RESOLUTION 18-226

A RESOLUTION TO AUTHORIZE MAYOR TO EXECUTE A PROFESSIONAL SERVICES AGREEMENT WITH KCI TECHNOLOGIES, INC. TO PREPARE A TRAFFIC SIGNAL OPTIMIZATION STUDY FOR U.S. 31 CORRIDOR

WHEREAS, RPM Transportation (later acquired by KCI Technologies, Inc.) prepared in 2014 a Signal Timing Optimization Study for the City of Spring Hill; and

WHEREAS, the 2014 Signal Timing Optimization Study provided a comprehensive assessment of the existing signalized intersections along the U.S. 31/SR-6 corridor that included short-, mid-, and long-term recommendations for equipment upgrades and related intersection improvements whereby the majority of those recommendations have been completed by the City resulting in improved signal system performance along the corridor; and

WHEREAS, in communities experiencing rapid and intensive growth and development that the traffic signal optimization study should be updated at least every three to five years in order to identify additional improvements to signal systems and intersections to further optimize traffic flow and performance; and

WHEREAS, KCI Technologies, Inc. has prepared for consideration and approval by the City of Spring Hill a professional services agreement to prepare a Traffic Signal Optimization Study to be completed over a six (6) month period for a lump sum fee of $75,800 plus an additional not to exceed amount of $1,500 for reimbursable expenses for a total project cost of $77,300; and

WHEREAS, the Board of Mayor and Aldermen approved Ordinance 18-29 to amend the Annual Operating Budget for the City to provide an appropriation of $83,000 from the Adequate Facilities Tax fund as the funding source for the completion of the traffic signal optimization study; and

WHEREAS, the Budget and Finance Advisory Committee favorably recommended approval of Resolution 18-226 to authorize the Mayor to execute a professional services agreement with KCI Technologies, Inc. to prepare the traffic signal optimization study for signalized intersections along the U.S. 31/SR-6 corridor at a total project cost of $77,300; and

WHEREAS, the Transportation Advisory Committee favorably recommended engaging KCI to prepare the traffic signal optimization study for signalized intersections along the U.S. 31/SR-6 corridor.

NOW, THEREFORE, BE IT RESOLVED, that the Board of Mayor and Aldermen of the City of Spring Hill authorizes the Mayor as follows:

1. To execute a Professional Services Agreement with KCI Technologies, Inc. attached hereto as Exhibit "A" to prepare a Traffic Signal Synchronization Study for existing and future signalized intersections located along the U.S. 31/SR-6 corridor. The study will be completed over a six (6) month period for a lump sum fee of $75,800 plus an additional not to exceed amount of $1,500 for reimbursable expenses for a total project cost of $77,300.

Passed and adopted by the Board of Mayor and Aldermen of the City of Spring Hill, Tennessee on this 17th day of December, 2018.

Rick Graham, Mayor

ATTEST:

April Goad, City Recorder

LEGAL FORM APPROVED:

Patrick Carter, City Attorney

REQUEST:	**Resolution 18-226 – Resolution to Authorize Mayor to Execute Professional Services Agreement with KCI to Prepare US-31 Signal Timing Optimization Study**
SUBMITTED BY:	**Chuck Downham, Assistant City Administrator and Victor Lay, City Administrator**
DATE:	**December 17, 2018**
RE:	**US-31 Signal Timing Optimization Study**
ATTACHMENTS:	**2014 Signal Timing Optimization Study; Professional Services Agreement – KCI Technologies**

PURPOSE:

To approve Resolution 18-226 to authorize the Mayor to execute a professional services agreement with KCI Technologies, Inc. to prepare a traffic signal optimization study for signalized intersections along the U.S. 31/SR-6 corridor to be completed over a six-month period while school is in session at a cost of $77,300.

BACKGROUND:

In 2014, the Board of Mayor and Aldermen authorized a signal timing optimization study to be prepared by RPM (now KCI) that is attached to the staff report.

The 2014 Signal Timing Optimization Study provided a series of short-, mid-, and long-term recommendations for improving overall signal system performance. A summary of these recommendations is provided below along with a synopsis of implementation actions by the City. As you will see below, the majority of projects identified have been completed.

Given the significant growth Spring Hill continues to experience, it is recommended that signal system performance be assessed every 3 to 5 years with the last study completed four years ago in 2014. As noted in the above recommendations and the subsequent intersection improvements that have been completed to improve signal system performance, there is measurable value in periodically studying signal performance to identify adjustments that need to be made to signal timing and phasing as well as overall system and equipment improvements that will result in improved efficiencies and performance.

Recommendation	City Action
Short-Term	
Pedestrian Signals – 1) Belshire Way/Commonwealth; 2) Campbell Station Pkwy; 3) Kedron Rd/Kedron Pkwy; 4) Depot St/McClemore Ave; 5) Duplex Rd/Beechcroft Rd; 6) Buckner Rd/Thompson's Ridge Rd	Belshire Way/Commonwealth Dr – Completed Buckner Rd/Thompsons Ridge Rd – Completed Campbell Station Pkwy – Awaiting Turn Lane Improvements *Kedron/Kedron Pkwy, Depot St/McClemore, Duplex/Beechcroft – Pending Funding*
Traffic Detector Repairs	Completed
Stop Line Detection on US-31 at Thompsons Station Road	Completed
Increased Detection Zone for Northbound Left-turn at Southern Walmart Access	Completed
Radar Detection	*3 Intersections Completed – Miles Johnson, Southern Springs, and Wilkes Lane; City requesting new future signals to have radar detection equipment*
Restriping Westbound Approach at Buckner Road	Completed
Update Signal Timings and Coordination for Miles Johnson	*Partial Completion; GPS unit pending to be installed in order to complete installation*
Right-turn Overlap for New Northbound Right-turn Lane at Buckner Road	Completed
Traffic Signal Standards	Pending
City-Sponsored Circulation Study	Not implemented
Mid-Term	
Implementation of Flashing Yellow Signal Displays	Not implemented due to night traffic volumes along Hwy 31
Dedicated Right-turn Lanes: 1) Northbound @ Commonwealth; 2) Northbound @ Nasdaq; 3) Northbound/Southbound @ Campbell Station; 4) NorthboundSouthbound @ Wilkes Lane/Spedale Ct	Northbound Turn @ Commonwealth – Completed Southbound Turn @ Campbell Station – Completed Southbound Turn @ Wilkes Lane/Spedale Ct – Completed *Northbound Turn @Campbell Station and @Wilkes Lane are awaiting overhead utility relocation prior to construction*
Improved Access Management	Completed - Access management/control policies adopted by Resolution
Long-Term	
Design/Construction of Alternate Route between Thompsons Ridge Rd. and Wilkes Lane to Campbell Station Parkway	Not implemented

Following the BOMA Work Session, Mayor Graham contacted Mayor Napier from Thompsons Station regarding their participation in the study. Mayor Napier indicated they have a signal study already underway but, expressed their interest and willingness to work cooperatively with the City of Spring Hill and KCI to ensure signal systems between our respective communities are synchronized to provide optimal performance during peak traffic flow. KCI prepared a revised proposal that provides for working collaboratively and cooperatively with the Town of Thompsons Station and their consultant, Barge Solutions, to evaluate study results from

Thompsons Station and synchronizing the signal systems between our respective communities to optimize performance during peak AM and PM traffic flows. The revised proposal resulted in a reduction in the base lump sum fee from $79,750 to $75,800.

FINANCIAL IMPACT:

KCI provided the City with a revised proposal for the Highway 31 Signal Timing Optimization Study with a lump sum fee in the amount of $75,800 plus reimbursable expenses not to exceed $1,500 for a total project cost of $77,300. A budget amendment is being considered for approval by the Board of Mayor and Aldermen to appropriate $83,000 from Adequate Facilities Tax fund for the project. The budget amendment will need to be approved by the Board prior to consideration of the Resolution to ensure sufficient funding has been appropriated for the project.

TRANSPORTATION ADVISORY COMMITTEE

The Transportation Advisory Committee (TAC) reviewed the initial proposal presented by KCI during its October 15, 2018 meeting. During the meeting, committee members recommended the scope be expanded to include the future signalization of Tanyard Springs. The proposal was later revised by KCI to reflect the inclusion of the Tanyard Springs signalization project. The TAC also recommended City staff contact the Town of Thompson's Station to confirm their interest in participating in the study for the Thompson's Station Road/Highway 31 intersection identified as part of the scope of services for the project. The TAC provided a favorable recommendation with the above noted refinements for the Board of Mayor and Aldermen to fund and authorize moving forward with the signal timing optimization study.

BUDGET & FINANCE ADVISORY COMMITTEE

On December 3, 2018, the Budget and Finance Advisory Committee reviewed Resolution 18-226 and supporting documentation and provided a favorable recommendation to approve to the Board of Mayor and Aldermen.

STAFF RECOMMENDATION:

Staff recommends approval of Resolution 18-226 to authorize the Mayor to execute a professional services agreement with KCI Technologies, Inc. to prepare a Traffic Signal Optimization Study for signalized intersections along the U.S. 31/SR-6 corridor to be completed over a 6 month period while school is in session for a lump sum fee in the amount of $75,800 plus a not to exceed amount of $1,500 for reimbursable expenses for a total project cost of $77,300. The funding for the project was approved previously in a budget amendment by the Board of Mayor Aldermen whereby $83,000 was appropriated from the Adequate Facilities Tax fund for the project.

ACTION REQUIRED (INCLUDE DEADLINE /PRIORITY):

In order to proceed with the signal timing optimization study, it will be necessary for the Board of Mayor and Aldermen to amend the current FY18-19 Budget to appropriate funding from Adequate Facilities Tax fund identified as having sufficient unencumbered/uncommitted funding available to cover the expense for the study. Once a budget amendment has been approved by

the Board, a resolution authorizing the Mayor to execute the professional services agreement will need to be reviewed and approved by the Board which should follow approval of the budget amendment. If the resolution is approved by the Board authorizing execution of the agreement by the Mayor, the agreement will be executed followed by the issuance of a notice to proceed by City staff to complete the work as outlined in the scope of services. City staff will provide periodic updates to the Board and TAC on the study. The results of the study including recommendations for short-, mid- and long-term improvements will be presented to the Transportation Advisory Committee and the Board of Mayor and Aldermen along with corresponding implementation strategies.

KCI

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ENGINEERS • PLANNERS • SCIENTISTS • CONSTRUCTION MANAGERS

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PROFESSIONAL SERVICES AGREEMENT LETTER

December 7, 2018

Chuck Downham
Assistant City Administrator
City of Spring Hill
199 Town Center Parkway
Spring Hill, TN 37174

Subject: **US 31 (Main Street) Signal Timing Optimization**

KCI Technologies, Inc. (KCI) is pleased to submit this professional services agreement (the "Proposal") to the City of Spring Hill ("Client") for the work (the "Work") described in detail in the Scope of Services section of this Proposal. The Work will be performed for the following:

Location: **US 31 (Main Street) from Crossings Boulevard to Thompson's Station Road**
Spring Hill, Tennessee

SCOPE OF SERVICES

This Proposal is limited exclusively to the Work as described in this Scope of Services section and anything not expressly described shall be considered expressly excluded from the Work. KCI proposes to perform the Work, which is described as follows:

PROJECT UNDERSTANDING

The principal purpose of this project is to develop optimized traffic signal timings for the US 31 corridor for immediate implementation. RPM Transportation Consultants, now KCI, previously completed a signal timing optimization study for the City of Spring Hill in 2014. The Institute of Transportation Engineers recommends systematically retiming traffic signals every three (3) to five (5) years. As recommended, the City of Spring Hill has requested that KCI provide updated optimized signal timings consistent with the procedure utilized during the 2014 study.

The following scope of services and fee estimate are associated with KCI providing engineering services for the above referenced project. Specifically, KCI's role for this project will be to prepare and implement optimized signal timings for the US 31 (Main Street) corridor from Crossings Boulevard to Buckner Road / Thompsons Ridge Road as well as develop recommendations for short, mid and long-term improvements. Additionally, KCI will coordinate with Barge Design Solutions, Inc. (Barge) with the intent of integrating new signal timings with a similar project being conducted for the Town of Thompson's Station at US 31 and Thompson's Station Road. Ultimately the traffic signals at Buckner Road / Thompsons Ridge Road

and Thompson's Station Road should operate in conjunction with one another and provide a seamless transition for motorists between the City of Spring Hill and Town of Thompson's Station.

Optimized traffic signal timings will be developed and implemented for typical weekday peak periods (AM, Midday, and PM) and off-peak conditions. Due to commercial development that has occurred since the last signal optimization study, it is critical that focus also be given to weekend conditions. For this reason, peak conditions will be evaluated for not only weekday AM, Midday, and PM time periods but also weekend peak conditions.

Secondly, through the process of detailed inventory and analysis; short, mid and long-term strategies will be identified for improving and maintaining optimized operations. Strategies will consider access management, modified signal phasing, signal timing, intersection laneage, vehicle detection, Intelligent Transportation Systems (ITS), and technologies such as adaptive signal control.

The study area will extend from Buckner Road/Thompsons Ridge Road on the northern end to Crossings Boulevard on the southern end. The study will focus on intersections that are currently signalized along the Main Street corridor. These include the following twelve (12) intersections:

1. Crossings Boulevard
2. Town Center Parkway
3. Kedron Road/Kedron Parkway
4. Depot Street/McLemore Avenue
5. Beechcroft Road (SR 247)/Duplex Road (SR 247)
6. Miles Johnson Parkway
7. Belshire Way/Commonwealth Drive (Lowes Access)
8. Southern Walmart Access (signalized)
9. Campbell Station Parkway
10. Wilkes Lane
11. Williford Court/Tanyard Springs (planned signal)
12. Buckner Road/Thompsons Ridge Road

(Thompson's Station Road, located within the Town Limits of Thompson's Station, will be coordinated with Barge)

At the conclusion of this project a system of optimized signal timing plans will be in place and operational, tailored for peak conditions and time of day. If the planned traffic signal at Williford Court/Tanyard Springs is not yet constructed during implementation, then optimized signal timing plans will be provided for this intersection based on anticipated peak traffic volumes that can be installed once the signal is operational. A recommended path for next step improvements and future technologies will be identified and an analysis of infrastructure in place will be provided to ensure continued maintenance of timings and operations. With proper upkeep of these products, this project will provide the City of Spring Hill with an operational strategy for managing the US 31 corridor.

In order to achieve the objectives the City has established for this effort, the scope has been divided into six (6) tasks, which are described as below:

TASK 1.0 – PROJECT MANAGEMENT

A critical part of this project will be effective communication with City of Spring Hill staff throughout the duration of the project. Our goal will be for KCI to essentially serve as an extension of the City staff. This

will require frequent and consistent communication. For this reason, the following scope of work includes multiple coordination and review meetings, as well as frequent communication via phone calls and e-mails throughout the course of the project. Our local presence also enables us to quickly respond if there are needs for sudden face to face meetings. This task will also include administrative and accounting activities for the project.

Sub-Task 1.1 – Agency Interview

At the inception of the project, KCI will meet with City of Spring Hill staff to identify specific goals, objectives, deliverables, and timeframes. The following specific items will be discussed:

- Points of contact
- Review process
- Existing signal timing philosophies (cycle lengths, phasing sequencing, etc.)
- Analysis techniques
- Traffic signal equipment, system capabilities, pedestrian requirements, and physical limitations;
- Citizen-perceived problems
- Agency-perceived problems
- Format of timing plans
- Project schedule
- Process of submittals and outline of deliverables

Sub-Task 1.2 – Existing Conditions Review Meeting

Following data collection (Task 2.0) and the development of the base model for the signal timing network, KCI will meet with City of Spring Hill staff to review the base model and calibration to ensure the accuracy and completeness of the model.

Sub-Task 1.3 – Signal Timing Review Meeting

Following the development of updated signal timings, KCI will meet with City of Spring Hill staff for review of the proposed timing plans prior to the development of coding sheets and implementation.

Sub-Task 1.4 – General Coordination

General correspondence throughout the course of the project, including phone calls and e-mails necessary to accomplish the study objectives, as well as general administration and accounting activities will be classified as general coordination.

TASK 2.0 – DATA COLLECTION

KCI will compile and review data from various sources to achieve the objectives described for this project. This will include current data collected by KCI as well as historical data obtained from various sources, including data to be obtained from the Tennessee Department of Transportation (TDOT) and the City. Data collection will include traffic counts to supplement the City's counts, intersection geometry, signal timing settings, and field observations of existing traffic operations.

Sub-Task 2.1 – Existing Historical Data

KCI will compile and review available existing historical data for the project area. This includes items such as previous traffic studies, signal designs, and data collected by the City of Spring Hill and TDOT. Specifically this includes, but is not limited to:

- Historical count data, such as historical turning movement counts (TMC) and historical average daily traffic (ADT) data collected by the City of Spring Hill and/or TDOT.

- Record design information for traffic signals and intersections.
- Existing traffic signal operational settings, such as phasing and timings as well as existing controller information and coding formats.
- Current signal controller user's manual and coding sheets.

Sources will include GIS and record information to be made available by the City, and data collected as part of TDOT's annual count program.

Sub-Task 2.2 – New Count Data

KCI will collect vehicle, bicycle, and pedestrian peak hour turning movement counts as needed for each of the intersections that make up the study area for the project as well as midblock 24-hour ADT counts.

Peak Hour Turning Movement Counts (TMC):

Peak hour turning movement counts will be collected for the following four (4) peak periods:

- Weekday AM peak (6:00 AM – 9:00 AM)
- Weekday Mid-day peak (11:00 AM – 1:00 PM)
- Weekday PM peak (2:00 PM – 7:00 PM)
- Weekend peak (Saturday, 11:00 AM – 3:00 PM)

Peak hour turning movement counts will be conducted during normal day-to-day operation when schools are in session and excluding holidays and weekdays abutting holidays.

ADT Automated Directional Counts

24-hour tube counts will be collected for the corridor in order to determine appropriate time-of-day programing. KCI will coordinate with the City of Spring Hill prior to data collection to determine the optimum number and locations for these counts. Data will be collected for up to four (4) locations within the corridor. Counts will be conducted at mid-block locations during normal day-to-day operation when schools are in session and excluding holidays and weekdays abutting holidays. These counts will include weekday and weekend traffic volumes.

Adverse Conditions

KCI will monitor traffic conditions within the study area as well as conditions along I-65, SR-840, and SR-396 prior to and during data collection to confirm that the data is not adversely affected by incidents such as lane closures due to construction or accidents that could influence normal travel conditions. If adverse conditions are identified prior to data collection, KCI will suspend activity and resume at a time more suitable. If adverse conditions are determined to impact data during collection, it may be necessary to repeat certain counts. If repeated traffic counts are necessary, they will be considered Additional Work.

Electronic copies of all count data (including videos) will be provided to the City of Spring Hill. TMC data will be provided in Microsoft Excel format.

Sub-Task 2.3 - Existing Network and Signal System Inventory

KCI will compile a detailed inventory of the existing roadway network and signal system. The network and signal system inventory will include photographs, field measurements and documentation of key features such as speed limits, lane widths and turn lane storage, bicycle and pedestrian facilities, adjacent land uses, documentation of visible traffic signal components such as signal heads, traffic signs, detector loops, video and radar detectors, emergency pre-emption equipment, pull boxes, and controller cabinet location and type. This will include a photograph of each signal cabinet with the participation of City of Spring Hill staff to oversee access to each cabinet.

KCI will assemble current signal timings and operation settings for each signalized intersection in the network, record signal designs (where available), current signal controller user's manuals, and coding sheets. GIS data made available by the City of Spring Hill will be utilized to document inventory information. In cooperation with City staff, KCI will compile this information for use in the study and analyses of existing conditions.

Sub-Task 2.4 – Existing Signal System Observations

Once count data has been obtained, KCI will perform field visits as a part of the signal system inventory during peak periods. KCI will observe existing platooning and progression of traffic, verify existing timing plans (cycle lengths, phasing sequences, etc.), identify and observe traffic flow and queuing patterns, as well as monitor potential sub-peaks within the peak periods.

Sub-Task 2.5 – Pre and Post Condition Travel Time and Delay Analysis

Travel time runs are a good measurement of signal timing efficiency along a corridor as well as a means of model calibration. KCI will collect and compile travel time and delay data for the signal system corridor before and after signal timing implementation, "pre" and "post" conditions respectively. Travel time and delay data will be collected for weekday AM, MD, and PM peak periods. No fewer than four travel time runs will be conducted during each time period. Data collected will include the total travel time, the running time, the stopped time, the average speed, the running speed, and the number of stops.

Following implementation and fine-tuning of the new timings, "post" conditions will be collected. The "post" travel time data will be collected once the system has had ample time to stabilize after the new timings have been implemented. Using the travel time data collected in the field, KCI will prepare "pre" and "post" comparisons of the data collected.

TASK 3.0 – TRAFFIC SIMULATION MODEL AND EXISTING CONDITIONS ANALYSIS

Using the data collected a simulation model of the network will be developed and calibrated. Utilizing the calibrated model operational analysis of existing conditions will be performed.

Sub-Task 3.1 – Traffic Simulation Model

In order to develop updated signal timings as well as identify needed improvements, KCI will utilize the traffic simulation and modeling software Synchro and SimTraffic. The use of traffic simulation and modeling software is extremely valuable in developing signal timings and optimizing a synchronized network; however, the software must be accurately configured and carefully calibrated in order to obtain good results. Utilizing the base information collected in Task 2, a Synchro network will be developed consisting of the intersections that make up the study area network. The model will be coded with geometric and volume data as well as existing signal phasing and timing information. This model will be provided to City of Spring Hill staff at project conclusion.

Sub-Task 3.2 Model Calibration

Using field observation information and pre-condition travel time, SimTraffic may be used to calibrate the Synchro model by comparing it to the existing field conditions. Factors such as speeds within intersections, headways, and reaction times will be adjusted to ensure the model accurately reflects existing conditions. If determined necessary, KCI will calibrate the Synchro model using SimTraffic. Models will be developed for each time-period studied.

Sub-Task 3.3 – Existing Operational Analysis

Once the model has been fully calibrated, existing operational conditions will be evaluated. To determine the current operation of the area intersections, capacity analyses will be performed for the peak hours at the signal timing project intersections. The capacity calculations will be performed according to the methods outlined in the *Highway Capacity Manual*, TRB 2010. This evaluation will establish the base condition to which all future modifications will be compared. In addition, these capacity analyses will be used to evaluate the need for roadway and traffic control improvements at the project area intersections. This information will be compiled in a summary memorandum submitted to the City of Spring Hill in an electronic format and discussed at the second project meeting.

Sub-Task 3.4 – Existing Conditions Report

KCI will prepare an existing conditions report documenting the existing operating conditions along the corridor, which includes existing performance measures such as level of service (LOS), average vehicle delay, and volume to capacity (v/c) ratio for each intersection. Furthermore, a summary of the existing operational analysis will be provided as part of this report.

TASK 4.0 – TIMING PLAN DEVELOPMENT

Once the Synchro model is developed and calibrated, it will be utilized to optimize the signal phasing and timings of the signalized intersections on the corridor. Using the data collected in Task 2 and files developed in Task 3, KCI will develop timing plans for each of the signalized intersections. It is anticipated that five (5) timing plans will be developed for each intersection. These include the following:

- Weekday AM Peak timing plan
- Weekday MD Peak timing plan
- Weekday PM Peak timing plan
- Off-Peak timing plan
- Weekend peak timing plan

Timing plans will be developed in five (5) sub-tasks:

Sub-Task 4.1 – Local Controller Settings Development

Using the criteria set forth in the *Manual on Uniform Traffic Control Devices* (MUTCD) and ITE's *Manual of Traffic Signal Design*, KCI will calculate and recommend values for the following local controller settings: minimum vehicular green, yellow clearance interval, all-red clearance interval, pedestrian walk time, and pedestrian flashing don't walk time. These values will be tabulated in a spreadsheet format and submitted to City of Spring Hill staff for review and comment prior to finalization.

Sub-Task 4.2 –System Boundary Determination

KCI will evaluate signal system boundaries throughout the corridor and use the following criteria to determine the system boundaries:

- ADT and TMC count data
- Signal spacing
- Cycle length requirements
- Driver expectancy
- Existing features (line of sight, topography, land use, etc.)
- Synchro coordinatability factors
- Coupling Index (I = V/D, where D = distance, V = link volume, and I = coupling index)

Sub- Task 4.3 – Cycle Length Evaluation

Using the base model developed in Task 3, the KCI will begin the re-timing process by performing peak hour cycle length evaluations in Synchro by evaluating the natural cycle lengths and coordinatability factors for each signal. Using evaluations from Synchro along with knowledge gained via observations in the field, a cycle length will be recommended for each timing plan. Preliminary cycle length recommendations will be tabulated for City of Spring Hill staff review along with accompanying remarks. This information will then be provided to City of Spring Hill staff and agreed upon prior to further timing plan development.

Sub-Task 4.4 – Cycle, Split, Offset, and Phase Sequence Development

Once the cycle lengths for each period have been finalized, each intersection will be evaluated to determine the optimal phase splits for each vehicle movement. Next, offset manipulation will be analyzed in an effort to maximize the arterial greenbands and reduce vehicle stops and delay. Both Synchro and SimTraffic will be used to analyze and observe coordination options. Recommended timing plans will be reviewed by City of Spring Hill staff and approved prior to field implementation as part of the third project meeting.

Sub-Task 4.5 – Coding Sheet/TOD Clock Development

Using the ADT counts collected in Task 2, KCI will develop a Time-of-Day (TOD) Clock for each signal system to determine the optimal timing plan for each hour of a typical weekday or weekend. KCI will also discuss overnight flash operation preferences with City of Spring Hill staff and make the appropriate changes in each signal's TOD Clock if flash operation is to be implemented at select intersections along the corridor.

KCI will transfer the recommended timings for each intersection into a coding sheet format that is compatible with the City's signal controllers. Coding sheets will be provided to City of Spring Hill staff electronically in Microsoft Excel format.

TASK 5.0 – SIGNAL TIMING IMPLEMENTATION

KCI will implement and fine-tune recommended phasing and timings. Subtasks associated with this work are described below.

Sub-Task 5.1 – Field Implementation

KCI will field implement the timing data into the local controllers once field implementation begins. Coding sheets will be provided to City of Spring Hill staff in electronic format after timing plans have been successfully implemented by KCI.

Sub-Task 5.2 - Field Monitoring and Adjustments

KCI will conduct field observations of each signalized intersection. Using the Time Space Diagrams (TSD) developed in Synchro for each signal, the coordinated timings will be verified as to effectiveness and fine-tuned as necessary. Progression, as well as split times, TOD settings or other settings, may be adjusted based on these observations. During field implementation any immediate adjustments recognized will be made that day in the field. KCI will revisit and monitor the implemented timings after the initial field implementation to make any final adjustments. These changes will also be documented via a second field implementation memorandum, and the Synchro files will be updated accordingly.

TASK 6.0 – ANALYSIS AND RECOMMENDATIONS

Building on the materials and work performed to develop and implement new signal timings, analyses will be performed to identify potential improvements and strategies for improving and maintaining optimized

operations. Strategies will consider access management, modified signal phasing, signal timing, intersection laneage, Intelligent Transportation Systems (ITS), and technologies such as adaptive signal control.

Sub-Task 6.1 – Development of Recommended Improvements

Initial analysis will focus on identifying how well the corridor operates with its existing infrastructure. It is anticipated that the opportunity exists to improve traffic operations along the corridor with minimal or no improvements to the existing network infrastructure. Specifically, signal phasing and timing adjustments are likely to offer immediate/short-term cost effective benefits to traffic operations.

Analyses may reveal that some key roadway improvements would substantially improve the benefit of a fully coordinated and interconnected traffic signal system. Analysis of the benefits of more significant infrastructure and signal system modifications such as traffic adaptive signal systems will also be performed. Improvements identified as such will be considered as potential long-term improvements, along with the recommended infrastructure improvements.

Identified improvements will be categorized as Short-Term Improvements , Mid-Term Improvements, or Long-Term Improvements. Network improvements and estimated costs necessary for implementation will be identified for each scenario. Following the completion of each analysis phase, KCI will meet with City of Spring Hill staff to discuss its findings.

Sub-Task 6.2 – Final Signal Timing Report

Following the development of recommended improvements, KCI will prepare a summary report documenting the following:

- Project overview
- Data collection summary
- Analysis techniques and approaches used
- Timing plan data development summary
- Results of field implementation/fine-tuning
- Project results (before and after studies: travel time results (stop / delay reductions), emissions results, fuel consumption results, benefit to cost ratio results)
- Recommended improvements

This report will be provided in electronic and hard copy format to the City of Spring Hill. Any recommended improvements identified will be discussed as a part of the report. The anticipated improvements performance measures (LOS, average vehicle delays, and v/c ratios) will also be determined.

Sub-Task 6.3 – Presentation of Analyses and Recommendations

Following the completion of implementation and analysis, KCI will be available to make one (1) presentation of the results to the Transportation Advisory Committee (TAC). KCI can make additional presentations, which will be considered additional work and prior written authorization will be required from the City of Spring Hill for any such additional work.

KCI shall not have the authority or responsibility to supervise, inspect, or direct the construction, and excludes any responsibility for a contractor's means, methods or safety precautions and practices.

SCHEDULE

Work will begin immediately upon authorization to proceed. The collection of existing traffic data represents a critical path for the project and will be scheduled immediately following authorization. All data will be obtained and new signal timings implemented while local schools are in session. Task 2.0 – Data Collection and Task 5.0 – Signal Timing Implementation must be performed while schools are in session. If either occur during summer break the schedule may extend up to 12 weeks, depending on whether the break is near the beginning or end.

Schedule																								
Month	1				2				3				4				5				6			
Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Task 1.0 - Project Management	A																							
Task 2.0 - Data Collection																								
Traffic Counts, Existing Conditions & Pre Travel Time						B																		
Post Travel Time																								
Task 3.0 - Simulation Model & Existing Conditions																								
Task 4.0 - Timing Plan Development																C								
Task 5.0 - Signal Timing Implementation																								
Task 6.0 - Analysis and Recommendations																							D	E

Note: Task 2.0 and Task 5.0 must be performed while schools are in session. If either occur during summer break the schedule may extend up to 12 weeks.

Meetings
A = Agency Interview
B = Existing Conditions Review
C = Signal Timing Review
D = Final Signal Timing Report
E = Transportation Advisory Committee Presentation

ADDITIONAL WORK

Experience indicates that certain additional items of work may be required or necessary which KCI cannot presently determine or estimate. For this reason, the fee for these items is not included in the provisions, which follow on "Fees and Payments". Further, the performance of these items is not included in the Work unless the item is expressly described as the Work in the preceding Scope of Services section. These additional items of work ("Additional Work") are caused by many factors, usually at the discretion of the Client and/or his construction contractors. They may also be caused by reviewing agency or Client variance/deviation from present policies and standards of reviewing governmental agencies. "Additional Work" may sometimes be referred to as extras, change orders, or add-ons, but for purposes of this Agreement, all such descriptions are intended to be encompassed within the term Additional Work.

For Client's reference, the following are some of the services that may be required as Additional Work to complete the Work but that are expressly excluded from the Scope of Services listed above. In view of their exclusion from this Proposal, KCI is not and shall not be held responsible for their performance as Work within the Scope of Services.

- Additional traffic data collection (including potential counts that may be necessary due to adverse traffic conditions impacting normal travel day counts)
- Additional timing plans for Holiday season operations such as Black Friday and December 1st thru December 24th

- Additional timing plans for special events
- Optimized signal timing plan at the intersection of US 31 and Thompson's Station Road
- Intersection signal and geometric design/modifications
- Signal system design
- Signal Communication Master Plans
- Training (both on the coordinated signal timing approach and on the use of the Synchro/SimTraffic software packages)
- Presentations in addition to the one (1) specified in Sub-Task 6.3
- Work revisions on any Scope of Services items that are required as a result of a change requested by Client after previous approval by it or any approving agencies.
- Retests, re-checking and repeat observations due to contractor errors or need for contractor to repeat work tasks due to failure to meet initial test requirements.
- Corrective work due to inaccurate or defective Client-supplied information or other previously prepared information relied upon in developing the Scope of Services.
- Checking of work performed by others.
- Revisions of work due to changes in policies or regulations during the progress of the work.
- Expert witness testimony.
- Others services, as requested by the City of Spring Hill

FEES AND PAYMENTS

The following fees are for the performance of the Work listed in the Scope of Services above, at the location described above. The fees listed in this FEES AND PAYMENTS section do not cover any Additional Work (defined above), or any other services which are not specifically described as part of the Work listed in the Scope of Services above.

Compensation for the work specified above is as follows:

Task	Description of Work	Fee
1.0	**Project Management**	$8,900.00
2.0	**Data Collection**	$21,150.00
3.0	**Traffic Simulation Model & Existing Conditions Analysis**	$9,850.00
4.0	**Timing Plan Development**	$13,200.00
5.0	**Signal Timing Implementation**	$9,800.00
	Sub-Total (Task 1.0-5.0)	**$62,900.00**
6.0	**Analysis and Recommendations**	$12,900.00
	Sub-Total (Task 6.0)	**$12,900.00**
	Total (Task 1.0-6.0)	**$75,800.00**
	Reimbursable Expenses	**$1,500.00**
Project Total (Labor Fee and Expenses)		**$77,300.00**

KCI's fee for the Work listed Task 1.0 through Task 6.0 in the Scope of Services above will be a lump sum of **$75,800.00** and will be invoiced monthly on the basis of percentage of work performed. Individual task amounts are provided for budgeting purposes only. KCI reserves the right to reallocate amounts among tasks as necessary.

Based upon currently available information, KCI estimates that the fees for reimbursable expenses associated with the performance of the Work stated in the Scope of Services above will be approximately **$1,500.00**. Reimbursable expenses will be billed at direct cost and will not include administrative markup or processing fees. The cost for automobile mileage associated with completing the Scope of Services will be $0.54 per mile.

FEES AND PAYMENTS FOR ADDITIONAL WORK

Fees and payments for Additional Work shall be in addition to any fees and payments for the Work described in the Scope of Services and shall be billed and paid on the same fee and payment terms described for the Work above or as mutually agreed upon in writing when the Additional Work is ordered by the Client.

SPECIAL PROVISIONS

KCI will submit monthly invoices for the Work, Additional Work rendered, and Charges incurred. Client shall make prompt monthly payments in response to KCI's monthly invoices. The Client agrees that timely payment in full of all invoices is a condition precedent to this Agreement.

GENERAL PROVISIONS

The attached General Provisions are specifically made a part of this Proposal. If this Proposal is accepted by Client, then the General Provisions along with the Proposal shall constitute a complete and binding contract between KCI and Client (the "Agreement").

Any other understandings, agreements, promises, inducements or representations are hereby void. Any modifications to the terms and conditions of this Agreement must be made in writing and signed by both parties hereto in order to be valid. The person executing this Agreement on behalf of the Client does hereby warrant that he/she has full authority to do so.

If this Proposal and the General Provisions attached hereto are satisfactory and acceptable, and fully set forth the terms of our understanding, please sign the Acceptance and return a copy to KCI's office. This Proposal and the General Provisions will then constitute our entire Agreement.

KCI reserves the right to terminate this contract in the event the Client, in the sole judgment of KCI, fails to establish sufficient credit to warrant proceeding with the work. In such event, Client shall be obligated to pay for all services rendered to date of termination, including any direct expenses, and no work will proceed thereafter unless Client provides a retainer, which KCI, in its sole discretion, shall determine to be satisfactory for the continuation of the work.

KCI welcomes the opportunity to serve the City of Spring Hill and looks forward to working on this project. The Project Manager is Jonathan Cleghon, P.E., and his telephone number is (615) 370-8410.

Very truly yours,

Robert P. Murphy, P.E., PTOE
Regional Practice Leader

Approved:

Robert P. Murphy, P.E., PTOE
Regional Practice Leader

pc: Contract File
Proposal File

ACCEPTANCE:

The City of Spring Hill, in consideration of the terms and conditions of the Proposal and General Provisions which are fully set forth herein, does hereby accept this Proposal and General Provisions as the complete and final Agreement with KCI Technologies, Inc. for the performance of the Work described herein, and does hereby further agree to comply with all the covenants in this Agreement.

ACCEPTED BY:

Name

Mayor
Title

12-17-2018
Date

KCI TECHNOLOGIES, INC.
GENERAL PROVISIONS
(Ver. July 2017)

The General Provisions set forth herein are incorporated by reference in the Proposal for the performance of certain services described as the "Work" in the Proposal KCI Technologies, Inc., a Delaware corporation ("KCI"), dated 12/7/2018 to *City of Spring Hill* ("Client"). These General Provisions shall constitute, along with the Proposal, a final, complete, and binding agreement (the "Agreement") between Client and KCI upon Client's acceptance of the Proposal. To the extent they are inconsistent or contradictory; the express terms of the Proposal take precedence over the General Provisions.

1. ACCEPTANCE OR REJECTION OF PROPOSAL
The Proposal shall be valid for a period of thirty (30) days from the date thereon. Acceptance thereafter shall be conditioned on KCI's reaffirmation of the Proposal. If, upon submission of this proposal to Client, Client fails to return a signed copy to KCI and Client knowingly allows KCI to proceed with work, such services shall be deemed performed pursuant to the Proposal and these General Provisions, which shall be binding the same as if the Proposal were fully executed.

2. ADJUSTMENTS TO QUOTATION (COST ESTIMATION)
Fees quoted in the Proposal are based on current salaries and operational costs. Unless a lump sum fee is quoted, KCI shall have the automatic right to adjust the fee basis to reflect change in salaries and operational cost on each twelve (12) month anniversary following the date of the Proposal. Estimates stated in the proposal are provided for convenience of the Client and KCI is not bound by nor does it guarantee such estimates.

Unless expressly identified as a cost item in the fee proposal, KCI's fees do not include sales tax or other governmental levies. In the event that taxes or other assessments are applied to the fees generated by KCI services, the client agrees that such taxes or assessments shall be added to the fee base quoted herein and shall become due and payable when invoiced by KCI.

3. CONDUCT OF THE WORK
All concept, preliminary and final plans prepared by KCI will be submitted to client for approval prior to or concurrent with submittal to appropriate governmental authorities. If Client does not respond to such plans within five (5) days of receipt, the plans shall be deemed approved by Client. After the Client's approval, any change shall be deemed Additional Work for which KCI shall receive additional compensation. KCI shall not be obligated to incorporate changes requested by Client into its plans if, in the opinion of KCI, such changes would result in a substandard work product.

KCI will make every reasonable effort to provide a survey crew as requested but it cannot guarantee the time within which a survey crew will be available. The size of the survey crew shall be determined by KCI based on the work to be performed. A minimum of four (4) hours shall be charged anytime a survey crew visits a site, all charges being portal to portal.

Client agrees that KCI shall not be liable for work performed by other parties, for the accuracy of data supplied by other parties upon which KCI may rely, or for testing or inspection work performed by others.

Any reference to existing subsurface objects is provided for general reference based on existing information supplied to KCI by the Client or others and such locations are not to be considered exact. At least forty-eight (48) hours before penetrating the ground, Client agrees to contact the local "State One-Call System (Dial 811)" and have a utilities representative on site unless otherwise stated in the scope of work. In the event KCI's work includes penetration of the ground, Client agrees that KCI shall not be responsible for any loss or damages claimed to result from said penetration unless direct result of KCI's sole negligence. Client agrees to indemnify and hold KCI harmless from any claim, suit or proceeding for loss or damages to person or property of others relating to said penetration except to the extent said damages are the direct result of KCI's sole negligence.

Client further agrees to indemnify and hold KCI harmless from any loss or damages to KCI personnel or equipment resulting from any ground penetration except when it is the direct result of KCI's sole negligence or when caused by normal wear and tear.

Subsurface and earth fill data are informational only. KCI does not guarantee such data.

Although KCI will attempt to complete all services in a timely fashion, KCI does not guarantee, expressed or implied, the time when work is completed.

4. RIGHT OF ENTRY; PERMITS
Client agrees to provide rights of entry and all permits necessary for the completion of KCI's services under this Agreement at no cost to KCI unless otherwise defined in the scope of work.

5. DOCUMENTS
All documents, including drawings and specifications, prepared or furnished by KCI pursuant to this agreement, are instruments of service and the property of KCI. Client may make and retain copies, subject to Client's compliance with Section 8, herein, but may only use such documents for the purposes described in the Proposal. Any other use shall be prohibited, and Client shall indemnify and hold harmless KCI for any liabilities, damages, losses, claims, and expenses arising therefrom.

6. RISK ALLOCATION
To the fullest extent permitted by law, the total liability, in the aggregate, of Design Professional and Design Professional's officers, directors, employees, agents, and consultants to Client and anyone claiming by, through or under Client, for any and all injuries, claims, losses, expenses, or damages whatsoever arising out of or in any way related to Design Professional's services, the Project or this Agreement, from any cause or causes whatsoever, including but not limited to, negligence, strict liability, breach of contract or breach of warranty shall not exceed $100,000.

Plans and designs prepared by KCI are predicated on sound engineering assumptions that must be tested and adjusted as conditions warrant during construction. If Client does not retain KCI for the purpose of construction services for the implementation of the Plans or Designs, then Client agrees to assume the risk of improper implementation and to hold KCI harmless from any loss or damage resulting from the failure to retain KCI to oversee the implementation of its plan or design.

Client further agrees that KCI shall not be responsible or liable for the cost of any and all corrective actions allegedly caused by KCI unless KCI is provided a reasonable opportunity to participate in the decision on said corrective work.

7. HAZARDOUS SUBSTANCES/MOLD INDEMNIFICATIONS
Client warrants that it has and will comply with all lawful obligations regarding hazardous or toxic substances, and it agrees to indemnify and hold KCI harmless from any loss, damage, expenditure or liability arising out of or in any way relating to the presence, discharge, exposure or release of hazardous or toxic substances of any kind except to the extent it is the direct result of KCI's sole negligence.

Client hereby agrees that, to the fullest extent permitted by law, KCI's maximum liability to Client for any and all claims, actions, damages, or losses arising out of or in any way related to mold shall not exceed the amount of any insurance coverage available to satisfy any claim made against KCI within the scope of any such coverage in existence at the time the claim is resolved by way of settlement award or judgment (exclusive of any required deductible). Client further agrees that in no event shall KCI be liable for any claims or damages of any nature, regardless of the insurance, (including costs relating thereto) for bodily or personal injury related to mold claims.

8. PAYMENTS
Invoices submitted by KCI to Client are due and payable in full from the date of said invoice without retainage and payment shall not be contingent upon receipt of funds from third parties. If an invoice remains unpaid for more than thirty (30) days from the date of the invoice, a service charge of one and one half percent (1-1/2%) per month, eighteen percent (18%) per annum, shall be assessed on all unpaid amounts dating from the date of the invoice. Failure to render full payment within thirty (30) days shall be deemed substantial non-compliance and KCI, at its option may undertake any or all of the following remedies: (1) stop all work, provide Client is given three (3) days prior written notice; (2) withdraw all certifications and plans previously submitted; (3) assert

a lien on the property pursuant to applicable law; (4) file suit for the collection of said overdue invoices in any Court of competent jurisdiction; and (5) undertake any other remedies accorded it by law or this Agreement. An exercise of one or more of these actions shall not be deemed a waiver of future exercise of other actions. Client agrees to indemnify and hold KCI harmless from any fees and expenses incurred by KCI as a result of Client's non-payment, including, but not limited to cost of personnel time, court costs, litigation expenses and reasonable attorneys fees.

9. ASSIGNS
Neither KCI nor Client may delegate, assign, sublet or transfer its duties or interest in this Agreement without the written consent of the other party.

10. SAFETY RESPONSIBILITY
KCI shall not be responsible for any safety precautions or programs of Client or any of Client's contractors or representatives. KCI shall only be responsible for the safety of its own employees.

11. MEDIATION
Client agrees that all claims, disputes and other matters in question between the parties arising out of or relating to the Agreement or breach thereof shall first be submitted for non-binding mediation to any one of the following, as agreed to by the parties: American Arbitration Association, American Intermediation Service, Americord, Dispute Resolution Inc., Endispute or Judicate. Any party hereto may initiate mediation and the parties hereto agree to fully cooperate and participate in good faith to resolve the dispute(s). The cost of mediation shall be shared equally by the parties hereto.

The demand for mediation shall be made within one (1) year of the date the claimant knew or should have known of the existence of the claim, dispute or other matter. If the demand for mediation is not within one (1) year the claim, dispute or other matter shall be forever barred. Mediation shall be optional and not mandatory at KCI's sole discretion with regard to the collection of earned fees as set forth in section 8, above.

In the event either party makes a claim or brings an action against the other party for any act arising out of the performance of the services hereunder, and the claimant fails to prove such claim or action, then the claimant shall pay all legal and other costs (including attorneys fees) incurred by the other party in defense of such claim or action.

12. CERTIFICATE OF MERIT
The Owner shall make no claim (whether directly or in the form of a third-party claim) against KCI unless the Owner shall have first provided KCI with written certification executed by an independent engineer licensed in the State in which the KCI office submitting this proposal is located, specifying each and every act or omission which the certifier contends constitutes a violation of the standard of care expected of an engineer performing professional services under similar circumstances. Such certificate shall be provided to the Engineer thirty (30) days prior to the presentation of any such claim or the institution of any arbitration or judicial proceeding.

13. TERMINATION
Either party shall have the right to terminate this agreement provided three (3) days written notice is given to the other party. In the event of termination, Client shall be liable for payment to KCI for all work performed, and expenses incurred, up to and including the day of termination.
It is understood and agreed that once the Work is started by KCI, only Client or Client's duly authorized representative shall have the authority to order the work stopped on its behalf and only by giving KCI written notice. Client may exercise the right to terminate only if it has made all payments due and owing to KCI.

It is further understood and agreed that, after a termination of the Agreement has been effected by client or its duly authorized representative in accordance with the notice referred to herein, Client or its duly authorizes representative may, within thirty (30) days of the notice to terminate, order work to resume on the project, provided KCI is given ten (10) days advance notice in writing as to when work shall resume. If Client fails to resume the work as provided herein, KCI shall have no obligation to resume the Work at any time thereafter.

KCI shall not be obligated to resume services under the Agreement until Client has paid all money previously due and owing by Client and a restart fee equal to ten percent (10%) of the balance remaining to be paid under the Agreement. KCI reserves the right to increase this restart fee if necessary to cover the additional expenses generated by starting the Work back up after it has been stopped.

14. WARRANTY OF AUTHORITY TO SIGN
The individual signing this contract warrants that he/she has authority to sign as, or on behalf of Client for whom or for whose benefit KCI's services are rendered. If such individual does not have such authority, he/she understands and agrees that he/she is personally responsible for this contract to KCI in addition to any liability which Client may have.

15. NON-ALTERATION TO TERMS - WAIVER OF RIGHT
This Agreement and all the terms herein may only be amended, deleted, or otherwise altered by a written document signed by KCI and Client. Only an officer of KCI has authority to waive any matter or to amend the Agreement between KCI and Client.

The failure of KCI to enforce or act upon any right afforded it by this Agreement shall not be deemed a waiver of such right for future acts of a similar nature.

If any term or part thereof is held to be invalid by a Court of competent jurisdiction, that term or part thereof shall be deemed deleted and the remainder of this Agreement shall continue in full force and effect and be binding upon the Parties.

16. THIRD PARTY BENEFICIARY
The Owner and KCI agree that the services performed by the Engineer pursuant to this Agreement are solely for the benefit of the Owner and are not intended by either the Owner or KCI to benefit any other person or entity. To the extent that any other person or entity, including but not limited to the project contractor and/or any of its subcontractors, is benefited by the services performed by KCI pursuant to this Agreement, such benefit is purely incidental and such other person or entity shall not be deemed a third party beneficiary to this contract.

17. ENTIRE AGREEMENT
These General Provisions, any drawings, plans, plats, and/or exhibits attached hereto, and the Proposal to which these items are attached, set forth the entire understanding and agreement between the parties with respect to the subject matter contained therein and shall be binding and insure (except as otherwise provided herein) to the benefit of the parties and their respective successors and assigns. This Agreement supersedes all prior documents, agreements, and understandings between the parties with respect to the transactions contemplated hereby.

18. CONTROLLING LAW
This Agreement is to be governed by State of Tennessee law.

Client Signature_____ Dated 12-17-2018

8.0 Recommended Improvements

The principal purpose of this project was to develop optimized traffic signal timings for the US Route 31 corridor. In addition, this study also identifies short-term, mid-term, and long-term roadway and traffic control improvements that would improve the safety and efficiency of the study area network. Short-term improvements comprise cost effective improvements requiring the least modification to existing infrastructure while yielding immediate benefit. Mid-term improvements (MTI) are improvements that require some infrastructure improvements but considered feasible. Long-term improvements (LTI) are improvements that will improve operations along the network but are more complex and/or complicated to implement.

Short-Term Improvements

The principal short-term improvement (STI) of this project is the traffic signal timing update for the study intersections on US Route 31. As described previously, interim traffic signal timing adjustments for the southern Walmart Access and the adjacent US-31 intersections with Belshire Way / Commonwealth Drive and Campbell Station Parkway were made in June 2014. Update signal timings for all ten (10) signalized intersections in the study corridor were implemented in October 2014.

In addition to updated signal timings, the following have also been identified as short-term improvements:

Pedestrian Signals

For approaches where pedestrians can be expected to cross, the minimum green interval must be long enough to accommodate pedestrian crossings parallel to the vehicular phase receiving the green indication. Providing pedestrian crossing time at signalized intersections without pedestrian phasing can cause some minor-street approaches to have significantly longer minimum green intervals than would be necessary to accommodate vehicular traffic alone. Even study intersections with the highest pedestrian activity have relatively infrequent pedestrian crossings. With the addition of pedestrian signals the minimum vehicular green interval can be shortened significantly, increasing the greenband for US-31. Pedestrian signals are recommended for the following intersections:

- Belshire Way / Commonwealth Drive;
- Campbell Station Parkway;
- Kedron Road / Kedron Parkway;
- Depot Street / McLemore Avenue;
- Duplex Road / Beechcroft Road (SR-247);
- Buckner Road / Thompson's Ridge Road.

Increased pedestrian activity is expected at Commonwealth Drive due to the completion of the new connection, and at Campbell Station Parkway due to future sidewalk installation as part of private developments.

Traffic Detector Repairs

Field observations identified a failed advance loop detector in the northbound through lane (Phase 2) on US Route 31 at Belshire Way / Commonwealth Drive. The detector card indicates a fault and there is no continuity between each end of the loop wire. The result is a constant call placed to that controller phase. During coordination this is not an issue because the loop is for northbound through traffic on US Route 31, but in off peak times the side street traffic will have to wait until the US Route 31 phase time maxes out.

Stop Line Detection on US-31 at Thompson's Station Road

Stop line detectors are recommended for the northbound and southbound through lanes on US-31 at Thompson's Station Road. Currently there is only advance detection for these approaches. While the use of only advance detectors on the through lanes of moderate/high speed approaches (35 mph and above) is common practice, field observations indicated that stop line detection would improve traffic operations at this intersection.

Increased Detection Zone for Northbound Left-Turn at Southern Walmart Access

Analyses indicated that lagging left-turn phasing for the southern Walmart Access would improve signal coordination on US-31. However, the detector loses the service call for the lagging left-turn phase if there are not multiple vehicles queued. Drivers tend to pull forward while looking for an acceptable gap during the permissive phase and due to the distance the detector is set back from the side street they leave the detection zone.

Radar Detection

Replacing existing inductive loop detectors with radar would solve these issues, as well as provide increased flexibility and reduced maintenance.

Restriping Westbound Approach at Buckner Road

Queues on the westbound approach sometimes extend back far enough that the turn lanes are not accessible. The City is going to restripe this approach to correct the issue.

Update Signal Timings and Coordination for Miles Johnson

The signal timings and coordination should be reevaluated and updated to reflect the addition of a traffic signal at the intersection of US-31 and Miles Johnson Parkway. Based on the Coupling Index, Miles Johnson Parkway would be coordinated with the traffic signals in Zone 1 – Crossings Boulevard to Duplex Road (Table 26). The coupling index is found using the following formula:

$$CI = V / L$$

where,
CI = coupling index;
V = two-way traffic volume on the major street (veh/h);
L = segment length in feet (measured center to center).

Research indicates that coordination should be considered for segments with volume and length combinations yielding a coupling index over 0.5.

Table 26: Coupling Index after Signalization of Miles Johnson Parkway.

No.	Link Start	Link End	Link Distance (miles)	Weekday Average Coupling Index	Weekend Average Coupling Index
1 – 2	Crossings Blvd	Town Center Pkwy	0.16	1.83	2.35
2 – 3	Town Center Pkwy	Kedron Road	0.25	1.03	1.31
3 – 4	Kedron Road	Depot / McLemore	0.39	0.64	0.79
4 – 5	Depot / McLemore	Duplex / Beechcroft (SR-247)	0.13	1.64	1.84
5 – 6	Duplex / Beechcroft (SR-247)	Miles Johnson Pkwy	0.30	0.74	0.80
6 – 7	Miles Johnson Pkwy	Belshire / Commonwealth	0.64	0.46	0.47
7 – 8	Belshire / Commonwealth	Southern Walmart Access	0.24	1.09	1.07
8 – 9	Southern Walmart Access	Campbell Station Pkwy	0.27	0.90	0.94
9 – 10	Campbell Station Pkwy	Buckner / Thompsons Ridge	0.73	0.34	0.40
10 – 11	Buckner / Thompsons Ridge	Thompsons Station Road	0.90	0.31	0.34

Right-Turn Overlap for New Northbound Right-Turn Lane at Buckner Road

Right-turn overlaps are common on the study corridor where there is a dedicated right-turn lane and a protected left-turn phase on the adjacent non-conflicting approach. A northbound dedicated right-turn lane was recently constructed on US Route 31 at Buckner Road. A right-turn overlap is recommended for this turn lane.

Traffic Signal Standards

The development/adoption of traffic signal standards by the City is recommended. The existing signalized intersections have a variety of traffic signal equipment. There are inconsistent traffic signal components, sign sizes, supports (mast arm / span wire), including some outdated parts such as incandescent lights. The standards should include provisions for routine signal maintenance and cabinet diagnostics, as well as routine signal timing updates (minimum every two years, or after significant development or network changes).

City-Sponsored Circulation Study

The US Route 31 intersections with Depot Street / McLemore Avenue and Duplex Road / Beechcroft Road (SR-247) are both offset intersections. The geometry necessitates the use of split phase timing plans, which require much more of the cycle time be used for side street traffic resulting in a shorter greenband for US Route 31 traffic. It is recommended that the City perform a circulation study of the downtown area to consider methods of improving traffic operations. Possible solutions the study could consider include realignment of the intersection approaches, or making one leg of each intersection one-way, for example.

Mid-Term Improvements

The following mid-term improvements (MTI) have been identified:

Implementation of Flashing Yellow Arrow Signal Displays

The addition of the flashing yellow arrow (FYA) for permissive-protected left-turn phases allows for further optimization of signal coordination through the use of lead-lag left-turn phasing. Using lead-lag left-turn phasing with the current five-section signal heads would cause the "yellow trap". The yellow trap occurs when the permissive left-turn phase ends (beginning the yellow circular indication) and the left-turning driver incorrectly assumes the opposing through movement phase is ending at the same.

Dedicated Right-Turn Lanes

Right-turns from a shared-traffic lane result in significantly reduced travel speeds, reduced throughput at signalized intersections, and increased risk of rear-end crashes. For these reasons, dedicated right-turn lanes are recommended on US Route 31 for the following intersections:

- Northbound at Commonwealth Drive;
- Northbound at Nasdaq Street;
- Northbound/Southbound at Campbell Station Parkway;
- Northbound/Southbound at Wilkes Lane / Spedale Court.

Improved Access Management

Frequent driveways, especially those with full-access and/or without dedicated turn lanes, further degrade traffic operations. Shared access points and channelized right-in/right-out driveways should be prioritized. Right-in/right-out channelization is recommended for the following access points:

- Northbound at Nasdaq Street;
- Northbound/Southbound at Wilkes Lane / Spedale Court.

Left-in/right-in/right-out channelization can also be considered where dedicated left-turn lanes are provided.

Long-Term Improvements

Due to the unfeasibility of widening US Route 31, the provision of alternate routes will be critical to maintain satisfactory traffic operations on US Route 31. One area to consider alternate routes would be to/from the schools on Thompson's Ridge Road. One possibility is a north-south connector between Thompsons Ridge Road (or Traders Way) and Wilkes Lane to Campbell Station Parkway. This concept is illustrated in Figure 7.

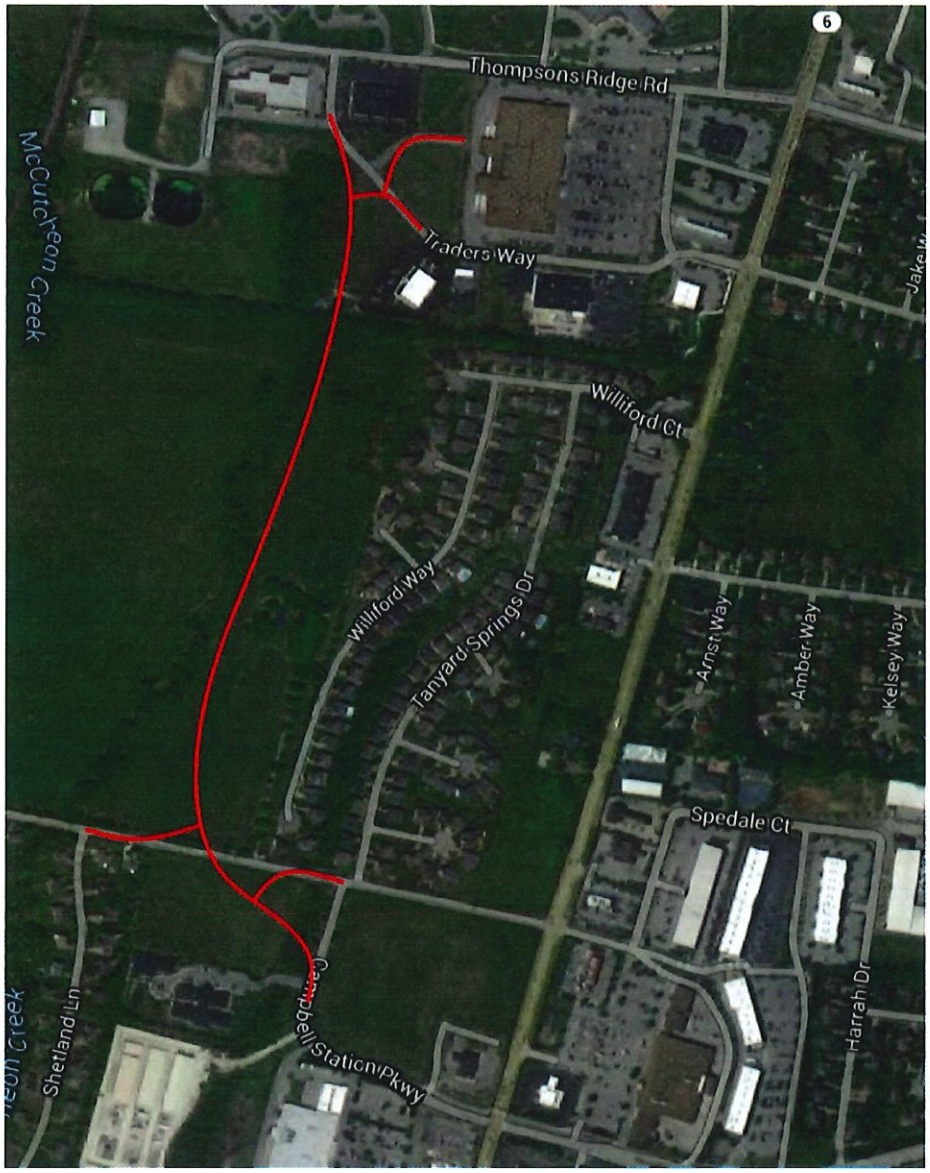

Figure 7: Conceptual Connector between Thompson's Ridge Road and Campbell Station Parkway.

Further consideration should be given to adaptive traffic signal control, the construction of additional laneage, and/or alternative intersection configurations.