RESOLUTION NO. _____

A RESOLUTION AUTHORIZING THE ADMINISTRATOR FOR THE DEPARTMENT OF TRANSPORTATION TO APPLY FOR AND, IF AWARDED, ACCEPT A CONGESTION MITIGATION AND AIR QUALITY IMPROVEMENT (CMAQ) GRANT FROM THE TENNESSEE DEPARTMENT OF TRANSPORTATION (TDOT) TO INSTALL TRANSIT SIGNAL PRIORITIZATION, BIKE AND PEDESTRIAN IMPROVEMENTS, AND TRAFFIC SIGNAL TIMING IMPROVEMENTS AT THIRTY-TWO (32) SIGNALIZED INTERSECTIONS ALONG BRAINERD ROAD, LEE HIGHWAY, SHALLOWFORD ROAD, GUNBARREL ROAD, AND HAMILTON PLACE BOULEVARD, WITH THE CITY'S MATCHING FUNDS IN THE AMOUNT OF FIVE HUNDRED THOUSAND DOLLARS ($500,000.00), FOR A TOTAL AMOUNT NOT TO EXCEED TWO MILLION FIVE HUNDRED THOUSAND DOLLARS ($2,500,000.00).

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF CHATTANOOGA, TENNESSEE, That the Administrator for the Department of Transportation is hereby authorized to apply for and, if awarded, accept a Congestion Mitigation and Air Quality Improvement (CMAQ) grant from the Tennessee Department of Transportation (TDOT) to install transit signal prioritization, bike and pedestrian improvements, and traffic signal timing improvements at thirty-two (32) signalized intersections along Brainerd Road, Lee Highway, Shallowford Road, Gunbarrel Road, and Hamilton Place Boulevard, with the City's matching funds in the amount of $500,000.00, for a total amount not to exceed $2.5 million.

ADOPTED: _____, 2015

/mem

City of Chattanooga

Resolution Request Form

(This form is only required for resolutions requiring expenditure of City funds)

Date Prepared: April 06 2015

Preparer: Bert Kuyrkendall **Department: Transportation**

Brief Description of Purpose for Resolution: **DISTRICT NUMBER** 4,5,6,9

A resolution authorizing the Adminstrator of Transportation to apply for and, if awarded, accept a Congestion Mitigation and Air Quality Improvement (CMAQ) grant from the Tennessee Department of Transportation for an amount not to exceed $2,500,000 to install transit signal prioritization, bike and pedestrian improvements, and traffic signal timing improvements at thirty-two signalized intersections along Brainerd Road, Lee Highway, Shallowford Road, Gunbarrel Road, and Hamilton Place Boulevard.

Total project cost	$ 2,500,000.00	New Contract/Project? (Yes or No)	YES
Total City of Chattanooga Portion	$ 500,000.00	Provide Fund	
City Amount Funded	$ $0.00	Provide Cost Center	
New City Funding Required	$ 500,000.00	Proposed Funding Source	
City's Match Percentage	% 20%	Grant Period (if applicable)	

List all other funding sources and amount for each contributor.

	Grantor(s)
$2,500,000.00	Tennessee Department of Transportation
$0.00	
$0.00	
$0.00	

Agency Grant Number

CFDA Number if known

Other comments: (Include contingency amount, contractor, and other information useful in preparing resolution)

Approved by: _____

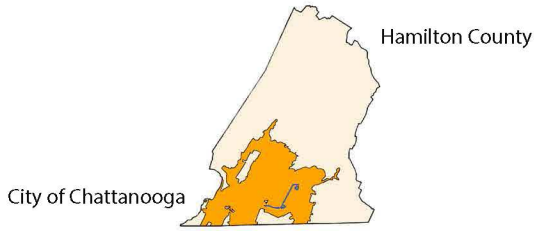
Reviewed by: FINANCE OFFICE — DESIGNATED OFFICIAL/ADMINISTRATOR

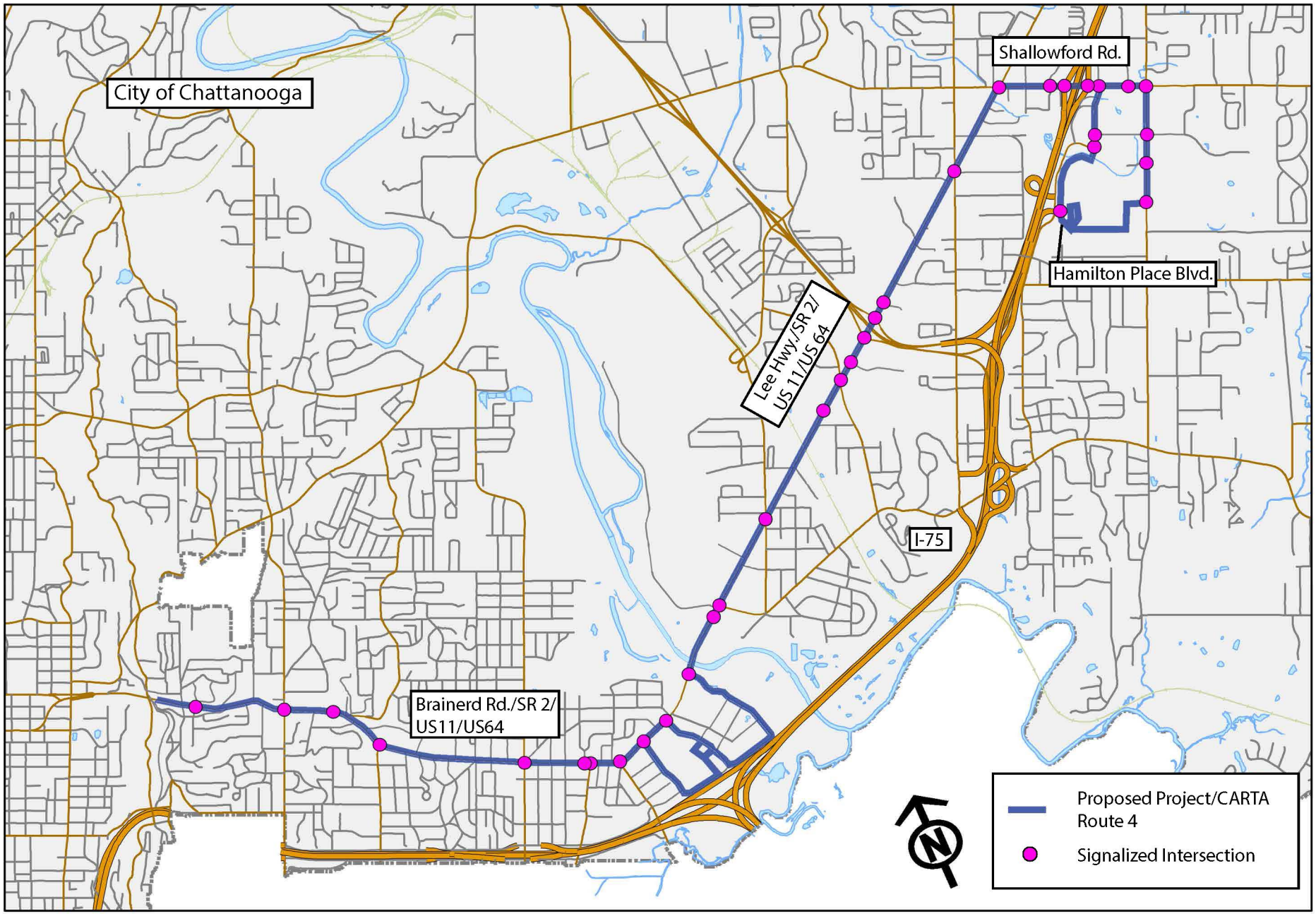
Please submit completed form to @budget, City Attorney and City Finance Officer

2015 Congestion Mitigation and Air Quality Grant Application

Chattanooga Department of Transportation

SR 2/US 11/US 64/Shallowford Rd./Hamilton Place Blvd.
Transit Signal Prioritization & Accessibility Project





City of Chattanooga, TN

2015 CMAQ Application

Chattanooga-Hamilton County, TN and North Georgia Area

Chattanooga Department of Transportation

SR 2/US 11/US 64/Shallowford Rd/Hamilton Place Blvd. Transit Signal Prioritization & Accessibility Project

Primary Contact:

Kevin E. Comstock
Traffic Signal Systems Engineer
City of Chattanooga Transportation Department
1250 Market Street Suite 3030
Chattanooga, TN 37402
(423) 643-5960
Comstock_k@chattanooga.gov

Secondary Contact:

Thomas Trotter
Traffic Signal Designer Specialist
City of Chattanooga Transportation Department
1250 Market Street Suite 3030
Chattanooga, TN 37402
(423) 643-5958
Trotter_t@chattanooga.gov

2015 CMAQ Project Application Form – Signature Page

Applicant Information

Organization Name: City of Chattanooga Department of Transportation

Address: 1250 Market Street

Suite 3030

City: Chattanooga State: TN Zip: 37402

County: Hamilton

Employer/Taxpayer No. (EIN/TIN): 62-6000259

Organizational DUNS Code (if available): 04-311-2341

Edison ID (if available): 207

Application Checklist

- ☒ Online Application Form
- ☒ Project Narrative (if applicable)
- ☒ Budget Form
- ☒ Signature Sheet

Total Budget

Project Cost: $2,500,000

Local Match: $500,000

Other Nonfederal Match: $0

Requested Funds: $2,000,000

Authorization

By signing, I certify the statements and information provided in this application are true and accurate to the best of my knowledge. If the application was prepared by a third party, I certify that I have read the application after completion of all forms and information. I agree with the information provided, and the date provided below is the date I signed the form. I further understand that prior to incorporating these forms and information into a grant contract, the data and information may be revised by TDOT for accuracy and that our acceptance of a grant contract will constitute agreement with those revisions. Failure to sign the application or signing it with a false statement may make the submitted offer or any resulting contract voidable. Intentional falsification of these forms may be used as an adverse factor in future awards. If selected for funding, I agree to provide the required documentation and assurances necessary for funding.

Authorized Signature:

Andy Berke Digitally signed by Andy Berke DN: cn=Andy Berke, o=City of Chattanooga, ou=Mayor of Chattanooga, email=katieswells@gmail.com, c=US Date: 2015.04.10 09:13:49 -04'00'

Date: April 10, 2015

Print Name: Andy Berke **Title:** Mayor

Email: mayor@chattanooga.gov **Phone:** 423-643-7800

SR 2/US 11/US 64/Shallowford Rd/Hamilton Place Blvd Transit Signal Prioritization & Accessibility Project

Project Description

This project will provide for the procurement and the installation of transit signal prioritization, bike and pedestrian improvements and traffic signal timing improvements at thirty-two (32) signalized intersections along SR 2/US 11/ US 64 (Brainerd Road and Lee Hwy) and Shallowford Road, Gunbarrel Road and Hamilton Place Blvd. The limits of this project will begin at the intersection of SR 2 (Brainerd Rd) and Elmwood Drive and continuing onto Shallowford Road to Hamilton Place Blvd where it circles the Hamilton Place Mall. A map of the area and its location within the state and county can be found in figure 1. The overall goal of the project is to improve access to the transit route for pedestrians and bicyclists, as well as improvements in headway and travel times accompanied by a reduction of emissions within the corridor and the region.

To accomplish these goals, this project will include upgrades to the traffic signal systems along the corridor such as new MUTCD compliant pedestrian (countdown) signals, push buttons, vehicle detection, and upgrading 9 signal controller cabinets along with the static prioritization equipment and the on-vehicle equipment to transmit the request packet for prioritization. The City of Chattanooga will also request new traffic signal timing plans with these new technologies included for maximization of the benefits provided by the technology.

The Chattanooga Area Regional Transit Authority (CARTA) Route #4 serves the SR 2/US 11/US 64 corridor and is the primary source of transportation for many economically disadvantaged individuals providing connection to the employment centers located in and around the Hamilton Place Mall.

This SR 2/US 11/US 64 corridor also serves as the primary alternate route for sections of Interstates 24 and 75 in the event of an incident. The impact of these incidents severely impacts the reliability of the transit route serving this corridor and is part of the City of Chattanooga's overall integrated corridor management philosophy.

The project is not specifically a continuation of existing traffic signal upgrades and telecommunications systems that were installed under the Chattanooga Regional ITS Projects, but will take advantage of those technologies to enhance the operations and maintenance of these systems being considered.

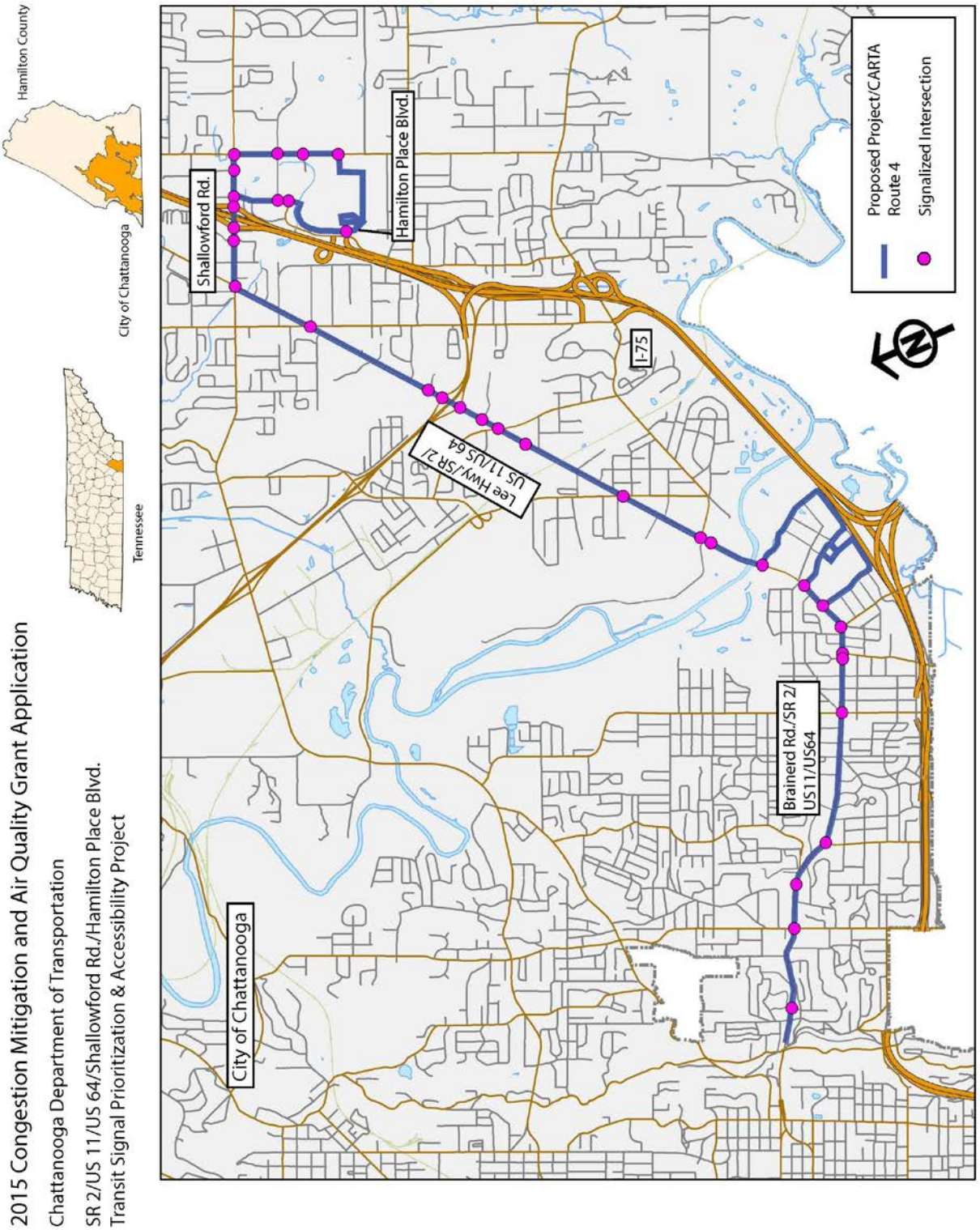

2015 Congestion Mitigation and Air Quality Grant Application
Chattanooga Department of Transportation
SR 2/US 11/US 64/Shallowford Rd./Hamilton Place Blvd.
Transit Signal Prioritization & Accessibility Project
Hamilton County
City of Chattanooga
Tennessee
Shallowford Rd.
Hamilton Place Blvd.
I-75
Lee Hwy/SR 2/
US 11/US 64
Brainerd Rd./SR 2/
US11/US64
City of Chattanooga
Proposed Project/CARTA
Route 4
Signalized Intersection

Figure 1

Operating Assistance

The City of Chattanooga requires no operating assistance for the deployment of this project. Maintenance and operations of these technologies will be performed by the City of Chattanooga Department of Transportation's Traffic Operations staff. All costs incurred for the maintenance and operation of these systems will be absorbed by the City in the general maintenance and operations budget for the full inventory of traffic signal systems.

Cost Overruns

The City of Chattanooga has numerous CMAQ projects in which we have participated. Although every effort was put into the accuracy of the needs and associated costs for these technologies, the City does recognize that we accept responsibility for any cost overruns for this proposed project.

Project Budget

The City of Chattanooga feels that the project budget represented in Table 1 accurately reflects our anticipated costs.

Table 1: Project Budget Estimates

Year	Phase	Activity	Cost			
			Match	80%	0%	20%
			Total	Fed	State	Local
2016	ROW	N/A	$ 0			
2016	NEPA	Anticipate "C" List CE	$ 0			
2016	PE	Design	$ 125,000	$ 100,000		$ 25,000
2017		Signal Timing	$ 175,000	$ 140,000		$ 35,000
2016 & 17	CONST	Construction	$1,875,500	$1,500,400		$375,100
		CEI	$250,000	$200,000		$ 50,000
2016	TDOT	Oversight	$74,500	$59,600		$14,900
2016	**TOTAL**		**$2,500,000**	**$200,000**		**$500,000**

The costs indicated per activity are indicated here:

1. ROW – This Project is not anticipated to require any additional ROW. All locations are current signalized intersections within TDOT or City of Chattanooga ROW. Cost $0.00.

2. NEPA – This project will require NEPA documentation, but as most ITS projects typically qualify for a Categorical Exclusion, this project should be granted that accreditation due to minimal field construction within existing right of way. As such these projects are typically granted a "C" List Categorical Exclusion. Cost $0.00.

3. PE – Engineering of the Project.

    a. Design – As this project will require some construction for the installation of accessible pedestrian ramps, pedestrian signal heads, push buttons, vehicle detection and the static prioritization equipment, a set of Plans, Specifications, and Contract Documents will need preparation. Cost $125,000.

    b. Signal Timing – As indicated earlier, the success of this transit signal prioritization deployment will be measured by the reductions seen in transit headway and travel time. The City feels that hiring a consultant to develop new traffic signal timing plans with the TSP and new ped facilities included will provide the greatest potential benefit towards reductions in CMAQ tracked pollutants. Cost $175,000.

4. CONST – Construction Phases of the TSP Project

    a. Construction – This represents the installation and testing of the hardware and infrastructure in the field and on board the transit vehicles for this project. Cost estimate - $1,875,500.

    b. CEI – As required by TDOT and FHWA for any construction project. Cost estimate - $250,000.

5. Oversight – TDOT oversight of a project. These fees are for TDOT Inspection and testing. Cost estimate - $74,500.

Air Quality Analysis and Emission Reduction Estimates

The emission reduction was analyzed for three distinct scenarios: (1) emission reductions due to traffic signal timing improvements for normal daily travel conditions, (2) emission reductions due to providing improved bike and pedestrian access to transit, and (3) emission reductions attributed to headway improvements as a result of transit

prioritization. Within each table reporting on each set of reductions based from the MOVES Emissions Calculator (model) there are several factors that go into those calculations. The YELLOW sections of each table indicate the Project-specific or user-defined values. These values are representative of the intents of the project design and implementation. The BLUE sections of each table are the constant values from the MOVES model as published by Cambridge Systematics for the Chattanooga/Hamilton County and Northern Georgia Transportation Planning Organization. These data are resident in the "2010ER" spreadsheet, the "Transit Expansion" spreadsheet and the "Bike-Ped with Transit" spreadsheet of the model. The GREEN sections are the results which are completely dependent upon the data from the YELLOW and BLUE section. The procedures were used to derive the emission reduction estimates for the three categories and are discussed in detail below.

1. Traffic Signal Timing Improvements

With the proposed implementation of a Transit Signal Prioritization project that includes Bike and Pedestrian improvements, the need to perform traffic signal timing improvements is self-evident. Table 2 indicates the reductions that are possible with a 10 mile per hour improvement in the speed during the 6 peak hours of a typical workday. The standard peak hours are from:

- The AM Peak (6:00 am-8:00 am),
- The Midday Peak (11:00 am to 1:00 pm) and
- The PM Peak (4:00 pm – 6:00 pm)

The evaluation considered the AADT on the corridor and averaged the AADT from 3 TDOT count stations along the route. (Hamilton County Sta. 000099, 000102 and 000103) This provided an aggregate AADT of 30,336. A review of the 3 Peak Hour counts at three intersections along the corridor provided a combined percentage of Peak Hour Demand vs. AADT of between 40% and 44%. [We used 42 %.]

The emission levels for Annual and Summer NO_x values, $PM_{2.5}$, summer VOC, and winter CO, were provide through the MOVES air quality model for the Chattanooga 2010 emission results. The MOVES model assumes that the amount of emissions is based on between 18-20% of heavy trucks in the traffic volume mix. We verified the data for both the 25 mph assumed speed that a corridor with congested traffic would experience and projected improvements to 35 mph as a result of the traffic signal timing improvements alone. We projected the reductions in each pollutant and its percentage reduction from the base. The improvements are indicated in the Net GHG Reductions section of the table and reflect only the traffic signal timing improvements portion of the project.

Table 2: Projected Traffic Signal Timing Improvement Estimates

Traffic Signal Timing Improvements

Calculation Inputs		
Average of AADT per TDOT count stations on		30,336
Peak Hour Factor (42% of AADT present during combined Peaks)		12,741
Average number of workdays per year		250
TOTAL Peak Hour Factor Annual AADT		3,185,280
	Mile Per Hour Change	
Emission Factors * 2010ER Chattanooga Air Quality Report	**25**	**35**
Annual NOx Emissions @ general speed - Car (grams per mile)	1.04	0.97
PM2.5 Emissions @ general speed - Car (grams per mile)	0.03	0.02
Summer NOx Emissions @ general speed - Car (grams per mile)	1.03	0.89
Summer VOC Emissions @ general speed - Car (grams per mile)	0.50	0.39
Winter CO Emissions @ general speed - Car (grams per mile)	7.78	6.67
	Reduction	
Reduction Scenario Outputs	**Qty. Reduction**	**Percentage Reduction**
Annual NOx Emissions @ general speed - Car (grams per mile)	0.0700	7%
PM2.5 Emissions @ general speed - Car (grams per mile)	0.0048	17%
Summer NOx Emissions @ general speed - Car (grams per mile)	0.1421	14%
Summer VOC Emissions @ general speed - Car (grams per mile)	0.1073	21%
Winter CO Emissions @ general speed - Car (grams per mile)	1.1162	14%
Net GHG Reductions	**Grams**	
Total Annual Reduction in NOx Emissions (grams)	**222,970**	
Total Annual Reduction in PM2.5 Emissions (grams)	**15,289**	
Total Annual Reduction in Summer NOx Emissions (grams)	**452,628**	
Total Annual Reduction in Summer VOC Emissions (grams)	**341,781**	
Total Annual Reduction in Winter CO Emissions (grams)	**3,555,410**	

The formulas used for this section are derived from a basic mathematics equation of:

PHF x 2010ER@25mph = PHF25

PHF x 2010ER@35mph = PHF 35

PHF25 – PHF35 = Net PHF Reduction

Where:

PHF = Peak Hour Factor Annual AADT

2010ER@x = NOx, VOC, CO or PM2.5 value at xxMPH on the 2010 ER table

2. Addition of Bike-Ped Facilities with Existing Transit

The intention of this overall project proposal is to enhance the usability of the existing transit route. This approach evaluates all bike and pedestrian infrastructure improvements that provide increased non-motorized accessibility to transit. The MOVES model for the Chattanooga Regional Area used this approach and rules for its inputs that were similar to those used in the bike/pedestrian project-type methodology. This also included the additional factors to estimate the effect of the interaction of non-motorized infrastructure improvements with existing transit facilities.

Pedestrian and bicycle facilities can reduce emissions when auto trips are replaced by walking and biking to transit stops. The methodology estimates the annual number of vehicle trips reduced, and the annual auto VMT reduced to approximate the emission reductions associated with pedestrian and bike improvements. The AADT on the corridor was averaged from AADT of 3 TDOT count stations along the route. (Hamilton County Sta. 000099, 000102 and 000103) This provided an aggregate AADT of 30,336.

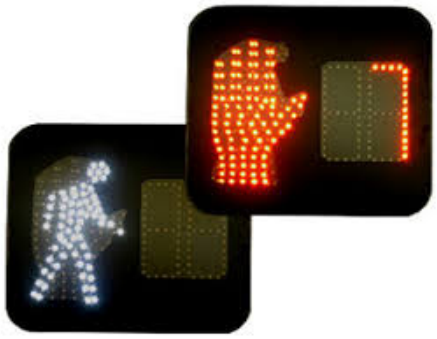


Figure 2

Figure 3

The images in figures 2 and 3 are representative of the 2009 MUTCD pedestrian countdown signal head and pedestrian push buttons proposed to be installed with this project.

Figure 4

Figure 4 is representative of the typical signage and markings to be installed along the route currently identified within the Chattanooga Bike Plan, but as of yet not .

Table 3: Projected Bike-Ped with Transit Improvement Estimates

Bike-Ped with Transit	
Calculation Inputs	
Annual average daily traffic (ADT) on the parallel arterial	30,336
Capacity of parallel arterial (vph)	2,420
Length of bike/ped project (miles)	0.7
Posted Speed on parallel arterial (mph)	35
Average length of bicycle trips (miles)	1.8
Average length of pedestrian trips (miles)	0.50
Average length of transit trips (miles)	7.15
Number of activity centers within 1/2 mile of project	7
Within 2 miles of a university or college (Y/N)?	N
Area Type	Urban
Does project provide access to transit (Y/N)?	Y
Existing daily transit boardings in project transit corridor or at fixed-guideway station	44
Is ped/bike access to fixed guideway transit (Y/N)?	N
Look up table values and other constants	
(C) activity center credit near project	0.002
(A) adjustment factor for ADT	0.005
default factor to convert average weekday traffic to AADT	0.910
Annualization factor	250
Increase in transit trips resulting from new bike/ped connections	2%
ADT to Hourly Volume Conversion	10%
Emission Factors * 20100ER Chattanooga Air Quality Report	
Annual NOx Emissions @ general speed - Car (grams per mile)	0.97
PM2.5 Emissions @ general speed - Car (grams per mile)	0.02
Summer NOx Emissions @ general speed - Car (grams per mile)	0.88
Summer VOC Emissions @ general speed - Car (grams per mile)	0.33
Winter CO Emissions @ general speed - Car (grams per mile)	5.89
Scenario Year Outputs	
Annual Auto Trips Reduced (bike)	53,088
Annual Auto Trip Reduced (walk)	48,310
Annual Auto Trip Reduced (transit)	219
Annual Auto Trips Reduced - Total	101,617
Daily Auto Trips Reduced - Total	406
Hourly Volume Reduced due to Improvements	41
Annual Auto VMT Reduced	121,280
Free flow travel time on parallel arterial (minutes)	1.2
V/C Ratio before improvements on parallel arterial	1.25
V/C Ratio after improvements on parallel arterial	1.24
Congested Travel Time before Improvements on parallel arterial (minutes)	2.50
Congested Travel Time after Improvements on parallel arterial (minutes)	2.46
Net GHG Reductions	
Total Annual Reduction in NOx Emissions (grams)	**117,642**
Total Annual Reduction in PM2.5 Emissions (grams)	**2,426**
Total Annual Reduction in Summer NOx Emissions (grams)	**106,727**
Total Annual Reduction in Summer VOC Emissions (grams)	**40,023**
Total Annual Reduction in Winter CO Emissions (grams)	**713,893**

The calculation for transit trips is detailed below. Trip reductions are equated to VMT savings based on average bike, walk, and transit trip lengths. VMT reductions are calculated separately for all modes on a daily scale, and then summed together and annualized (assuming a factor of 250 days).

$$\text{Daily auto trips reduced}_{(\text{transit})} = B_{(\text{project corridor})} * I_{(\text{area type \& mode})}$$

B = Daily transit boarding for all transit access points along bike/pedestrian project corridor; and

I = Percent increase in transit trips (2.0% as indicated in Table 3.7 of the Chattanooga Air Quality Report.)

3. Installation of the Transit Signal Prioritization

This portion of the project is intended to improve transit vehicle headway and travel time creating a more reliable transit system. As there was no calculator specifically developed for the implementation of a Transit Signal Prioritization (TSP) within the MOVES Emissions Calculator, the City extrapolated a reduction result using the Transit Expansion Calculator.

Figure 5

Figure 5 indicates the basic concept of Transit Signal Prioritization. The Transit vehicle has on-board equipment that indicates its geographic location and proximity to signalized intersections. The transit vehicle sends a request to the signal which will do one of two things in response. The signal may extend a green for the transit vehicle or it can provide an early green for the vehicle. The location of the vehicle, speed and other traffic parameters dictate how the signal will respond.

Table 4: Projected Transit Signal Prioritization Improvement Estimates

Transit Signal Priority System (CARTA Route 4)	
	2010
Calculation Inputs	
Average Daily Headways before Improvements (both directions)	23
Average Daily Headways after Improvements (both directions)	15
Does Project Include Real Time Arrival Info (Y/N)	N
Transit Corridor Length	8
Transit Corridor Hours of Service	20
Daily Transit Ridership Affected by Improvements	2,371
	2010
Constants	
Bus occupancy (persons/vehicle)	18
Auto Occupancy	1.2
Annualization Factor	250
Headway Elasticity to Ridership Increase	-0.50
Share of Wait Time as a portion of the Total Travel Time	22%
Travel Time Reduction Due to Real Time Arrival	20%
Elasticity of Transit Ridership WRT Transit Travel Time	-0.23
Average Trip Length (mi)	16
Emission Factors	
Annual NOx Emissions @ general speed - Car (grams per mile)	1
PM2.5 Emissions @ general speed - Car (grams per mile)	0
Summer NOx Emissions @ general speed - Car (grams per mile)	1
Summer VOC Emissions @ general speed - Car (grams per mile)	0
Winter CO Emissions @ general speed - Car (grams per mile)	6
Annual NOx Emissions @ general speed - Bus (grams per mile)	11
PM2.5 Emissions @ general speed - Bus (grams per mile)	0
Summer NOx Emissions @ general speed - Bus (grams per mile)	10
Summer VOC Emissions @ general speed - Bus (grams per mile)	1
Winter CO Emissions @ general speed - Bus (grams per mile)	4
	2010
Scenario Year Outputs (Headways)	
Change in Headways due to Improvement	-33%
Ridership Change due to Change in Headways	17%
Increase in Daily Transit Person Trips	395
Eliminated Annual Auto VMT	1,317,222
Total Annual Reduction in NOx Emissions (grams)	1,283,852
Total Annual Reduction in PM2.5 Emissions (grams)	28,573
Total Annual Reduction in Summer NOx Emissions (grams)	1,155,776
Total Annual Reduction in Summer VOC Emissions (grams)	440,017
Total Annual Reduction in Winter CO Emissions (grams)	7,727,236
Scenario Year Outputs (Travel Time)	
Ridership Change due to Change in Travel Time	4.60%
Increase in Daily Transit Person Trips	109
Eliminated Annual Auto VMT	363,553
Net GHG Reductions	
Total Annual Reduction in NOx Emissions (grams)	**1,283,852**
Total Annual Reduction in PM2.5 Emissions (grams)	**28,573**
Total Annual Reduction in Summer NOx Emissions (grams)	**1,155,776**
Total Annual Reduction in Summer VOC Emissions (grams)	**440,017**
Total Annual Reduction in Winter CO Emissions (grams)	**7,727,236**

The Transit Expansion Calculator utilizes data from the ER Model and the project variables to develop a set of data. A TSP project is a Transit Expansion project without the need for additional transit vehicles. Considering this, the model was modified so that the "Added Transit" emissions were removed from the formulation. The project specifics were added to reflect the network and the constant data from the "2010 ER" model and "Transit Expansion" models were maintained. The formulas used are indicated in the following text.

The equation to calculate the change in ridership and resulting decrease in weekday light-duty VMT is as follows:

$$VMT = \frac{(\Delta H \times e_h \times R)}{AVO} \times TL$$

Where:

VMT	=	Reduction in daily light-duty VMT;
ΔH	=	Percent change in headways due to improvement;
e_h	=	Headway elasticity (-0.5);
R	=	Existing ridership impacted improvement;
AVO	=	Average passenger vehicle occupancy; and
TL	=	Average passenger vehicle trip length.

The methodology also accounts for the impact of real-time transit arrival information, which is based on an average travel time reduction as a result of real-time transit information. The 1995 NHTS indicated that transit wait times represent 22 percent of total transit trip time (or 10 minutes) on average (This was also validated through evaluation of the 2001 NHTS.).[1] The methodology assumes that the presence of real-time transit arrival information allows users to reduce average wait times by approximately 50 percent, resulting in a 10-percent reduction of overall travel time.

$$VMT = \frac{(\Delta T \times e_t \times R)}{AVO} \times TL$$

[1] CUTR (1998), Public Transit in America: Findings from the 1995 Nationwide Personal Transportation Survey, Center for Urban Transportation Research, Table 4-13.

Where:

VMT	=	Reduction in daily light-duty VMT;
ΔT	=	Percent change in travel time due to real-time arrival info (10 percent);
et	=	Travel time elasticity (+0.23);[2]
R	=	Existing ridership impacted improvement;
AVO	=	Average passenger vehicle occupancy; and
TL	=	Average passenger vehicle trip length

Table 5 below compiles the reductions in pollutants from each category above and provides a total annual projected reduction for each of the 5 primary emission values.

Table 5: Projected Annual Reduction of Pollutants in Kg

Net GHG Reductions	Signal Timing Improvements	Bike-Ped w/Transit	Transit Signal Prioritization	Totals	Total Kg
		Grams			
Total Annual Reduction in NOx Emissions (grams)	222,969.60	117,642.04	1,283,851.94	1,624,463.59	**1,624.46**
Total Annual Reduction in PM2.5 Emissions (grams)	15,289.34	2,425.61	28,572.75	46,287.71	**46.29**
Total Annual Reduction in Summer NOx Emissions (grams)	452,628.29	106,726.80	1,155,776.24	1,715,131.33	**1,715.13**
Total Annual Reduction in Summer VOC Emissions (grams)	341,780.54	40,022.55	440,017.16	821,820.25	**821.82**
Total Annual Reduction in Winter CO Emissions (grams)	3,555,409.54	713,893.14	7,727,236.31	11,996,538.99	**11,996.54**

Worksheets documenting the calculations for emissions reduction are included in Appendix B.

Cost-Effectiveness of Project Emission Reductions

Cost-effectiveness of the proposed TSP project was conducted by year and calculated for the 5-year life cycle for the project. A 5-year life cycle projection was adopted as the "traffic signal timing improvements" typically deteriorate after 5 years due to changes in volume or traffic flow. The Institute of Transportation Engineers recommends re-timing traffic signals every 5 years at minimum to offset this phenomenon.

Per TDOT instructions for this round of CMAQ applications, the two primary groups of emissions were evaluated: (1) CO, VOC, and NOx emissions, and (2) $PM_{2.5}$ emissions. The cost-effectiveness was calculated as the total number of units of emission reduced per year divided by the estimated total cost (CMAQ funding) per fiscal year for each group of

[2] VTPI (2010), *Transportation Elasticities: How Prices and Other Factors Affect Travel Behavior*. Victoria Transport Policy Institute, May 3, 2010.

emissions described above. These calculations are summarized in Table 6 below. The detailed summary and supporting worksheets can be found in Appendix A.

Table 6 - Annual Cost Effectiveness of Emission Reductions

Fiscal Year	Total CO, VOC and NOx Reduction (Kg) per year	PM 2.5 Reduction (Kg) per year	CMAQ Funding Request	Per Year Cost Effectivenss for Total CO, VOC and NOx ($/Kg)	Per Year Cost Effectiveness for PM 2.5 ($/Kg)
2016	16,157.95	46.29	$ 2,500,000	$ 154.72	$ 54,010.02
2017	16,157.95	46.29	$ -	$ 77.36	$ 27,005.01
2018	16,157.95	46.29	$ -	$ 51.57	$ 18,003.34
2019	16,157.95	46.29	$ -	$ 38.68	$ 13,502.51
2020	16,157.95	46.29	$ -	$ 30.94	$ 10,802.00
5-Year Total	**80,789.77**	**231.44**	**$ 2,500,000**		

Innovation, Regional Diversity and Complementary Projects.

The key innovation this project promotes is the ability to utilize a combination of technologies to provide the enhanced capabilities of this project. It includes simple low-cost solutions such as signs and markings added with the high-tech solutions of transit vehicles communicating with the traffic signal system.

The City of Chattanooga has committed to improving the transportation network for all users across all modes. This project exemplifies that commitment as it will improve accessibility to transit through enhanced bike and pedestrian infrastructure, it will improve the transit system's reliability in their arrival and departure schedules, and it will improve the transportation network for the motorist within the corridor through traffic signal timing improvements.

With scarce resources, escalating construction costs and constrained right of way, conventional road widening is inefficient in addressing congestion or congestion management in the traditional ways. New innovations such as the Transit Signal Prioritization and Accessibility Project must leverage information and provide opportunities for change. The hierarchal goal of this system is to improve the effectiveness, efficiency, and safety of the transportation system for all users. This project begins to meld those typical transportation treatments and offers "modal choice" for Transit, Bike or Ped users.

Project Impact on Diversity and Comprehensiveness of Regional Initiatives

Chattanooga has been working over the past several years on a comprehensive Transportation Network plan to address the transportation needs of this region while improving air quality and the quality of life. Chattanooga, like most other cities, has experienced urban sprawl, which in turn causes more and more congestion with longer commuter travel times.

Making transit a more attractive option for users through better schedule reliability, better bike and pedestrian access is a goal defined by Chattanooga's Mayor Andy Berke through the "Mayor's Challenge" initiated by the United States Secretary of Transportation Anthony Foxx in September of 2014 at the "Pro Walk, Pro Bike, Pro Place Conference" and updated as of March 20, 2015. To that point, the City had already adopted a "Complete Street" Ordinance (Ord. No. 12822, § 1, 04-01-14) and has been amended to the City of Chattanooga Municipal Code. (Chapter 32; Article XIV. Complete Streets, §§32-340 – 346) These actions address the accessibility and safety for all users of the transportation network and are indicative of the City of Chattanooga's commitment to these issues.

The areas served by this project have made CARTA Route #4 the most used route within the City of Chattanooga. As indicated earlier in this document, Route #4 serves many of the economically disadvantaged citizens and provides them with access to health, shopping and employment opportunities along the entirety of the corridor. The route also provides greater access to the southeastern region via the Megabus stop located at the Eastgate Center.

Project Benefits for Multimodal Infrastructure

This project paves the way for future benefits of Multimodal Infrastructure and will serve as a "benchmark for modal choice". The project proposed by the Chattanooga Department of Transportation will benefit the transit system by adding devices that will enhance the communication between buses and traffic signals to allow them to stay on schedule along with reducing the time of idling at traffic signals. This will encourage more riders who may walk or bike to the bus stop as well, further reducing emissions and saving fuel costs.

Project Schedule, Project Milestones, Description of Major Tasks and Project Management

Upon receipt of notice of funding from this application, the City Of Chattanooga will concentrate their efforts in preparing the construction plans contingent upon the dollar value awarded and adjust the schedule to expedite the implementation of the project.

Once the project has been approved and the City Of Chattanooga receives approval from TDOT to proceed with implementation, the City Of Chattanooga will contract and advertise a Request for Qualifications (RFQ) that meets the TDOT requirements for Implementation. The Implementation firm would manage the project on a daily basis to ensure compliance with all requirements of the State and Federal governments. The City Of Chattanooga will also assign a Project Manager to actively oversee the project through the implementation and system burn in phases of the project.

The schedule for the design and construction process for this project is included below based on acknowledgement from TDOT and subsequent City approvals. This will typically occur on the 1st of July of the year following the award notification.

Table 7. City of Chattanooga TSP Project Schedule for 2015 CMAQ Funding

TASK		MONTHS	Year 1												Year 2							
Activity	Description	Schedule	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Pre-PE	Develop Contract & NEPA Documentation	1																				
	Develolop RFQ for Design, Timing and CEI	1																				
PE	Develop Systems Engineering Analysis	3																				
	Develop Plans 30%	1																				
	Develop Plans 60%	1																				
	Develop Plans 90%	1																				
	Complete Plans and Contract Documents	1																				
CONST	Bid Project	1																				
	Construct Project	9																				
	Systems Tests (Run Before & After Study)	6																				
	Burn-In Period	3																				
	Project Close-Out	1																				

Appendix A

2015 CMAQ General Competition Project Budget Worksheet - Construction Related Projects

*Complete budget worksheet for each project proposed for CMAQ funding. See instructions.

*Show amounts and sources of all match funding committed to this project. Add rows or columns if needed and adjust formulas for Total Project Cost and Total CMAQ Funds

Applicant/Project Sponsor: City of Chattanooga

Name of Project: SR 2/US 11/US 64/Shallowford Rd/Hamilton Place Blvd Transit Signal Prioritization & Accessibility Prjt.

Type of Project: Bike-Ped with Transit/Traffic Signal Timing/Transit Signal Prioritization

List All Funding Sources: **FHWA CMAQ 80% and City of Chattanooga General Fund (Capital) 20%**

Please review instructions.	**Year One**	**TIP Year: 2016**		**Year Two**	**TIP Year: 2017**		**Year Three**	**TIP Year:**	
	CMAQ Funds Requested	**Local Match Funds**	**Total Costs**	**CMAQ Funds Requested**	**Local Match Funds**	**Total Costs**	**CMAQ Funds Requested**	**Local Match Funds**	**Total Costs**
Construction Projects									
Preliminary Engineering - NEPA	0	0	0	0	0	0	0	0	0
Preliminary Engineering - Design/ Signal Timing	100,000	25,000	125,000	140,000	35,000	175,000	0	0	0
Implementation (show activities below and funding requested by activity)									
List Major Tasks/Activities and show funding proposed for this project by activity and funding source: CONST	750,200	187,750	937,750	750,200	187,750	937,750			
List Major Tasks/Activities and show funding proposed for this project by activity and funding source: CEI	100,000	25,000	125,000	100,000	25,000	125,000			
List Major Tasks/Activities and show funding proposed for this project by activity and funding source: TDOT Oversight	59,600	14,900	74,500						
List Non-CMAQ Activities involved and funding source:	0	0	0						
Total Project Costs	1,009,800	252,650	1,262,250	990,200	247,750	1,237,750	0	0	0

Total Proposed Project Cost $2,500,000

Total CMAQ Funds Requested $2,000,000

Appendix B: Emission Reductions Calculations

See the Attached file 2015 CMAQ TSP Emissions Estimates – Chattanooga Appendix B