
Laburnum	77076	At Rt 360	Turn lanes	360.3		341.4		701.7						701.7	309 (g/hr)	259 (g/hr)	
Sub-Total				613.0	-	341.4		954.4	1,197.6	1,197.6	1,360.9	2,257.0	2,000.0	**8,967.5**			
Richmond																	
Rt 1	15955	Hopkins Rd - Decatur St	Improvements		1,422.2			1,422.2			1,992.1			3,414.3	0.56	0.59	
Forest Hill Ave	19036	Hathaway Rd to Powhite Pkv	Improvements				500.0	500.0						500.0	0.59	0.28	
Jahnke Rd	19035	Intersections	Bike/ped				1,081.9	1,081.9						1,081.9	0.06	0.12	
Main St	64219	Main St Station	Capital funds	1,250.0 1,067.1	1,250.0 975.6	3,957.2		8,499.9						8,499.9	4.05 (ton/yr)	16.00 (ton/yr)	ERA on Operating
City of Richmond employee trip reduction prog.			(UPC#T1811)	250.0		250.0	600.0	1,100.0						1,100.0	3.51 (ton/yr)	.68 (ton/yr)	
Bike sharrows	100490	Bike sharrows and signs (EW)				163.5		163.5						163.5	1.27	4.08	
Bike sharrows	100491	Bike sharrows and signs (US Bike Rt 1)				223.0		223.0						223.0	2.25	7.24	
Bike sharrows	100493	Bike sharrows and signs (NS)				163.5		163.5						163.5	1.27	4.08	
Bike share sys	T11910	Citywide	Bike share system									1,000.0	2,000.0	3,000.0	545.48	1,372.43	

RICHMOND AREA MPO

CMAQ PROJECT ALLOCATIONS BY YEAR

FEDERAL AND STATE MATCH FUNDS FOR FY 10 THRU FY 18

($000)

12/3/12

Jurisdiction/ Route	UPC #	Location	Type	Actual Allocation (Fed+State Match) FY10	FY11	FY12	FY13	Actual Total (FY10+FY13)	Projected Allocation (Fed+State Match) FY14	FY15	FY16	FY17	FY18	Actual+ Projected Total (FY10 to FY18)	Emissions Reduction Analsis (ERA) VOC/HC (Kg/day)	NOx (Kg/day)	Comments
ITS signal sys	100498	South of the city	ITS signal system			1,500.0	2,500.6	4,000.6	3,000.0	3,003.5				10,004.1	58.05	28.05	
ITS signal sys	T11911	East, north, and west of the c	ITS signal system								3,000.0	2,612.4		5,612.4	52.78	21.34	
Sub-Total				2,567.1	3,647.8	6,257.2	4,682.5	17,154.6	3,000.0	3,003.5	4,992.1	3,612.4	2,000.0	**33,762.6**			
GRTC																	
GRTC	T998	Service area	Global position. sys./automa. veh. Locat./automa.passeng. cnt	200.0	200.0			400.0						400.0	3,452.00	4,841.00	
GRTC	T9717	Service area	Mechanicsville commuter service			314.5	85.0	399.5						399.5	0.48	1.57	
Sub-Total				200.0	200.0	314.5	85.0	799.5						**799.5**			
RideFinders																	
Regionwide	T203	Regionwide	Pollution reduction program (Includes	674.2	697.2	1,013.8	870.9	3,461.1	942.1	960.8	985.4	1,020.7	1,056.5	8,426.6	6.25	12.00	ERA in Feb.
			Fredericksburg commuter buspool service	107.1	97.9										(ton/yr)	(ton/yr)	2012
Sub-Total				781.3	795.1	1,013.8	870.9	3,461.1	942.1	960.8	985.4	1,020.7	1,056.5	**8,426.6**			
CRAC																	
CRAC	98530	CRAC	Alternative fuel buses: Fuel facility	385.9	500.0			1,000.0						1,000.0	22.96	67.10	
				114.1													
Sub-Total				500.0	500.0			1,000.0						1,000.0			
Port of Richmond/VA Port Authority																	
Marine highway program (UPC #90354)				891.0	1,900.0			3,055.7						3,055.7	3,563.0	63,385.0	
				264.7													
Sub-Total				1,155.7	1,900.0			**3,055.7**						3,055.7			
Regionwide																	
Regionwide rail	T10723						284.4	284.4	638.0		477.1	800.0	1,100.0	3,299.5			
POZ areawide	T10724						284.5	284.5	500.0	303.8	500.0	814.6	1,154.8	3,557.7			
Regionwide bike/pe	101485						284.4	284.4	200.0		100.0	500.0	500.0	1,584.4	Qualitative analysis		
Regionwide transit	T10726						284.5	284.5	600.0		507.9	500.0	2,000.0	3,892.4			

RICHMOND AREA MPO

CMAQ PROJECT ALLOCATIONS BY YEAR

FEDERAL AND STATE MATCH FUNDS FOR FY 10 THRU FY 18

($000)

12/3/12

Jurisdiction/ Route	UPC #	Location	Type	Actual Allocation (Fed+State Match)					Projected Allocation (Fed+State Match)					Actual+ Projected	Emissions Reduction Analsis (ERA)		Comments
				FY10	FY11	FY12	FY13	Actual Total (FY10+FY13)	FY14	FY15	FY16	FY17	FY18	Total (FY10 to FY18)	VOC/HC (Kg/day)	NOx (Kg/day)	
Regionwide traffic operations	101492						287.4	287.4	1,049.6	414.8	614.5	1,902.1	2,028.4	6,296.8			
Sub-Total							1,425.2	1,425.2	2,987.6	718.6	2,199.5	4,516.7	6,783.2	18,630.8			
MPO Allocations				8,567.1	8,718.0	11,116.6	10,974.2		10,567.7	10,838.6	11,012.9	######	11,839.7	95,041.6			
CTB Allocations	Original CTB Allocations (2/9/12 and 6/11/12)			8,567.1	8,718.0	11,116.6	9,549.0		10,329.7	10,534.8	10,805.0	######	######	92,397.3			
	Balance Entry/Release Funds (7/12/12)						1,425.2		238.0	303.8	207.9	214.6	254.8	2,644.3			
	Sub-Total			8,567.1	8,718.0	11,116.6	10,974.2		10,567.7	10,838.6	11,012.9	######	######	95,041.6			
Difference between MPO and CTB				0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0			

PPMS	Project Description	Cost	HC Benefit (kg/day)	CO Benefit (kg/day)	NOx Benefit (kg/day)	Notes
	Ozone Alert Multi-jurisdictional	N/A	Qualitative	Qualitative	Qualitative	Modeled by VDOT
12953	Route 1 Fairfax to Westover	$1,043,912	0.085	-	-	Previously documented by CPDC
12954	Rte 36 at Crossings Bl. Coordinated signal	$222,848	1.69	-	-	Previously documented by CPDC
12955	Rte 10 at Hummel Ross coordinate signals	$339,000	0.17	-	-	Previously documented by CPDC
12956	Turn signal at Cavalier Sq.	$9,783	0.23	-	-	Previously documented by CPDC
12957	Jeff Davis at Woods Edge	$150,000	0.245	-	0.97	Modeled by Chesterfield
13460	Rebuild median Rte 36	$7,813	0.08	-	-	Previously documented by CPDC
14742	River Road at Pickett Ave	$586,290	3.89	-	0.649	Modeled by Chesterfield
19003	RTL at Jefferson Park on Route 36	$84,000	0.39	10.21	0.52	Modeled by VDOT
50016	Route 10 at Enon Church	$763,000	0.6	-	0.1	Modeled by Chesterfield
50018	Route 10 at Allied Road	$259,000	0.5	-	0.1	Modeled by Chesterfield
52434	Centerlane on Rt 1	$1,206,000	0.6	15.7	0.79	Modeled by VDOT
57963	Signal System Temple-295	$268,800	0.15	3.72	0.2	Modeled by VDOT
58657	LTL Matoaca Woodpecker	$200,000	0.00044	0.012	0.00063	Modeled by Chesterfield
59118	Colonial Corner Turn Lanes	$498,000	0.0040	0.1035	0.0052	Modeled by VDOT
77600	Rt 1 Signal Coordination	$332,000	0.02	0.59	0.03	Modeled by VDOT
	Halloway Ave Sidewalks	$350,000	0.029	-	0.041	Modeled by Chesterfield
	VSU Sidewalks	$358,000	0.026	-	0.037	Modeled by Chesterfield
	Downtown Petersburg Signal Optimization	$50,000	Qualitative	Qualitative	Qualitative	Assumes no implementation
	LTL NB Rt 630 onto 460	$322,000	0.0054	0.14	0.0071	Modeled by VDOT
	LTL Rt 156 onto 640	$800,000	0.176	4.59	0.232	Modeled by VDOT
	Sidewalk from Jefferson Park to Redwood	$54,000	Qualitative	Qualitative	Qualitative	Modeled by VDOT
	RTL on Southpark onto Dimmock	$654,000	0.37	9.71	0.49	Modeled by VDOT
		TOTAL (kg/day)	**9.26**	**44.78**	**4.17**	

Analyses done by Laurie Henley, VDOT

CONGESTION MITIGATION AND AIR QUALITY
AIR QUALITY ANALYSIS OF PROPOSED PROJECTS FOR FY-99
GEOMETRIC IMPROVEMENTS AND SIGNAL RETIMING

JURISDICTION: Hopewell PROJECT NO.: 19003
LOCATION: Route 36 and Jefferson Park
IMPROVEMENT: Add RTL EB 36 onto Jefferson Park, turn existing RTL into through lane
PROJECT COST: $84,000

TURNING MOVEMENT COUNTS: 2004 grown to 2011 using 1.39% growth rate

ANALYSIS PERIOD: PM Peak Hour

PROCEDURE: Using the total number of vehicles entering the intersection during the PM peak hour and the change in intersection delay resulting from the project, compute the vehicle-hours of delay for the PM peak hour.
Convert that value to hours of delay per day using the 17% K(d) factor derived in the **Cost Benefit Model for Intersection Level of Service Improvements**, HRPDC, June 1997.

ANALYSIS:

TOTAL VEHICLES DURING PM PEAK HOUR:	6,423
INTERSECTION DELAY BEFORE PROJECT (sec/veh):	265
INTERSECTION DELAY AFTER PROJECT (sec/veh):	203
CHANGE IN INTERSECTION DELAY (sec/veh):	62
CHANGE IN VEHICLE DELAY (hours/day):	650.6961

PROJECT EFFECT ON AIR QUALITY: 2011 Emissions Factors and traffic

EQUATION: Emission (grams/hour) x Change in Delay (hours/day)

	HC	CO	NOx
Reduction in Emissions (kilograms/day):	0.39	10.21	0.52
Reduction in Emissions (kilograms/year):	97.60	2,553.33	129.16
Cost Benefit Ratio ($/kg/year):	$860.6	$32.9	$650.3

Template Prepared By: Hampton Roads Planning District Commission, December 1997.

CONGESTION MITIGATION AND AIR QUALITY
AIR QUALITY ANALYSIS OF PROPOSED PROJECTS FOR FY-99
GEOMETRIC IMPROVEMENTS AND SIGNAL RETIMING

JURISDICTIO Prince George PROJECT NO.:
LOCATION: Route 156 at 646
IMPROVEMENT: install a LTL on NB 156 onto 646
PROJECT CC $800,000

TURNING MOVEMENT COUNTS: 2004 grown to 2011 at 1.36%

ANALYSIS PE PM Peak Hour

PROCEDURE Using the total number of vehicles entering the intersection during the PM peak hour and the change in intersection delay resulting from the project, compute the vehicle-hours of delay for the PM peak hour.
Convert that value to hours of delay per day using the 17% K(d) factor derived in the **Cost Benefit Model for Intersection Level of Service Improvements**, HRPDC, June 1997.

ANALYSIS:	TOTAL VEHICLES DURING PM PEAK HOUR:	1,673
	INTERSECTION DELAY BEFORE PROJECT (sec/veh):	136
	INTERSECTION DELAY AFTER PROJECT (sec/veh):	29
	CHANGE IN INTERSECTION DELAY (sec/veh):	107
	CHANGE IN VEHICLE DELAY (hours/day):	292.5016

PROJECT EFFECT ON AIR QUALITY: 2011 Emissions Factors and Traffic

EQUATION: Emission (grams/hour) x Change in Delay (hours/day)

	HC	CO	NOx
Reduction in Emissions (kilograms/day):	0.17550	4.59111	0.23225
Reduction in Emissions (kilograms/year):	43.88	1,147.78	58.06
Cost Benefit Ratio ($/kg/year):	$18,233.5	$697.0	$13,778.5

CONGESTION MITIGATION AND AIR QUALITY
AIR QUALITY ANALYSIS OF PROPOSED PROJECTS FOR FY-99
GEOMETRIC IMPROVEMENTS AND SIGNAL RETIMING

JURISDICTION: Prince George PROJECT NO.:
LOCATION: LTL NB 630 onto W460
IMPROVEMENT: Add NB LTL, adjust signal
PROJECT COST: $579,600

TURNING MOVEMENT COUNTS: 2004 grown to 2011 at 1.36%
*Estimated using 10% rule

ANALYSIS PERIOD: PM Peak Hour

PROCEDURE: Using the total number of vehicles entering the intersection during the PM peak hour and the change in intersection delay resulting from the project, compute the vehicle-hours of delay for the PM peak hour.
Convert that value to hours of delay per day using the 17% K(d) factor derived in the **Cost Benefit Model for Intersection Level of Service Improvements**, HRPDC, June 1997.

ANALYSIS:

TOTAL VEHICLES DURING PM PEAK HOUR:	2,750	
INTERSECTION DELAY BEFORE PROJECT (sec/veh):		58
INTERSECTION DELAY AFTER PROJECT (sec/veh):		56
CHANGE IN INTERSECTION DELAY (sec/veh):		2
CHANGE IN VEHICLE DELAY (hours/day):		8.986928

PROJECT EFFECT ON AIR QUALITY: 2008 Emissions Factors and Traffic

EQUATION: Emission (grams/hour) x Change in Delay (hours/day)

	HC	CO	NOx
Reduction in Emissions (kilograms/day):	0.0054	0.14	0.0071
Reduction in Emissions (kilograms/year):	1.35	35.26	1.79
Cost Benefit Ratio ($/kg/year):	$429,957.8	$16,435.7	$324,619.0

Template Prepared By: Hampton Roads Planning District Commission, December 1997.

CONGESTION MITIGATION AND AIR QUALITY
AIR QUALITY ANALYSIS OF PROPOSED PROJECTS FOR FY-99
GEOMETRIC IMPROVEMENTS AND SIGNAL RETIMING

JURISDICTION:	Colonial Heights	PROJECT NO.:	52434
LOCATION:	Route 1 from Westover to Windsor		
IMPROVEMENT:	Add center left turn lane		
PROJECT COST:	$1,206,000		

TURNING MOVEMENT COUNTS: 2004 grown at 1.67% to 2011.

ANALYSIS PERIOD: PM Peak Hour

PROCEDURE: Using the total number of vehicles entering the intersection during the PM peak hour and the change in intersection delay resulting from the project, compute the vehicle-hours of delay for the PM peak hour.
Convert that value to hours of delay per day using the 17% K(d) factor derived in the **Cost Benefit Model for Intersection Level of Service Improvements**, HRPDC, June 1997.

ANALYSIS:

AVERAGE INTERSECTION VOLUME DURING PM PEAK HOUR:	2,986
INTERSECTION DELAY BEFORE PROJECT (sec/veh):	234
INTERSECTION DELAY AFTER PROJECT (sec/veh):	29
CHANGE IN INTERSECTION DELAY (sec/veh):	205
CHANGE IN VEHICLE DELAY (hours/day):	1000.212

PROJECT EFFECT ON AIR QUALITY: 2011 Emissions Factors and traffic

EQUATION: Emission (grams/hour) x Change in Delay (hours/day)

	HC	CO	NOx
Reduction in Emissions (kilograms/day):	0.60	15.70	0.79
Reduction in Emissions (kilograms/year):	150.03	3,924.83	198.54
Cost Benefit Ratio ($/kg/year):	$8,038.3	$307.3	$6,074.3

Template Prepared By: Hampton Roads Planning District Commission, December 1997.

CONGESTION MITIGATION AND AIR QUALITY
AIR QUALITY ANALYSIS OF PROPOSED PROJECTS
ISOLATED INTERSECTIONS
(NO GEOMETRIC IMPROVEMENTS)

JURISDICTION: Hopewell
LOCATION: Rte 36 Signal Computer System from Temple to 295
PROJECT: install signal system and coordinate 3 intersections
COST: $268,800

ANALYSIS NOTES: Overall average reduction in intersection delay resulting from retiming = 54.67 seconds/vehicle for the PM peak hour. These figures were determined using Synchro 6 and modeling the coordination of the 3 intersections.

Overall average intersection volume = 4997 vehicles/PM peak hour.

ANALYSIS: Number of Intersections: 3

	PM PEAK
Change in Delay per Intersection:	-54.67 (sec/veh)
Total Change in Delay:	-164.01 (sec/veh)
Overall Average Intersection Volume:	4,997 (veh/hr)

PROJECT EFFECT ON AIR QUALITY: 2010 Emission Factors

EQUATION: Emission (grams/second) x Change in Delay (seconds/vehicle) x Total Vehicles (vehicles/hour)

	PM PEAK
CHANGE IN HC (kilograms/hour):	-0.15
CHANGE IN CO (kilograms/hour):	-3.72
CHANGE IN NOx (kilograms/hour):	-0.20

Template Prepared By: Hampton Roads Planning District Commission, December 1993.

CONGESTION MITIGATION AND AIR QUALITY
AIR QUALITY ANALYSIS OF PROPOSED PROJECTS FOR FY-99
GEOMETRIC IMPROVEMENTS AND SIGNAL RETIMING

JURISDICTION:	Chesterfield	PROJECT NO.:	58657
LOCATION:	Woodpecker Road at Matoaca Road		
IMPROVEMENT:	Add LTL WB Matoaca onto NB Woodpecker		
PROJECT COST:	$200,000		

TURNING MOVEMENT COUNTS: 2004 grown to 2011 with a 1.77% growth rate

ANALYSIS PERIOD: PM Peak Hour

PROCEDURE: Using the total number of vehicles entering the intersection during the PM peak hour and the change in intersection delay resulting from the project, compute the vehicle-hours of delay for the PM peak hour.
Convert that value to hours of delay per day using the 17% K(d) factor derived in the **Cost Benefit Model for Intersection Level of Service Improvements**, HRPDC, June 1997.

ANALYSIS:

TOTAL VEHICLES DURING PM PEAK HOUR:	902
INTERSECTION DELAY BEFORE PROJECT (sec/veh):	11
INTERSECTION DELAY AFTER PROJECT (sec/veh):	10
CHANGE IN INTERSECTION DELAY (sec/veh):	1
CHANGE IN VEHICLE DELAY (hours/day):	1.473856

PROJECT EFFECT ON AIR QUALITY: 2008 Emissions Factors and traffic

EQUATION: Emission (grams/hour) x Change in Delay (hours/day)

	HC	CO	NOx
Reduction in Emissions (kilograms/day):	0.00088	0.023134	0.001170
Reduction in Emissions (kilograms/year):	0.22	5.78	0.29
Cost Benefit Ratio ($/kg/year):	$904,656.3	$34,581.7	$683,619.4

Template Prepared By: Hampton Roads Planning District Commission, December 1997.

CONGESTION MITIGATION AND AIR QUALITY
AIR QUALITY ANALYSIS OF PROPOSED PROJECTS
ISOLATED INTERSECTIONS
(NO GEOMETRIC IMPROVEMENTS)

JURISDICTION: Colonial Heights
LOCATION: Boulevard from Temple Ave to Sherwood
PROJECT: Retime and Coordinate 5 Intersections
COST: $332,000

ANALYSIS NOTES: Overall average reduction in intersection delay resulting from retiming = 4 seconds/vehicle for the PM peak hour. These figures were determined using Synchro 6 and modeling the retiming of the 5 intersections. A growth rate of 1.77% was used.

Overall average intersection volume = 6711 vehicles/PM peak hour.

ANALYSIS: Number of Intersections: 5

	PM PEAK	
Change in Delay per Intersection:	-4	(sec/veh)
Total Change in Delay:	-20	(sec/veh)
Overall Average Intersection Volume:	6,711	(veh/hr)

PROJECT EFFECT ON AIR QUALITY: 2011 Emission Factors

EQUATION: Emission (grams/second) x Change in Delay (seconds/vehicle) x Total Vehicles (vehicles/hour)

	PM PEAK
CHANGE IN HC (kilograms/hour):	-0.02
CHANGE IN CO (kilograms/hour):	-0.59
CHANGE IN NOx (kilograms/hour):	-0.03

Template Prepared By: Hampton Roads Planning District Commission, December 1993.

GEOMETRIC IMPROVEMENTS AND SIGNAL RETIMING

JURISDICTION: Colonial Heights PROJECT NO.:
LOCATION: Southpark Blvd. And Charles Dimmock Parkway
IMPROVEMENT: Add RTL on NB Southpark onto Charles Dimmock
PROJECT COST: $654,000

TURNING MOVEMENT COUNTS: 2002 grown to 2011 using a growth rate of 1.011%

ANALYSIS PERIOD: PM Peak Hour

PROCEDURE: Using the total number of vehicles entering the intersection during the PM peak hour and the change in intersection delay resulting from the project, compute the vehicle-hours of delay for the PM peak hour.
Convert that value to hours of delay per day using the 17% K(d) factor derived in the **Cost Benefit Model for Intersection Level of Service Improvements**, HRPDC, June 1997.

ANALYSIS:

TOTAL VEHICLES DURING PM PEAK HOUR:	7,281
INTERSECTION DELAY BEFORE PROJECT (sec/veh):	970
INTERSECTION DELAY AFTER PROJECT (sec/veh):	918
CHANGE IN INTERSECTION DELAY (sec/veh):	52
CHANGE IN VEHICLE DELAY (hours/day):	618.6471

PROJECT EFFECT ON AIR QUALITY: 2011 Emissions Factors

EQUATION: Emission (grams/hour) x Change in Delay (hours/day)

	HC	CO	NOx
Reduction in Emissions (kilograms/day):	0.37	9.71	0.49
Reduction in Emissions (kilograms/year):	92.80	2,427.57	122.80
Cost Benefit Ratio ($/kg/year):	$7,047.6	$269.4	$5,325.7

CONGESTION MITIGATION AND AIR QUALITY
AIR QUALITY ANALYSIS OF PROPOSED PROJECTS FOR FY-99
GEOMETRIC IMPROVEMENTS AND SIGNAL RETIMING

JURISDICTION: Hopewell PROJECT NO.:
LOCATION: Route 36 at Crossings Shopping Center
IMPROVEMENT: Continue crossover at Colonial Corner and Route 36, install signal at Rte 36WB and crossover
PROJECT COST: $498,000

TURNING MOVEMENT COUNTS: 2004 grown to 2008 at 1.36%

ANALYSIS PERIOD: PM Peak Hour

PROCEDURE: Using the total number of vehicles entering the intersection during the PM peak hour and the change in intersection delay resulting from the project, compute the vehicle-hours of delay for the PM peak hour.
Convert that value to hours of delay per day using the 17% K(d) factor derived in the **Cost Benefit Model for Intersection Level of Service Improvements**, HRPDC, June 1997.

ANALYSIS:

TOTAL VEHICLES DURING PM PEAK HOUR:	4,034
INTERSECTION DELAY BEFORE PROJECT (sec/veh):	17
INTERSECTION DELAY AFTER PROJECT (sec/veh):	16
CHANGE IN INTERSECTION DELAY (sec/veh):	1
CHANGE IN VEHICLE DELAY (hours/day):	6.591503

PROJECT EFFECT ON AIR QUALITY: 2008 Emissions Factors and Traffic

EQUATION: Emission (grams/hour) x Change in Delay (hours/day)

	HC	CO	NOx
Reduction in Emissions (kilograms/day):	0.00395	0.10346	0.00523
Reduction in Emissions (kilograms/year):	0.99	25.87	1.31
Cost Benefit Ratio ($/kg/year):	$503,678.7	$19,253.8	$380,613.7

Qualitative Analyses of Tri-Cities CMAQ Projects
November 2005

I. Ozone Alert- Multi-Jurisdictional

This is an annual program in the Tri-Cities Area. The obligated funds for this project for fiscal years 2005-2008 total $36,000. The benefits of this program are not easily quantified. Since this is a public awareness and outreach program, the air quality benefits are mostly qualitative: an enhanced public knowledge of ozone and ozone reducing activities, and increased participation in such activities.

II. Route 36 Sidewalk- Prince George

The obligated funds for this project for fiscal years 2005-2008 total $43,200. The emissions benefits of this project can not be clearly quantified. The construction of pedestrian facilities as included as a TCM in section 108(f)(1)(A) of the Clean Air Act, thus this project is eligible and assumed to have some impact on the reduction of emissions.

III. Downtown Traffic Signal Optimization- Petersburg

The obligated funds for this project for fiscal years 2005-2008 total $40,000. This project has three steps: to determine which signals will be removed, how to best coordinate remaining signals and to make a recommendation of the best course of action. Since it is unclear what will be implemented, the benefits can not be quantified at this time. However, it is safe to assume that a coordinated signal system in the downtown Petersburg area will have a positive air quality benefit due to the improvement in traffic flow.

No.	Jurisdiction & priority CMAQ / RSTP	Project	Administered by	UPC
1	Chesterfield	Route 1 NB right turn lane at Woods Edge Road	VDOT	90367
2	Chesterfield	Route 144 Harrowgate Road & South Street (turn ln & sdwlk	VDOT	98994
3	Chesterfield	Lakeview & Branders Bridge Road intersection (right and left turn lns on Lakeview, right turn ln on s/b Branders Brdg)	VDOT	99004
4	Colonial Hts.	Southpark & Dimmock intersection - NBR ln on Southpark Blvd at Walmart	Col. Hts.	97692
5	Colonial Hts.	Route 144 Temple & Dimmock Parkway Intersection Improvement, turn lane from WB Temple Ave onto SB Dimmock Pkwy	Col. Hts.	97691
6	Colonial Hts.	Route 144 Temple & Conduit Intersection Improvement, extend a right turn LN from W/B Temple Ave. onto N/B Conduit	Col. Hts.	98882
7	Colonial Hts.	Route 1 (Boulevard) & Dupuy Ave. Add center turn lane from Westover Avenue to Windsor Ave	Col. Hts.	52434
8	Colonial Hts.	Route 1 (Boulevard) Add center turn lane from Windsor Ave to Pickwick	Col. Hts.	90374
9	Colonial Hts.	Route 1/Dupuy Avenue (intersection)	Col. Hts.	3945
10	Colonial Hts.	Route 144 Temple Avenue Corridor Signal Coordination	Col. Hts.	98883
11	Colonial Hts.	Branders Bridge Road & Route 1 intersection	Col. Hts.	99194
12	Colonial Hts.	Route 1 & Temple Avenue SBL lane	Col. Hts.	101116
13	Colonial Hts.	Route 1 & Westover Avenue	Col. Hts.	100501
14	Hopewell	Route 10 & Hummel Ross Intersection Improvement	VDOT	12955
15	Hopewell	Hopewell Circulator Bus Route	PAT	T9443
16	Hopewell	Route 36 WBL at Jefferson Park Road	VDOT	100500
17	Petersburg	South Crater Road Area Signal Coordination	Petersburg	101039
18	Petersburg	Puddledock & Industrial Blvd	Petersburg	101289
19	Prince George	Route 460 & Enterprise Parkway, RTE 657	VDOT	100499
20	Prince George	Route 156 and Laurel Springs Road	Prince George	97635
21	Prince George	CONSTRUCT LT LANE NB ON RTE 630 (BULL HILL ROAD) ONTO RTE 460 FOR WB TRAFFIC	VDOT	82849
22	various	Ozone Alert	Ridefinders	T204
23	Chesterfield	Matoaca Road & Hickory Road	VDOT	101028
24	Tri-Cities	Tri-Cities CMAQ Balance Entry	MPO	70722