HIGHWAY OPERATIONS – ITS ENGINEERING AND SUPPORT

COMPUTERIZED TRAFFIC SIGNAL SYSTEMS (CTSS) GUIDELINES

CONNECTICUT DEPARTMENT OF TRANSPORTATION

Prepared as a reference for
Highway Operations – ITS Engineering and Support CTSS Engineers

FORWARD

The guidelines and supplementary information contained in this manual are intended to provide a reference for various computerized traffic signal systems (CTSS)-related activities performed by the Highway Operations – ITS Engineering and Support. The guidelines also outline the necessary interaction with other Department Offices. When a Highway Operations – ITS Engineering and Support activity necessitates the use of a guideline from this manual, it should be conducted according to that specific guideline, or in other relevant references such as: "FHWA Signal Timing Manual", "2009 FHWA Traffic Signal Operations and Maintenance Staffing Guidelines", "CTDOT Traffic Control Signal Design Manual", "Manual on Uniform Traffic Control Devices" (MUTCD), Office of the State Traffic Administration (OSTA) regulations, and the "DOT Policy Statement".

The information in this manual will be updated and revised as changes occur in related Highway Operations – ITS Engineering and Support activities, therefore making this manual a "living" document. As revisions are made, they will be updated in this manual and the revision date will be printed on the bottom of the corresponding section.

Although these guidelines are an attempt to develop uniformity in the activities and practices of the Highway Operations – ITS Engineering and Support, there are times when engineering judgment should be exercised. In other words, there may be other ways or means of addressing a condition which may be acceptable, with the approval of the supervisor.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

CONTACTS

At times, personnel in Highway Operations receive certain assignments. There are "go to" people when seeking information on certain topics. Please refer to Highway Operations – ITS Engineering and Support for information regarding CTSS timing plans and intersections. Any information regarding non-CTSS is maintained by the Traffic Signal Lab. The purpose of this list is to make available a list of topics and the person expected to be up-to-date on that topic.

Highway Operations – ITS Engineering & Support

John F. Korte
Supervising Engineer
Connecticut Department of Transportation
2800 Berlin Turnpike
Newington CT 06131-7546
Phone: 860-594-3459
Email: John.Korte@ct.gov

Kevin Danh
Transportation Engineer
Connecticut Department of Transportation
2800 Berlin Turnpike
Newington CT 06131-7546
Phone: 860-594-3431
Email: Kevin.Danh@ct.gov

Shawn M. McDuffee
Transportation Engineer
Connecticut Department of Transportation
2800 Berlin Turnpike
Newington CT 06131-7546
Phone: 860-594-3434
Email: Shawn.McDuffee@ct.gov

Traffic Signal Lab

Mark Zampini
Transportation Engineer
Connecticut Department of Transportation
2800 Berlin Turnpike
Newington CT 06131-7546
Phone: 860-258-0349
Email: Mark.Zampini@ct.gov

Donald W. Assard
Transportation Engineer
Connecticut Department of Transportation
2800 Berlin Turnpike
Newington CT 06131-7546
Phone: 860-258-0346
Email: Donald.Assard@ct.gov

INTRODUCTION

Signal systems are designed to move platoons of traffic on arterial roadways and/or for queue control. Emphasis should be placed on the development of a wide "green band" to favor the flow of the arterial street traffic while not restricting the flow of other traffic. Sometimes the volume of traffic entering or leaving the system from side streets may exceed the through volume on the arterial. Every effort should be made to define the origin and destination of traffic in the system and to be sure that the major flows are incorporated into the progression. According FHWA, Computerized Traffic Signal System (CTSS) is an Intelligent Transportation System (ITS).

ITS means electronics, communications, or information processing used singly or in combination to improve the efficiency or safety of a surface transportation system. ITS applications for CTSS - includes communications systems, adaptive control systems, traffic responsive, real-time data collection and analysis, and maintenance management systems – enable signal control systems to operate with greater efficiency. Please refer to Federal Regulations for more information.

Below is a list of CTSS and Non-CTSS (defined partially by CTDOT Traffic Control Signal Design Manual):

CTSS

1. A closed loop system is a method of coordinating several signalized intersections with a master. The master is interconnected to and communicates periodically with each local controller (usually transmitting the correct time of day). The master also communicates with a central office computer. Once the system timing plan is initially programmed and stored in the local controllers the master serves as a communication hub between the central office and the locals. When necessary, for example due to an incident or an extreme weather condition, the on-street master receives coordination instructions from an operator at the central office and in turn downloads the information to the local controllers. The master also receives pertinent information from the local controllers and transmits that to the central office. An operator, at the central office, has the ability to revise the system timing plan, monitor the status of each local controller, extract vehicle volume and occupancy data, pre-emption history, mal-function history, and even change local controller phase timing.

2. An adaptive signal control systems coordinate control of traffic signals across a signal network, adjusting the lengths of signal phases based on prevailing traffic conditions. The master is also capable of communicating with a central office computer. An operator, at the central office, has the ability to revise the system timing plan, monitor the status of each local controller, extract performance measure data, pre-emption history, malfunction history, and so on.

Non-CTSS

1. A time base system is a method of coordination in which the system timing plan is typically programmed in an external device known as a time clock/time base coordinator (TC/TBC). This device is located in each controller cabinet. The system timing plan may also be programmed directly into the local controller. There is no interconnect or communication between intersections or to a central office. The time

base electronic clock is very accurate and once programmed, supplies the coordination information such as system cycle length, offset, yield point, max 2 selection, permissive period, etc.

2. An open loop system is a method of coordinating several signalized intersections with a master. As with a closed loop system, the master serves as a hub and communicates periodically with the local intersections. The system timing plan resides in the local controllers. The master also receives pertinent information from the local controllers. In an open loop system however, there is no communication with a central office computer. The system timing plan is either manually programmed or downloaded from a laptop computer into the master. To revise the system parameters or extract data from the local controllers the operator must go to the master and connect a laptop. This type of system is seldom used by the Department.

3. Isolated signalized intersections would also be considered non-CTSS.

The Connecticut Department of Transportation (CTDOT) currently has over one hundred state-owned CTSS (all are closed loop systems) statewide covering fifty (50) routes total in the state of Connecticut. The Department operates two types of closed loop systems: DOS-based Transyt systems and Naztec systems. The Dos-based Transyt systems are obsolete and incompatible with CTDOT's current Operations and Maintenance IT Network. While many of these devices installed between the early-1990s to the early-2000s are functional with frequent and continued maintenance, they are approaching the end of their serviceable life. ConnDOT manages these CTSS devices through two centers in Newington and Rocky Hill. Many of Communications to field CTSS devices are provided through leased telecommunications lines. Unreliable data communication through the leased lines to field devices results in data collection limitations.

The intent for coordination traffic signals is to provide smooth flow of traffic along streets and highways in order to reduce travel times, stops, and delays. The FHWA Traffic Signal Timing Manual (FHWA-HOP-08-024) recommends retiming and re-evaluating signal systems every three (3) to five (5) years to ensure efficient operations. Below is a general list of benefits (2012 National Traffic Signal Report Card) for signal systems retiming, but not limited to:

- Improve Traffic Performance
  - Reduce delay
  - Reduce stops
  - Intersection Queue Management
  - Reduce fuel consumption/emissions
  - Increase average speed
  - Improve travel time
  - Enhance Performance Measures Reporting Capabilities
- Improve Traffic Safety
  - Reduce accidents involving vehicles and pedestrians
- Improve Emergency Vehicle Responsiveness

STATE-OWNED CTSS RESOURCES

Several CTSS resources are available below for a Highway Operations Engineer.

Traffic Signal Inventory – Information on signalized intersections that are part of State-owned CTSS can be found here. Engineer will maintain CTSS information with Traffic Signal Inventory.

CTSS Interconnect Plans – Engineer shall include all copies of CTSS interconnect plans, if available.

CTSS Listing – Complete CTSS listing with intersections maintained by Highway Operations.

CTSS Cover Sheets – Engineer shall update and maintain cover sheets in the following location. Engineer should remember to backup original cover sheets before modifying.

CTSS Original TSDWIN – File location is intended for backup purposed only. Engineer shall copy of Original TSDWIN files before modifying.

CTSS File Storage Location – Engineer shall store information on CTSS in this location.

Signalized Intersections Plans – ProjectWise location for Traffic Signal Plans.

CTSS Highway Operations Engineer will be contacted for updated CTSS timing plans and CTSS information.

CTSS ROLES AND RESPONSIBILITIES

CTDOT Highway Operations - ITS Engineering and Support is responsible for the operation of CTSS. This section is responsible for the following duties:

- Monitor system hardware for failure and report all malfunctions to the Traffic Signal Lab.
- Monitor system detectors for measures of effectiveness (MOEs).
- Fine tune system timing plan to meet traffic demands.
- Maintain records of timing plans and time-space diagrams and update as necessary.
- Conduct traffic analysis of system performance on a continuous basis.
- Expands system components as needed.
- Respond to traffic incidents and emergencies accordingly.

CTDOT Traffic Signal Lab is responsible for maintaining the CTSS. This section is responsible for the following duties:

- Upload and download database changes to field equipment.
- Maintain policies for preventative maintenance.
- Maintain records of as-built plans for all state-owned traffic signals.
- Maintain and monitor field equipment and troubleshoot as necessary.
- Monitor system software for malfunctions and communicate with software manufacturer as necessary.
- Maintain spare parts and all necessary test equipment for field equipment malfunctions.

CTDOT Traffic Engineering is responsible for maintaining traffic appurtenances at these intersections as specified by the "CTDOT Traffic Guidelines". This section is responsible for the following duties, but not limited to:

- Maintain policies for preventative maintenance.
- Maintain and monitor traffic signal heads, pedestrian signal heads, and other signal appurtenances and equipment.
- Maintain and monitor intersection signing and striping.

CTSS INFORMATION REQUEST GUIDELINES

Request for Information (RFI) - Cover Sheet Request

Cover sheets will be updated to match existing field “timing plans”. The term “timing plans” shall include cycles, splits, offsets and schedules. Any RFI request for “timing plan” information for closed loop systems or any intersections part of closed loop systems shall be handled by an appropriate Transportation Engineer from Highway Operations – ITS Engineering and Support**.** Other information requests for CTSS intersections shall be handled by the Traffic Signal Lab.

Please keep in mind that updating cover sheets is not a simple task and may require several days to complete depending on size of system, database discrepancies, communication errors, etc.

1. Engineer shall identify if signal(s) is (are) part of the part of Naztec or Transyt closed loop system.
    a. For Transyt intersection(s), please make sure Transyt database matches the Mark Zampini’ s Transyt database from the Traffic Signal Lab.
    b. For Naztec intersection(s), please make sure correct Naztec Database (v41 and v61 database) is used to update cover sheets.
2. Engineer shall log on to ProjectWise (02.2 - Asset - Signal Intersections) and obtain the “Plan of Record” for requested intersection (s) within closed loop system.
3. Engineer shall locate and make copy of outdated closed loop system coversheet in shared drive location (accessible only by Traffic Signal Lab and Highway Operations staff as of February 2nd, 2016) to start updating process, if necessary.
4. Engineer shall upload intersection(s) database and conduct database comparison for each intersection. Please refer to Naztec Guide and Transyt Guide for more information.
    a. Engineer shall contact Traffic Signal Lab if there are any discrepancies in databases before continuing to update database.
5. Engineer shall use Naztec/Transyt cover sheet template (shared drive location) to input closed loop timing. Closed Loop timing information shall be updated by comparing outdated cover sheet, signal plan(s), and Naztec/Transyt database (once discrepancies, if any, are resolved) to update cover sheet.
6. Engineer shall check if timings on updated cover sheet make sense before submitting.
7. Engineer shall submit updated cover sheet to individual requesting cover sheet by email correspondence and copy Supervisor.

Note: Any cover sheets requests pertaining to changes with State-Owned CTSS (Projects, Permits, And So On) shall be submitted with Time-Space Diagrams and review comments by Highway Operations Engineer as part of review comments package.

Non-CTSS Information Request

Any request for information to Highway Operations – ITS Engineering and Support on non-CTSS (identified above) shall be forwarded to the Traffic Signal Lab.

UPDATING CTSS TIME-SPACE DIAGRAMS

A Time-Space diagram is defined as a chart that plots the location of signalized intersections along the vertical axis and the signal timing along the horizontal axis. This is a visual tool that illustrates coordination relationships between intersections. The time-space diagram highlights the locations on the corridor that experience stops and long delays under the before and after conditions. Based on time-of-day volume information, progression along corridors can be favored in one direction or both directions, if allowable.

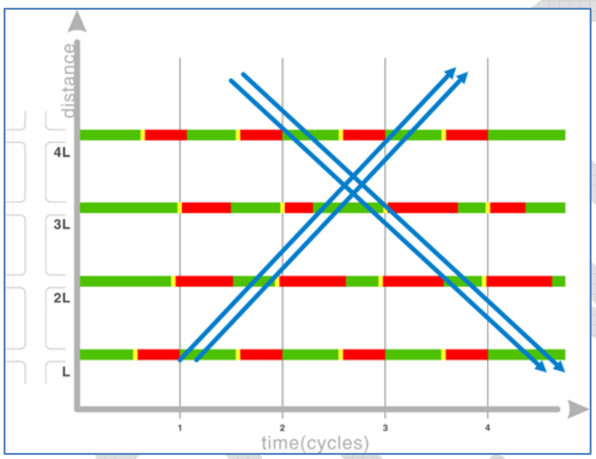

FIGURE 1 - TIME SPACE DIAGRAM EXAMPLE

Highway Operations use Fortran TSDWIN to generate, view, and modify Time-Space Diagrams. TSDWIN Time-Space Diagrams are a little different. TSDWIN plots the location of signalized intersections along the horizontal axis and the signal timing along the vertical axis. Engineer should refer to the [Fortran TSDWIN Manual] for guidance in using TSDWIN.

Once cover sheets are updated to match existing field conditions, the Engineer shall begin to update time-space diagrams to match existing field conditions.

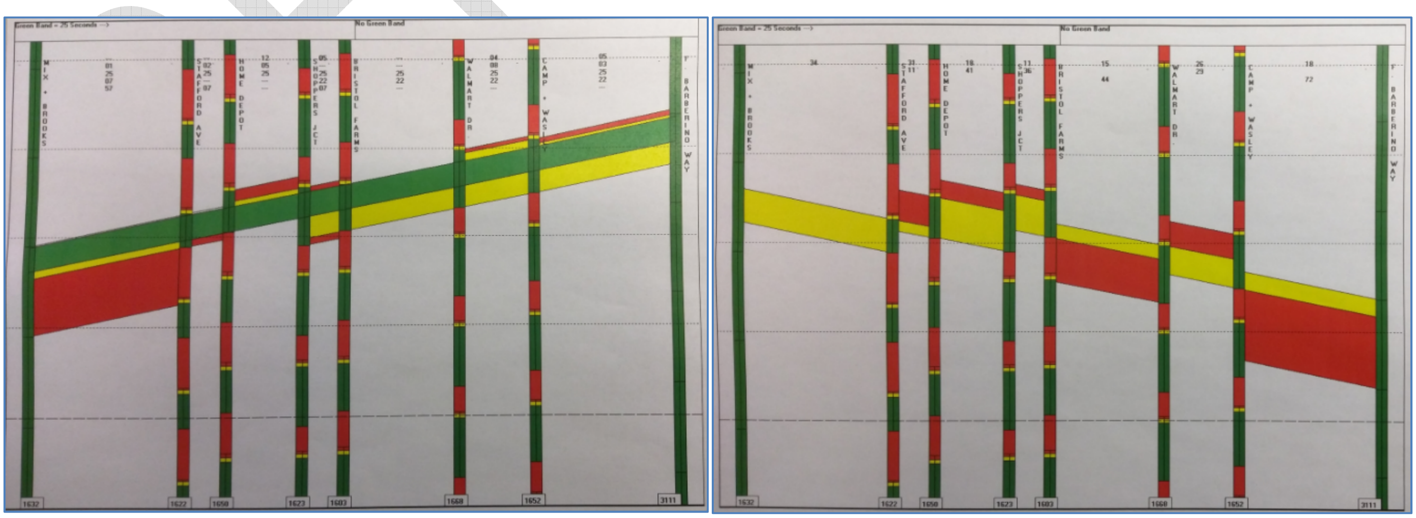

FIGURE 1 - TSDWIN A.M. PEAK TIME SPACE DIAGRAM EXAMPLE

CTSS TIMING COMPLAINT EVALUATION PROCESS

The Engineer shall utilize the flow diagram below to handle any CTSS timing complaint:

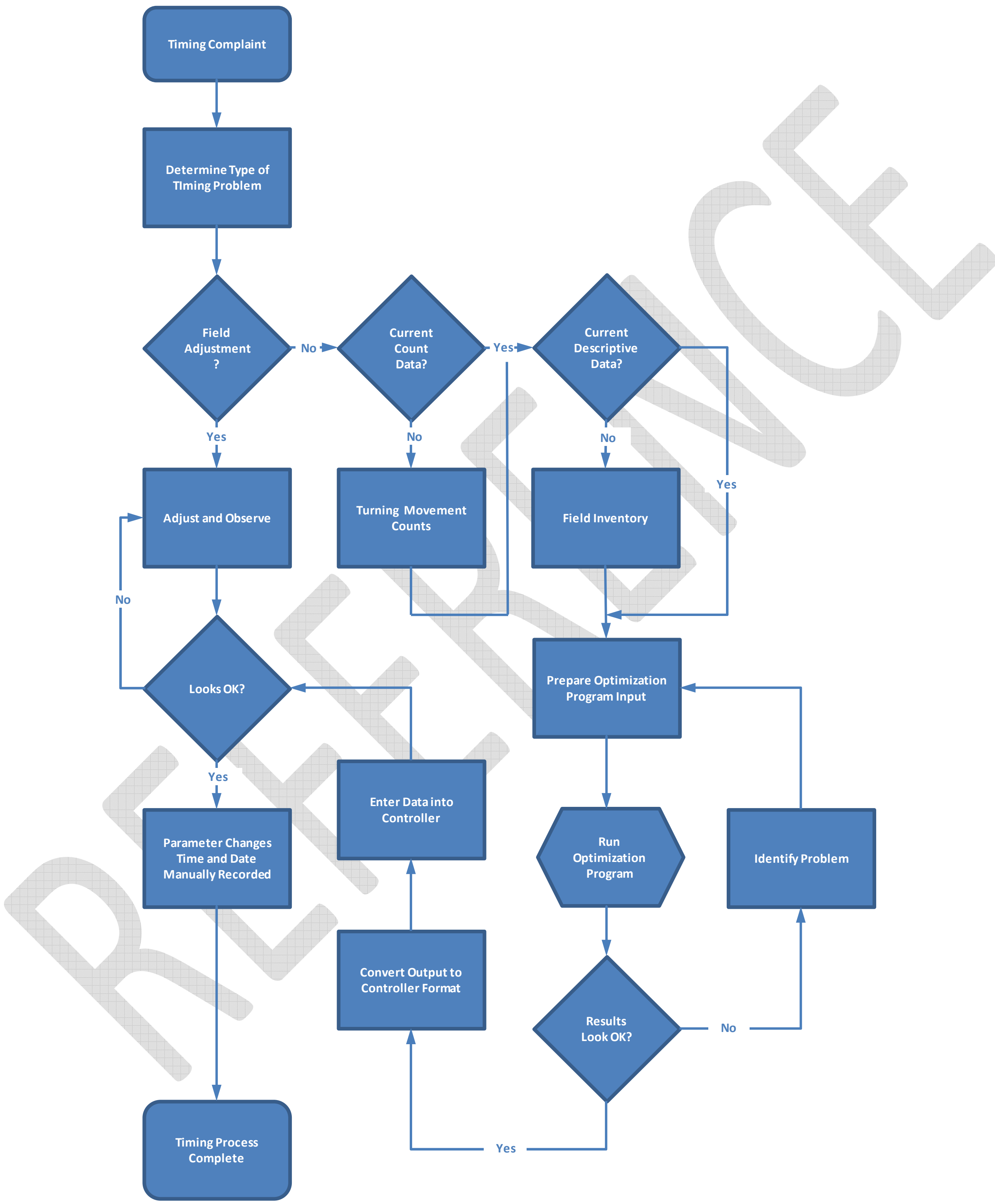

FIGURE 2 - CTSS TIMING COMPLAINT EVALUATION PROCESS

The Traffic Signal Lab will be available for assistance, if needed.

CTSS TIMING PLAN EVALUATION PROCESS

Engineer shall refer 2008 FHWA Signal Timing Manual Section 6.0, 7.0 and 8.0 for further guidance on signal retiming. Tasks for CTSS Timing Plan Evaluation are based on past Highway Operations Engineer experience and are subject to change. Please keep in mind that the term "timing plans" shall include cycles, splits, offsets and schedules.

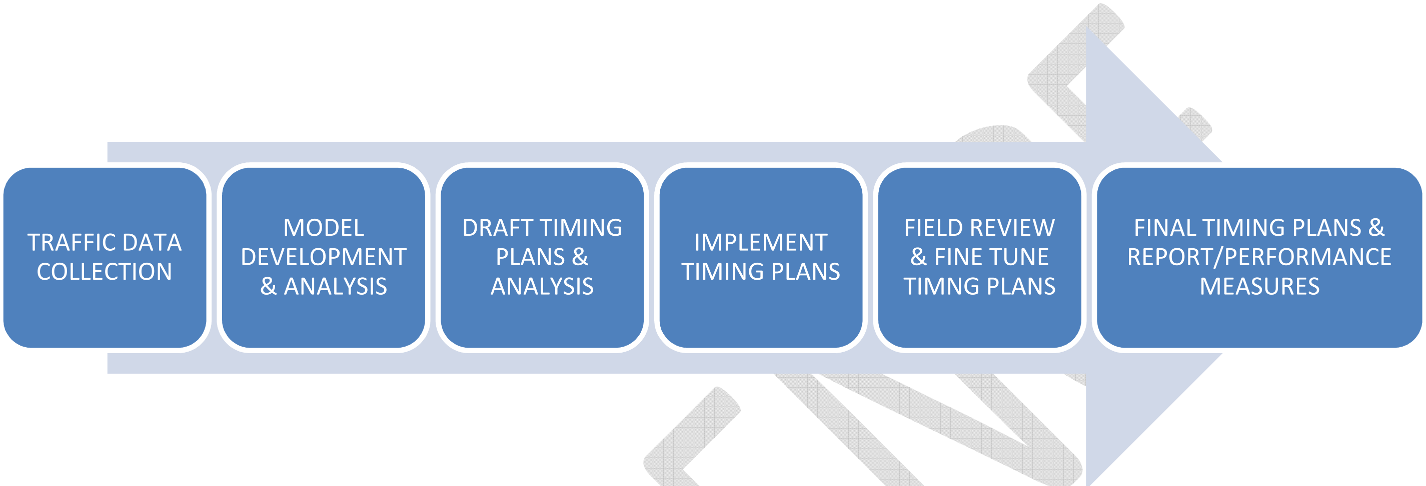

FIGURE 3 - CTSS TIMING EVALUATION PROCESS

Task 1 - Traffic Data Collection

- 1-A. Pre-Implementation Data Collection / Field Inventory
- 1-B. 24 Hour Volume Data / Turning Movement Count Data
- 1-C. Roadway Speed Data
- 1-D. Split-Monitoring
- 1-E. CTSS Location
- 1-F. Warrant Timing Plan Change

Task 2 - Model Development & Analysis

- 2-A. Create Network with Nodes in **PASSER V**
- 2-B. Input Intersection Data into **PASSER V**
- 2-C. Input Traffic Data into **PASSER V**
- 2-D. Use **PASSER V** for all time periods

Task 3 - Draft Timing Plans & Analysis

- 3-A. Using PASSER V, Optimize the Network
- 3-B. Signal Phasing Recommendations using PASSER V
- 3-C. Develop Time-Space Diagrams Via **TSDWIN**
- 3-D. Determine Offsets Via **TSDWIN**

Task 4 - Implement Timing Plans

- 4-A. Implementation Of Signal Timing Plans

Task 5 - Field Review & Fine Tune Timing Plans

- 5-A. Field Review
- 5-B. Revise Signal Timing Plans and Update if Necessary

Task 6 - Final Timing Plans & Report / Performance Measures

- 6-A. Post-Implementation Data Collection
- 6-B. Develop Final Report To Include Changes And Benefits

DETAILED CTSS TIMING PLAN EVALUATION PROCESS

TASK 1. TRAFFIC DATA COLLECTION

1-A Pre-Implementation Data Collection / Field Inventory

1-A.1 The Engineer shall obtain existing information for all intersection in the CTSS. The existing information should include, but not limited to:

- Existing Traffic Signal Plans (should include signal timings, phasings, and timing plans)
- Time Space Diagrams
- Cover Sheet
- Volume Information
- Any Previous Studies
- Site History

1-A.2 The Engineer shall field review for existing conditions of all intersections using appropriate field observation template.

1-A.3 The Engineer shall conduct before studies that will be made in each direction through the systems (3 runs each direction per period).

1-A.4 Engineer will update system timing plans and time-space diagrams to match system database.

1-B 24 Hour Volume Data / Turning Movement Data Collection

1-B.1 The Engineer shall collect/obtain 24 hour traffic count data at all intersections in the CTSS and, identify any apparent issues concerning the usefulness of these data. The Engineer shall use internal data collection team to collect data as described above, if necessary. Volume vs Time of day charts shall be created to determine patterns for timing plans.

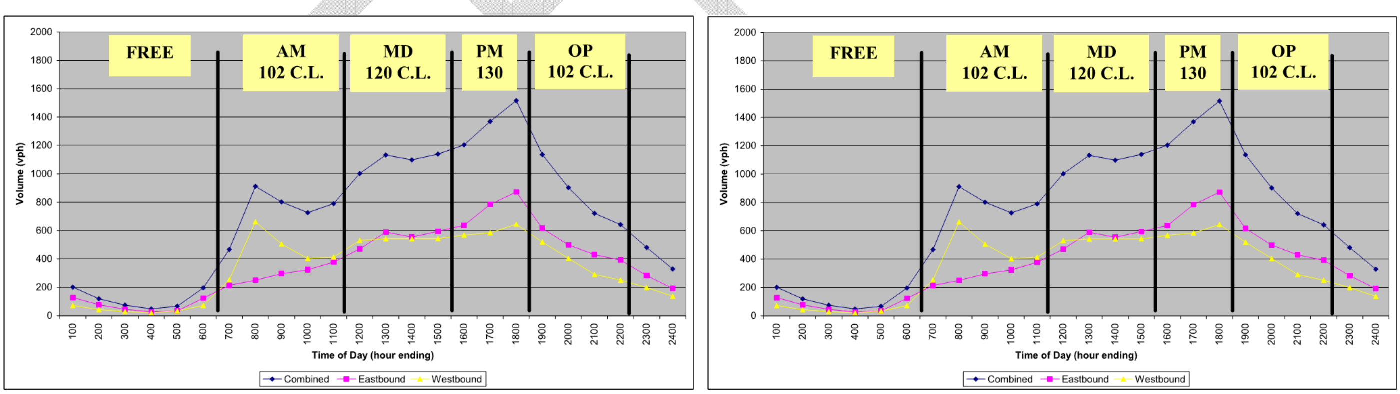

FIGURE 4 – EXAMPLE 24 HOUR TOD VOLUME PROFILE

1-B.2 The Engineer shall collect turning movement count data in 15 minute intervals by basic vehicle classifications during the weekday morning peak (7:00a.m. to 8:00a.m.), weekday evening peak (4:00 p.m. to 6:00 p.m.), weekday (11:30a.m. to 2:30p.m.) at locations to be determined by The Engineer and Saturday/Sunday midday peak (12:00 noon to 2:00 p.m.) at locations to be determined by The Engineer (4 periods) to verify if 24 hour count will be usable.

1-B.3 The Engineer should collect pedestrian data and note as light, medium or heavy with respect to the frequency.

1-B.4 The Engineer shall collect existing level of service analyses during the weekday morning peak (7:00a.m. to 8:00a.m.), weekday evening peak (4:00 p.m. to 6:00 p.m.), weekday (11:30a.m. to 2:30p.m.) at locations to be determined by The Engineer and Saturday/Sunday midday peak (12:00 noon to 2:00 p.m.) at locations to be determined by The Engineer (4 periods).

1-C Roadway Speed Data

1-C.1 The Engineer shall determine roadway speed from posted speed limit either by Google Earth or Field review. Engineer should contact the Office of the State Traffic Administration or Legal Traffic Authority to verify approved posted speed limits and 85th percentile speeds for roadways within the CTSS limits. The posted speed limit will be used as the travel speed in the corridor, except when the operating speed is less than the posted speed limit, at which time the operating speed will be used.

1-D Split-Monitoring

1-D.1 The Engineer shall split-monitor each intersection of the CTSS through system server (three (3) 15-minute split monitoring periods shall be conducted per timing plan pattern for each intersection for several days). Actuals splits will useful in finalizing timing plans. Engineer should refer to Naztec Guide and Transyt Guide for more information on split monitoring.

1-E CTSS Location

1-E.1 The Engineer shall use google maps/bing maps to create a map for CTSS location and identify signalized intersection within map.

1-F Warrant Timing Plan Change

1-F.1 Engineer will compare and warrant timing plan change if necessary.

a) If system does not warrant timing change, Engineer will report timing changes are not necessary but may provide recommendations for intersection improvements to Traffic Engineering.

b) If system warrants timing change, Engineer will collect additional data (including volumes, speeds, before studies, etc.)

(i) Engineer will move on to Task 2.

<u>TASK 2 - MODEL DEVELOPMENT AND ANALYSIS</u>

2-A Create Network with Nodes in PASSER V

2-A.1 The Engineer shall create a network with nodes to represent CTSS in PASSER V.

2-B Input Intersection Data into PASSER V

2-B.1 The Engineer shall input lane geometry roadway widths, saturation flow rates, and other roadway related information in PASSER.

2-B.2 The Engineer shall input type of controller and loop detector information from the existing signal plans into PASSER.

2-C Input Traffic Data into PASSER V

2-C.1 The Engineer shall adjust intersection traffic volumes for seasonal variations using current year volumes.

2-C.2 The Engineer shall input balanced traffic volumes into latest PASSER V for each peak hour period.

2-C.3 The Engineer shall input existing signal timings and phasings into PASSER V for each intersection.

2-C.4 The Engineer shall input existing offset information into PASSER V.

2-D Use PASSER V for all time periods

2-D.1 The Engineer shall run PASSER V with existing timing plans and adjusted balanced traffic volumes,

2-D.2 The Engineer shall obtain existing level of service analyses for the intersections in the computerized signal system from The Engineer for weekday morning peak hour, weekday evening peak hour, weekday midday peak hour (when appropriate), and Saturday/Sunday midday peak hour (when appropriate).

TASK 3. REVISION OF SIGNAL TIMINGS USING PASSER V

3-A Using PASSER V, Optimize the Network

3-A.1 The Engineer shall optimize timing plans maintaining the signal phasing for all locations in the CTSS with PASSER V.

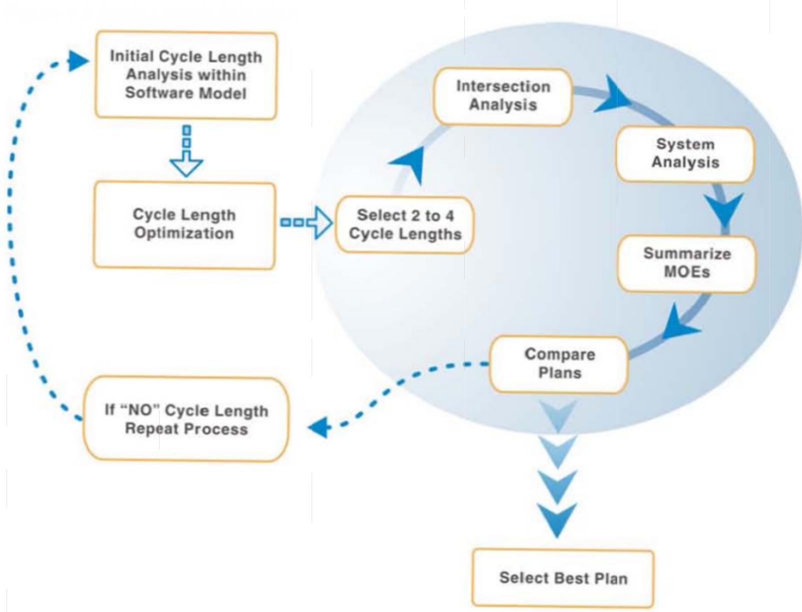

FIGURE 5 – PASSER SIGNAL TIMING REVISIONS PROCESS

3-A.2 The Engineer shall use PASSER V to obtain the system timing plan.

3-A.3 The Engineer shall optimize the splits for all intersections using the system timing plan.

3-A.4 Determine the network offsets from the PASSER V maintaining the timing plans.

3-A.5 Determine PASSER V signal timing plans for all periods of the day especially weekday morning peak hour, weekday evening peak hour, weekday midday peak hour (when appropriate), and Saturday/Sunday midday peak hour (when appropriate).

3-B Signal Phasing Recommendations using PASSER V

3-B.1 Final PASSER output products will be analyzed for current conditions, including signal phasing, for immediate database input into the CTSS.

3-B.2 Signal Phasing recommendations will be developed based on the PASSER analysis only, for the purpose of determining intersection efficiency, neither accident data nor sight distances will be analyzed. Recommendations may include changing lead-lags, adding a protected phase or adding an overlap phase to improve intersection operations.

3-B.3 All signal phasing recommendations will be analyzed in PASSER.

3-B.4 Signal phasing changes will not be recommended if:

- It requires additional signal equipment and or hardware; or,
- It requires changes in the roadway geometry.

When the above conditions occur, and after notifying Supervisor, optimization will continue using the existing timing plan phasing contained in Task 1. All analyses for future phasing recommendations are speculative; and, therefore will be treated as work for future projects.

3-C Develop Time-Space Diagram (TSD) via TSDWIN

3-C.1 The Engineer shall develop time-space diagrams for each timing plan using **TSDWIN** and outputs from **PASSER V**. Please refer to TSDWIN Guide for guidance.

3-D Determine Offsets via TSDWIN

3-D.1 The Engineer shall determine offsets with TSDWIN by fine-tuning each time-space diagram to maximize the bandwidth and progression for each direction.

TASK 4 - IMPLEMENT SIGNAL TIMINGS

4-A Implementation of Signal Timings

4-A.1 The Engineer shall coordinate with Department Traffic Signal Lab for implementation of signal timings.

TASK 5 - FIELD REVIEW AND FINE TUNING OF SIGNAL TIMINGS

5-A Field Review

5-A.1 The Engineer shall field observe the signal timing recommendations as implemented by Traffic Signal Lab Technician.

5-B Revise Signal Timing Plans

5-B.1 The Engineer shall modify the signal timing plans after the field work, if necessary.

5-B.2 The Engineer shall revise signal timing plans and update PASSER V and TSDWIN to reflect field findings.

5-B.3 The Engineer shall coordinate with Traffic Signal Lab Technician for implementation of fine-tuned signal timings.

TASK 6. Final Timing Plans & Report / Performance Measures

6-A Post - Implementation Data Collection

6-A.1 The Engineer shall conduct before studies that will be made in each direction through the systems (3 runs each direction per period).

6-B Develop Final Report to include Changes and Benefits

6-B.1 The Engineer shall submit collected data in a presentable format to Supervisor.

6-B.2 The Engineer shall prepare a final report that will include changes and benefits of the timing plan evaluation of the CTSS such as:

- Average Travel Time
- Average Speed

- Average Number of Stops
- Average Delay Time
- Emissions Reduction

6-B.3 The Engineer shall incorporate services which were not documented in Task 1 through 5 in detail in the final report, including:

- Changes implemented in the CTSS settings.
- Benefits derived from a progressive signal timing optimization project.

6-B.4 The Engineer shall suggest potential geometric improvements at intersections in the CTSS to Traffic Engineering. Detailed studies/analyses and functional plans are not required in this effort.

6-B.5 The Engineer shall suggest critical provisions for new signal equipment and/or hardware at any location in the CTSS to Traffic Engineering. Detailed studies/analyses and traffic signal plan revisions are not required in this effort.

CTSS REVIEW GUIDELINES

The Engineer will review several types of submittals including, but not limited to:

- Clearance Interval Timing changes that will affect CTSS coordination
- State Projects that involves CTSS intersections or whole systems
- Encroachment Permits involving CTSS intersection
- Municipal CTSS Projects

More information on review process to be added on a later date.

Any proposed changes to a state-owned CTSS should be forwarded to Highway Operations for review. Proposed changes include any changes to a CTSS intersection or the addition/removal of a signalized intersection to a state-owned CTSS.

Highway Operations will use information in proposed changes to update system timings (Cycle/Split/Offset). A time space diagram and an updated cover sheet to match proposed changes will be provided by Highway Operations along with any review comments. A Highway Operations Engineering should review and comment on the following sections:

1. Preliminary Study
    - o Systems Engineering Analysis Form (SEAFORM)
    - o Systems Requirements Engineer Shall
2. Preliminary Design Submittals
- Estimate
    - o The consultant will estimate the project quantities and costs.
    - o The items and quantities will be shown on the detailed estimate sheet.
    - o Estimates will be submitted on approved forms.
- Traffic Signal Plans
    - o Phasing Sequence and Timings – Engineer shall coordinate with Traffic Safety Unit for changes in clearance interval timings, if any.
    - o Coordination Chart – Engineer shall provide updated cover sheet and time-space diagrams to satisfy proposed changes in signalized intersection(s), if necessary.
    - o System Loc – Engineer shall make sure all intersections are included in this section
    - o Closed Loop Detector Chart -
    - o Construction Notes -
    - o Technical Notes – Engineer shall verify if the following notes are included in this section:
        - ▪ ARTERY PHASE DETECTORS TO BE NON-ACTUATING DURING COORDINATION.
        - ▪ TIMINGS SHOWN INDICATE FREE OPERATION.
        - ▪ ACTUAL COORDINATION INFORMATION TO BE DETERMINED BY CLLCU.

- Phasing Sequence Diagram – Engineer shall verify if phasing sequence diagram make sense.
- Traffic Signal Layout
  - Communication Cable
  - Detection Location (For Vehicle Count Purposes)

Engineer shall coordinate comments with Traffic Signal Lab before submitting to supervisor for approval.

Engineer shall submit memorandum package in department format to supervisor for approval. Package should include:

- Memorandum
- Review Comments
- Cover Sheet
- Time-Space Diagrams (if proposed changes will affect coordination)
- Review Submittals with comments (ex. Traffic signal plans)

Engineer shall submit comments on all plans, specifications, and estimates accordance with current Department Standards to project engineer by e-mail correspondence

2. Semi-final Design

Engineer shall verify all comments in previous review submission have been addressed.

After drafting is complete, review the design with the LTA and determine context sensitive areas or features at the intersection. Then forward a copy to Electrical for their design with copies to the Highway Operations Unit (for signal systems) and to the District Construction Office for their input. Electrical then designs the electrical requirements in accordance with the Traffic Signal Electrical Design Procedures, contained elsewhere.

Final Design

Electrical then forwards the final contract signal plans, specifications, estimates, and standard sheets (PS&E) to Traffic Engineering. The Electrical PS&E are combined with any additional plans or specifications prepared by Traffic Engineering. The combined PS&E is then uploaded onto ProjectWise following the steps contained in the Digital Project Development Manual and a memo is sent to Highway Design from the Principal Engineer of the Project Design Unit to the Principal Engineer of Highway Design.

TIRs, if required, are to be prepared and forwarded to OSTA.
Special Provisions

Traffic Engineering will supply available Special Provisions.

The consultant will prepare items not covered in the Special Provisions, the Standard Specifications, or the Supplemental Specifications.

NOTES:

Design Phases

1. Preliminary Engineering Phase:

a. Determine locations where traffic control signals may be warranted.

b. Develop geometric configurations for the intersections including turning lanes, channelization, and requirements for signalization.

c. Perform capacity analysis to the construction and design year volumes utilizing methods that are based on the Highway Capacity Manual.

d. Indicate the signal phasing

e. Indicate interconnect required and means of establishing coordination between signals.

2. Preliminary Design Phase:

a. If the Preliminary Engineering Phase is not undertaken, include items under Preliminary Engineering Phase into this phase.

b. Prepare 40-Scale intersection plans including signs, pavement markings, and sidewalks.

c. Add the phasing diagram as needed.

d. Complete the Sequence and Timing portion of the plan.

e. Design equipment location such as poles, signal heads, and detectors. Do not show electrical requirements at this time.

f. If unknown determine Town/City preferences to design elements such as emergency preemption, pedestrian provisions, and other special design considerations.

3. Final Design Phase:

a. Semi-final Design Submittal:
1. Incorporate comments from preliminary design submittal.

b. Final Design Submittal:
1. Engineer shall verify if Incorporate comments from semi-final design submittal or provide an explanation why such comments cannot be incorporated.
2. Resubmit all plans, specifications, and estimates for review.
3. Digitally stamp/watermark each traffic control signal plan. Digitally certify the Traffic Subset with a note stating which pages contained in the subset the consultant is responsible for and e-mail the signed subset to Traffic Engineering for incorporation into the full design submission into ProjectWise. Upon completion of an acceptable set of plans, specifications, and estimates the consultant will provide one (1) file in MicroStation format and one (1) file in PDF format containing the digital signed electronic files of each signal plan and or pavement marking plan in the project to Traffic Engineering for the preparation of TIRs and for their permanent files.

CTSS PROJECT DEVELOPMENT GUIDE

The Engineer should refer to CTDOT Project Development Guide and Division of Traffic Engineering Guidelines Section 6.02 for guidance.

Any proposed CTSS projects shall follow ITS requirements. Project Development for CTSS projects is similar to CTDOT Traffic Engineering Signal Project Process with the exception of SEAFORM development in project initiation.

More information on project development to be added on a later date.

REFERENCES

1. 2008 FHWA Signal Timing Manual
2. 2009 ITE Traffic Signal Timing Manual
3. 2014 CTDOT Traffic Control Signal Design Manual
4. 2009 FHWA Traffic Signal Operations and Maintenance Staffing Guidelines
5. 2009 Manual for Uniform Traffic Control Devices + Supplements
6. 2012 National Traffic Signal Report Card
7. 2015 Statewide Computerized Traffic Signal Systems Needs Assessment Brochure and Appendices
8. 2014 Before and After Evaluation of Computerized Traffic Signal System Timing Plans for Route 15 Berlin, CT
9. 23 CFR 940
10. ITS Stewardship - Operation