2021 CMAQ Application

City of Bristol, Connecticut

PREPARED BY

City of Bristol
111 North Main Street
Bristol, Connecticut 06101

FEBRUARY 2021

ATTACHMENT C

CTDOT's CMAQ Application

All information requested below must be furnished by the project sponsor to ensure complete processing of the application. If the information requested below does not apply to your project, indicate so by writing "NA" next to the question being asked. Submit an electronic copy of your completed application to Mr. Grayson A. Wright at Grayson.Wright@ct.gov

Attach additional sheets of paper if you are unable to fit the information on the application.

1. **Project Title**

Provide a descriptive title for the project that provides enough information to identify the project.

Downtown Signal System Modernization Project

2. **Project Sponsor**

Provide the name of the group or agency requesting the CMAQ activity or project.

City of Bristol

3. **Date**

Provide the application submittal date.

02/22/2021

4. **Contact Information**

Include name, title, agency, address, telephone, FAX number and email address of the individual who will be responsible for directing this project on a daily basis.

Name

Raymond Rogozinski

Title

Director of Public Works

Agency

City of Bristol

Address

111 North Main Street Bristol, CT

telephone/fax

860-584-6113

email address

raymondrogozinski@bristolct.gov

5. **Town**

Provide the name of the town where the project is located.

Bristol

6. **Metropolitan Planning Organizations (MPOs)/Rural Council of Governments (COGs)**

Provide the name of the MPO/Rural COG that serves the area where the project will be located.

NVCOG

7. **County**

Provide the name of the County where the project will be located.

Hartford

8. **CMAQ Eligible Activities**

Identify the category under which the proposed project qualifies for CMAQ funding. Indicate the category for CMAQ Eligibility from the following list. Reference FHWA's Interim Program Guidance issued in November 12, 2013 for qualifying information for each of the headings listed below. Not all possible requests for CMAQ funding are covered. To be eligible, projects must demonstrate air quality benefits.

- ☐ Diesel Engine Retrofits & Other Advanced Truck Technologies
- ☐ Transportation Control Measures (TCMs)
- ☐ Extreme Low-Temperature Cold Start Programs
- ☐ Transit Improvements
- ☐ Transportation Management Associations
- ☐ Carpooling and Vanpooling
- ☐ Carsharing
- ☐ Training
- ☑ Congestion Reduction & Traffic Flow Improvements
- ☐ Travel Demand Management
- ☐ Pedestrian and Bicycle Facilities and Programs
- ☐ Public Education and Outreach Activities
- ☐ Freight/Intermodal
- ☐ Idle Reduction
- ☐ Inspection/Maintenance (I&M) Programs
- ☐ Innovative Projects
- ☐ Alternative Vehicles and Fuels

Additional information regarding project eligibility may also be found on-line in the federal Highway Administration's (FHWA) Final Program Guidance located here:

http://www.fhwa.dot.gov/environment/air_quality/cmaq/policy_and_guidance/

9. **Project Description**

Provide a written description of the proposed project that identifies (as appropriate):

a. Project Location: Indicate the street or facility name and the project limits. For roadway projects indicate the northernmost/southernmost and/or westernmost/easternmost point of the project. For transit station, transfer center or parking projects indicate the nearest intersections. Accurate descriptions are extremely important since the emissions benefits depend on the location.

b. Identify project objectives, and why the project is needed.

c. If the project will require operation and maintenance three years after initial construction, submit a "systems engineering analysis" indicating how the project will be maintained and operated.

d. Specify if project will be designed in-house or by an outside consultant. If an outside consultant will be used, please follow the Department's consultant selection process. This can be located at the following link: https://portal.ct.gov/-/media/DOT/documents/dhighwaydesign/ConsultantSelectionGuidelinesSeptember2016FHWAApprovedpdf.pdf

e. For ITS projects, a consultant with ITS expertise should be used.

f. If applicable, indicate how the project contributes to a reduction in congestion, i.e. reduction in vehicular delay, increased travel speeds, etc.

g. If a new traffic signal is proposed at a new location, a signal warrant analysis is required.

Additionally, on a separate sheet(s), provide a map of the project area that shows the proposed project location.

Project Location: Indicate the street or facility name and the project limits.
See attached City wide map showing locations of all City signals, recent upgrades and proposed six locations for this application.

b.Identify project objectives, and why the project is needed.
Primary objective is to improve traffic operations in the Downtown area to accommodate anticipated development on the Depot Square site. Recent Bristol Hospital project has increased traffic in Downtown area. Traffic signals are more than 20 years old and in need of retiming to minimize congestion as well as updated pedestrian clearance timings.

c.If the project will require operation and maintenance three years after initial construction, submit a "systems engineering analysis" indicating how the project will be maintained and operated.
ATTACHED

d.Specify if project will be designed in-house or by an outside consultant.
Project will be designed by an outside consultant to be selected in accordance with Federal QBS procedures.

e.For ITS projects, a consultant with ITS expertise should be used.
Outside consultant selection will include ITS expertise.

f.If applicable, indicate how the project contributes to a reduction in congestion, reduction in vehicular delay, increased travel speeds, etc.
The project will result in improved traffic operations in the Downtown area, including reduced vehicle delays, increased travel times while maintaining safe travel speeds.

A detailed traffic analysis was conducted for Existing and Build Conditions for the Downtown 6 intersections proposed for upgrading. The analysis is attached and includes a summary LOS matrix.

10. **Operations & Maintenance Plan**

a. Identify funding and policies supporting on-going operation & maintenance

b. Identify the aspects of the project/program needing operation or maintenance

c. Identify the manuals [users, administrators, and maintenance], configuration records, and procedures that are to be used in operation & maintenance

d. Identify the personnel who will be responsible for operations & maintenance

e. Identify initial and on-going personnel training procedures, special skills, tools, and other resources

f. Identify operations& maintenance related data to be collected and how it is to be processed and reported

g. Identify methods to be used to monitor the effectiveness of operations & maintenance

For ITS projects, a completed System Engineering Analysis FORM (SEAFORM) is required with the applications.
https://portal.ct.gov/DOT/Bureau-of-Highway-Operations/Highway-Ops-ITSEngineering--Support

Page 1 of 2 for operation and maintenance plan. Once page 1 is full, please continue on page 2.

a.Identify funding and policies supporting on-going operation &maintenance
The City of Bristol Department of Public Works recently assumed the operation and maintenance of the City's 30+ traffic signal system from the Police Department. The DPW is currently programming funding for the FY21/22 budget year.

b.Identify the aspects of the project/program needing operation or maintenance
The six intersections identified in the application are more than 30 years old and have regular maintenance calls for service. They are in need of replacement with substandard appurtenances and equipment.

c.Identify the manuals [users, administrators, and maintenance],configuration records, and procedures that are to be used in operation & maintenance
As the City DPW has assumed ownership of the signals, the City is in the process of compiling and updating records from the Police Department in order to establish the formal traffic signal operations and maintenance.

d.Identify the personnel who will be responsible for operations &maintenance
The Director of Public Works is directly responsible, with supporting staff the City Engineer and engineering staff and technicians as well as DPW forces.

e.Identify initial and on-going personnel training procedures, special skills,tools, and other resources
The City DPW has engaged a consultant to provide training for operating the traffic signals.

f.Identify operations& maintenance related data to be collected and how itis to be processed and reported
The City DPW will be establishing procedures for collecting the traffic signal data.

g.Identify methods to be used to monitor the effectiveness of operations &maintenance
The City DPW will be establishing procedures for monitoring the effectiveness of the traffic signal system operations and maintenance with the Fiscal 21/22 budget year.

11. Project Schedule

Provide the project schedule for all phases, including the start and completion dates, and project milestones. Also, provide the federal fiscal year in which each phase will begin.

PHASE	START DATE mm/yy	COMPLETION DATE mm/yy	FFY	
consultant selectio	06/21	08/21	2022	
PD	09/21	11/21	2022	
FD	02/22	05/22	2022	
project bid	08/22	09/22	2023	
CON	10/22	10/23	2024	

Duration of project: 12 months from Preliminary Design to Project Bid

12. Estimated Budget

Provide the total cost of the project with a breakdown by phases – Preliminary Engineering, Right-of-Way and Construction/Implementation. This includes, for example, construction estimates, equipment purchases, in-house services, and consultant services. Please use "implementation" to denote the completion of a non-construction project (e.g., purchasing buses). Good cost estimating is critical because the project sponsors will be responsible for cost overruns on selected projects. Utilize the latest CTDOT weighted unit bid prices for project cost. The Department's cost estimating guidelines can be located at the following website:

http://www.ct.gov/dot/cwp/view.asp?a=3886&q=459664

PLEASE ATTACH ESTIMATED BUDGET TO APPLICATION

13. Documentation of Local Match

Provide the source of the local match. This cannot be other federal funds. **If the local government will be providing the match, complete and attach a Resolution of Intent to Provide a Local Match. The local match must be a cash match.**

14. **Project Assessment**

To facilitate the air quality emission analysis for the proposed project, please provide the information requested below (as appropriate):

a. If the project involves the **purchase of vehicles** the following must be included:
   1) Number and type of vehicles (passenger car, school bus, truck [weight, type])
   2) Annual average mileage anticipated per vehicle
   3) Average number of days per week in service
   4) Type of alternative fuel (if applicable)
   5) Percent time such fuel will be used (hybrids)
   6) Type, number and fuel of vehicles being replaced if known

b. For **signal system updates or proposed systems**, please provide:
   1) Estimated completion date
   2) The number and location of signals
   3) Average Daily Traffic (ADT) by lane for each intersection for Build and NoBuild Scenarios
   4) Peak-Hour Volume (both directions)
   5) Existing Corridor Travel Time
   6) A Level of Service/vehicle delay analysis should be provided for build and NoBuild to be able to determine effectiveness of these types of projects.

c. For **Diesel fuel particulate filters** and other **diesel retrofit** devices, please provide:
   1) The type of filter
   2) Number and type of vehicles (bus, tractor trailer)
   3) Annual mileage per vehicle
   4) Percent of idle time
   5) Model year of vehicle to be retrofitted

d. **Alternative Fuel Vehicles:**
   1) Number and type of Vehicles (passenger car, school bus, truck (weight, type, model, make and year) being purchased
   2) Number and type of vehicles (passenger car, school, truck (weight, type, model, make and year) being replaced
   3) Cost of each new vehicle
   4) Type of fuel for each vehicle
   5) Percentage of time, if hybrid, of each fuel usage

6) Number of annual average miles per vehicle
7) Average number of days per week vehicle will be used

e. If **additional parking spaces** or **new parking lots** are constructed near mass transit stations, provide:
   1) Location of new parking spaces/lot
   2) The number of parking spaces or new spaces (if an existing lot)
   3) Any existing survey data which would provide O/D data from station area.

f. **Incident Management:**
   1) Location of project
   2) Estimated Build and No-Build ADT or VMT
   3) Length of roadway where equipment will be used (if only ADT is given)

g. For **bicycle lockers or paths:**
   1) Location of project
   2) Length of facility
   3) Number of potential users
   4) Number of lockers
   5) Survey results if available
   6) Does facility have an end point in a Central Business Area?
   7) Estimate the shift in daily motorized passenger vehicle trips to non-motorized travel due to the bicycle and pedestrian project (Before & After)
   8) Provide the typical one-way trip distance

h. **Transit Projects:**
   1) Project type (System start-up, service and equipment, facility improvement)
   2) Auto trips eliminated per day (round trips)
   3) Trip length

Keep in mind, the following types of projects do not historically provide enough data to prepare a quantitative analysis; therefore, they will require some subjective judgments about their potential benefits, hence they are analyzed qualitatively:

- Marketing of Transit Services
- Telecommuting
- Research and Support programs
- Variable Message Signs

In all cases, please provide all necessary data (even if not listed above) to facilitate emission analysis procedures. The nature of the project defines what is needed to complete an analysis.

1)Estimated completion date

2)The number and location of signals
Six traffic control signals are proposed in the Downtown area as shown on the attached map.
3)Average Daily Traffic (ADT) by lane for each intersection for Build and NoBuild Scenarios
The downtown system roadways carry and average of 13,000 ADT (2015 counts) across all six intersections. These are shown on the CTDOT Traffic Monitoring Station Viewer.

4)Peak-Hour Volume (both directions)
The peak-hour traffic volumes are shown on the attached traffic volume figures.

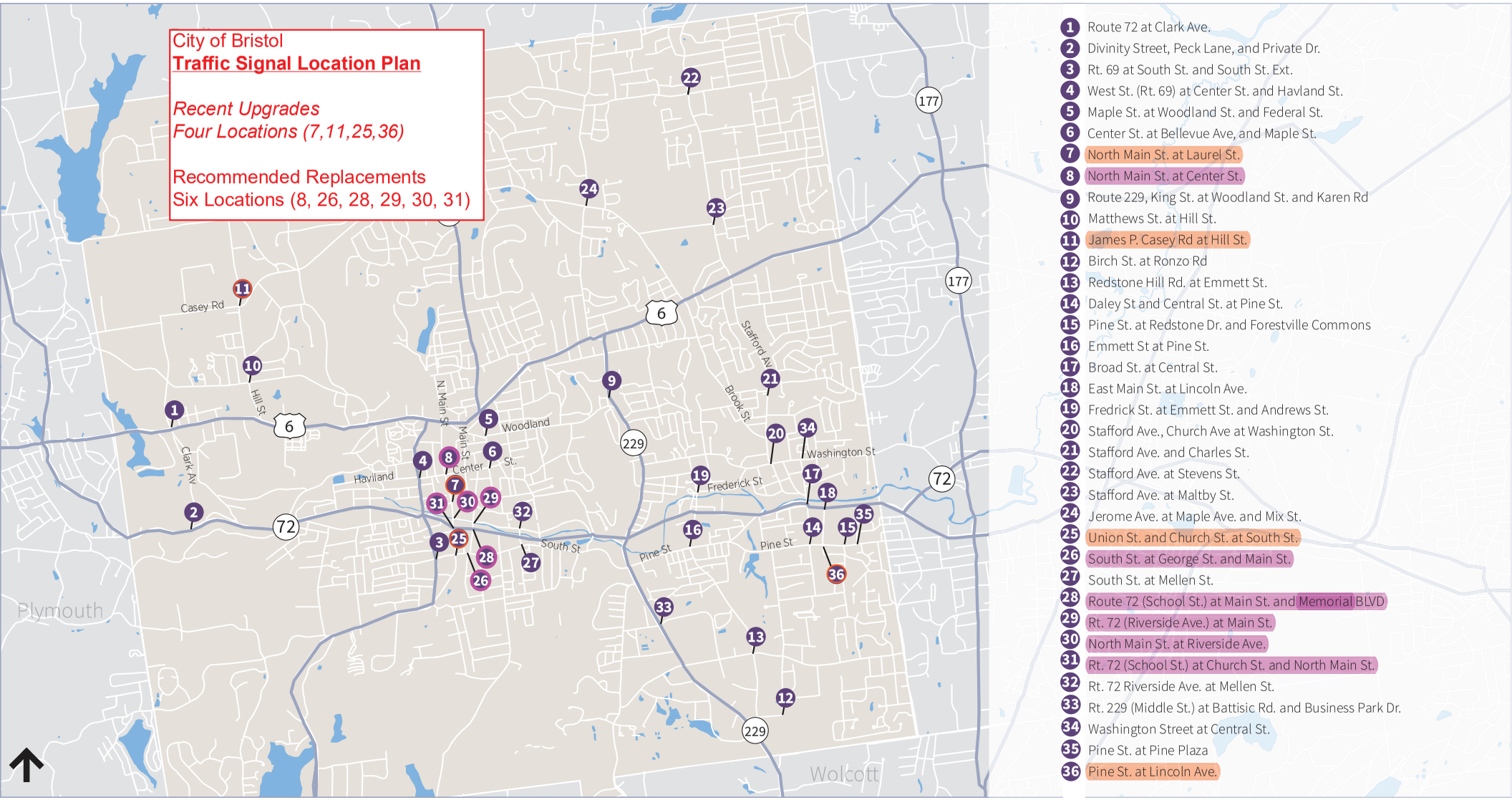
5)Existing Corridor Travel Time
The project is in a grid system in the Downtown. Corridor travel times have not been calculated given the grid system.
6)A Level of Service/vehicle delay analysis should be provided for build andNoBuild to be able to determine effectiveness of these types of projects.
The LOS/Vehicle delay analyses are provided on the attached worksheets.

Signature of Authorized Representative:

Date:

Name:

Title:


City of Bristol
Traffic Signal Location Plan
Recent Upgrades
Four Locations (7,11,25,36)
Recommended Replacements
Six Locations (8, 26, 28, 29, 30, 31)
Casey Rd
Hill St
N. Main St
Main St
Woodland St.
Center St.
Haviland
Clark Av
Brook St
Stafford Ave
Washington St
Frederick St
South St
Pine St
Pine St
Plymouth
Wolcott
1 Route 72 at Clark Ave.
2 Divinity Street, Peck Lane, and Private Dr.
3 Rt. 69 at South St. and South St. Ext.
4 West St. (Rt. 69) at Center St. and Havland St.
5 Maple St. at Woodland St. and Federal St.
6 Center St. at Bellevue Ave, and Maple St.
7 North Main St. at Laurel St.
8 North Main St. at Center St.
9 Route 229, King St. at Woodland St. and Karen Rd
10 Matthews St. at Hill St.
11 James P. Casey Rd at Hill St.
12 Birch St. at Ronzo Rd
13 Redstone Hill Rd. at Emmett St.
14 Daley St and Central St. at Pine St.
15 Pine St. at Redstone Dr. and Forestville Commons
16 Emmett St at Pine St.
17 Broad St. at Central St.
18 East Main St. at Lincoln Ave.
19 Fredrick St. at Emmett St. and Andrews St.
20 Stafford Ave., Church Ave at Washington St.
21 Stafford Ave. and Charles St.
22 Stafford Ave. at Stevens St.
23 Stafford Ave. at Maltby St.
24 Jerome Ave. at Maple Ave. and Mix St.
25 Union St. and Church St. at South St.
26 South St. at George St. and Main St.
27 South St. at Mellen St.
28 Route 72 (School St.) at Main St. and Memorial BLVD
29 Rt. 72 (Riverside Ave.) at Main St.
30 North Main St. at Riverside Ave.
31 Rt. 72 (School St.) at Church St. and North Main St.
32 Rt. 72 Riverside Ave. at Mellen St.
33 Rt. 229 (Middle St.) at Battisic Rd. and Business Park Dr.
34 Washington Street at Central St.
35 Pine St. at Pine Plaza
36 Pine St. at Lincoln Ave.

Traffic Volume Network Capacity Summary

The table submitted as part of the CMAQ filing for six intersections in Bristol, Connecticut summarizes the existing conditions on the traffic network as well as proposed modifications to the network under CMAQ funding.

Existing Traffic Volume Network

The Existing conditions network was created using 2017 and 2020 Turning Movement Count (TMC) data provided by the City and collected by VHB. During the initial analysis of the network, it was noted that the volumes collected in 2020 were approximately 20% lower than the 2017 volumes due to the COVID pandemic impact on the traffic network. The 2020 volumes were increased by 20% to balance with the 2017 volumes and the 2017 volumes were grown by 1-percent per year to a common year of 2020 pre-pandemic conditions.

The analysis of the network results in acceptable levels of service (LOS) at four of the six intersections while the remaining two intersections indicate room for improvement in LOS and delay. The intersections of Route 72 (School Street) at Main Street and Memorial Boulevard and Route 72 (School Street) at North Main Street and Church Street contained turning movements or overall intersection operations with LOS E or F and high delays. Due to the coordinated nature of the network, any changes to the signal timing of these two intersections would need to be reflected on the rest of the intersections on the network.

Proposed Traffic Volume Network under CMAQ

The proposed ("Build") conditions of the traffic volume network took into account the coordinated nature of the network and focused on improving functions at the intersections of Route 72 (School Street) at Main Street and Memorial Boulevard and Route 72 (School Street) at North Main Street and Church Street while reflecting minor modifications across the network. The analysis for the network was completed in a stepped process; each modification analyzed on the network at a time, culminating in an analysis of the conglomerate modifications.

The first of the modifications conducted on the network was instituting a system-wide cycle length of 90 seconds with optimized splits for each intersection.

The second modification was revising lane usage at the two target intersections. At the Intersection of Route 72 (School Street) at Main Street and Memorial Boulevard, the westbound exclusive left-turn lane and through lane were revised to a single shared left-turn/through lane as the left-turn lane was servicing a low volume of turning vehicles. Narrowing the roadway at this intersection would improve pedestrian safety as well as improve the crash frequency (33 over five years) at this location.

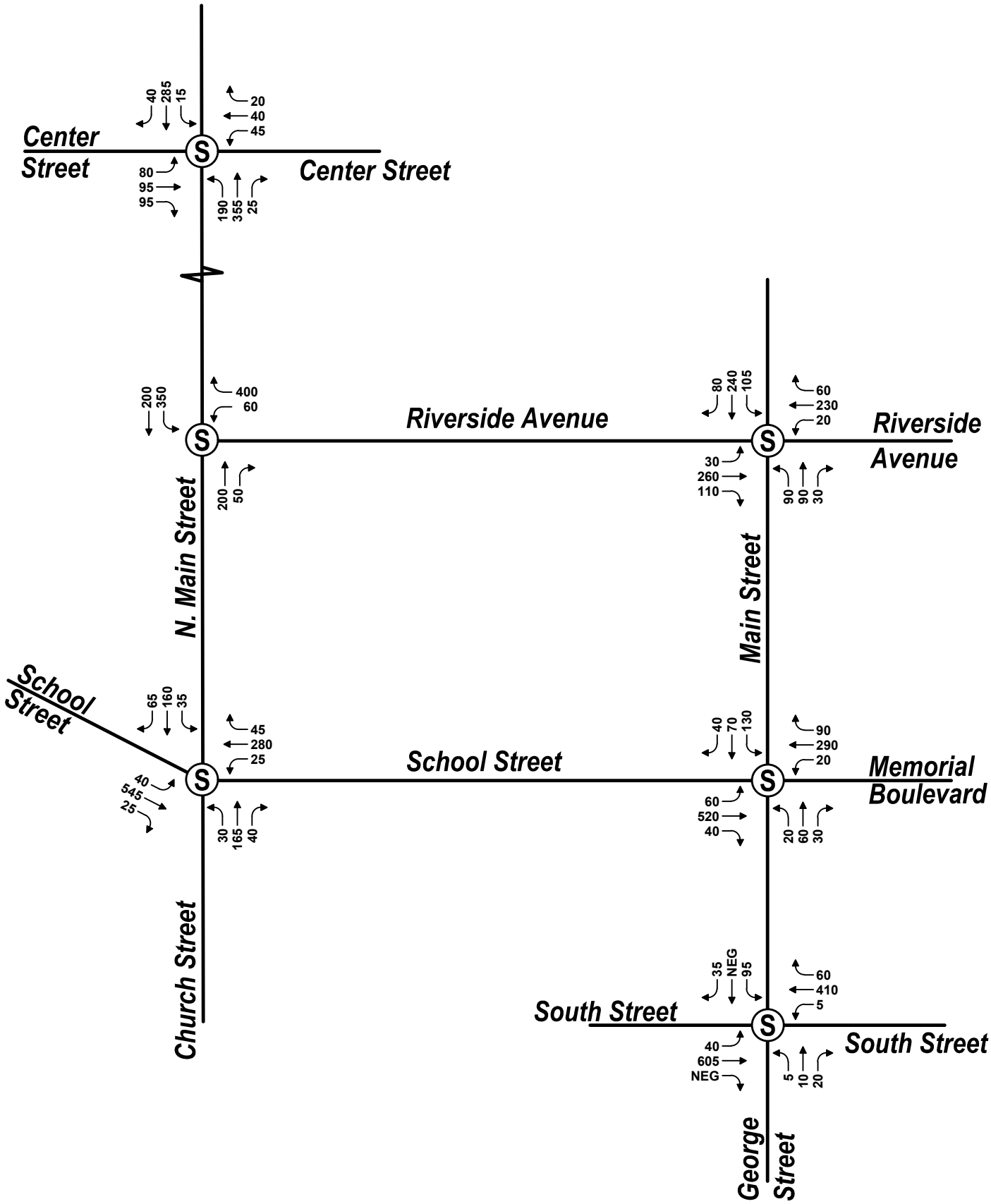
The intersection of Route 72 (School Street) at North Main Street and Church Street was modified to create an exclusive left-turn lane on the eastbound and westbound approaches as

well as merged the northbound right-turn lane with the northbound through lane to consolidate lane usage. Where lanes were added, signal phasing was changed to reflect the lane designation modifications.

The third modification to the network was changing the coordination from north/south coordination to east/west coordination. The east/west direction carries the heavier volumes on the network. Lastly, the intersection of North Main Street at Center Street signal phasing was changed to include a left-turn eastbound/westbound lead phase to better accommodate the turning volumes. Upon review of the crash data this intersection contained 37 crashes over five years, modifications to the signal phasing may marginally increase vehicle delay but provides for increased safety.

Under proposed conditions the two target intersections operate with acceptable levels of service and decreased delays; the remaining intersections on the network may see minor increases in delay or level of service but still operate acceptably.

As part of the CMAQ design of the downtown signals, coordination operation will be reestablished within the existing conduits and new interconnect cable installed to provide fixed coordination between the signals.



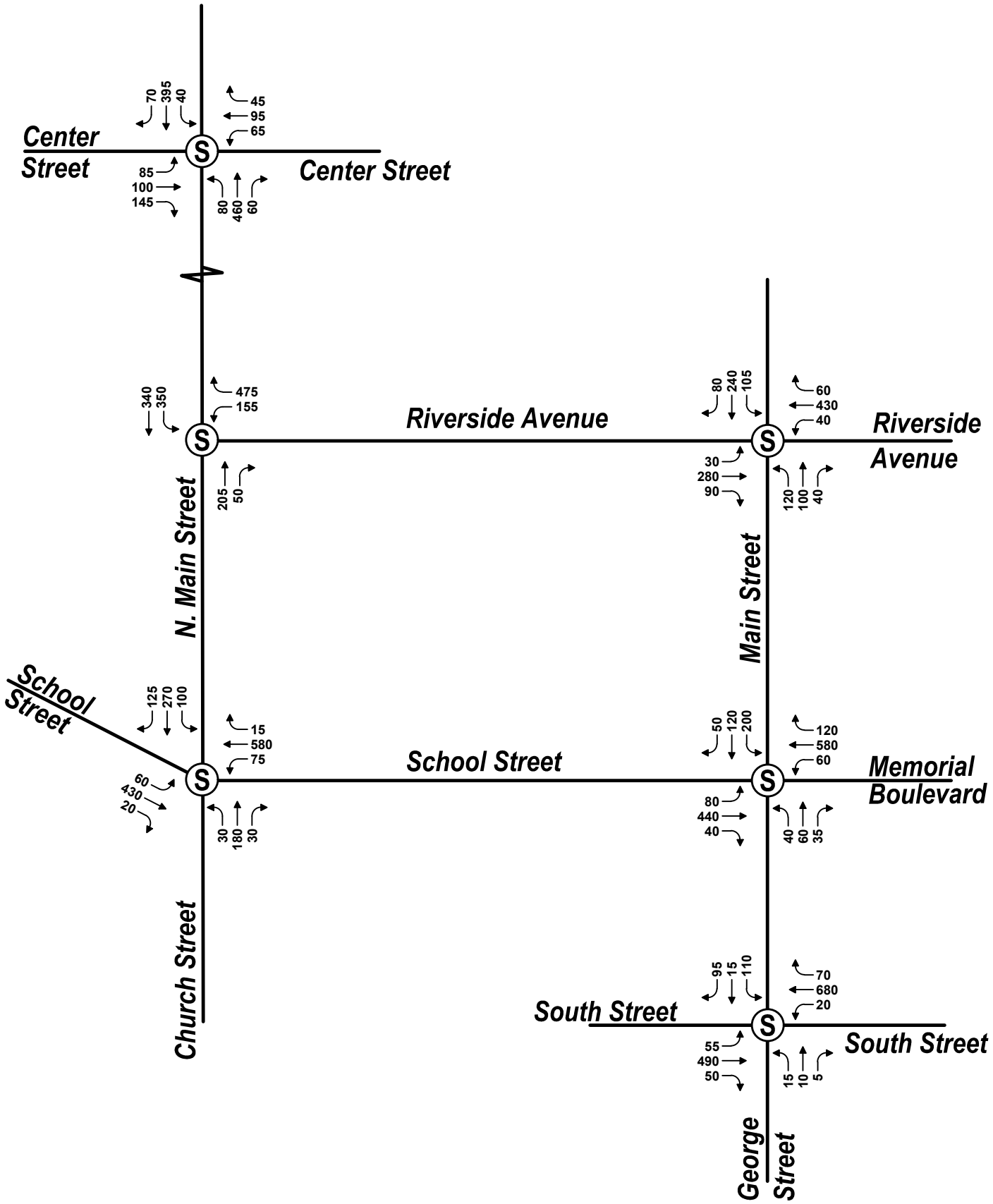
Legend

XX → Weekday Morning Traffic Volume
NEG (Negligible)
Ⓢ Signalized
NOT TO SCALE

2021 CMAQ Application
Weekday Morning Peak Hour
Traffic Volumes
Bristol, CT

Figure 2

02/19/2021



Legend

XX →	Weekday Evening Traffic Volume
NEG	(Negligible)
Ⓢ	Signalized

NOT TO SCALE

2021 CMAQ Application
Weekday Evening Peak Hour
Traffic Volumes
Bristol, CT

Figure 3

02/19/2021

Capacity Analysis Summary

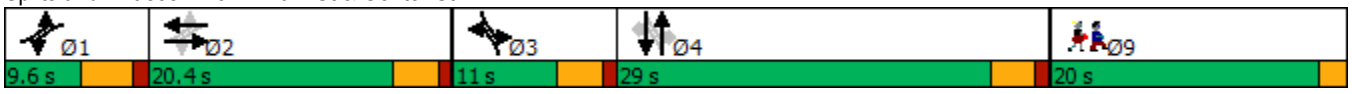
		Existing Conditions						Build Conditions					
		Weekday Morning Peak			Weekday Evening Peak			Weekday Morning Peak			Weekday Evening Peak		
Intersection	Lane Group	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS
1) North Main Street at Center Street	Eastbound LT	0.35	23.0	C	0.35	21.4	C	0.22	20.8	C	0.26	20.5	C
Intersection #8	Eastbound TH-RT	0.5	24.0	C	0.55	23.3	C	0.44	28.5	C	0.55	30.6	C
	Westbound LT	0.28	22.7	C	0.43	22.8	C	0.16	20.4	C	0.28	20.7	C
	Westbound RT	0.14	21.4	C	0.34	21.0	C	0.12	23.7	C	0.33	26.0	C
	Northbound LT	0.34	7.7	A	0.19	8.4	A	0.47	14.6	B	0.28	13.9	B
	Northbound TH	0.5	15.9	B	0.61	17.3	B	0.61	24.8	C	0.67	23.4	C
	Northbound RT	0.02	10.9	B	0.04	10.6	B	0.02	16.4	B	0.04	14.1	B
	Southbound LT	0.03	6.8	A	0.1	8.3	A	0.04	12.6	B	0.16	13.7	B
	Southbound TH	0.4	14.4	B	0.54	16.0	B	0.49	22.1	C	0.59	21.4	C
	Southbound RT	0.03	10.9	B	0.05	10.6	B	0.03	16.5	B	0.05	14.2	B
	Overall	**0.45**	**16.1**	**B**	**0.51**	**17.4**	**B**	**0.48**	**22.20**	**C**	**0.55**	**22.50**	**C**
2) South Street at George Street and Main Street	Eastbound LT-TH-RT	0.67	9.8	A	0.85	20.2	C	0.86	22.4	C	0.93	33.5	C
Intersection #26	Westbound LT	0.02	9.9	A	0.06	11.1	B	0.02	8.5	A	0.05	7.4	A
	Westbound TH-RT	0.6	14.6	B	0.94	37.7	D	0.57	12.1	B	0.76	15.5	B
	Northbound LT-TH-RT	0.14	26.7	C	0.15	25.8	C	0.09	20.5	C	0.12	24.8	C
	Southbound LT	0.73	42.5	D	0.6	30.6	C	0.52	26.6	C	0.62	34.3	C
	Southbound TH-RT	0.03	26.3	C	0.14	25.7	C	0.03	22.4	C	0.14	26.8	C
	Overall	**0.64**	**15.2**	**B**	**0.81**	**29.2**	**C**	**0.69**	**19.10**	**B**	**0.79**	**24.50**	**C**
3) Route 72 (School Street) at Main Street	Eastbound LT	0.18	16.7	B	0.39	20.8	C	0.19	12.2	B	0.43	14.3	B
and Memorial Boulevard	Eastbound TH-RT	1.05	79.5	E	0.92	47.2	D	0.75	19.9	B	0.52	11.1	B
Intersection #28	Westbound LT	0.1	18.9	B	0.29	19.4	B	-	-	-	-	-	-
	Westbound TH	0.54	24.3	C	1.1	96.5	F	0.56	19.5	B	0.95	40.6	D
	Westbound RT	0.06	19.8	B	0.11	20.7	C	0.06	15.2	B	0.08	12.2	B
	Northbound LT	0.06	23.3	C	0.12	23.6	C	0.05	17.8	B	0.16	24.4	C
	Northbound TH	0.16	25.9	C	0.17	27.3	C	0.15	21.3	C	0.23	27.5	C
	Northbound RT	0.02	25.0	C	0.02	26.3	C	0.02	20.5	C	0.02	26.2	C
	Southbound LT	0.28	17.3	B	0.43	18.5	B	0.35	19.6	B	0.78	40.1	D
	Southbound TH	0.13	20.8	C	0.24	22.8	C	0.18	21.5	C	0.45	29.2	C
	Southbound RT	0.03	20.0	B	0.03	21.3	C	0.03	20.5	C	0.03	26.3	C
	Overall	**0.59**	**45.2**	**D**	**0.7**	**52.0**	**D**	**0.60**	**19.30**	**B**	**0.83**	**27.60**	**C**
4) Route 72 (Riverside Avenue) at Main Street	Eastbound LT	0.14	22.9	C	0.15	24.6	C	0.24	21.9	C	0.13	21.8	C
Intersection #29	Eastbound TH	0.64	29.1	C	0.67	31.9	C	0.67	29.1	C	0.71	32.1	C
	Eastbound RT	0.08	22.4	C	0.06	23.8	C	0.08	21.6	C	0.06	23.0	C
	Westbound LT	0.13	13.5	B	0.27	16.4	B	0.12	22.4	C	0.1	12.6	B
	Westbound TH	0.44	15.7	B	0.6	19.6	B	0.87	44.4	D	0.66	21.9	C
	Westbound RT	0.04	12.7	B	0.04	14.0	B	0.04	22.0	C	0.04	15.0	B
	Northbound LT	0.22	15.7	B	0.34	18.1	B	0.35	23.9	C	0.68	38.7	D
	Northbound TH	0.18	20.1	C	0.22	23.7	C	0.24	22.8	C	0.34	28.4	C
	Northbound RT	0.02	19.0	B	0.03	22.3	C	0.02	21.5	C	0.03	26.3	C
	Southbound LT	0.09	20.6	C	0.25	20.3	C	0.11	9.6	A	0.52	22.0	C
	Southbound TH	0.27	23.8	C	0.59	29.8	C	0.13	9.6	A	0.41	19.5	B
	Southbound RT	0.03	22.2	C	0.06	24.2	C	0.03	9.1	A	0.06	16.8	B
	Overall	**0.42**	**20.7**	**C**	**0.57**	**23.8**	**C**	**0.43**	**27.70**	**C**	**0.62**	**24.40**	**C**
5) North Main Street at Riverside Avenue	Westbound LT	0.34	34.2	C	0.72	44.0	D	0.08	14.7	B	0.21	15.3	B
Intersection #30	Westbound RT	0.16	32.7	C	0.19	31.2	C	0.16	15.3	B	0.19	14.9	B
	Northbound TH	0.13	7.0	A	0.14	6.8	A	0.58	36.8	D	0.47	65.9	E
	Northbound RT	0.03	7.4	A	0.03	4.1	A	0.03	18.6	B	0.03	26.9	C
	Southbound LT	0.43	6.2	A	0.45	7.1	A	0.71	28.6	C	0.77	32.2	C
	Southbound TH	0.09	3.6	A	0.15	4.4	A	0.16	17.6	B	0.27	19.3	B
	Overall	**0.39**	**15.7**	**B**	**0.46**	**17.3**	**B**	**0.38**	**22.90**	**C**	**0.42**	**26.70**	**C**
6) Route 72 (School Street) at Church Street	Eastbound LT-TH-RT	1.11	95.6	F	1.04	76.1	E	0.13	14.6	B	0.51	23.7	C
and North Main Street	Eastbound TH-RT	-	-	-	-	-	-	0.93	44.6	D	0.7	29.3	C
Intersection #31	Westbound LT-TH-RT	0.6	21.8	C	1.32	183.1	F	0.2	19.0	B	0.36	18.7	B
	Westbound TH-RT	-	-	-	-	-	-	0.47	21.3	C	0.97	54.7	D
	Northbound LT	0.09	21.1	C	0.1	21.3	C	0.11	32.6	C	0.19	32.9	C
	Northbound TH	0.33	23.7	C	0.36	24.2	C	0.48	42.0	D	0.75	45.5	D
	Northbound RT	0.03	20.3	C	0.02	20.2	C	-	-	-	-	-	-
	Southbound LT	0.1	15.8	B	0.24	18.1	B	0.15	17.2	B	0.28	15.6	B
	Southbound TH	0.27	15.2	B	0.37	18.0	B	0.33	16.4	B	0.43	15.2	B
	Southbound RT	0.05	20.5	C	0.07	31.4	C	0.05	22.7	C	0.07	21.0	C
	Overall	**0.67**	**52.9**	**D**	**0.81**	**94.3**	**F**	**0.68**	**32.80**	**C**	**0.76**	**35.50**	**D**

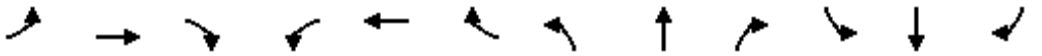
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR	Ø9
Lane Configurations											
Traffic Volume (vph)	80	95	45	40	190	355	25	15	285	40	
Future Volume (vph)	80	95	45	40	190	355	25	15	285	40	
Lane Group Flow (vph)	87	206	49	65	207	386	27	16	310	43	
Turn Type	pm+pt	NA	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	Perm	
Protected Phases	1	2	1	2	3	4		3	4		9
Permitted Phases	2		2		4		4	4		4	
Detector Phase	1	2	1	2	3	4	4	3	4	4	
Switch Phase											
Minimum Initial (s)	5.0	5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	5.0
Minimum Split (s)	9.5	9.0	9.5	9.0	9.0	9.0	9.0	9.0	9.0	9.0	20.0
Total Split (s)	9.6	20.4	9.6	20.4	11.0	29.0	29.0	11.0	29.0	29.0	20.0
Total Split (%)	10.7%	22.7%	10.7%	22.7%	12.2%	32.2%	32.2%	12.2%	32.2%	32.2%	22%
Yellow Time (s)	3.5	3.0	3.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.5	4.0	4.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Recall Mode	None	Max	None	Max	None	Max	Max	None	Max	Max	None
v/c Ratio	0.22	0.47	0.15	0.15	0.45	0.59	0.04	0.04	0.47	0.07	
Control Delay	20.7	24.4	19.9	19.8	16.8	26.0	0.1	12.8	23.3	0.2	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	20.7	24.4	19.9	19.8	16.8	26.0	0.1	12.8	23.3	0.2	
Queue Length 50th (ft)	25	57	13	15	46	132	0	3	101	0	
Queue Length 95th (ft)	74	154	48	56	131	#325	0	18	239	0	
Internal Link Dist (ft)		401		666		988			331		
Turn Bay Length (ft)	150		130		75		75	130		130	
Base Capacity (vph)	403	436	319	426	458	657	648	394	657	648	
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.22	0.47	0.15	0.15	0.45	0.59	0.04	0.04	0.47	0.07	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 72
Natural Cycle: 75
Control Type: Semi Act-Uncoord
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 8: N Main St & Center St





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	80	95	95	45	40	20	190	355	25	15	285	40
Future Volume (vph)	80	95	95	45	40	20	190	355	25	15	285	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.0		4.5	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.93		1.00	0.95		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1723		1770	1768		1770	1863	1583	1770	1863	1583
Flt Permitted	0.71	1.00		0.50	1.00		0.43	1.00	1.00	0.34	1.00	1.00
Satd. Flow (perm)	1331	1723		927	1768		804	1863	1583	625	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	87	103	103	49	43	22	207	386	27	16	310	43
RTOR Reduction (vph)	0	38	0	0	17	0	0	0	18	0	0	28
Lane Group Flow (vph)	87	168	0	49	48	0	207	386	9	16	310	15
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	1	2		1	2		3	4		3	4	
Permitted Phases	2			2			4		4	4		4
Actuated Green, G (s)	20.7	16.7		20.7	16.7		32.5	25.4	25.4	32.5	25.4	25.4
Effective Green, g (s)	20.7	16.7		20.7	16.7		32.5	25.4	25.4	32.5	25.4	25.4
Actuated g/C Ratio	0.28	0.22		0.28	0.22		0.44	0.34	0.34	0.44	0.34	0.34
Clearance Time (s)	4.5	4.0		4.5	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	392	385		302	395		442	634	538	381	634	538
v/s Ratio Prot	c0.01	c0.10		0.01	0.03		c0.04	c0.21		0.00	0.17	
v/s Ratio Perm	0.05			0.04			0.16		0.01	0.01		0.01
v/c Ratio	0.22	0.44		0.16	0.12		0.47	0.61	0.02	0.04	0.49	0.03
Uniform Delay, d1	20.5	24.9		20.1	23.1		13.8	20.5	16.3	12.6	19.5	16.4
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.3	3.6		0.3	0.6		0.8	4.3	0.1	0.0	2.7	0.1
Delay (s)	20.8	28.5		20.4	23.7		14.6	24.8	16.4	12.6	22.1	16.5
Level of Service	C	C		C	C		B	C	B	B	C	B
Approach Delay (s)		26.2			22.3			21.0			21.1	
Approach LOS		C			C			C			C	

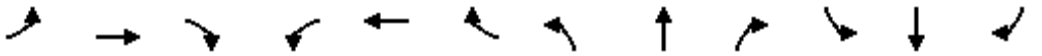
Intersection Summary			
HCM 2000 Control Delay	22.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	74.6	Sum of lost time (s)	18.5
Intersection Capacity Utilization	53.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	Ø3
Lane Configurations									
Traffic Volume (vph)	40	605	5	410	5	10	95	0	
Future Volume (vph)	40	605	5	410	5	10	95	0	
Lane Group Flow (vph)	0	741	5	511	0	56	119	44	
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	NA	
Protected Phases		4		4	1	1 2		2	3
Permitted Phases	4		4		1 2		2		
Detector Phase	4	4	4	4	1	1 2	2	2	
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.0	5.0
Minimum Split (s)	10.0	10.0	10.0	10.0	10.0		22.5	22.5	22.0
Total Split (s)	35.0	35.0	35.0	35.0	10.0		23.0	23.0	22.0
Total Split (%)	38.9%	38.9%	38.9%	38.9%	11.1%		25.6%	25.6%	24%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.5	3.5	2.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		1.0	1.0	0.0
Lost Time Adjust (s)		0.0	0.0	0.0			0.0	0.0	
Total Lost Time (s)		5.0	5.0	5.0			4.5	4.5	
Lead/Lag	Lag	Lag	Lag	Lag	Lead		Lag	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Recall Mode	None	None	None	None	None		Min	Min	None
v/c Ratio		0.81	0.02	0.54		0.14	0.49	0.06	
Control Delay		26.6	15.2	17.5		11.4	33.0	0.1	
Queue Delay		0.0	0.0	0.0		0.0	0.0	0.0	
Total Delay		26.6	15.2	17.5		11.4	33.0	0.1	
Queue Length 50th (ft)		213	1	116		6	40	0	
Queue Length 95th (ft)		#714	10	#432		21	98	0	
Internal Link Dist (ft)		450		1933		681		812	
Turn Bay Length (ft)			100						
Base Capacity (vph)		914	297	951		616	428	911	
Starvation Cap Reductn		0	0	0		0	0	0	
Spillback Cap Reductn		0	0	0		0	0	0	
Storage Cap Reductn		0	0	0		0	0	0	
Reduced v/c Ratio		0.81	0.02	0.54		0.09	0.28	0.05	

Intersection Summary
Cycle Length: 90
Actuated Cycle Length: 61.2
Natural Cycle: 110
Control Type: Actuated-Uncoordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 26: George St/Main St & South St



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	40	605	0	5	410	60	5	10	20	95	0	35
Future Volume (vph)	40	605	0	5	410	60	5	10	20	95	0	35
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0		5.0	5.0			5.0		4.5	4.5	
Lane Util. Factor		1.00		1.00	1.00			1.00		1.00	1.00	
Frt		1.00		1.00	0.98			0.92		1.00	0.85	
Flt Protected		1.00		0.95	1.00			0.99		0.95	1.00	
Satd. Flow (prot)		1857		1770	1827			1707		1770	1583	
Flt Permitted		0.95		0.31	1.00			0.97		0.72	1.00	
Satd. Flow (perm)		1765		574	1827			1669		1342	1583	
Peak-hour factor, PHF	0.87	0.87	0.87	0.92	0.92	0.92	0.63	0.63	0.63	0.80	0.80	0.80
Adj. Flow (vph)	46	695	0	5	446	65	8	16	32	119	0	44
RTOR Reduction (vph)	0	0	0	0	5	0	0	25	0	0	37	0
Lane Group Flow (vph)	0	741	0	5	506	0	0	31	0	119	7	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			4		1	1 2			2	
Permitted Phases	4			4			1 2			2		
Actuated Green, G (s)		31.7		31.7	31.7			13.7		11.0	11.0	
Effective Green, g (s)		31.7		31.7	31.7			13.7		11.0	11.0	
Actuated g/C Ratio		0.49		0.49	0.49			0.21		0.17	0.17	
Clearance Time (s)		5.0		5.0	5.0					4.5	4.5	
Vehicle Extension (s)		2.0		2.0	2.0					3.0	3.0	
Lane Grp Cap (vph)		866		281	896			355		228	269	
v/s Ratio Prot					0.28			c0.00			0.00	
v/s Ratio Perm		c0.42		0.01				0.01		c0.09		
v/c Ratio		0.86		0.02	0.57			0.09		0.52	0.03	
Uniform Delay, d1		14.4		8.5	11.6			20.4		24.4	22.3	
Progression Factor		1.00		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2		8.0		0.0	0.5			0.0		2.2	0.0	
Delay (s)		22.4		8.5	12.1			20.5		26.6	22.4	
Level of Service		C		A	B			C		C	C	
Approach Delay (s)		22.4			12.0			20.5			25.4	
Approach LOS		C			B			C			C	

Intersection Summary			
HCM 2000 Control Delay	19.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	64.6	Sum of lost time (s)	16.5
Intersection Capacity Utilization	83.3%	ICU Level of Service	E
Analysis Period (min)	15		

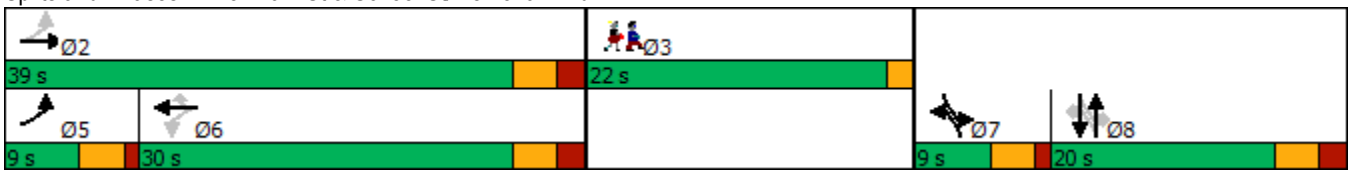
c Critical Lane Group

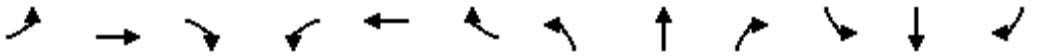
Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	Ø3
Lane Configurations												
Traffic Volume (vph)	60	520	20	290	90	20	60	30	130	70	40	
Future Volume (vph)	60	520	20	290	90	20	60	30	130	70	40	
Lane Group Flow (vph)	65	608	0	337	98	22	65	33	141	76	43	
Turn Type	pm+pt	NA	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	
Protected Phases	5	2		6		7	8		7	8		3
Permitted Phases	2		6		6	8		8	8		8	
Detector Phase	5	2	6	6	6	7	8	8	7	8	8	
Switch Phase												
Minimum Initial (s)	5.0	15.0	15.0	15.0	15.0	5.0	15.0	15.0	5.0	15.0	15.0	5.0
Minimum Split (s)	9.0	20.0	20.0	20.0	20.0	9.0	20.0	20.0	9.0	20.0	20.0	22.0
Total Split (s)	9.0	39.0	30.0	30.0	30.0	9.0	20.0	20.0	9.0	20.0	20.0	22.0
Total Split (%)	10.0%	43.3%	33.3%	33.3%	33.3%	10.0%	22.2%	22.2%	10.0%	22.2%	22.2%	24%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0
All-Red Time (s)	1.0	2.0	2.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0	0.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.0	5.0		5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	
Lead/Lag	Lead		Lag	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	
Lead-Lag Optimize?	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Recall Mode	None	Min	Min	Min	Min	None	Min	Min	None	Min	Min	None
v/c Ratio	0.16	0.75		0.53	0.15	0.05	0.14	0.07	0.31	0.17	0.09	
Control Delay	13.3	24.3		23.4	2.1	19.1	26.4	0.3	21.1	26.6	0.3	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	13.3	24.3		23.4	2.1	19.1	26.4	0.3	21.1	26.6	0.3	
Queue Length 50th (ft)	13	175		107	0	6	22	0	38	25	0	
Queue Length 95th (ft)	49	#514		267	15	27	69	0	113	78	0	
Internal Link Dist (ft)		609		686			812			189		
Turn Bay Length (ft)								490				
Base Capacity (vph)	399	1024		717	731	457	455	496	461	455	496	
Starvation Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.16	0.59		0.47	0.13	0.05	0.14	0.07	0.31	0.17	0.09	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 65
Natural Cycle: 90
Control Type: Actuated-Uncoordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 28: Main St & School St/Memorial Blvd





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	60	520	40	20	290	90	20	60	30	130	70	40
Future Volume (vph)	60	520	40	20	290	90	20	60	30	130	70	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0			5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	1.00			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99			1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00			1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1843			1857	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.37	1.00			0.94	1.00	0.71	1.00	1.00	0.71	1.00	1.00
Satd. Flow (perm)	686	1843			1759	1583	1318	1863	1583	1331	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	65	565	43	22	315	98	22	65	33	141	76	43
RTOR Reduction (vph)	0	3	0	0	0	64	0	0	25	0	0	33
Lane Group Flow (vph)	65	605	0	0	337	34	22	65	8	141	76	10
Turn Type	pm+pt	NA		Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	5	2			6		7	8		7	8	
Permitted Phases	2			6		6	8		8	8		8
Actuated Green, G (s)	30.3	30.3			23.7	23.7	19.7	15.9	15.9	19.7	15.9	15.9
Effective Green, g (s)	30.3	30.3			23.7	23.7	19.7	15.9	15.9	19.7	15.9	15.9
Actuated g/C Ratio	0.44	0.44			0.34	0.34	0.29	0.23	0.23	0.29	0.23	0.23
Clearance Time (s)	4.0	5.0			5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	342	810			605	544	401	429	365	404	429	365
v/s Ratio Prot	0.01	c0.33					0.00	0.03		c0.02	0.04	
v/s Ratio Perm	0.08				0.19	0.02	0.01		0.00	c0.08		0.01
v/c Ratio	0.19	0.75			0.56	0.06	0.05	0.15	0.02	0.35	0.18	0.03
Uniform Delay, d1	11.9	16.1			18.3	15.1	17.8	21.1	20.5	19.1	21.3	20.5
Progression Factor	1.00	1.00			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.3	3.8			1.1	0.0	0.1	0.2	0.0	0.5	0.2	0.0
Delay (s)	12.2	19.9			19.5	15.2	17.8	21.3	20.5	19.6	21.5	20.5
Level of Service	B	B			B	B	B	C	C	B	C	C
Approach Delay (s)		19.1			18.5			20.4			20.3	
Approach LOS		B			B			C			C	

Intersection Summary			
HCM 2000 Control Delay	19.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	68.9	Sum of lost time (s)	20.0
Intersection Capacity Utilization	72.1%	ICU Level of Service	C
Analysis Period (min)	15		

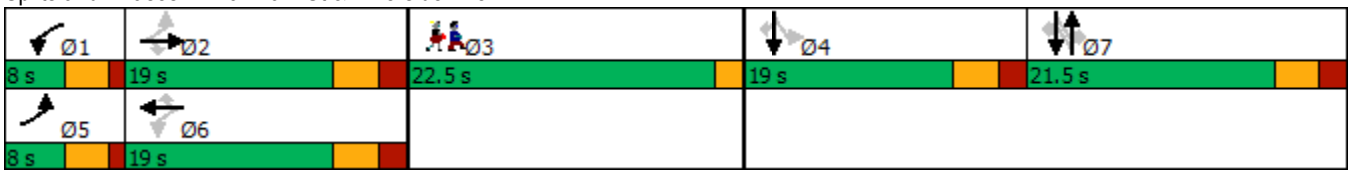
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	260	110	20	320	60	90	90	30	30	110	50
Future Volume (vph)	30	260	110	20	320	60	90	90	30	30	110	50
Lane Group Flow (vph)	33	283	120	22	348	65	98	98	33	33	120	54
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			7			4 7	
Permitted Phases	2		2	6		6	7		7	4 7		4 7
Detector Phase	5	2	2	1	6	6	7	7	7	4 7	4 7	4 7
Switch Phase												
Minimum Initial (s)	4.0	14.0	14.0	4.0	14.0	14.0	15.0	15.0	15.0			
Minimum Split (s)	8.0	19.0	19.0	8.0	19.0	19.0	21.5	21.5	21.5			
Total Split (s)	8.0	19.0	19.0	8.0	19.0	19.0	21.5	21.5	21.5			
Total Split (%)	8.9%	21.1%	21.1%	8.9%	21.1%	21.1%	23.9%	23.9%	23.9%			
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0			
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0			
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Total Lost Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	5.0	5.0	5.0			
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lag	Lag	Lag			
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes			
Recall Mode	None	Min	Min	None	Min	Min	Min	Min	Min			
v/c Ratio	0.16	0.63	0.24	0.08	0.86	0.14	0.33	0.22	0.07	0.11	0.12	0.06
Control Delay	21.7	33.0	4.1	20.8	49.9	0.6	28.1	25.3	0.3	13.1	11.2	1.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	21.7	33.0	4.1	20.8	49.9	0.6	28.1	25.3	0.3	13.1	11.2	1.2
Queue Length 50th (ft)	9	88	0	6	113	0	27	27	0	4	16	0
Queue Length 95th (ft)	37	#318	27	28	#408	0	98	93	0	33	79	7
Internal Link Dist (ft)		646			1697			189			1031	
Turn Bay Length (ft)				50		50				130		130
Base Capacity (vph)	206	452	503	260	407	469	326	479	525	319	1032	920
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.16	0.63	0.24	0.08	0.86	0.14	0.30	0.20	0.06	0.10	0.12	0.06

Intersection Summary

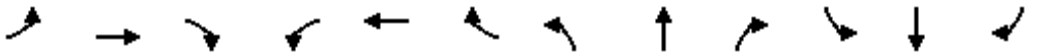
Cycle Length: 90
Actuated Cycle Length: 65.9
Natural Cycle: 95
Control Type: Actuated-Uncoordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 29: Main St & Riverside Ave



Lane Group	Ø3	Ø4
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Lane Group Flow (vph)		
Turn Type		
Protected Phases	3	4
Permitted Phases		
Detector Phase		
Switch Phase		
Minimum Initial (s)	5.0	15.0
Minimum Split (s)	22.0	20.0
Total Split (s)	22.5	19.0
Total Split (%)	25%	21%
Yellow Time (s)	2.0	3.0
All-Red Time (s)	0.0	2.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		Lead
Lead-Lag Optimize?		Yes
Recall Mode	None	Min
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		

Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	260	110	20	320	60	90	90	30	30	110	50
Future Volume (vph)	30	260	110	20	320	60	90	90	30	30	110	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.25	1.00	1.00	0.42	1.00	1.00	0.68	1.00	1.00	0.31	1.00	1.00
Satd. Flow (perm)	466	1863	1583	777	1863	1583	1266	1863	1583	578	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	33	283	120	22	348	65	98	98	33	33	120	54
RTOR Reduction (vph)	0	0	93	0	0	51	0	0	26	0	0	27
Lane Group Flow (vph)	33	283	27	22	348	14	98	98	7	33	120	27
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			7			4 7	
Permitted Phases	2		2	6		6	7		7	4 7		4 7
Actuated Green, G (s)	17.4	16.0	16.0	15.8	15.2	15.2	15.7	15.7	15.7	35.1	35.1	35.1
Effective Green, g (s)	17.4	16.0	16.0	15.8	15.2	15.2	15.7	15.7	15.7	35.1	35.1	35.1
Actuated g/C Ratio	0.25	0.23	0.23	0.22	0.22	0.22	0.22	0.22	0.22	0.50	0.50	0.50
Clearance Time (s)	4.0	5.0	5.0	4.0	5.0	5.0	5.0	5.0	5.0			
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0			
Lane Grp Cap (vph)	140	422	358	182	401	340	281	414	352	287	926	787
v/s Ratio Prot	c0.00	0.15		0.00	c0.19			0.05			c0.06	
v/s Ratio Perm	0.05		0.02	0.03		0.01	c0.08		0.00	0.06		0.02
v/c Ratio	0.24	0.67	0.08	0.12	0.87	0.04	0.35	0.24	0.02	0.11	0.13	0.03
Uniform Delay, d1	21.0	24.9	21.5	22.1	26.7	21.9	23.1	22.5	21.4	9.5	9.5	9.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.9	4.2	0.1	0.3	17.6	0.0	0.8	0.3	0.0	0.2	0.1	0.0
Delay (s)	21.9	29.1	21.6	22.4	44.4	22.0	23.9	22.8	21.5	9.6	9.6	9.1
Level of Service	C	C	C	C	D	C	C	C	C	A	A	A
Approach Delay (s)		26.5			39.9			23.1			9.5	
Approach LOS		C			D			C			A	

Intersection Summary			
HCM 2000 Control Delay	27.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	70.6	Sum of lost time (s)	21.0
Intersection Capacity Utilization	54.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø9
Lane Configurations							
Traffic Volume (vph)	60	400	200	50	350	200	
Future Volume (vph)	60	400	200	50	350	200	
Lane Group Flow (vph)	65	435	217	54	380	217	
Turn Type	Prot	Prot	NA	pm+ov	pm+pt	NA	
Protected Phases	2	2	4	2	3	3 4	9
Permitted Phases				4	3 4		
Detector Phase	2	2	4	2	3	3 4	
Switch Phase							
Minimum Initial (s)	10.0	10.0	7.0	10.0	5.0		5.0
Minimum Split (s)	14.0	14.0	11.0	14.0	9.0		25.0
Total Split (s)	23.0	23.0	14.0	23.0	28.0		25.0
Total Split (%)	25.6%	25.6%	15.6%	25.6%	31.1%		28%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		2.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		0.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0		
Lead/Lag			Lag		Lead		
Lead-Lag Optimize?			Yes		Yes		
Recall Mode	C-Min	C-Min	None	C-Min	None		None
v/c Ratio	0.08	0.29	0.58	0.06	0.71	0.16	
Control Delay	20.9	3.5	40.8	6.6	28.2	16.7	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	20.9	3.5	40.8	6.6	28.2	16.7	
Queue Length 50th (ft)	18	0	27	0	160	40	
Queue Length 95th (ft)	70	44	102	m41	215	55	
Internal Link Dist (ft)	646		265			499	
Turn Bay Length (ft)							
Base Capacity (vph)	834	1543	393	990	584	1397	
Starvation Cap Reductn	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	
Reduced v/c Ratio	0.08	0.28	0.55	0.05	0.65	0.16	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:WBL, Start of Yellow
Natural Cycle: 65
Control Type: Actuated-Coordinated
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 30: N Main St & Riverside Ave

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	60	400	200	50	350	200
Future Volume (vph)	60	400	200	50	350	200
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.88	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	2787	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.52	1.00
Satd. Flow (perm)	1770	2787	3539	1583	972	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	65	435	217	54	380	217
RTOR Reduction (vph)	0	242	0	24	0	0
Lane Group Flow (vph)	65	193	217	30	380	217
Turn Type	Prot	Prot	NA	pm+ov	pm+pt	NA
Protected Phases	2	2	4	2	3	3 4
Permitted Phases				4	3 4	
Actuated Green, G (s)	39.9	39.9	9.5	49.4	31.5	35.5
Effective Green, g (s)	39.9	39.9	9.5	49.4	31.5	35.5
Actuated g/C Ratio	0.44	0.44	0.11	0.55	0.35	0.39
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	784	1235	373	868	535	1395
v/s Ratio Prot	0.04	c0.07	0.06	0.02	c0.17	0.06
v/s Ratio Perm				0.00	c0.07	
v/c Ratio	0.08	0.16	0.58	0.03	0.71	0.16
Uniform Delay, d1	14.5	15.0	38.4	9.3	24.2	17.6
Progression Factor	1.00	1.00	0.90	1.99	1.00	1.00
Incremental Delay, d2	0.2	0.3	2.1	0.0	4.4	0.1
Delay (s)	14.7	15.3	36.8	18.6	28.6	17.6
Level of Service	B	B	D	B	C	B
Approach Delay (s)	15.2		33.2			24.6
Approach LOS	B		C			C

Intersection Summary			
HCM 2000 Control Delay	22.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	43.6%	ICU Level of Service	A
Analysis Period (min)	15		

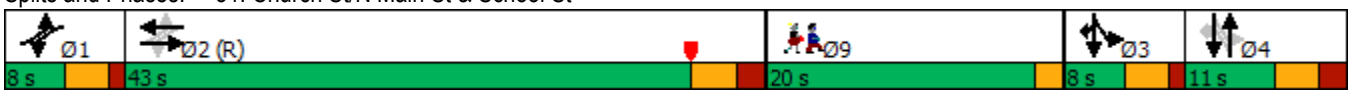
c Critical Lane Group

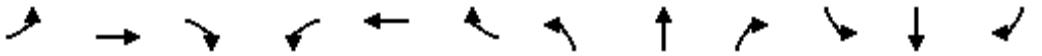
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR	Ø9
Lane Configurations										
Traffic Volume (vph)	40	545	25	280	30	165	35	160	65	
Future Volume (vph)	40	545	25	280	30	165	35	160	65	
Lane Group Flow (vph)	48	687	27	346	32	220	45	208	84	
Turn Type	pm+pt	NA	pm+pt	NA	Perm	NA	pm+pt	NA	custom	
Protected Phases	1	2	1	2		4	3	3 4	3	9
Permitted Phases	2		2		4		3 4		3 4	
Detector Phase	1	2	1	2	4	4	3	3 4	3	
Switch Phase										
Minimum Initial (s)	4.0	5.0	4.0	5.0	5.0	5.0	4.0		4.0	3.0
Minimum Split (s)	8.0	10.0	8.0	10.0	10.0	10.0	8.0		8.0	26.0
Total Split (s)	8.0	43.0	8.0	43.0	11.0	11.0	8.0		8.0	20.0
Total Split (%)	8.9%	47.8%	8.9%	47.8%	12.2%	12.2%	8.9%		8.9%	22%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	2.0
All-Red Time (s)	1.0	2.0	1.0	2.0	2.0	2.0	1.0		1.0	0.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	
Total Lost Time (s)	4.0	5.0	4.0	5.0	5.0	5.0	4.0		4.0	
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lag	Lead		Lead	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	
Recall Mode	None	C-Max	None	C-Max	Max	Max	None		None	None
v/c Ratio	0.12	0.87	0.17	0.44	0.11	0.49	0.14	0.32	0.14	
Control Delay	11.4	37.7	13.1	19.8	39.1	43.2	18.5	19.5	5.8	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	11.4	37.7	13.1	19.8	39.1	43.2	18.5	19.5	5.8	
Queue Length 50th (ft)	13	355	7	133	0	129	8	93	0	
Queue Length 95th (ft)	27	#500	20	209	m34	m#323	47	159	39	
Internal Link Dist (ft)		355		609		913		265		
Turn Bay Length (ft)	25		25		30					
Base Capacity (vph)	412	788	156	781	286	449	314	641	608	
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.12	0.87	0.17	0.44	0.11	0.49	0.14	0.32	0.14	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:EBWB and 6:, Start of Yellow
Natural Cycle: 100
Control Type: Actuated-Coordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 31: Church St/N Main St & School St





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	40	545	25	25	280	45	30	165	40	35	160	65
Future Volume (vph)	40	545	25	25	280	45	30	165	40	35	160	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	10	11	11	10	11	11	12	12	12	12	12	12
Total Lost time (s)	4.0	5.0		4.0	5.0		5.0	5.0		4.0	4.0	4.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	0.98		1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1652	1789		1652	1763		1770	1808		1770	1863	1583
Flt Permitted	0.44	1.00		0.11	1.00		0.63	1.00		0.49	1.00	1.00
Satd. Flow (perm)	766	1789		187	1763		1169	1808		921	1863	1583
Peak-hour factor, PHF	0.83	0.83	0.83	0.94	0.94	0.94	0.93	0.93	0.93	0.77	0.77	0.77
Adj. Flow (vph)	48	657	30	27	298	48	32	177	43	45	208	84
RTOR Reduction (vph)	0	2	0	0	6	0	0	8	0	0	0	60
Lane Group Flow (vph)	48	685	0	27	340	0	32	212	0	45	208	24
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		pm+pt	NA	custom
Protected Phases	1	2		1	2			4		3	3 4	3
Permitted Phases	2			2			4			3 4		3 4
Actuated Green, G (s)	40.4	37.2		40.4	37.2		22.0	22.0		26.0	30.0	26.0
Effective Green, g (s)	40.4	37.2		40.4	37.2		22.0	22.0		26.0	30.0	26.0
Actuated g/C Ratio	0.45	0.41		0.45	0.41		0.24	0.24		0.29	0.33	0.29
Clearance Time (s)	4.0	5.0		4.0	5.0		5.0	5.0		4.0		4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0		3.0
Lane Grp Cap (vph)	375	739		136	728		285	441		303	621	527
v/s Ratio Prot	0.00	c0.38		c0.01	0.19			c0.12		0.01	c0.11	0.00
v/s Ratio Perm	0.05			0.08			0.03			0.04		0.01
v/c Ratio	0.13	0.93		0.20	0.47		0.11	0.48		0.15	0.33	0.05
Uniform Delay, d1	14.4	25.1		18.3	19.2		26.4	29.1		23.5	22.5	23.1
Progression Factor	1.00	1.00		1.00	1.00		1.21	1.34		0.72	0.72	0.98
Incremental Delay, d2	0.2	19.5		0.7	2.1		0.7	3.1		0.2	0.3	0.0
Delay (s)	14.6	44.6		19.0	21.3		32.6	42.0		17.2	16.4	22.7
Level of Service	B	D		B	C		C	D		B	B	C
Approach Delay (s)		42.6			21.2			40.8			18.1	
Approach LOS		D			C			D			B	

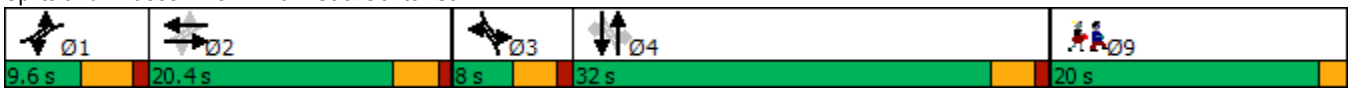
Intersection Summary			
HCM 2000 Control Delay	32.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	59.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

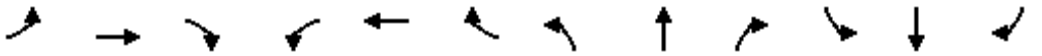
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	NBR	SBL	SBT	SBR	Ø9
Lane Configurations											
Traffic Volume (vph)	85	100	65	95	80	445	60	40	395	70	
Future Volume (vph)	85	100	65	95	80	445	60	40	395	70	
Lane Group Flow (vph)	92	267	71	152	87	484	65	43	429	76	
Turn Type	pm+pt	NA	pm+pt	NA	pm+pt	NA	Perm	pm+pt	NA	Perm	
Protected Phases	1	2	1	2	3	4		3	4		9
Permitted Phases	2		2		4		4	4		4	
Detector Phase	1	2	1	2	3	4	4	3	4	4	
Switch Phase											
Minimum Initial (s)	5.0	5.0	5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	5.0
Minimum Split (s)	9.5	9.0	9.5	9.0	8.0	9.0	9.0	8.0	9.0	9.0	20.0
Total Split (s)	9.6	20.4	9.6	20.4	8.0	32.0	32.0	8.0	32.0	32.0	20.0
Total Split (%)	10.7%	22.7%	10.7%	22.7%	8.9%	35.6%	35.6%	8.9%	35.6%	35.6%	22%
Yellow Time (s)	3.5	3.0	3.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.5	4.0	4.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lead/Lag	Lead	Lag	Lead	Lag	Lead	Lag	Lag	Lead	Lag	Lag	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Recall Mode	None	Max	None	Max	None	Max	Max	None	Max	Max	None
v/c Ratio	0.25	0.58	0.25	0.34	0.25	0.64	0.09	0.14	0.56	0.10	
Control Delay	21.1	26.1	21.2	24.8	14.5	24.9	0.2	13.2	22.9	0.7	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	21.1	26.1	21.2	24.8	14.5	24.9	0.2	13.2	22.9	0.7	
Queue Length 50th (ft)	26	73	20	46	18	164	0	9	139	0	
Queue Length 95th (ft)	78	#215	63	124	61	#421	0	35	#328	4	
Internal Link Dist (ft)		401		666		988			331		
Turn Bay Length (ft)	150		130		75		75	130		130	
Base Capacity (vph)	374	460	285	442	347	762	729	304	762	729	
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.25	0.58	0.25	0.34	0.25	0.64	0.09	0.14	0.56	0.10	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 70.5
Natural Cycle: 80
Control Type: Semi Act-Uncoord
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 8: N Main St & Center St





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	85	100	145	65	95	45	80	445	60	40	395	70
Future Volume (vph)	85	100	145	65	95	45	80	445	60	40	395	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.0		4.5	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.91		1.00	0.95		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1697		1770	1773		1770	1863	1583	1770	1863	1583
Flt Permitted	0.61	1.00		0.39	1.00		0.33	1.00	1.00	0.27	1.00	1.00
Satd. Flow (perm)	1139	1697		719	1773		620	1863	1583	511	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	92	109	158	71	103	49	87	484	65	43	429	76
RTOR Reduction (vph)	0	55	0	0	18	0	0	0	40	0	0	46
Lane Group Flow (vph)	92	212	0	71	134	0	87	484	25	43	429	30
Turn Type	pm+pt	NA		pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	1	2		1	2		3	4		3	4	
Permitted Phases	2			2			4		4	4		4
Actuated Green, G (s)	20.8	16.9		20.8	16.9		31.8	28.8	28.8	31.8	28.8	28.8
Effective Green, g (s)	20.8	16.9		20.8	16.9		31.8	28.8	28.8	31.8	28.8	28.8
Actuated g/C Ratio	0.28	0.23		0.28	0.23		0.43	0.39	0.39	0.43	0.39	0.39
Clearance Time (s)	4.5	4.0		4.5	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	353	388		257	405		313	726	616	270	726	616
v/s Ratio Prot	0.01	c0.13		c0.01	0.08		c0.01	c0.26		0.01	0.23	
v/s Ratio Perm	0.06			0.06			0.11		0.02	0.06		0.02
v/c Ratio	0.26	0.55		0.28	0.33		0.28	0.67	0.04	0.16	0.59	0.05
Uniform Delay, d1	20.1	25.1		20.1	23.8		13.4	18.6	14.0	13.4	17.9	14.0
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	5.5		0.6	2.2		0.5	4.8	0.1	0.3	3.5	0.1
Delay (s)	20.5	30.6		20.7	26.0		13.9	23.4	14.1	13.7	21.4	14.2
Level of Service	C	C		C	C		B	C	B	B	C	B
Approach Delay (s)		28.0			24.3			21.1			19.8	
Approach LOS		C			C			C			B	

Intersection Summary			
HCM 2000 Control Delay	22.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	73.9	Sum of lost time (s)	18.5
Intersection Capacity Utilization	58.8%	ICU Level of Service	B
Analysis Period (min)	15		

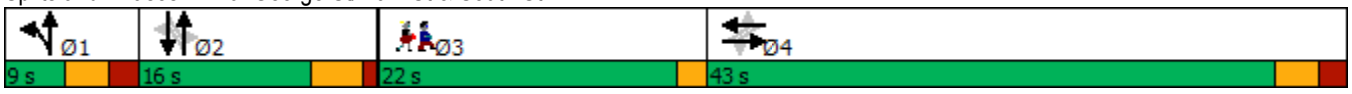
c Critical Lane Group

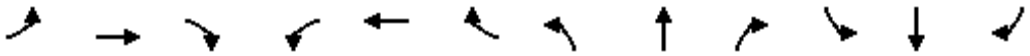
Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	Ø3
Lane Configurations									
Traffic Volume (vph)	55	490	20	680	15	10	110	15	
Future Volume (vph)	55	490	20	680	15	10	110	15	
Lane Group Flow (vph)	0	653	21	773	0	40	122	123	
Turn Type	Perm	NA	Perm	NA	pm+pt	NA	Perm	NA	
Protected Phases		4		4	1	1 2		2	3
Permitted Phases	4		4		1 2		2		
Detector Phase	4	4	4	4	1	1 2	2	2	
Switch Phase									
Minimum Initial (s)	5.0	5.0	5.0	5.0	4.0		5.0	5.0	5.0
Minimum Split (s)	10.0	10.0	10.0	10.0	9.0		19.0	19.0	22.0
Total Split (s)	43.0	43.0	43.0	43.0	9.0		16.0	16.0	22.0
Total Split (%)	47.8%	47.8%	47.8%	47.8%	10.0%		17.8%	17.8%	24%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		3.5	3.5	2.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0		1.0	1.0	0.0
Lost Time Adjust (s)		0.0	0.0	0.0			0.0	0.0	
Total Lost Time (s)		5.0	5.0	5.0			4.5	4.5	
Lead/Lag	Lag	Lag	Lag	Lag	Lead		Lag	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Recall Mode	None	None	None	None	None		Min	Min	None
v/c Ratio		0.88	0.05	0.72		0.14	0.59	0.36	
Control Delay		32.9	11.7	19.5		20.8	43.2	12.9	
Queue Delay		0.0	0.0	0.0		0.0	0.0	0.0	
Total Delay		32.9	11.7	19.5		20.8	43.2	12.9	
Queue Length 50th (ft)		222	4	220		10	47	6	
Queue Length 95th (ft)		#671	22	#679		34	#151	58	
Internal Link Dist (ft)		450		1933		681		812	
Turn Bay Length (ft)			100						
Base Capacity (vph)		739	403	1068		326	239	372	
Starvation Cap Reductn		0	0	0		0	0	0	
Spillback Cap Reductn		0	0	0		0	0	0	
Storage Cap Reductn		0	0	0		0	0	0	
Reduced v/c Ratio		0.88	0.05	0.72		0.12	0.51	0.33	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 67.5
Natural Cycle: 120
Control Type: Actuated-Uncoordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 26: George St/Main St & South St





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	55	490	50	20	680	70	15	10	5	110	15	95
Future Volume (vph)	55	490	50	20	680	70	15	10	5	110	15	95
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0		5.0	5.0			5.0		4.5	4.5	
Lane Util. Factor		1.00		1.00	1.00			1.00		1.00	1.00	
Frt		0.99		1.00	0.99			0.98		1.00	0.87	
Flt Protected		1.00		0.95	1.00			0.98		0.95	1.00	
Satd. Flow (prot)		1833		1770	1837			1774		1770	1622	
Flt Permitted		0.69		0.37	1.00			0.84		0.73	1.00	
Satd. Flow (perm)		1270		695	1837			1524		1362	1622	
Peak-hour factor, PHF	0.91	0.91	0.91	0.97	0.97	0.97	0.75	0.75	0.75	0.90	0.90	0.90
Adj. Flow (vph)	60	538	55	21	701	72	20	13	7	122	17	106
RTOR Reduction (vph)	0	3	0	0	3	0	0	6	0	0	91	0
Lane Group Flow (vph)	0	650	0	21	770	0	0	34	0	122	32	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		4			4		1	1 2			2	
Permitted Phases	4			4			1 2			2		
Actuated Green, G (s)		39.2		39.2	39.2			12.5		10.3	10.3	
Effective Green, g (s)		39.2		39.2	39.2			12.5		10.3	10.3	
Actuated g/C Ratio		0.55		0.55	0.55			0.18		0.14	0.14	
Clearance Time (s)		5.0		5.0	5.0					4.5	4.5	
Vehicle Extension (s)		2.0		2.0	2.0					3.0	3.0	
Lane Grp Cap (vph)		699		382	1011			275		197	234	
v/s Ratio Prot					0.42			c0.00			0.02	
v/s Ratio Perm		c0.51		0.03				0.02		c0.09		
v/c Ratio		0.93		0.05	0.76			0.12		0.62	0.14	
Uniform Delay, d1		14.7		7.4	12.4			24.7		28.6	26.6	
Progression Factor		1.00		1.00	1.00			1.00		1.00	1.00	
Incremental Delay, d2		18.8		0.0	3.1			0.1		5.7	0.3	
Delay (s)		33.5		7.4	15.5			24.8		34.3	26.8	
Level of Service		C		A	B			C		C	C	
Approach Delay (s)		33.5			15.3			24.8			30.6	
Approach LOS		C			B			C			C	

Intersection Summary			
HCM 2000 Control Delay	24.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	71.2	Sum of lost time (s)	16.5
Intersection Capacity Utilization	93.8%	ICU Level of Service	F
Analysis Period (min)	15		

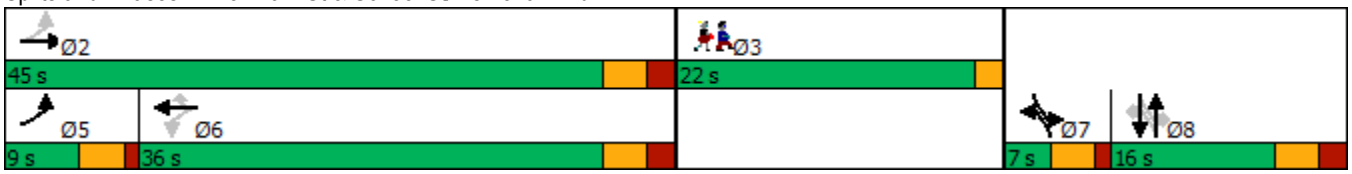
c Critical Lane Group

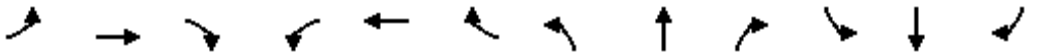
Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	Ø3
Lane Configurations												
Traffic Volume (vph)	80	440	60	580	120	40	60	35	200	120	50	
Future Volume (vph)	80	440	60	580	120	40	60	35	200	120	50	
Lane Group Flow (vph)	87	521	0	695	130	43	65	38	217	130	54	
Turn Type	pm+pt	NA	Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm	
Protected Phases	5	2		6		7	8		7	8		3
Permitted Phases	2		6		6	8		8	8		8	
Detector Phase	5	2	6	6	6	7	8	8	7	8	8	
Switch Phase												
Minimum Initial (s)	5.0	15.0	15.0	15.0	15.0	3.0	11.0	11.0	3.0	11.0	11.0	5.0
Minimum Split (s)	9.0	20.0	20.0	20.0	20.0	7.0	16.0	16.0	7.0	16.0	16.0	22.0
Total Split (s)	9.0	45.0	36.0	36.0	36.0	7.0	16.0	16.0	7.0	16.0	16.0	22.0
Total Split (%)	10.0%	50.0%	40.0%	40.0%	40.0%	7.8%	17.8%	17.8%	7.8%	17.8%	17.8%	24%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0
All-Red Time (s)	1.0	2.0	2.0	2.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0	0.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.0	5.0		5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0	
Lead/Lag	Lead		Lag	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag	
Lead-Lag Optimize?	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Recall Mode	None	Min	Min	Min	Min	None	Min	Min	None	Min	Min	None
v/c Ratio	0.37	0.52		0.92	0.16	0.15	0.22	0.10	0.71	0.44	0.14	
Control Delay	13.5	13.8		40.2	3.4	24.6	31.5	0.5	41.6	35.1	0.8	
Queue Delay	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	13.5	13.8		40.2	3.4	24.6	31.5	0.5	41.6	35.1	0.8	
Queue Length 50th (ft)	13	110		254	0	13	24	0	74	50	0	
Queue Length 95th (ft)	55	328		#693	31	48	73	0	#257	129	0	
Internal Link Dist (ft)		609		686			812			189		
Turn Bay Length (ft)								490				
Base Capacity (vph)	237	1064		759	788	294	295	373	307	295	373	
Starvation Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0		0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.37	0.49		0.92	0.16	0.15	0.22	0.10	0.71	0.44	0.14	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 70.6
Natural Cycle: 100
Control Type: Actuated-Uncoordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 28: Main St & School St/Memorial Blvd





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	80	440	40	60	580	120	40	60	35	200	120	50
Future Volume (vph)	80	440	40	60	580	120	40	60	35	200	120	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0			5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor	1.00	1.00			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.99			1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00			1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1840			1854	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.12	1.00			0.91	1.00	0.67	1.00	1.00	0.71	1.00	1.00
Satd. Flow (perm)	223	1840			1696	1583	1255	1863	1583	1331	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	87	478	43	65	630	130	43	65	38	217	130	54
RTOR Reduction (vph)	0	3	0	0	0	74	0	0	32	0	0	46
Lane Group Flow (vph)	87	518	0	0	695	56	43	65	6	217	130	8
Turn Type	pm+pt	NA		Perm	NA	Perm	pm+pt	NA	Perm	pm+pt	NA	Perm
Protected Phases	5	2			6		7	8		7	8	
Permitted Phases	2			6		6	8		8	8		8
Actuated Green, G (s)	39.5	39.5			31.6	31.6	14.3	11.2	11.2	14.3	11.2	11.2
Effective Green, g (s)	39.5	39.5			31.6	31.6	14.3	11.2	11.2	14.3	11.2	11.2
Actuated g/C Ratio	0.54	0.54			0.43	0.43	0.20	0.15	0.15	0.20	0.15	0.15
Clearance Time (s)	4.0	5.0			5.0	5.0	4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	203	996			735	686	268	286	243	279	286	243
v/s Ratio Prot	0.02	c0.28					0.01	0.03		c0.03	0.07	
v/s Ratio Perm	0.21				c0.41	0.04	0.02		0.00	c0.12		0.01
v/c Ratio	0.43	0.52			0.95	0.08	0.16	0.23	0.02	0.78	0.45	0.03
Uniform Delay, d1	12.9	10.7			19.8	12.1	24.1	27.1	26.2	27.3	28.1	26.2
Progression Factor	1.00	1.00			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.5	0.5			20.8	0.1	0.3	0.4	0.0	12.8	1.1	0.1
Delay (s)	14.3	11.1			40.6	12.2	24.4	27.5	26.2	40.1	29.2	26.3
Level of Service	B	B			D	B	C	C	C	D	C	C
Approach Delay (s)		11.6			36.1			26.3			34.7	
Approach LOS		B			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	27.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	72.9	Sum of lost time (s)	20.0
Intersection Capacity Utilization	89.7%	ICU Level of Service	E
Analysis Period (min)	15		

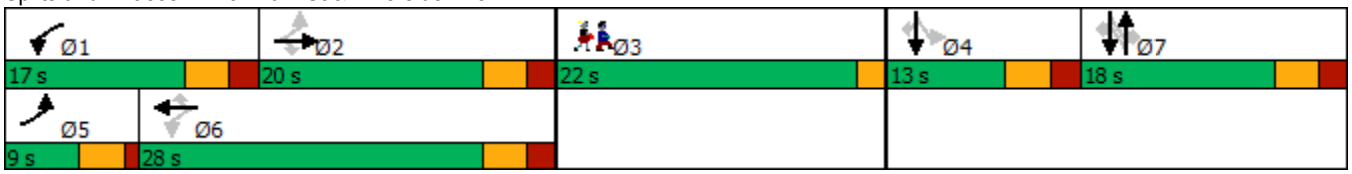
c Critical Lane Group

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	280	90	40	430	60	120	100	40	105	240	80
Future Volume (vph)	30	280	90	40	430	60	120	100	40	105	240	80
Lane Group Flow (vph)	33	304	98	43	467	65	130	109	43	114	261	87
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			7			4 7	
Permitted Phases	2		2	6		6	7		7	4 7		4 7
Detector Phase	5	2	2	1	6	6	7	7	7	4 7	4 7	4 7
Switch Phase												
Minimum Initial (s)	5.0	15.0	15.0	12.0	15.0	15.0	13.0	13.0	13.0			
Minimum Split (s)	9.0	20.0	20.0	17.0	20.0	20.0	18.0	18.0	18.0			
Total Split (s)	9.0	20.0	20.0	17.0	28.0	28.0	18.0	18.0	18.0			
Total Split (%)	10.0%	22.2%	22.2%	18.9%	31.1%	31.1%	20.0%	20.0%	20.0%			
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0			
All-Red Time (s)	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0			
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Total Lost Time (s)	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0			
Lead/Lag	Lead	Lag	Lag	Lead	Lag	Lag	Lag	Lag	Lag			
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes			
Recall Mode	None	Min	Min	Min	Min	Min	Min	Min	Min			
v/c Ratio	0.10	0.78	0.19	0.10	0.63	0.09	0.64	0.32	0.09	0.49	0.39	0.13
Control Delay	15.2	44.7	0.9	14.5	26.0	0.2	46.8	30.9	0.4	29.7	20.9	0.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	15.2	44.7	0.9	14.5	26.0	0.2	46.8	30.9	0.4	29.7	20.9	0.7
Queue Length 50th (ft)	7	119	0	9	130	0	50	39	0	35	76	0
Queue Length 95th (ft)	31	#337	0	38	#460	0	#172	108	0	#132	196	3
Internal Link Dist (ft)		646			1697			189			1031	
Turn Bay Length (ft)				50		50				130		130
Base Capacity (vph)	326	390	504	439	747	729	202	339	465	233	677	675
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.10	0.78	0.19	0.10	0.63	0.09	0.64	0.32	0.09	0.49	0.39	0.13

Intersection Summary

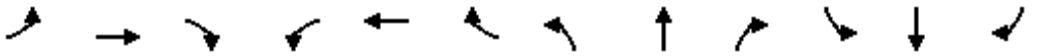
Cycle Length: 90
Actuated Cycle Length: 72.4
Natural Cycle: 100
Control Type: Actuated-Uncoordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 29: Main St & Riverside Ave



Lane Group	Ø3	Ø4
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Lane Group Flow (vph)		
Turn Type		
Protected Phases	3	4
Permitted Phases		
Detector Phase		
Switch Phase		
Minimum Initial (s)	5.0	15.0
Minimum Split (s)	22.0	20.0
Total Split (s)	22.0	13.0
Total Split (%)	24%	14%
Yellow Time (s)	2.0	3.0
All-Red Time (s)	0.0	2.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		Lead
Lead-Lag Optimize?		Yes
Recall Mode	None	Min
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		

Intersection Summary



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	280	90	40	430	60	120	100	40	105	240	80
Future Volume (vph)	30	280	90	40	430	60	120	100	40	105	240	80
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1583	1770	1863	1583	1770	1863	1583	1770	1863	1583
Flt Permitted	0.49	1.00	1.00	0.27	1.00	1.00	0.60	1.00	1.00	0.34	1.00	1.00
Satd. Flow (perm)	906	1863	1583	508	1863	1583	1114	1863	1583	642	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	33	304	98	43	467	65	130	109	43	114	261	87
RTOR Reduction (vph)	0	0	75	0	0	40	0	0	36	0	0	57
Lane Group Flow (vph)	33	304	23	43	467	25	130	109	7	114	261	30
Turn Type	pm+pt	NA	Perm	pm+pt	NA	Perm	Perm	NA	Perm	Perm	NA	Perm
Protected Phases	5	2		1	6			7			4 7	
Permitted Phases	2		2	6		6	7		7	4 7		4 7
Actuated Green, G (s)	19.6	17.7	17.7	34.9	29.0	29.0	13.2	13.2	13.2	26.3	26.3	26.3
Effective Green, g (s)	19.6	17.7	17.7	34.9	29.0	29.0	13.2	13.2	13.2	26.3	26.3	26.3
Actuated g/C Ratio	0.26	0.23	0.23	0.46	0.38	0.38	0.17	0.17	0.17	0.34	0.34	0.34
Clearance Time (s)	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0			
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0			
Lane Grp Cap (vph)	253	431	366	433	707	600	192	321	273	221	641	544
v/s Ratio Prot	0.00	0.16		c0.02	c0.25			0.06			0.14	
v/s Ratio Perm	0.03		0.01	0.03		0.02	c0.12		0.00	c0.18		0.02
v/c Ratio	0.13	0.71	0.06	0.10	0.66	0.04	0.68	0.34	0.03	0.52	0.41	0.06
Uniform Delay, d1	21.5	27.0	22.9	12.5	19.6	14.9	29.6	27.8	26.3	20.0	19.1	16.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.2	5.2	0.1	0.1	2.3	0.0	9.1	0.6	0.0	2.0	0.4	0.0
Delay (s)	21.8	32.1	23.0	12.6	21.9	15.0	38.7	28.4	26.3	22.0	19.5	16.8
Level of Service	C	C	C	B	C	B	D	C	C	C	B	B
Approach Delay (s)		29.3			20.5			32.8			19.6	
Approach LOS		C			C			C			B	

Intersection Summary			
HCM 2000 Control Delay	24.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	76.4	Sum of lost time (s)	22.0
Intersection Capacity Utilization	66.1%	ICU Level of Service	C
Analysis Period (min)	15		

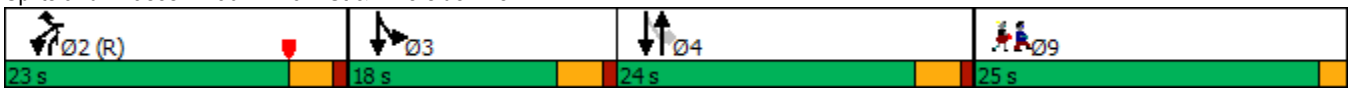
c Critical Lane Group

Lane Group	WBL	WBR	NBT	NBR	SBL	SBT	Ø9
Lane Configurations							
Traffic Volume (vph)	155	475	205	50	350	340	
Future Volume (vph)	155	475	205	50	350	340	
Lane Group Flow (vph)	168	516	223	54	380	370	
Turn Type	Prot	Prot	NA	pm+ov	pm+pt	NA	
Protected Phases	2	2	4	2	3	3 4	9
Permitted Phases				4	3 4		
Detector Phase	2	2	4	2	3	3 4	
Switch Phase							
Minimum Initial (s)	10.0	10.0	7.0	10.0	5.0		5.0
Minimum Split (s)	14.0	14.0	11.0	14.0	9.0		25.0
Total Split (s)	23.0	23.0	24.0	23.0	18.0		25.0
Total Split (%)	25.6%	25.6%	26.7%	25.6%	20.0%		28%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0		2.0
All-Red Time (s)	1.0	1.0	1.0	1.0	1.0		0.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0		
Lead/Lag			Lag		Lead		
Lead-Lag Optimize?			Yes		Yes		
Recall Mode	C-Min	C-Min	None	C-Min	None		None
v/c Ratio	0.20	0.32	0.47	0.05	0.77	0.27	
Control Delay	18.4	2.9	66.4	7.2	34.5	19.4	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	18.4	2.9	66.4	7.2	34.5	19.4	
Queue Length 50th (ft)	51	0	71	0	155	69	
Queue Length 95th (ft)	138	41	m99	m13	#306	107	
Internal Link Dist (ft)	646		265			499	
Turn Bay Length (ft)							
Base Capacity (vph)	838	1592	786	1038	494	1662	
Starvation Cap Reductn	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	
Reduced v/c Ratio	0.20	0.32	0.28	0.05	0.77	0.22	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:WBL, Start of Yellow
Natural Cycle: 65
Control Type: Actuated-Coordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 30: N Main St & Riverside Ave



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (vph)	155	475	205	50	350	340
Future Volume (vph)	155	475	205	50	350	340
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.88	0.95	1.00	1.00	0.95
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	2787	3539	1583	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.54	1.00
Satd. Flow (perm)	1770	2787	3539	1583	1006	3539
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	168	516	223	54	380	370
RTOR Reduction (vph)	0	281	0	22	0	0
Lane Group Flow (vph)	168	235	223	32	380	370
Turn Type	Prot	Prot	NA	pm+ov	pm+pt	NA
Protected Phases	2	2	4	2	3	3 4
Permitted Phases				4	3 4	
Actuated Green, G (s)	41.0	41.0	12.1	53.1	30.4	34.4
Effective Green, g (s)	41.0	41.0	12.1	53.1	30.4	34.4
Actuated g/C Ratio	0.46	0.46	0.13	0.59	0.34	0.38
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	806	1269	475	933	495	1352
v/s Ratio Prot	c0.09	0.08	0.06	0.02	c0.16	0.10
v/s Ratio Perm				0.00	c0.10	
v/c Ratio	0.21	0.19	0.47	0.03	0.77	0.27
Uniform Delay, d1	14.7	14.6	36.0	7.7	25.1	19.2
Progression Factor	1.00	1.00	1.82	3.48	1.00	1.00
Incremental Delay, d2	0.6	0.3	0.5	0.0	7.0	0.1
Delay (s)	15.3	14.9	65.9	26.9	32.2	19.3
Level of Service	B	B	E	C	C	B
Approach Delay (s)	15.0		58.3			25.8
Approach LOS	B		E			C

Intersection Summary			
HCM 2000 Control Delay	26.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	43.8%	ICU Level of Service	A
Analysis Period (min)	15		

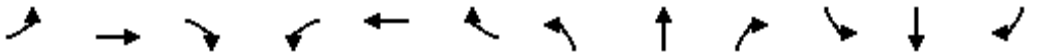
c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	SBR	Ø9
Lane Configurations										
Traffic Volume (vph)	60	430	75	580	30	180	100	270	125	
Future Volume (vph)	60	430	75	580	30	180	100	270	125	
Lane Group Flow (vph)	65	484	84	669	33	229	106	287	133	
Turn Type	pm+pt	NA	pm+pt	NA	Perm	NA	pm+pt	NA	custom	
Protected Phases	1	2	1	2		4	3	3 4	3	9
Permitted Phases	2		2		4		3 4		3 4	
Detector Phase	1	2	1	2	4	4	3	3 4	3	
Switch Phase										
Minimum Initial (s)	3.5	5.0	3.5	5.0	5.0	5.0	4.0		4.0	3.0
Minimum Split (s)	8.0	10.0	8.0	10.0	10.0	10.0	8.5		8.5	26.0
Total Split (s)	8.0	40.5	8.0	40.5	13.0	13.0	8.5		8.5	20.0
Total Split (%)	8.9%	45.0%	8.9%	45.0%	14.4%	14.4%	9.4%		9.4%	22%
Yellow Time (s)	3.5	3.0	3.5	3.0	3.0	3.0	3.5		3.5	2.0
All-Red Time (s)	1.0	2.0	1.0	2.0	2.0	2.0	1.0		1.0	0.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	
Total Lost Time (s)	4.5	5.0	4.5	5.0	5.0	5.0	4.5		4.5	
Lead/Lag	Lead	Lag	Lead	Lag	Lag	Lag	Lead		Lead	
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes	
Recall Mode	None	C-Max	None	C-Max	None	None	None		None	None
v/c Ratio	0.44	0.65	0.33	0.90	0.19	0.75	0.28	0.42	0.20	
Control Delay	22.4	27.0	16.7	43.7	38.7	54.8	20.3	19.8	5.8	
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Delay	22.4	27.0	16.7	43.7	38.7	54.8	20.3	19.8	5.8	
Queue Length 50th (ft)	19	222	25	359	16	122	21	137	0	
Queue Length 95th (ft)	41	336	49	#577	48	#315	#107	#294	85	
Internal Link Dist (ft)		355		609		913		265		
Turn Bay Length (ft)	25		25		30					
Base Capacity (vph)	147	739	257	740	178	305	376	682	664	
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	
Reduced v/c Ratio	0.44	0.65	0.33	0.90	0.19	0.75	0.28	0.42	0.20	

Intersection Summary

Cycle Length: 90
Actuated Cycle Length: 90
Offset: 0 (0%), Referenced to phase 2:EBWB and 6:, Start of Yellow
Natural Cycle: 100
Control Type: Actuated-Coordinated
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 31: Church St/N Main St & School St



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	60	430	20	75	580	15	30	180	30	100	270	125
Future Volume (vph)	60	430	20	75	580	15	30	180	30	100	270	125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	10	11	11	10	11	11	12	12	12	12	12	12
Total Lost time (s)	4.5	5.0		4.5	5.0		5.0	5.0		4.5	4.5	4.5
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1652	1788		1652	1794		1770	1822		1770	1863	1583
Flt Permitted	0.12	1.00		0.27	1.00		0.58	1.00		0.37	1.00	1.00
Satd. Flow (perm)	201	1788		471	1794		1088	1822		685	1863	1583
Peak-hour factor, PHF	0.93	0.93	0.93	0.89	0.89	0.89	0.92	0.92	0.92	0.94	0.94	0.94
Adj. Flow (vph)	65	462	22	84	652	17	33	196	33	106	287	133
RTOR Reduction (vph)	0	2	0	0	1	0	0	6	0	0	0	92
Lane Group Flow (vph)	65	482	0	84	668	0	33	223	0	106	287	41
Turn Type	pm+pt	NA		pm+pt	NA		Perm	NA		pm+pt	NA	custom
Protected Phases	1	2		1	2			4		3	3 4	3
Permitted Phases	2			2			4			3 4		3 4
Actuated Green, G (s)	37.4	34.6		37.4	34.6		14.8	14.8		28.0	32.5	28.0
Effective Green, g (s)	37.4	34.6		37.4	34.6		14.8	14.8		28.0	32.5	28.0
Actuated g/C Ratio	0.42	0.38		0.42	0.38		0.16	0.16		0.31	0.36	0.31
Clearance Time (s)	4.5	5.0		4.5	5.0		5.0	5.0		4.5		4.5
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0		3.0
Lane Grp Cap (vph)	128	687		232	689		178	299		372	672	571
v/s Ratio Prot	c0.02	0.27		0.01	c0.37			c0.12		0.04	c0.15	0.01
v/s Ratio Perm	0.19			0.14			0.03			0.05		0.02
v/c Ratio	0.51	0.70		0.36	0.97		0.19	0.75		0.28	0.43	0.07
Uniform Delay, d1	20.6	23.4		17.7	27.2		32.4	35.8		22.9	21.7	21.8
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.66	0.68	0.96
Incremental Delay, d2	3.1	5.9		1.0	27.5		0.5	9.7		0.4	0.4	0.1
Delay (s)	23.7	29.3		18.7	54.7		32.9	45.5		15.6	15.2	21.0
Level of Service	C	C		B	D		C	D		B	B	C
Approach Delay (s)		28.6			50.7			43.9			16.8	
Approach LOS		C			D			D			B	

Intersection Summary			
HCM 2000 Control Delay	35.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	69.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

ITS Projects – Systems Engineering Analysis FORM (SEAFORM)

The Checklist needs to be filled out by the Project Manager. Please refer to the guidance document accompanying the checklist for information on the checklist items as well as a completed example.

Project Name: City of Bristol, Downtown Traffic Signal Modernization Phase 1		
Date	**Name of Person Filling/Modifying the Form**	**Notes**
02/19/21	Raymond Rogozinski	Email: raymondrogozinski@bristolct.gov Phone: 860.584.6113

SECTION 1 – Project Information – Required for Project Initiation

1.1 PROJECT TITLE
Downtown Traffic Signal Modernization, Phase I

1.2 PROJECT NUMBER
☒ New Project
☐ Modification to existing Project

1.3 BRIEF DESCRIPTION/PURPOSE
The City of Bristol currently maintains 36 traffic signals within the city limits with an average age of 30+ years old. Creating a safe, efficient and reliable transportation system is a vital component of a successful community, especially in the Downtown area where development is happening.

The project scope consists of the full replacement of traffic signal equipment at six intersections in the Downtown area along the major North/South routes in the downtown. The intersections included in this project are identified on the attached location map (Figure 1) as well as the overall City intersection listing.

Modernizing the City's traffic signals will help improve traffic flow and reduce vehicle delay, therefore saving fuel and reducing emissions. New standard traffic signal equipment, such as video detection capable of detecting bicyclists, will help promote biking within the city in turn reducing emissions.

1.4 CONTACT PERSON/GROUP	1.5 PROJECT LOCATION	1.6 PERIOD OF PERFORMANCE	1.7 BUDGET & FUNDING SOURCE
Raymond Rogozinski raymondrogozinski@bristolct.gov 860.584.5113	Downtown Bristol (see attached project location map)	20 years	Congestion Mitigation and Air Quality (CMAQ)

1.8 NATURE OF WORK
☒ Scoping ☒ Design ☐ Software/Integration ☒ Implementation ☒ Operations
Evaluations ☐ Others (Please specify)
If Other, Please Specify

1.9 RELATIONSHIP TO OTHER PROJECTS AND PHASES

The City replaced two intersections in the Downtown area over the last 5 years and upgraded video detection at 17 of the Citywide 36 intersections.

This is the City's first submission for CMAQ funding, as the City has self-funded signal upgrades over the last two decades.

1.10 EQUIPMENT TO BE PURCHASED WITH PROJECT FUNDING

Traffic Control Signal Equipment Including: Controllers/Cabinets, Mast Arms, Pedestrian traffic signal equipment, Video Detection Systems, Interconnect cable with associated hardware between intersections

1.11 STATUS
☒ CMAQ
☐ Environmental Compliance, If applicable
☐ SLOSS/Safety Improvement
☐ TIP/STIP Approval
☐ FHWA Authorization

1.12 IS THERE A WORK PLAN FOR THIS PROJECT WITH TASK BREAKDOWN?
☐ No
☐ Yes, Provide Document Reference
☒ To Be Developed **The Project Work plan will be updated with more detail during design.**

1.13 IS THERE A TRAFFIC SIGNAL MANAGEMENT PLAN?
☐ No
☐ Yes, Provide Document Reference

☒ To Be Developed
If "No" was selected, please identify what other steps have been taken to adopt and commit to clear goals and objectives and a plan for management, operations, and maintenance of your agencies traffic control system
The has transferred the management and ownership of the traffic signals from the Police Department to Public Works in 2020/2021. The traffic signal management plan is being developed for DPW.

SECTION 2 – Needs Assessment – Required for Project Initiation

2.1 WHAT IS/ARE THE PROBLEM(S) WITH THE CURRENT SITUATION?

The project intersections in the Downtown area are interconnected however they are no longer coordinated. Previously installed detection is no longer functioning at many of the intersections within these corridors. The lack of coordination and detection creates unnecessary delay for motorists and limit throughput. Pedestrian and bicycle amenities do not meet current MUTCD and ADA standards.

The existing signal system is not capable of accommodating future redevelopment in the downtown area as the equipment is over 20 years old.

The existing traffic signal operations are congested at times at some of the intersections with substantial queueing that can be addressed with improved traffic signal equipment and timings and phasing.

2.2 WHAT NEEDS DOES THIS PROJECT ADDRESS?

Upgrading the obsolete field traffic signal equipment, installing video detection systems, and coordinating the traffic signals will improve traffic operations and reduce congestion Downtown by reducing delay, reducing vehicle queues, and increasing throughput. Additionally, this project will provide enhanced capabilities to monitor, maintain, and adjust traffic signal operations in real time.

New traffic signal equipment will replace outdated pedestrian facilities and failing vehicle detection at some of the City's older intersections and bring them up to current standards.

2.3 HOW WERE THESE NEEDS IDENTIFIED?

☐ Internal CTDOT Assessment ☒ Town / City Request ☐ From CE Technical Review or other studies ☐ Other

Please provide details on how needs were identified – If other documentation was used as reference, please identify it here.
The Needs were identified in an ongoing Citywide Traffic Signal inventory and retiming study as well as from informal assessments by city staff. The need for transportation improvements were identified in the Citywide Traffic Signal Inventory and Retiming Study.

SECTION 3 – Regional Architecture Assessment and Concept Exploration – Required for Design Approval

3.1 TOWN / CITY IN CTDOT REGIONAL ARCHITECTURE INCLUDED IN DESIGN ATMS03

The City of Bristol will utilize the standards and specifications identified in ATMS03 – Surface Street Control, Municipal Traffic Operations Center.

Included ☒ Yes ☐ No

Architecture is a project specific description of both logical and physical elements arranged in a hierarchical form showing inter-connections among the elements.

3.2 INVENTORY CURRENT SYSTEMS IN CTDOT REGIONAL ARCHITECTURE INCLUDED IN PROJECT

Municipal Traffic Signals
APTS7 - Multi-modal Coordination
ATMS03 - Surface Street Control
EM02 - Emergency Routing
MC07 - Roadway Maintenance and Construction

3.3 SYSTEM IMPACTS / INTEGRATION (I.E DATA EXCHANGES) DUE TO PROJECT. PORTIONS OF ARCHITECTURE BEING IMPLEMENTED

No integration is required. In the future data may be shared with City Police and Emergency Management. Data can also be shared with CTDOT.

3.4 OTHER REGIONAL ARCHITECTURES IMPACTED BY PROJECT

☐ NYDOT ☐ Massachusetts ☐ Other CTDOT Districts ☐ CTDOT Statewide ☒ None

Changes communicated to appropriate architecture maintenance agencies ☐ Yes ☐ No

3.5 CHANGES RECOMMENDED TO CTDOT and/or REGIONAL ARCHITECTURES

☐ Yes ☒ No

If "Yes", Please Specify and provide detail

SECTION 4 – Alternative Analysis – Required for Project Initiation

4.1 WERE ANY ALTERNATE CONCEPTS/IDEAS CONSIDERED? ANY OTHER SOLUTIONS TO THE PROBLEM?

☐ Yes ☐ No

Please Specify how the best concept was selected

Existing equipment was evaluated and depending on condition, improvements range from minor upgrades to full equipment replacement.

During the preparation of the Citywide Traffic Signal Inventory and Retiming project, it was found the City is utilizing five different controller manufacturers and on-street Closed Loop Signal Systems. The City intends to solicit a generic traffic signal controller using the CTDOT standard controller specifications.

The City uses video detection equipment at other locations however intends to use the latest 360 degree video detection technology and CTDOT specification.

4.2 REFERENCE DOCUMENTS (IF ANY)

Citywide Traffic Signal Inventory and Retiming Report

SECTION 5 – Concept of Operations – Required for Project Initiation

5.1 IS THERE A CONCEPT OF OPERATIONS (COO) FOR THIS PROJECT?

☐ Yes ☒ No

If "No" was selected, please specify reason

The Concept of Operations is being developed by the City Department of Public Works with the assumption of operation and maintenance of the City traffic signals from the Police Department. The intent of the upgrade of the six intersections is to reestablish the coordinated operation of the Downtown signals for an east/west peak hour coordinated operation.

The Concept of Operations is a description of how the system will be used.

5.2 IF "Yes" WAS SELECTED, PLEASE FILL OUT THE FOLLOWING

COO Contains:

Scope (Geographic, Timeframe, Region etc)	☐ Yes ☐ No
– Description of what the project/system is expected to do	☐ Yes ☐ No
– Roles and Responsibilities for Town / City / State	☐ Yes ☐ No
– Operational Scenarios	☐ Yes ☐ No
– Project/System Impacts	☐ Yes ☐ No

If "No" was checked in any of the boxes, please specify reason

SECTION 6 – Requirement Definitions (High-Level and Detailed) Required for Design Approval

6.1 ARE HIGH-LEVEL FUNCTIONAL REQUIREMENTS WRITTEN AND DOCUMENTED

☐ Yes ☒ No ☐ To Be Developed

High-level design is the transitional step between WHAT the proposed requirements i.e. Design Scope and HOW system will be implemented i.e. Preliminary Engineering, Preliminary Design, SF and FD.

6.2 IF "Yes" WAS SELECTED, PROVIDE REQUIREMENTS DOCUMENT REFERENCE IF AVAILABLE

☐ Attached ☒ Unavailable

SECTION 7 – Detailed Design – Required for Design Approval

7.1 IS THERE A DESIGN DOCUMENT AVAILABLE

☐ Yes ☐ No ☒ To Be Developed

Please provide reference to design document

Signal system elements, standard interfaces and System Integration structured into modules.

7.2 IF "YES" WAS SELECTED, PLEASE FILL OUT THE FOLLOWING

Are the design details well documented	☐ Yes ☐ No
Do the details of the design trace to requirements definitions	☐ Yes ☐ No
Are boundaries and interfaces of the system clearly identified (Limit of computer, signal, camera control)	☐ Yes ☐ No
Is there a process for Configuration Control (System Setup by Contractor or Highway ops.)	☐ Yes ☐ No

If No was checked in above boxes , please provide an explanation

7.3 DOES THE DESIGN INCORPORATE NATIONAL ITS STANDARDS

☐ No ☒ Yes

IF YES, Please mention what ITS Standards are being used

Standards development statuses as of May 2, 2007 http://www.standards.its.dot.gov/Status_Published.asp

NEMA/AASHTO/ITE

Advanced Transportation Controller (ATC) Standard Specification for the Type 2070 Controller ITE ATC Type 2070

AASHTO/ITE

Standard for Functional Level Traffic Management Data Dictionary (TMDD) ITE TM 1.03

Message Sets for External TMC Communication (MS/ETMCC) ITE TM 2.01

AASHTO/ITE/NEMA

Transportation Management Protocols (TMP) NTCIP 1103

Center-to-Center Naming Convention Specification NTCIP 1104

Object Definitions for Signal Control and Prioritization (SCP) NTCIP 1211

Structure and Identification of Management Information NTCIP 8004

Testing and Conformity Assessment Documentation within NTCIP Standards Publications NTCIP 8007

ANSI

Commercial Vehicle Safety Reports ANSI TS284

Commercial Vehicle Safety and Credentials Information Exchange ANSI TS285

Commercial Vehicle Credentials ANSI TS286

APTA

Standard for Transit Communications Interface Profiles APTA TCIP-S-001 3.0.0

ASTM

Standard Specification for Dedicated Short Range Communication (DSRC) Physical Layer using Microwave in the 902-928 MHz Band ASTM E2158-01

Standard Specification for Telecommunications and Information Exchange Between Roadside and Vehicle Systems - 5 GHz Band Dedicated Short Range Communications (DSRC) Medium Access Control (MAC) and Physical Layer (PHY) Specifications ASTM E2213-03

Standard Guide for Archiving and Retrieving ITS-Generated Data ASTM E2259-03

Standard Practice for Metadata to Support Archived Data Management Systems ASTM E2468-05

EIA

Data Radio Channel (DARC) System EIA 794

Subcarrier Traffic Information Channel (STIC) System EIA 795

IEEE

Standard for Message Sets for Vehicle/Roadside Communications IEEE 1455-1999

Standard for Common Incident Management Message Sets for use by Emergency Management Centers IEEE 1512 -2006

Standard for Traffic Incident Management Message Sets for Use by Emergency Management Centers IEEE 1512.1-2006

Standard for Public Safety Traffic Incident Management Message Sets for Use by Emergency Management Centers IEEE 1512.2-2004

Standard for Hazardous Material Incident Management Message Sets for Use by Emergency Management Centers IEEE 1512.3-2006

Standard for the Interface Between the Rail Subsystem and the Highway Subsystem at a Highway Rail Intersection IEEE 1570-2002

Standard for Wireless Access in Vehicular Environments (WAVE) - Resource Manager IEEE 1609.1-2006

Standard for Wireless Access in Vehicular Environments (WAVE) - Security Services for Applications and Management Messages IEEE 1609.2-2006
Standard for Wireless Access in Vehicular Environments (WAVE) - Multi-Channel Operation IEEE 1609.4-2006
Standard for Wireless Access in Vehicular Environments (WAVE) - Networking Services IEEE P1609.3
The Survey and Analysis of Existing Standards and those Under Development Applicable to the Needs of the Intelligent Transportation System (ITS) Short Range and Wide Area Wireless and Wireline Technologies IEEE SH94633-SH94638
NEMA/AASHTO/ITE
Advanced Transportation Controller (ATC) ITE ATC Controller 5.2
ITS Standard Specification for Roadside Cabinets ITE ITS Cabinet
AASHTO/ITE
TMDD & MS/ETMCC Guide Standard for Functional Level Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications ITE TMDD Guide
AASHTO/ITE/NEMA
Simple Transportation Management Framework (STMF) NTCIP 1101
Octet Encoding Rules (OER) Base Protocol NTCIP 1102
Global Object Definitions NTCIP 1201
Object Definitions for Actuated Traffic Signal Controller (ASC) Units NTCIP 1202
Object Definitions for Dynamic Message Signs (DMS) NTCIP 1203
Object Definitions for Environmental Sensor Stations (ESS) NTCIP 1204
Object Definitions for Closed Circuit Television (CCTV) Camera Control NTCIP 1205
Object Definitions for Data Collection and Monitoring (DCM) Devices NTCIP 1206
Object Definitions for Ramp Meter Control (RMC) Units NTCIP 1207
Object Definitions for Closed Circuit Television (CCTV) Switching NTCIP 1208
Data Element Definitions for Transportation Sensor Systems (TSS) NTCIP 1209
APTA
TCIP Framework Standard NTCIP 1400
TCIP Common Public Transportation (CPT) Objects NTCIP 1401
TCIP Incident Management (IM) Objects NTCIP 1402
TCIP Passenger Information (PI) Objects NTCIP 1403
TCIP Scheduling/Runcutting (SCH) Objects NTCIP 1404
TCIP Spatial Representation (SP) Objects NTCIP 1405
TCIP On-Board (OB) Objects NTCIP 1406
TCIP Control Center (CC) Objects NTCIP 1407
TCIP Fare Collection (FC) Business Area Objects NTCIP 1408
AASHTO/ITE/NEMA
Class B Profile NTCIP 2001
Point to Multi-Point Protocol Using RS-232 Subnetwork Profile NTCIP 2101
Point to Multi-Point Protocol Using FSK Modem Subnetwork Profile NTCIP 2102
Point-to-Point Protocol Over RS-232 Subnetwork Profile NTCIP 2103
Ethernet Subnetwork Profile NTCIP 2104
Transportation Transport Profile NTCIP 2201
Internet (TCP/IP and UDP/IP) Transport Profile NTCIP 2202
Simple Transportation Management Framework (STMF) Application Profile NTCIP 2301
Trivial File Transfer Protocol (TFTP) Application Profile NTCIP 2302
File Transfer Protocol (FTP) Application Profile NTCIP 2303
Application Profile for DATEX-ASN (AP-DATEX) NTCIP 2304
Profile Framework NTCIP 8003
NTCIP Guide NTCIP 9001
XML in ITS Center-to-Center Communications NTCIP 9010
SAE
Truth-in-Labeling Standard for Navigation Map Databases SAE J1663
Serial Data Communications Between Microcomputer Systems in Heavy-Duty Vehicle Applications SAE J1708
ISP-Vehicle Location Referencing Standard SAE J1746
Standard Metrology for Vehicular Displays SAE J1757
ITS Data Bus Data Security Services SAE J1760
Location Referencing Message Specification (LRMS) SAE J2266
On-Board Land Vehicle Mayday Reporting Interface SAE J2313
Mayday Industry Survey Information Report SAE J2352
Message Set for Advanced Traveler Information System (ATIS) SAE J2354
ITS Data Bus Architecture Reference Model Information Report SAE J2355
Calculation of the Time to Complete In-Vehicle Navigation and Route Guidance Tasks SAE J2365
ITS Data Bus - IDB-C Physical Layer SAE J2366/1
ITS Data Bus - Low Impedance Stereo Audio SAE J2366/1L
ITS Data Bus - Link Layer SAE J2366/2
ITS Data Bus - Thin Transport Layer SAE J2366/4
ITS Data Bus - Application Message Layer SAE J2366/7
Standard for ATIS Message Sets Delivered Over Reduced Bandwidth Media SAE J2369
Field Test Analysis Information Report SAE J2372
Stakeholders Workshop Information Report SAE J2373
ITS In-Vehicle Message Priority SAE J2395
Definitions and Experimental Measures Related to the Specification of Driver Visual Behavior Using Video Based Techniques SAE J2396
Adaptive Cruise Control (ACC) Operating Characteristics and User Interface SAE J2399

Human Factors in Forward Collision Warning Systems: Operating Characteristics and User Interface Requirements SAE J2400
Comparison of GATS Messages to SAE ATIS Standards Information Report SAE J2539
Messages for Handling Strings and Look-Up Tables in ATIS Standards SAE J2540
RDS (Radio Data System) Phrase Lists SAE J2540/1
ITIS (International Traveler Information Systems) Phrase Lists SAE J2540/2
National Names Phrase List SAE J2540/3
Converting ATIS Message Standards from ASN.1 to XML SAE J2630
Dedicated Short Range Communications (DSRC) Message Set Dictionary SAE J2735

Turbo Architecture – "Standards Report" ☐ Attached ☐ Unavailable

7.4 DOES THE DESIGN INCORPORATE ANY CTDOT STANDARDS

☐ No ☒ Yes,

IF Yes, Please mention what CTDOT Standards are being used

Standards identified in the CTDOT Traffic Control Signal Design Manual and CTDOT Functional Specifications for Traffic Signals and all CTDOT Standard, Typical and Miscellaneous Details will be followed.

SECTION 8 – Implementation – Required for Project Initiation

8.1 PROCUREMENT DETAILS

Competitive Low Bid

(i.e. Competitive Low Bid)

8.2 REFERENCE DOCUMENTS (IF ANY)

Turbo Architecture – "List of Agreements" ☐ Attached ☒ Unavailable

SECTION 9 – Integration and Test – Required for Design Approval

9.1 IS THERE AN INTEGRATION PLAN

☐ No ☐ Yes ☒ To Be Developed

If "Yes" Please provide reference

An Integration Plan as a separate written document is not always needed. The complexity of the system, the complexity of the eventual deployment of the system and the complexity of the development effort, influence the decision to prepare an Integration Plan.

Integration Plan includes and covers integration of all of the components and sub-systems either developed or purchased of the project.

Account for all external systems to be integrated with the system (i.e. communications networks, field equipment and other systems owned by controlling agency.)

An Integration Plan should identify all participants, define what their roles and responsibilities are, establish the sequence - schedule for every integration step and document how integration problems are recorded and resolved.

9.2 IS THERE A TEST PLAN

☐ No ☐ Yes ☒ To Be Developed

If "Yes" Please provide reference .

SECTION 10 – System Verification and Acceptance – Required for Design Approval

10.1 IS THERE A SYSTEM VERIFICATION AND ACCEPTANCE PLAN (verification of the entire system and acceptance criteria)

☐ No ☐ Yes ☒ To Be Developed

If "Yes" Please provide reference
(i.e. Signal, Construction checklist)

10.2 IF YES, PLEASE FILL OUT THE FOLLOWING

Is there a clear criteria for completion	☒ Yes ☐ No
Are there clear performance metrics for system acceptance	☒ Yes ☐ No
Will there be adequate system documentation for all users and maintainers	☒ Yes ☐ No

If No was checked in above boxes , please provide an explanation

SECTION 11 – Operations and Maintenance – Required for Project Initiation

11.1 IDENTIFY THE PERSONEL WHO WILL BE RESPONSIBLE FOR OPERATIONS AND MAINTENANCE

The City of Bristol Department of Public Works, Engineering Division, will operate the proposed Downtown Traffic Signal Modernization Project.

- **Raymond Rogozinski, PE, Director of Public Works**
- **Nancy Levesque, PE, City Engineer – Supervises engineering staff.**
- **Christopher Parrotta, Staff engineer – Manages traffic engineering, planning, operations and maintenance tasks.**
- **Jason Morrocco, Lead Technician – Responsibilities include regular maintenance and repair of the city's traffic signals.**
- **Traffic Maintainer – Responsibilities include regular maintenance and repair of the city's traffic signals.**
- **Public Works Maintainers – Additional Public Works Maintainer and Operators are available on an as needed basis to assist in larger maintenance and/or repairs.**

Is there an operations and maintenance plan?
☐ No ☒ Yes ☐ To Be Developed

If "Yes" Please provide reference

(i.e. Signal, Timing Plans)

11.2 IDENTIFY ASPECTS OF THE SYSTEM NEEDING OPERATIONS AND MAINTENANCE

Public Works Traffic Maintainers maintain the City's traffic signal equipment. Field personnel perform routine drive-by and checks on equipment. The City also retains an on-call vendor/contractor for issues beyond the Public Works ability.

Traffic Maintainers report directly to a Foreperson and General Foreperson however the Engineering Division oversees all traffic signal maintenance and repairs. Engineering also manages the design, implementation and updating of traffic signal equipment

11.3 IDENTIFY METHODS TO BE USED TO MONITOR THE EFFECTIVENESS OF OPERATIONS AND MAINTENANCE

Data collection provided from the new equipment will be utilized to perform routine traffic analysis measuring the effectiveness of operations. Adjustments will be made as determined appropriate

11.4 IDENTIFY FUNDING AND POLICIES SUPPORTING ON-GOING OPERATIONS AND MAINTENANCE

Funding for traffic operations and maintenance is included in the annual Public Works budget and is also available in the City's Street Infrastructure Bond. Funding for current and future improvement projects is available through City Bonding, the City's annual LOCIP allocation, and various grants opportunities.

It is Public Work's policy to maintain all 36 City owned traffic signals in good working order. Depending on the location, Public Works staff is deployed to traffic signal issues 24 hours a day. For larger scale and/or complex repairs, the City has several contractors available through an on-call contractor bid to assist. All traffic signal related calls are logged, documented and tracked.

11.5 IDENTIFY OPERATIONS AND MAINTENANCE PROCEDURES INCLUDING MANUALS, TRAINING AND DATA COLLECTION

The City DPW is developing the operations and maintenance procedures for traffic signals.

SECTION 12 – Retirement/Replacement Schedule – Required for Project Initiation

12.1 IS THERE A SCHEDULE FOR UPGRADES/ENHANCEMENTS TO THE SYSTEM

A schedule for upgrades/enhancements will be developed. Research shows the design life for most traffic control equipment is about 20 years. Specific field equipment such as lamps, relays, etc. will be replaced as needed. Software will continue to be upgraded as new versions become available

12.2 WILL THERE BE AN EVALUATION OF THE SYSTEM

Yes, a Before and After Study will be performed at the completion of the project.

CONSTRUCTION COST ESTIMATE

FOR THE CONSTRUCTION OF: Downtown Traffic Signal Improvements

February 19, 2021

CITY OF: Bristol

PROJECT NO.: TBD

ESTIMATE BY: JCB

ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
Full Replacement of Traffic Signal Equipment*	EA	6	$ 350,000.00	$ 2,100,000.00
				$ -
*Per intersection cost based upon recent bidding of signals in New Britain				$ -

CONSTRUCTION ITEMS TOTAL	**$ 2,100,000.00**
INFLATION (3.5% per year for 2 years)	$ 147,000.00
CONTINGENCIES (20%)	$ 449,400.00
CONSTRUCTION COSTS & CONTINGENCIES	**$ 2,696,400.00**
PRELIMINARY ENGINEERING (PE)	$ 200,000.00
INCIDENTALS (25%)	$ 674,100.00
TOTAL COST	**$ 3,370,500.00**