
Clayton County Traffic Signal and ITS Design Guidelines

October 2004



G R E S H A M
S M I T H A N D
P A R T N E R S

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Introduction

These design guidelines have been developed for the Clayton County Department of Transportation and Development, Traffic Engineering Division, to assist designers who prepare traffic signal, signal communications and Intelligent Transportation System (ITS) plans for the County. These guidelines were prepared by Gresham, Smith and Partners with the approval of Traffic Engineering staff. These guidelines apply to all designers preparing traffic signal and ITS construction plans for Clayton County, including in-house staff and consultants.

This document has been divided into sections that allow the designer to step through the design process, including base mapping, engineering and plan production. These guidelines are not intended to be all inclusive, as the designer is expected to have familiarity with traffic signal operations and general equipment requirements. The designer should review the current editions of the following additional publications, which provide additional design guidance:

- *Manual of Uniform Traffic Control Devices*, Federal Highway Administration
- *Manual of Traffic Signal Design*, Institute of Transportation Engineers
- *Traffic Signal Design Guidelines*, Georgia Department of Transportation
- *ATMS Design Manual*, Georgia Department of Transportation
- *Plans Presentation Guide*, Georgia Department of Transportation
- *Electronic Data Guidelines*, Georgia Department of Transportation
- *Signing and Marking Guidelines*, Georgia Department of Transportation
- *Pedestrian and Streetscape Guide*, Georgia Department of Transportation

These design guidelines will expand on the information presented in the above documents to address specific traffic signal, signal communications and ITS design requirements for Clayton County. This document should be updated as new design procedures, plan requirements, and emerging technologies are adopted by the County. In the event of conflicting requirements between these guidelines and GDOT's, the County's requirements shall override unless identified by the County.

Revision Summary Table		
<i>Date</i>	<i>Section</i>	<i>Description of Revision</i>

Section 1: Base Mapping

Base mapping shall be developed for traffic signal and ITS plans. Base mapping can be acquired through field surveys, aerial mapping or GIS database mapping. Base mapping shall include the following:

- edge of pavements
- sidewalk
- curb and gutter
- pedestrian ramps
- driveways
- existing striping and islands,
- existing utilities
- existing traffic signs
- drainage structures
- existing right of way and property lines

Base mapping shall be developed in MicroStation or AutoCAD. Base mapping developed for projects on State Routes with Federal or State funding must follow the GDOT Electronic Data Guidelines.

Section 2: Signal Inventory (for signal upgrades)

Designers should perform a field inventory of signals to be upgraded to determine what type of equipment is currently in operation. Important features which should be noted include:

- cabinet and controller type
- existing phasing
- existing pre-emption
- existing communications
- existing pedestrian equipment
- existing detection

A sample signal inventory form is included in Appendix A.

Section 3: Existing Conditions Sheets (for signal upgrades)

Existing conditions sheets shall be prepared for each intersection, with the main line movement oriented horizontally across the sheet. Existing conditions sheets should show the following:

- right of way
- signal poles and type
- span wire or mast arm configuration
- placement and type of signal heads
- pedestrian signals and pushbuttons

- locations of detector loops, if visible
- loop lead-in routing (aerial or underground)
- pull boxes
- cabinet location
- channelization islands and striping
- crosswalks and curb ramps
- drainage structures
- existing utility poles
- location of power service
- nearest transformer
- CCTV/ATMS equipment
- communications cable
- traffic signs
- phasing and phase sequencing
- pre-emption phasing and cable routing

The scale for existing conditions sheets shall match the scale for traffic signal design sheets. If the traffic signal(s) is to be included in a set of road design plans, the scale and CADD presentation shall match accordingly.

Section 4: Traffic Signal Design

4.1 Plan Sheet Layout

The traffic signal plan sheet shall show the main line movement oriented horizontally across the sheet. The sheet shall contain the limits of signal construction. Whenever possible, a scale of 1"=20' shall be used. For large intersections or signal equipment designed outside the sheet limits at 1"=20' scale (i.e. detector loops), a 1"=30' scale may be used or break lines can be inserted to allow the equipment to fit on a single sheet. Where break lines are used, the designer should make sure the missing conduit or span wire is accounted for in the signal equipment quantities. The break line should be appropriately located as to not exclude driveways and other vital information.

All plan sheets shall contain the following items in addition to those described below:

- border
- north arrow
- scale

4.2 Cabinet and Controller Equipment

Clayton county prefers the following controller equipment :

- 332 cabinet and components
- 2070L controller
- 2010 conflict monitor

Proposed signal cabinets should be designed close to available power service. The Cabinet shall be located so that it does not block a sidewalk or passageway and complies with ADA clearance requirements. Do not locate the cabinet within drainage areas or areas likely to collect and hold surface water. A suitable cabinet location should also provide good accessibility for maintenance and visibility of the signal operation. A technician pad should typically be included in the cabinet design.

4.3 Pole Placement

Traffic signal poles should be placed outside of the clear zone near the back edge of the existing right of way. When mast arm poles are designed, the poles should be placed as close to the road as possible while meeting clear zone requirements to minimize mast arm lengths.

Poles shall be located to minimize the need to acquire additional right of way. If adequate right of way does not exist, the designer should consult the County for the appropriate procedures for right of way acquisition.

A minimum type 2 pull box shall be provided adjacent to every pole with a minimum 3 – 2" and 2 – 1" PVC conduit stub-outs. More conduit may be required depending on the quantity of wire.

4.4 Span/Mast Arm Layout

Clayton County prefers that all new traffic signals be designed as mast arm assemblies. Current GDOT guidelines restrict mast arm lengths to a maximum length of 65 ft. on State Routes; however, the County has no such mast arm length restriction for signals on County roads. Exceptions for mast arm lengths > 65 ft. shall be obtained through the GDOT Office of Bridge Design. The County prefers a single mast arm for each approach whenever possible, especially for signals located on four lane roadways. Tandem mast arms can be utilized on two lane

roadways and at intersections where right of way or other design considerations dictate the use of tandem arms. All signal heads shall be designed to rigidly attach to mast arms with Astro-brackets.

Where mast arms are not possible, span wire designs shall be acceptable. Clayton County prefers a modified box span configuration, with an interior box span supported by leg spans to each signal pole. The modified box span is connected with bull-rings.

For signal upgrades, it is preferable that proposed spans be designed behind the existing spans so the existing signal heads will remain visible while the new equipment is installed. Tethers are not required on span wire signals, unless special conditions warrant tethered spans. Signal heads shall be mounted with saddle clamps on the span wire, which shall open to the right as viewed from the stop bar.

4.5 Signal Head Placement

Signal heads shall be LED and shall be totally black in color. They shall be placed according to examples in the GDOT Traffic Signal Design Guidelines. For skewed intersections, signal heads should be placed over the departure lanes to guide vehicles through the intersection. Louvered backplates shall be designed for all signal heads.

Designers shall analyze the available sight distance for each intersection approach and determine sight distance deficiencies. If necessary, near side signal heads shall be designed for approaches with deficient sight distance. Nearside signal heads shall be 4-section displays with red lenses side by side.

4.6 Detector Placement

Clayton County prefers to utilize I-VDS (intersection video detection systems) on all mast arm signals where possible. I-VDS detection zones shall be designed as described below for loop detector placement. I-VDS cameras must be designed to mount at a minimum height of (1) foot for every (10) feet distance the detection zone is from the camera. If necessary, vertical extension arms may be designed to elevate the I-VDS cameras above the mast arms up to an additional 5 feet. When

possible, center the I-VDS camera over the detected lane(s) for optimal operation. If the mast arm design will not allow the I-VDS camera to be centered over the detection zone, the camera may be designed to detect lanes at an angle. The designer should consult the I-VDS manufacturer for allowable angles of detection.

If necessary, designers can specify extensions for mast arm poles to provide the necessary mounting height for advance detection loops. Designers can also consider mounting I-VDS cameras on the back side of mast arms for advance detection zones. If advance detection zones are too far from the intersection for effective I-VDS camera mounting on mast arm poles, the designer should consider mounting cameras on other poles or other detection technologies, such as radar or loop detectors. I-VDS can also be used on span wire intersections by mounting directly to the signal pole or a 10 foot extension arm for detection zones within the manufacturer's allowable angle of detection.

The priority for I-VDS placement at an intersection is as follows:

1. Attach I-VDS to proposed mast arm assembly
2. Attach to other pole located at the intersection
3. Attach cantilever bracket arm to utility pole near detection zone

IVDS use 2 separate cables, Belden #8281 coax and Belden #8618 power.

In locations where video detection is not possible and on span wire installations, detector loops will be acceptable. Presence loops at intersections shall be 6' x 40' quadrupole and should extend 2 ft. in front of the stop bar. Pulse loops shall be 6' x 6' and shall be located the appropriate distance behind the stop bar based on the speed limit of the roadway. For some intersections with numerous driveways between the set back loops and stop bars, additional 6' x 18' loops may be placed at the stop bars to ensure detection.

Loop lead-ins shall not be constructed through the radius of an intersection. If curb & gutter is present the loop wire shall be drilled through the gutter line into a pull box.

For all inductive loop installations where sidewalk and curb & gutter are present, the signal pull boxes shall be installed within the grass strip between the curb and sidewalk. If there is not a grassed strip, the pull box shall be installed on the back side of the sidewalk. For underground wire runs for setback loops, a pull box shall be provided at the midpoint of the run or at a minimum 200 feet.

If a pole (signal or utility) is within 15 feet of the loop wire pull box, the loop wire can be installed directly in the pole base or utility riser without going through an additional pull box. If the pole is more than 15 feet an additional pull box should be provided at the base of the pole.

For all setback loop detector wire ran aerially, the wire shall travel on the utility poles as far as possible before being routed directly to the signal cabinet corner pole. No loop detector wire shall attach externally to a mast arm pole; access shall be provided underground.

4.7 Pedestrian Equipment

Clayton County prefers LED, clamshell type pedestrian signal heads. Pedestrian signal heads may be located on pedestal poles or on strain poles and should be in the line of sight with the crosswalk. Pedestrian signals should be designed on all legs of the intersection, unless circumstances exist where no pedestrian activity is possible. Push button stations need to be accessible according to ADA guidelines and should be located within 10 inches of the back of sidewalk or landing.

A type 1 pull box shall be provided for all pedestal poles mounted within raised concrete channelization islands. A separate pull box shall be provided for all pedestrian pedestals located greater than 15 feet from the signal pole or other utilized pull box.

For pedestrian crossings, the following is the order of preference for providing point-to-point crossings:

- raised concrete channelization islands with ADA ramps
- raised concrete channelization islands with cut-through walk areas
- striped channelization islands.

All intersections with curb and gutter and sidewalk shall have curb ramps which conform to ADA guidelines. Crosswalks shall be placed at locations where sidewalks and ramps are present. All raised islands shall be concrete and have ramps which conform to ADA guidelines, including a detectable warning surface. To provide a safer pedestrian crossing and efficient signal operation, intersection radii's can be modified to provide for a raised concrete channelization island if right of way is available.

For intersections without curb & gutter, curb & gutter can be added as needed to provide adequate pedestrian facilities. For intersections without curb & gutter and sidewalks, landing pads of appropriate size shall be provided. The landing pads shall have ADA detectable warning surfaces.

4.8 Intersection Signage

Clayton County prefers LED illuminated street name signs on selected corridors. Elsewhere, 18" D-3 signs shall be designed for all approaches and shall be made out of Type 6 reflective sheeting. Street name signs shall be mounted between the through signal heads of each approach. Clayton County prefers all signs be mounted on span wire with standard 3/8" 3-Bolt clamps.

For all 5-section signal heads, a R10-12 sign shall be provided and mounted to the left of the 5-section head.

If additional traffic signs are necessary, such as in advance of pedestrian crossings, they shall conform to the MUTCD and shall be made out of Type 6 reflective sheeting.

Section 5: Plans Production

5.1 General Notes

All signal plans shall include general notes which typically apply to all installations. A listing of traffic signal notes is included in Appendix C.

5.2 Signal Plan

The traffic signal plan shall include the following:

- traffic signal legend
- traffic signal design
- installation notes
- materials list
- wiring table
- signal phasing chart
- signal sequence chart
- signal head displays
- signage displays
- 332 cabinet input assignment chart
- output file chart
- conflict monitor programming chart

Traffic signal elements shall be shown in a darker CADD line weight than the road configuration elements.

5.3 Installation Notes

Installation notes shall be shown for all strain poles, pedestal poles, conduit runs, pull boxes, detectors, signs, and striping. Items such as pull boxes and detector loops can be called out with the designation "(TYP)", thus they can be labeled in one location on the plan sheet to reduce text conflicts on the plans.

5.4 Signal Plan/Sequence/Pre-Empt Diagrams

Phasing, sequence, and pre-empt (if applicable) diagrams shall be shown along the top of the traffic signal plan sheet. Phases 2 and 6 shall be assigned to the through movement of the main street, with Phase 2 either southbound or westbound. Even numbered phases increase in the clockwise direction, beginning at phase 2. Where pre-empt phasing is designed, the pre-empt diagram shall show the clearance, dwell and exit phases.

5.5 Signal Head Displays

Signal head displays shall be shown along the top of the traffic signal plan sheet. Each signal head shall be labeled with its corresponding phase number(s).

5.6 Signage Displays

Signage displays shall be shown along the top of the traffic signal plan sheet and shall include pedestrian pushbutton signs

as well as any required span or mast arm mounted regulatory signs. D-3 street name signs shall also be shown.

5.7 Wiring Table

The County has a standard preferred wiring method, which includes 7 Conductor cable for each vehicle approach and pedestal pole or strain pole, including up to three pedestrian signals. Loop and pedestrian push-button lead-ins require 3-pair shielded cable to each loop splice pull box and pedestal pole or strain pole, including up to three push buttons.

Each mast arm, span wire segment, or conduit run shall be labeled on the traffic signal plan with a letter inside a small circle which corresponds to the appropriate wiring run in the wiring table. If possible, the wiring table should be placed on the same sheet as the signal plan. The wiring table shall include power wire connections as well as any communication cable. An example signal plan and wiring table is included in Appendix B.

Span-wire installations shall show access closures (splice bags) to the right of all signal heads and next to the box span corner or bull ring for each approach.

All PVC conduit installed underground for wire runs shall be 2" diameter, and power wire shall be installed in 1" rigid conduit.

5.8 Materials List

A materials list shall be included which shows the items and quantities to be installed and paid for under the lump sum traffic signal pay item, 647-1000. The materials list should also show the pay item number, description and quantities of all other materials.

5.9 Output File Chart

Clayton County requires an output file chart showing phase assignments for each load switch. See Appendix B for an example.

5.10 Conflict Monitor Chart

Clayton County requires a conflict monitor programming chart showing which phases are permitted to occur simultaneously, i.e. do not conflict with each other. See Appendix B for an example.

5.11 Signal Sequence Chart

Clayton County requires this chart to illustrate the phase sequencing for each output. See Appendix B for an example.

Section 6: Communications

Unless directed otherwise by the County, the following guidelines apply to all design projects where communications for traffic signals or other ITS infrastructure is a component.

The location, routing, configuration, etc. of communications infrastructure/outside plant shall be in accordance with the County's current ITS Master Plan, including physical and logical communications. The quantity, sizing and configuration of all existing outside plant within the design limits, regardless of the function or devices served, shall be retained or rerouted/replaced with equivalent facility, unless being modified in accordance with the Master Plan.

Communications outside plant designs shall follow GDOT standards for materials and installation and County preferences.

All outside plant cable installed shall have "Clayton County DOT" printed on the cable's exterior jacket instead of GDOT's information.

Aerial trunk cables should follow the utility lines and should not be attached to traffic signal spans, unless absolutely necessary. At mast arm locations where the trunk line will be located underground, use a separate conduit across the intersection and minimize the trunk cables' routing through traffic signal pull boxes. Underground fiber splice closures shall not be located in traffic signal pull boxes.

Existing trunk cables should be retained unless absolutely impossible. In most cases, new drop cables will be required, however, new drops shall be designed from existing splice closures on the existing trunk. Ensure that existing splice closures are reusable and/or reconfigurable

as desired by the new design. Typically, one fiber optic closure shall be provided for each device (signal, CCTV, and ITS element).

In the cabinets, GDOT preterminated fiber distribution centers shall be used. For locations that currently use multimode (MM) cables and will continue to be on MM for the near term, design hybrid drop cable assemblies so the signal can be changed over to singlemode (SM) cable in the future with no need to replace the drop assembly.

Communication plans shall indicate slack locations. All aerial slack locations shall be provided with snowshoes. 150 feet of slack shall be provided for each 1000 ft of communication cable. Additionally, 65 feet of slack shall be provided at each component and/or splice location.

All necessary communication equipment required in the TCC and/or Hub buildings shall be provided as part of the design.

Section 7: CCTV/ITS

Unless directed otherwise by the County, the following guidelines apply to all design projects where CCTV is a component:

7.1 Location

The locations of CCTV installations shall be in accordance with the County's current ITS Master Plan. All existing CCTV locations shall be retained.

Existing CCTV locations shall be replaced with new CCTV equipment, including the CCTV assembly, Type A equipment cabinet, and fiber modem/communications interface. New CCTV equipment shall be mounted on taller poles or mast arm extensions.

7.2 Installation and Mounting

CCTV designs shall follow GDOT standards for materials and installation and County preferences, which are currently for Type B CCTV with ground-mounted Type A cabinets. CCTV interface equipment shall not be mounted in traffic signal cabinets.

The County's typical height for mounting CCTV camera assemblies is 40 ft, depending on site conditions, with a

maximum mounting height of 45 ft. Designers shall ensure a suitable setup position for the County's current lift equipment, with the CCTV mounted at an appropriate height and reach for this setup position and equipment.

7.3 Communications

CCTV communications shall be in accordance with the County's current ITS Master Plan and, where applicable, the existing fiber cable configuration over which the CCTV will communicate. Unless directed otherwise, CCTV communications shall follow GDOT standards for networked video communications. CCTV cabinets shall be base mounted.

APPENDIX A
Traffic Signal Checklist

APPENDIX B
Example Traffic Signal Plans

APPENDIX C
Traffic Signal Notes