



City of Raleigh
North Carolina

August 6, 2012

MEMORANDUM

TO: Eric Lamb, PE
Transportation Planning Manager

FROM: Bowman Kelly, PE, PTOE
Transportation Engineer

SUBJECT: Addendum to the Traffic Impact Analysis Report on the
Capital Boulevard/Peace Street Interchange Alternatives



In response to concerns expressed by stakeholders in the Capital Boulevard Corridor Study, I have reviewed the Traffic Impact Analysis (TIA) report for the interchange of Capital Boulevard and Peace Street. The TIA report submitted on June 11, 2012 analyzed the following intersections:

- Capital Boulevard Northbound Ramp at Peace Street (*Existing*)
- Capital Boulevard Southbound Ramp at Peace Street (*Existing*)
- Peace Street at West Street (*Existing*)
- Peace Street at Wilmington Street (*Existing*)
- Lane Street at McDowell Street (*Existing*)
- Lane Street at Dawson Street (*Existing*)
- Peace Street at Johnson Street (*Proposed*)
- Peace Street at Harrington Street (*Proposed*)

The proposed intersections at Johnson Street and Harrington Street are part of an interchange configuration known as the Square Loop alternative that was described in detail in the June 11th TIA report. The Square Loop alternative is the preferred option.

Concerns were expressed by stakeholders at the June 27th Comprehensive Planning Committee meeting that:

1. There is bias in favor of the bridge alternatives due to failure to incorporate the traffic signals at Lane Street at Dawson and at McDowell.
2. The report should look at other areas and the impact to existing roads.
3. The report should estimate what diversion of traffic would mean as a consequence of an at-grade intersection.

In response to issue #1 above, the TIA and all subsequent analyses *did* include the intersections of Lane Street at Dawson and at McDowell as noted on page 4 of the report. In response to the second issue, I have expanded the roadway network to include the intersections of Peace Street at

Glenwood Avenue, Seaboard Station Drive, Blount Street and Person Street. In addition, those intersections along Blount and Person Streets from Lane Street to Franklin Street were added to the traffic model. Lane geometry at the intersection of Peace/Wilmington/Halifax/Salisbury was revised to better model the roadway bifurcation on Wilmington and Salisbury Streets and to account for the turning restriction on eastbound Peace Street during the AM peak period. Signal timings and offsets were then re-optimized for the signals along Peace Street between Glenwood Avenue and Wilmington Street (traffic signals at Peace/Blount and Peace/Person are on a separate timing plan and were not revised). The maximum allowable cycle length was increased from 180 to 240 seconds. Detailed results for the expanded roadway network are shown in the accompanying tables.

In response to issue #3, diversion of traffic to other roads in the immediate area was analyzed for the AM peak (the most congested period). Traffic from the southbound thru, southbound left-turn and northbound thru movements at Peace and Capital were shifted first to Glenwood Avenue, then to Blount Street and Person Street. Trips were systematically diverted to Glenwood Avenue at Peace Street until that intersection reached LOS-F. At that point, the traffic signals were retimed and measures of effectiveness rechecked. If delay for the Peace/Capital at-grade intersection was still greater than 80 sec/veh (LOS-F) more trips were diverted to Blount Street or Person Street and the process was repeated. Using 2011 traffic volumes, it was determined that by diverting 600 southbound thru vehicles and 500 northbound thru vehicles to Glenwood Avenue and 98 southbound left-turns to Blount Street, the at-grade intersection of Peace and Capital could operate at LOS-E. Average delay per vehicle was 68 seconds. However, this left little room for the intersection to absorb additional trips that are expected from increased residential and commercial development in downtown Raleigh. When this process was applied to 2035 traffic volumes, assuming a 1% annual increase in trips, it was found that diverted trip volumes must be much higher to allow the at-grade intersection to operate at LOS-E. By 2035, a total of 4050 vehicles per hour would need to divert to other roads in the network for the at-grade intersection of Peace Street and Capital Boulevard to operate at LOS-E: 500 vph northbound thru vehicles from Capital to Glenwood Avenue, 1500 vph northbound thru vehicles from Capital to Person Street, 1750 vph southbound thru vehicles from Capital to Blount Street and 300 vph southbound left-turns from Capital to Blount Street. Even with the reduction in trips along Capital Boulevard, southbound motorists would typically have to wait through one signal cycle before clearing the intersection.

It is theoretically possible for the at-grade intersection of Peace Street and Capital Boulevard to operate with acceptable level-of-service if a sufficiently large number of trips are diverted to other streets. The issue then becomes a question of desirability. Glenwood Avenue north of Peace Street is largely residential in character as are the northern segments of Blount Street, Person Street and Wake Forest Road. I am unwilling to assume that residents along those streets would agree to accept the additional traffic diverted from Capital Boulevard. I am also unwilling to assume that a sufficient number of motorists would choose to divert to those other streets. It is conceivable that the at-grade intersection would cause spillover onto Blount Street, Person Street and Wake Forest Road that is high enough to cause delay and disruption for residents of those streets but not high enough for the Peace/Capital signal to operate at LOS-E.

Given the additional analyses and traffic modeling described above, given a reasonable set of assumptions regarding trip diversion and the expected increase in motorists traveling to and from downtown Raleigh, I recommend supporting the Square Loop alternative for the interchange of Peace Street and Capital Boulevard. Measures of effectiveness for the various alternatives are summarized in the following tables.

Table 1: Network Measures of Effectiveness

Total Network Performance* - AM			
MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative
Total Delay/Veh (sec)	328.2	355.0	34.4
Stops/Veh	1.35	1.53	0.90
Travel Distance (mi)	6,637	7,125	1,380
Travel Time (hr)	1,233	1,341	64
Avg Speed (mph)	16	13	22
Fuel Used (gal)	482	517	55
Fuel Efficiency (mpg)	13.8	13.8	24.9
Density (ft/veh)	191	153	215
Occupancy (veh)	415	544	379
Total Network Performance* - PM			
MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative
Total Delay/Veh (sec)	319.8	272.7	44.4
Stops/Veh	1.42	2.12	1.15
Travel Distance (mi)	6,552	7,104	8,084
Travel Time (hr)	1,204	1,146	414
Avg Speed (mph)	12	10	21
Fuel Used (gal)	468	475	336
Fuel Efficiency (mpg)	14.0	14.9	24.1
Density (ft/veh)	141	110	202
Occupancy (veh)	538	730	389

* Average of 10 SimTraffic Runs

Table 2: Network Measures of Effectiveness - At-Grade Alternative, Diverted Trips

Total Network Performance* - AM			
MOE	At-Grade 2011 Volume No Diversion	At-Grade 2011 Volume w/ Trip Diversion	At-Grade 2035 Volume w/ Trip Diversion
Total Delay/Veh (sec)	355.0	203.6	382.9
Stops/Veh	1.53	1.30	1.36
Travel Distance (mi)	7,125	7,209	8,337
Travel Time (hr)	1,341	960	2,106
Avg Speed (mph)	13	14	12
Fuel Used (gal)	517	439	733
Fuel Efficiency (mpg)	13.8	16.4	11.4
Density (ft/veh)	153	167	119
Occupancy (veh)	544	500	700

* Average of 10 SimTraffic Runs

Table 3: Peace Street Arterial Measures of Effectiveness

Peace AM Arterial MOEs[†]			
MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative
Eastbound Travel Time (sec)	220	317	214
Eastbound Arterial Speed (mph)	13.1	9.1	13.5
Eastbound Arterial LOS	E	F	E
Westbound Travel Time (sec)	249	241	203
Westbound Arterial Speed (mph)	10.4	10.7	12.8
Westbound Arterial LOS	F	E	E
Peace PM Arterial MOEs[†]			
MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative
Eastbound Travel Time (sec)	257	253	197
Eastbound Arterial Speed (mph)	11.2	11.4	14.6
Eastbound Arterial LOS	E	E	D
Westbound Travel Time (sec)	222	276	183
Westbound Arterial Speed (mph)	11.7	9.4	14.1
Westbound Arterial LOS	E	F	D

[†]Synchro Deterministic Model

Table 4: Peace St Arterial Measures of Effectiveness - At-Grade Alternative, Diverted Trips

Peace AM Arterial MOEs[†]			
MOE	At-Grade 2011 Volume No Diversion	At-Grade 2011 Volume w/ Trip Diversion	At-Grade 2035 Volume w/ Trip Diversion
Eastbound Travel Time (sec)	317	287	433
Eastbound Arterial Speed (mph)	9.1	10.0	6.6
Eastbound Arterial LOS	F	F	F
Westbound Travel Time (sec)	241	245	342
Westbound Arterial Speed (mph)	10.7	10.5	7.6
Westbound Arterial LOS	E	F	F

[†]Synchro Deterministic Model

Table 5: Intersection Measures of Effectiveness

Peace/Capital Northbound Ramp Intersection† - AM				Peace/Capital Northbound Ramp Intersection† - PM			
Measure of Effectiveness	Existing Bridge	At-Grade Alternative	Square Loop Alternative	Measure of Effectiveness	Existing Bridge	At-Grade Alternative	Square Loop Alternative
Intersection Delay (sec/veh)	4.4	108.0	---	Intersection Delay (sec/veh)	33.9	98.9	---
Level-of-Service	A	F	---	Level-of-Service	C	F	---
Peace/Capital Southbound Ramp Intersection† - AM Southbound Approach (Stop-Controlled)				Peace/Capital Southbound Ramp Intersection† - PM Southbound Approach (Stop-Controlled)			
MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative	MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative
SB Approach Delay (sec/veh)	50.3	---	---	SB Approach Delay (sec/veh)	32.4	---	---
Level-of-Service	F	---	---	Level-of-Service	D	---	---
Peace/West Intersection† - AM				Peace/West Intersection† - PM			
MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative	MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative
Intersection Delay (sec/veh)	11.5	14.3	11.4	Intersection Delay (sec/veh)	11.8	13.4	10.5
Level-of-Service	B	B	B	Level-of-Service	B	B	B
Peace/Wilmington Intersection† - AM				Peace/Wilmington Intersection† - PM			
MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative	MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative
Intersection Delay (sec/veh)	16.6	15.0	14.0	Intersection Delay (sec/veh)	48.1	30.7	28.6
Level-of-Service	B	B	B	Level-of-Service	D	C	C
Peace/Glenwood Intersection† - AM				Peace/Glenwood Intersection† - PM			
MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative	MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative
Intersection Delay (sec/veh)	39.9	45.4	28.9	Intersection Delay (sec/veh)	32.8	38.6	26.3
Level-of-Service	D	D	C	Level-of-Service	C	D	C
Peace/Johnson Intersection† - AM				Peace/Johnson Intersection† - PM			
MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative	MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative
Intersection Delay (sec/veh)	---	---	4.3	Intersection Delay (sec/veh)	---	---	10.9
Level-of-Service	---	---	A	Level-of-Service	---	---	B
Peace/Harrington Intersection† - AM				Peace/Harrington Intersection† - PM			
MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative	MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative
Intersection Delay (sec/veh)	---	---	16.8	Intersection Delay (sec/veh)	---	---	10.9
Level-of-Service	---	---	B	Level-of-Service	---	---	B
Peace/Blount Intersection† - AM				Peace/Blount Intersection† - PM			
MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative	MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative
Intersection Delay (sec/veh)	17.6	15.3	17.6	Intersection Delay (sec/veh)	12.4	12.4	9.5
Level-of-Service	B	B	B	Level-of-Service	B	B	A
Peace/Person Intersection† - AM				Peace/Person Intersection† - PM			
MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative	MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative
Intersection Delay (sec/veh)	19.1	11.3	19.1	Intersection Delay (sec/veh)	12.4	12.4	11.8
Level-of-Service	B	B	B	Level-of-Service	B	B	B
Lane/Dawson Intersection† - AM				Lane/Dawson Intersection† - PM			
MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative	MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative
Intersection Delay (sec/veh)	35.6	14.4	35.6	Intersection Delay (sec/veh)	9.1	7.3	9.5
Level-of-Service	D	B	D	Level-of-Service	A	A	A
Lane/McDowell Intersection† - AM				Lane/McDowell Intersection† - PM			
MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative	MOE	Existing Bridge	At-Grade Alternative	Square Loop Alternative
Intersection Delay (sec/veh)	16.8	12.7	16.8	Intersection Delay (sec/veh)	21.9	21.9	20.4
Level-of-Service	B	B	B	Level-of-Service	C	C	C

†Synchro Deterministic Model

Table 6: Intersection Measures of Effectiveness - At-Grade Alternative, Diverted Trips

Peace/Capital Intersection [†] - AM			
Measure of Effectiveness	At-Grade 2011 Volume No Diversion	At-Grade 2011 Volume w/ Trip Diversion	At-Grade 2035 Volume w/ Trip Diversion
Intersection Delay (sec/veh)	108.0	67.8	78.0
Level-of-Service	F	E	E
Peace/West Intersection [†] - AM			
MOE	At-Grade 2011 Volume No Diversion	At-Grade 2011 Volume w/ Trip Diversion	At-Grade 2035 Volume w/ Trip Diversion
Intersection Delay (sec/veh)	14.3	13.3	16.8
Level-of-Service	B	B	B
Peace/Wilmington Intersection [†] - AM			
MOE	At-Grade 2011 Volume No Diversion	At-Grade 2011 Volume w/ Trip Diversion	At-Grade 2035 Volume w/ Trip Diversion
Intersection Delay (sec/veh)	15.0	14.8	22.8
Level-of-Service	B	B	C
Peace/Glenwood Intersection [†] - AM			
MOE	At-Grade 2011 Volume No Diversion	At-Grade 2011 Volume w/ Trip Diversion	At-Grade 2035 Volume w/ Trip Diversion
Intersection Delay (sec/veh)	45.4	56.1	80.5
Level-of-Service	D	E	F
Peace/Blount Intersection [†] - AM			
MOE	At-Grade 2011 Volume No Diversion	At-Grade 2011 Volume w/ Trip Diversion	At-Grade 2035 Volume w/ Trip Diversion
Intersection Delay (sec/veh)	15.3	16.9	89.7
Level-of-Service	B	B	F
Peace/Person Intersection [†] - AM			
MOE	At-Grade 2011 Volume No Diversion	At-Grade 2011 Volume w/ Trip Diversion	At-Grade 2035 Volume w/ Trip Diversion
Intersection Delay (sec/veh)	11.3	5.3	8.5
Level-of-Service	B	A	A
Lane/Dawson Intersection [†] - AM			
MOE	At-Grade 2011 Volume No Diversion	At-Grade 2011 Volume w/ Trip Diversion	At-Grade 2035 Volume w/ Trip Diversion
Intersection Delay (sec/veh)	14.4	14.4	14.4
Level-of-Service	B	B	B
Lane/McDowell Intersection [†] - AM			
MOE	At-Grade 2011 Volume No Diversion	At-Grade 2011 Volume w/ Trip Diversion	At-Grade 2035 Volume w/ Trip Diversion
Intersection Delay (sec/veh)	12.7	12.7	12.7
Level-of-Service	B	B	B

[†]Synchro Deterministic Model