Chapter 10

Work Zone Traffic Control

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Chapter 10

Work Zone Traffic Control

10.1 General

The need to improve the capacity of, and to rehabilitate Florida's highways, has greatly increased the frequency of highway construction taking place immediately adjacent to or under traffic. The traveling public, as well as construction and inspection personnel, are exposed to conflicts that may become hazardous. In addition to the safety issue, the potential delays to the public, as traffic is interrupted by construction, can be significant. As a result, the Department places a great deal of emphasis upon ensuring that all traffic, including motorists, transit operations, bicyclists and pedestrians can be accommodated through construction zones with minimum delay and exposure to unsafe conditions.

10.2 References

The following references contain the basic criteria and other required information for work zone traffic control in Florida:

1. The ***Manual on Uniform Traffic Control Devices for Streets and Highways, (MUTCD),*** Federal Highway Administration. ***Part VI*** of the ***MUTCD*** deals specifically with work zone traffic control. Other parts of the ***MUTCD*** may also be useful in designing a traffic control plan.
2. ***Policy on Geometric Design of Highways and Streets, AASHTO***.
3. ***Roadside Design Guide, AASHTO, Chapter 9***.
4. ***Design Standards, Indexes 412, 414, 415, 416, 417*** and the ***600 Series***.
5. ***Standard Specifications for Road and Bridge Construction***.
6. ***Basis of Estimates Handbook***.

10.2.1 Design Standards

The ***Design Standards, Index 600 Series,*** contains information specific to the Federal and State guidelines and standards for the preparation of traffic control plans and for the execution of traffic control in work zones, for construction and maintenance operations and utility work on the State Highway System. Certain requirements in the ***Design Standards*** are based on the high volume nature of state highways. For highways, roads and streets off the State Highway System, the local agency (city/county) having jurisdiction, may adopt requirements based on the minimum requirements provided in the ***MUTCD.***

10.3 Comprehensive Work Zone Traffic Control Planning

Consideration of traffic control must begin at the Project Development and Environmental (PD&E) study stage. Impacts on traffic, traffic handling options, constructability, and design features and constraints, as they affect traffic and transit operations, are to be evaluated for each alternate alignment studied. The preliminary engineering report must specifically address work zone traffic control.

Traffic control considerations must begin in the early stages of design, using the work zone traffic control material from the PD&E study as the basis. As the design progresses, the following should be considered:

Design features and constraints. Length of the project, lane configuration, transit stops, bike lanes, sidewalks and grade differentials between existing and proposed, interchanges and intersections, pavement materials, storm sewers, roadway lighting, utilities and bridge features are some of the design element decisions that might be influenced by work zone traffic control considerations.

Contract specifications. Provisions such as time restrictions on construction activities; incentive-disincentive clauses; daily, weekly and seasonal restrictions and special materials may be necessary. Time restrictions could include work stoppages for Manatee (or other endangered/protected species) inhabitation, sporting events, holidays or other special considerations. The designer should coordinate with local agencies as to the dates of local events or other community sensitive issues. Public relations activities such as media releases, television and radio spots, handbills, and highway advisory radio may be specified.

Other actions. Actions may need to be taken by the Department prior to or during construction that may not be a contract requirement. Examples are dealing with the media and local businesses, provisions for mass transit options to commuters, service patrols, improvements to alternate routes, coordination with other projects and maintenance activities, and special inspection requirements.

Public input. On very large and complicated projects, it may be necessary to involve the public through informal public meetings to be held early in the design of a project. Close coordination with city and county officials may be necessary. Citizen and business advisory committees may be established as sources of input.

Utility work. If contract utility work is anticipated in conjunction with or during the highway construction, the Traffic Control Plan (TCP) must account for and adequately protect all work activities. The phasing of construction activities must be compatible with the utility work. Utilities, whose work affects traffic, are required to have a TCP by FHWA. This requires early and effective coordination with utilities.

10.4 Traffic Control Plans (TCP)

A TCP is a set of specific plan sheets, references to standard (typical) layouts, and/or notes on roadway plans describing how traffic will be controlled through a work zone. All projects and work on highways, roads and streets shall have a traffic control plan, as required by Florida Statute and Federal regulations. All work shall be executed under the established plan and Department approved procedures. The TCP is the result of considerations and investigations made in the development of a comprehensive plan for accommodating traffic through the construction zone. These considerations include the design itself, contract specifications, and plan sheets.

TCP sheets detail the proper delineation of traffic through the work zone during all construction phases. The complexity of the TCP varies with the complexity of the traffic problems associated with a project. Many situations can be covered adequately with references to specific sections from the ***Manual on Uniform Traffic Control Devices (MUTCD)***, or the ***Design Standards, Series 600***. Specific TCP sheets shall be required in the plans set whenever project conditions are not specifically addressed in a typical layout from the manuals noted above. This is usually the case for complex projects; therefore references to the ***Design Standards***, as well as specific TCP sheets, will likely be necessary.

A traffic control plan should address the appropriate following information for the mainline and any affected crossroads, side streets, and ramps:

1. The location of all advance warning signs and lighting units.
2. Temporary pavement markings, (including RPM's).
3. Location of temporary barriers and attenuators.
4. Temporary drainage design.
5. Channelizing devices at special locations.
6. Locations for special devices such as changeable (variable) message signs (CMS), arrow panels, radar speed display units (RSDU), portable regulatory signs (PRS) and temporary signals.
7. CMS messages for each phase.
8. Signal timing for each phase, including temporary actuation, to maintain all existing actuated or traffic responsive mode signal operations for main and side street movements for the duration of the Contract (Check with Traffic Operations Engineer).

9. Location and geometry for transitions, detours, and diversions.
10. Typical sections for each phase of work on all projects, except simple resurfacing projects, in order to show lane widths, offsets, barrier locations and other features influencing traffic control.
11. The proposed regulatory speed(s) for each phase.
12. Reference to appropriate ***Design Standards*** or ***MUTCD*** drawings whenever applicable.
13. Appropriate quantities, pay items and pay item notes.
14. Resolve any conflicts between permanent signing and markings and work zone signing and markings.
15. Key strategies such as service patrol, police, public service announcements, Highway Advisory Radio, night work, etc..
16. Good plan notes.
17. Address the need for maintaining existing roadway lighting.
18. Work area access plan.
19. Address the need for transit operations to safely stop along the roadway to board and discharge passengers, and to maintain transit stop signage.

Volume II, Chapter 19*,* explains the required information for specific TCP sheets.

Consideration must also be given to adjoining, intersecting or sequential work zones. This can be a particular problem with maintenance operations, bridge or roadway projects under different contracts, operations of other jurisdictions or utilities. When such work must take place, the operations must be coordinated and taken into account in the TCP so that the motorist encounters one, consistently designed, work zone.

TCP's for project designs "on the shelf" must be updated prior to contract letting.

10.5 TCP Development

The following step-by-step process should be followed by designers when preparing traffic control plans:

Step #1 Understand the Project

1. Field reviews by designers should be required.
2. Review the scope.
3. Examine the plans (Phase I to Phase II).
4. Look at plan-profiles and cross sections for general understanding.
5. Review PD&E study for any constraints.
6. Consider transit and bicycle/pedestrian needs during construction.
7. For complex projects consider developing a TCP study and other possible strategies such as public awareness campaigns, alternate route improvements, service patrols, etc..

Step #2 Develop Project Specific Objectives

What are your objectives? Examples might be:

1. Use barrier wall to separate workers from traffic.
2. Close road if adequate detour exists.
3. Maintaining 2-way traffic at all times.
4. Maintaining existing roadway capacity during peaks.
5. Maintaining business/resident access.
6. Maintaining transit operations.
7. Provide bike/pedestrian access.
8. Minimize wetland impacts.
9. Expedite construction.

Step #3 Brainstorm TCP Alternatives

Develop some rough alternatives considering what could be used to accomplish the work, such as constructing temporary pavement and/or temporary detours, using auxiliary lanes, placing 2-way traffic on one side of divided facility, using detour routes, etc. Also, south side as opposed to north side on an east-west roadway. Don't worry that an alternate doesn't meet all objectives.

Designers should check condition of any proposed detour routes. If off state system, may need agreement with locals. Design should prevent or minimize interruption of local transit operations.

Step #4 Develop a Construction Phasing Concept

1. Examine existing facility versus what is to be built. This is a major task on jobs other than resurfacing.
2. Coordinate with bridge designer.
3. Color or mark the plan-profile sheets to show existing roadway versus new construction. Then, check station by station, the plan sheet against cross section sheets. Make notes on plan sheets as to drop-offs or other problems. Use profile grade lines or centerlines for reference points.
4. List out major tasks to be completed, such as:
   a. Construct new WB Roadway
   b. Construct new EB Roadway
   c. Construct frontage roads
   d. Construct bridge/flyover

   Note: The designer may need input from construction personnel or even contractors' representatives in determining construction phases.
5. Make notes on plan sheets or notepad as to "decisions" that you make along the way.

Step #5 Examine/Analyze Alternatives Which Meet Objectives (for each phase)

Next, consider how you could achieve the proposed alternatives and meet the stated objectives.

1. Examine pros and cons of various alternatives.
2. Consider how much work and expense is involved for each alternative.

3. Consider detour/transition locations, signal operations during construction, how to handle buses, bicycles, pedestrians, service vehicles, etc..

Step #6 Develop Detailed TCP

Select the most feasible alternative for each phase. Add details such as:

1. Detour/transition geometrics and locations.
2. If lane closures are needed, use the lane closure technique discussed in ***Section 10.14.7*** to determine time frame for closures.
3. Advanced signing scheme and locations, revisions needed to existing signs - including guide signs, and proposed signs for all work activities - lane closures, detours, etc., on mainline, side roads, crossroads and ramps.
4. Need for portable traffic signals, changeable (variable) message signs, and barriers.
5. How existing operations will be maintained - side streets, businesses, residents, bikes, pedestrians, buses - bus stops, etc..
6. Revisions to signal phasing and/or timing during each TCP phase.
7. Regulatory speed desired for each phase.
8. All pay items and quantities needed for TCP.
9. How existing auxiliary lanes will be used and any restriction necessary during construction.
10. Typical sections for each phase.
11. Outline key strategies to be used:
    a. Service patrol
    b. Police
    c. Public service announcements
    d. Highway Advisory Radio
    e. Night work
    f. Motorist Awareness System (MAS)
12. Need for alternate route improvements.

10.6 Coordination

Work zone traffic control can be a complex undertaking that requires the coordination of a number of agencies and other interested parties. Planning and coordination must begin early in a project design.

Traffic control is a joint responsibility of design (both roadway and bridge), construction and traffic operations personnel. Coordination is necessary by all three parties in the development of TCPs. Both traffic operations and construction personnel must routinely review TCPs during Initial Engineering (Phase I to Phase II plans) to ensure that the plan is sound and constructible and bid items are complete and quantities reasonable. With subsequent reviews of Phase III plans, designers are also encouraged to contact contractors for ideas on Traffic Control Plans.

Traffic control plans should also be reviewed with other appropriate entities such as maintenance, FHWA, community awareness teams, general public, transit agencies, businesses, freeway coordinator management teams, and local agencies. **Initial reviews should be made by construction and traffic operations no later than the Phase II plans stage with subsequent reviews of Phase III plans**. Input from local engineering and law enforcement agencies should be obtained early in the process, such as during the PD&E study and the Phase I plans stage.

Adjoining work zones may not have sufficient spacing for standard placement of signs and other traffic control devices within their traffic control zones. These situations can occur when separate contracts adjoin each other (separate bridge and roadway contracts are a typical example), utility work performed separately from roadway work or when maintenance activities are performed adjacent to a construction project. Where such restraints or conflicts occur, or are likely to occur, the designer should try to resolve the conflicts in order to prevent misunderstanding on the part of the traveling public.

10.6.1 Phase Submittals

TCP phase submittals should include the following:

1. **Phase I** - a typical section for each phase as well as a description of the phasing sequence and work involved.
2. **Phase II** - a majority of the TCP completed (75-90%), including the information outlined in ***Section 10.4*** of this chapter, and a list of the pay items needed.
3. **Phase III** - a final TCP, including all notes, pay items and preliminary quantities.

(Note: The construction office estimates the duration for each phase of construction during Phase III review. The designer will finalize the quantities in the plans, comp book, and TRNS*PORT after receiving the estimated durations for construction.)

10.7 Work Zone Traffic Control Training

10.7.1 Background

Work zone traffic control is an important function affecting the safety of the traveling public, contractor personnel and equipment, and department employees. Every reasonable effort should be made to eliminate or reduce involvement in crashes within work zones. Proper traffic control training is vital to achieving this objective.

The Department's Maintenance of Traffic Committee consists of representatives from Roadway Design, Construction, Maintenance, Traffic Operations and FHWA. Its purpose is to develop, review or revise procedures, standards and specifications regarding work zone traffic control to maximize efficiency and enhance safety of motorists, transit operations, bicyclists, pedestrians, and workers within the work zone.

10.7.2 Training Requirements

The Department's Maintenance of Traffic Committee has prescribed work zone traffic control training requirements outlined in ***Department Procedure, Topic No. 625-010-010***.

All Department employees, contractors, consultants, utility company personnel, local maintaining agency, or any other person responsible for work zone traffic control planning, design, implementation, inspection and/or for supervising the selection, placement, or maintenance of traffic control schemes and devices in work zones on the State Highway System, shall satisfactorily complete the training requirements of this procedure in the appropriate category of involvement. The Department may request to see a person’s certificate or wallet size card documenting the successful completion of a Work Zone Traffic Control training course.

District Design, Construction, and Maintenance Engineers shall ensure that employees, including consultant personnel, who are responsible for traffic control plan design, implementation, inspection or supervision of the design, selection, placement, or maintenance of traffic control schemes and devices in work zones have been certified under the provisions of this procedure.

10.8 Traffic Control Devices

Traffic control devices/methods that are available for use include:

1. Signs (warning, regulatory and guide)
2. Lighting units (arrow panels, barricade and sign lights, illumination devices, temporary signals and changeable (variable) message signs)
3. Channelizing devices (cones, tubular markers, plastic drums, vertical panels, and Types I, II and III barricades)
4. Markings (pavement markings, raised pavement markings, delineators, and removal of conflicting markings)
5. Safety appurtenances (portable concrete barriers, guardrail and crash cushions) - See ***AASHTO Roadside Design Guide*** (***Chapter 9***)
6. Flaggers
7. Law Enforcement
8. Motorist Awareness System (MAS)

The ***MUTCD*** contains detailed instructions on the use of traffic control devices. Special design considerations applicable to Florida are discussed in the following sections.

Traffic control devices should not be placed in locations where they will block transit stops, sidewalks or bike lanes.

10.9 Signs

Sign messages for speed limits and distances are to be posted in English units.

10.9.1 Advance Warning Signs

The TCP should identify the advance construction warning signs, including legends and location. These include signs such as "Road Work Ahead" and "Road Work One Mile". The TCP should provide the advanced warning signs, legends and locations for all proposed operations that require signing. These include diversions, detours, lane closures, and lane shifts, on the mainline as well as crossroads. The sequence for advance signing should be from general to more specific. As an example: Road Work Ahead (general), Left Lane Closed Ahead (more specific), Merge Right (specific).

10.9.2 Length of Construction Sign

The length of construction sign (G20-1) bearing the legend "Road Work Next X Miles" is required for all projects of more than 2 miles in length. The sign shall be located at begin construction points.

10.9.3 Existing Signs

Existing (regulatory, warning, etc.) signs that conflict with the TCP shall be removed or relocated to complement the work zone conditions (i.e., if a stop sign on an existing side road is needed, use the existing sign and show the location that it is to be relocated to). Existing guide signs should be modified as necessary. It is good practice to revise existing guide signs by using black on orange panels to show changes made necessary by the construction operations.

If permanent guide signs are to be removed during construction, provisions should be made for temporary guide signing. The temporary sign should be black on orange with the legend designed in accordance with ***MUTCD*** requirements for permanent guide signing whenever possible.

10.10 Lighting Units

10.10.1 Warning Lights

Warning lights shall be in accordance with the ***Design Standards, Index 600.***

1. **Type A Flashing**

   To be mounted on Vertical Panel, Barricade, or Drums to mark an obstruction adjacent to or in the intended travel way. It is to be paid for as part of the device that it is mounted on.

2. **Type B Flashing**

   To be mounted on the first and second advanced warning signs where two or more signs are used, as well as on advanced warning signs of intersecting roads. Type B Warning lights are to be paid for as High Intensity Flashing Lights (Temporary - Type B).

3. **Steady-Burn Type C**

   Steady-Burn lights are to be placed on channelizing devices and barrier wall to delineate the traveled way on lane closures, lane changes, diversion curves and other similar conditions. On channelizing devices (Vertical Panels, Barricades, and Drums), their payment is included as part of the device. For use on Barrier wall, they are to be paid for separately as Lights, Temporary, Barrier Wall Mount (Type C, Steady-Burn). Their spacing on barrier wall is as follows:

   a. Transitions - 50 ft. on center

   b. Curves - 100 ft. on center

   c. Tangents - 200 ft. on center (Note: Curves flat enough to maintain a normal 2% cross slope are to have steady burn lights placed at the same spacing as tangents)

10.10.2 Advance Warning Arrow Panels

Arrow panels shall be used to supplement other devices for all lane closures on high-speed (55 mph or greater) and high-traffic density multilane roadways. The use of arrow panels should be considered for all other multilane closures. These devices are also useful for short-term operations, such as during work zone installation and removal.

Arrow panels should not be used in lane shift situations. Research has shown that motorists tend to change lanes (on multilane facilities) whenever an arrow panel is used to indicate a lane shift. Since this "response" is not desired, the arrow panel should not be used for lane shift situations on multilane roadways. Refer to current ***MUTCD*** for further information.

Arrow panel locations shall be shown on the TCP, along with any necessary notes concerning the use of this device.

10.10.3 Changeable (Variable) Message Signs

Changeable (variable) message signs (CMS) may be used to supplement a traffic control zone. As a supplemental device, it cannot be used to replace any required sign or other device. These devices can be useful in providing information to the motorist about construction schedules, alternate routes, expected delays, and detours. Changeable (variable) message signs should be considered for use in complex, high-density work zones. Messages must be simple, with a minimum number of words and lines and should require no more than two displays of no more than three lines each with 8 characters per line. The TCP shall include the location and messages to be displayed.

The message displayed should be visible and legible to the motorist at a minimum distance of 900 ft. on approach to the signs. All messages should be cycled so that two message cycles are displayed to a driver while approaching the sign from 900 ft. at 55 mph.

The CMS units may be used:

1. To supplement conventional traffic control devices in construction work areas and should be placed approximately 500 to 800 ft. in advance of potential traffic problems, or
2. 0.5 to 2 miles in advance of complex traffic control schemes that require new and/or unusual traffic patterns for the motorists.

A CMS is required for night time work that takes place within 4 ft. of the traveled way.

Typical Conditions

Consistent with the factors described above, CMS messages should be considered under the following conditions:

1. Road closures
2. Ramp closures
3. Delays one hour or longer created by:
    a. Congestion
    b. Crashes
    c. Lane closures
    d. Two-way traffic on divided highway
    e. Multiple lane closures
    f. Unexpected shifts in alignment

Message Selection

Programmed messages should provide appropriate messages for the conditions likely to be encountered. A worksheet is provided and may be placed in the TCP. The following items must be carefully considered in the development of a message:

1. **Message elements - not necessarily in order**
    a. Problem statement (where?)
    b. Effect statement (what?)
    c. Attention statement (who?)
    d. Action statement (do?)
2. **Message format**
    a. Will vary depending on content
    b. "Where" or "what" will generally lead
    c. "Who" and "do" follow in that order
    d. "Who" often understood from "where"
3. **Display format**
    a. Discrete, with entire message displayed at once is most desirable
    b. Sequential is OK, 2 part maximum
    c. Run-on moving displays prohibited
    d. One abbreviation per panel display desirable, two abbreviations are the maximum. Route designation is considered as one abbreviation and one word. Guidelines for abbreviations are provided on the following pages.

CHANGEABLE (VARIABLE) MESSAGE SIGNS WORKSHEET

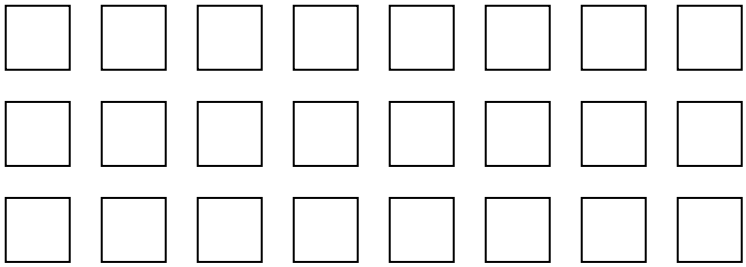
Location of board:_____

Used: from _____-_____-_____at _____:_____am/pm

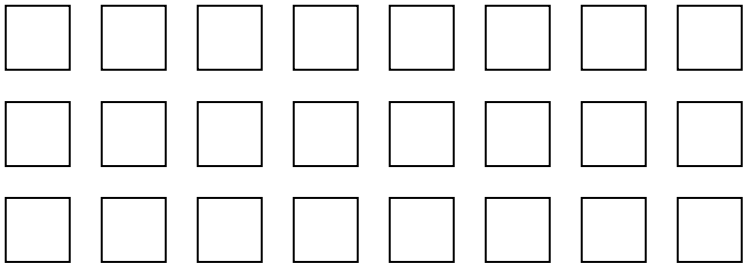
to _____-_____-_____at _____:_____am/pm

Message programmed by: _____

MESSAGE 1



MESSAGE 2



Timing:

Message 1 will run ____.____ seconds.

Message 2 will run ____.____ seconds.

STANDARD ABBREVIATIONS FOR USE ON CHANGEABLE (VARIABLE) MESSAGE SIGNS

Standard abbreviations easily understood are:

WORD	ABBREV.	WORD	ABBREV.
Boulevard	BLVD	Normal	NORM
Center	CNTR	Parking	PKING
Emergency	EMER	Road	RD
Entrance, Enter	ENT	Service	SERV
Expressway	EXPWY	Shoulder	SHLDR
Freeway	FRWY, FWY	Slippery	SLIP
Highway	HWY	Speed	SPD
Information	INFO	Traffic	TRAF
Left	LFT	Travelers	TRVLRS
Maintenance	MAINT	Warning	WARN

Other abbreviations are easily understood whenever they appear in conjunction with a particular word commonly associated with it. These words and abbreviations are as follows:

WORD	ABBREV.	PROMPT
Access	ACCS	Road
Ahead	AHD	Fog*
Blocked	BLKD	Lane*
Bridge	BRDG	[Name]*
Chemical	CHEM	Spill
Construction	CONST	Ahead
Exit	EX, EXT	Next*
Express	EXP	Lane
Hazardous	HAZ	Driving
Interstate	I	[Number]
Major	MAJ	Accident
Mile	MI	[Number]*
Minor	MNR	Accident
Minute(s)	MIN	[Number]*
Oversized	OVRSZ	Load
Prepare	PREP	To Stop
Pavement	PVMT	Wet*
Quality	QLTY	Air*
Route	RT	Best*
Turnpike	TRNPK	[Name]*
Vehicle	VEH	Stalled*
Cardinal Directions	N, E, S, W	[Number]
Upper, Lower	UPR, LWR	Level

*** = Prompt word given first**

The following abbreviations are understood with a **prompt** word by about 75% of the drivers. These abbreviations may require some public education prior to usage.

WORD	ABBREV.	PROMPT
Condition	COND	Traffic*
Congested	CONG	Traffic
Downtown	DWNTN	Traffic
Frontage	FRNTG	Road
Local	LOC	Traffic
Northbound	N-BND	Traffic
Roadwork	RDWK	Ahead [Distance]
Temporary	TEMP	Route
Township	TWNNSHP	Limits

*** = Prompt word given first**

Certain abbreviations are prone to inviting confusion because another word is abbreviated or could be abbreviated in the same way. **DO NOT USE THESE ABBREVIATIONS:**

ABBREV.	INTENDED WORD	WORD ERRONEOUSLY GIVEN
WRNG	Warning	Wrong
ACC	Accident	Access (Road)
DLY	Delay	Daily
LT	Light (Traffic)	Left
STAD	Stadium	Standard
L	Left	Lane (Merge)
PARK	Parking	Park
RED	Reduce	Red
POLL	Pollution (Index)	Poll
FDR	Feeder	Federal
LOC	Local	Location
TEMP	Temporary	Temperature
CLRS	Clears	Color

10.10.4 Traffic Signals

Frequently portable or temporary traffic signals will be a preferred alternative to a flagger. Also, existing signal operations may need to be revised to accommodate the construction operations. The TCP should identify all existing actuated or traffic responsive mode signal operations for main and side street movements that are to be maintained for the duration of the Contract. In addition, the TCP should identify the specific alterations (physical location and timing) necessary for existing signals and the location and timing of portable signals. It shall include signal installation plans for each phase of construction. The signal installation plan shall include both the initial signal operation plan and the initial timing adjustments. Traffic control signal requirements or responsibilities shall be included in the Technical Special Provisions. Signal displays and location must meet ***MUTCD*** requirements. If temporary signals are used where a pedestrian crossing is present, either existing or temporary, the pedestrian must be accommodated in the signal timing.

Temporary Signal Plans or modification to existing signals should be reviewed by the appropriate section in the district for structural soundness and signal function.

10.11 Channelizing Devices

10.11.1 Type III Barricades

Two Type III barricades should be used to block off or close a roadway. Whenever two barricades are used together, only one warning light is required on each barricade.

10.11.2 Separation Devices

Placing two lane two-way operations (traffic) (TLTWO) on one roadway of a normally divided highway should be a last resort (see ***MUTCD***) and should be done with special care.

When traffic control must be maintained on one roadway of a normally divided highway, opposing traffic shall be separated either with portable barrier wall or Temporary Traffic Separators (see the ***Design Standards, Index 614***). The use of striping, raised pavement markers, and complementary signing, either alone or in combination is not considered acceptable for separation purposes.

10.11.3 Channelizing Device Alternates

It is intended that cones, Type I and II barricades, vertical panels, drums and tubular markers be considered as alternative channelizing devices to be used at the contractor's option. The only exceptions to this are that tubular markers are not allowed at night and the use of cones at night is restricted. (See the ***Design Standards, Index 600 & 614***). The designer should not further restrict the options of channelizing devices.

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10.12 Pavement Markings

10.12.1 Removing Pavement Markings

Existing pavement markings that conflict with temporary work zone traffic patterns must be obliterated where operations will exceed one work period. Painting over existing pavement markings is not permitted.

10.12.2 Raised Retro-Reflective Pavement Markers (RPM)

Raised Retro-Reflective Pavement Markers (RPM) are required as a supplement to all lane lines during construction. For further direction on the use of RPMs in the work zone the designer should refer to the ***Design Standards, Index 600***.

10.12.3 Work Zone Markings

Markings for work zones include "Removable" and "Non-Removable" markings. ***Section 102-10*** of the ***Standard Specifications*** describes when each type is required. A separate pay item number is used for each. The designer should be aware of this information and provide appropriate pay items in the plans.

The designer should also consider using an asphalt layer and/or milling with an asphalt layer for covering/removing unneeded markings, especially in areas such as diversions or crossovers. Some construction phase durations may be long enough to require use of interim friction courses. When these type issues arise, the designer should work with the District Pavement Design Engineer, to determine what combination of pavement options best complements the Maintenance of Traffic with the final pavement design.

10.13 Safety Appurtenances for Work Zones

10.13.1 Traffic Barriers

Work zone traffic barriers are designed either as permanent barriers or as temporary barriers that can be easily relocated. They have four specific functions: to protect traffic from entering work areas, such as excavations or material storage sites; to provide positive protection for workers; to separate two-way traffic; and to protect construction such as false work for bridges and other exposed objects. The designer should anticipate when and where barriers will be needed and include this information and the quantities on the plans.

10.13.2 Barrier Walls (Temporary)

Portable concrete safety shape barriers, also known as portable concrete barriers (PCBs), are used in work zones to protect motorists as well as workers. Care must be taken in their design, installation and maintenance. Installation instructions and flare rates are given in the ***Design Standards, Index 415 & 600.***

When a PCB system other than ***Design Standards, Index 414***, Type K Temporary Concrete Barrier is used, the surface that the PCB is placed on shall have a cross slope of 1:10 or flatter carried a minimum of 2 ft. behind the barrier. See ***Design Standards, Index 414*** for specific requirements for the use of Type K Temporary Concrete Barrier. When the designer proposes temporary barrier walls, the cross-slope should be checked and temporary earthwork shown in the plans if necessary for the proper placement of the barrier system. For requirements for PCB's that are used on bridges and retaining wall sections, see the ***Structures Design Guidelines, Section 6.7***. When ***Design Standards, Index 414,*** Type K Temporary Concrete Barrier is used on bridges, see ***Design Standards, Index 415*** for details on transitioning between the Type K Temporary Concrete Barrier on the bridge and the Index 415 Barrier Wall on the adjoining roadway.

Water filled barriers should be used in accordance with the ***Design Standards, Index 416.***

The designer should show or note the location of all temporary barrier walls in the plans. The plans should also include a work area access plan for those projects with median work which is shielded with barrier wall.

10.13.3 End Treatments

The desirable treatments for exposed ends of barriers are:

1. Connecting to an existing barrier (smooth, structural connections are required - Refer to the ***Design Standards, Indexes 410 & 415***) or
2. Attaching a crashworthy terminal (such as a crash cushion) or
3. Flaring away to the edge of the clear zone (For Work Zone Clear zones, see the ***Design Standards, Index 600***)

10.13.4 Modifications of Existing Barriers

When 2-way traffic is placed on a facility that is normally one-way, the existing permanent or temporary barriers will be modified as necessary to ensure their proper crashworthiness during the temporary situation. This will include eliminating non-crashworthy end treatments, snag points or other protrusions normally angled away or hidden from approaching vehicles.

10.13.5 Crash Cushions

Crash cushions in work zones may be used in the same manner as at permanent highway installations. Crash cushions are used to protect the motorists from the exposed ends of barriers, fixed objects and other hazards within the clear zone. The designer must determine the need for crash cushions, select the appropriate type, and provide the necessary details and quantities in the plans. Selection of a system should be the result of an analysis of site conditions (i.e., space and need). Two types of stationary crash cushions are commonly used; redirective crash cushions and inertial crash cushions (i.e., sand filled module systems).

Redirective crash cushion systems will shield hazards by redirecting vehicles or absorbing end-on hits and are the principal type systems that should be used for shielding exposed ends of temporary concrete barrier wall on FDOT projects. ***Index 415*** provides details for shielding exposed ends of temporary concrete barrier wall using redirective systems. Temporary redirective crash cushions are paid for using the pay item IMPACT ATTENUATOR - CRASH CUSHION (TEMPORARY) (REDIRECTIVE OPTION). When this pay item is used, the contractor is allowed to use any temporary redirective crash cushion on the ***Qualified Products List***, unless the plans restrict the options to a specific redirective crash cushion system. Restricting the options is

normally not necessary and when done, must be justified with the reasons documented.

Inertial systems are gating devices with no redirection capability for side impacts and can only shield a hazard by absorbing end-on hits. Conditions and sites where these type systems are used are limited. ***Index 417*** provides standard arrays that may be used for shielding the ends of temporary concrete barrier wall where site conditions and duration restrictions can be met. Site conditions must provide for a clear runout area behind the array as shown in the index, as well as sufficient lateral space for the 5 degree taper in the alignment of the array with respect to the traffic lane. This taper helps to minimize the potential for side impacts into the heavier modules near the rear of the array as well as side impacts at the corner of the barrier wall end. When these site conditions can be met and the installation does not exceed 30 days in duration, ***Index 417*** may be used. Otherwise, a redirective system must be called for. As stated in ***Index 417*** the contractor does not have the option to use ***Index 417*** unless specifically called for in the plans.

End protection for hazards other than temporary barrier wall ends, must be custom engineered for each independent installation and detailed in the plans. The ***Design Standards*** and the ***AASHTO Roadside Design Guide*** can be consulted for more information.

10.14 Traffic Control Plan Details

The ***Design Standards, Indexes 601*** through ***670,*** are layouts of work zone traffic control for typical conditions. These indexes should be referenced only if project conditions are nearly the same as the typical layout. Otherwise, specific plan sheets or details must be prepared. Some conditions that will require specific plan sheets include:

1. Construction work zones near railroad crossings.
2. Work not covered by a typical layout.
3. Nighttime work requiring special lighting, oversized or additional devices.
4. Ramps and intersections that interrupt the standard layout.
5. Sight distance restrictions such as horizontal or vertical curves.
6. Lane or shoulder configurations that do not match the standards.
7. Special considerations during installation, intermediate traffic shifts and removal.
8. Complex projects, including add-lane projects, which involve many phases, traffic shifts, entrances and exits.
9. Special plan and notes detailing bus pullover bay/bus stop configuration.

When designing layouts, the following shall be considered:

10.14.1 Taper Lengths

Minimum taper lengths in the ***Design Standards*** are shown on individual Index sheets when applicable. When an Index sheet is not used, the minimum taper length shall be calculated by the formulas shown below ***Table 10.14.1***.

Table 10.14.1 (taken from ***MUTCD***) gives the criteria for the lengths of the various taper types.

Table 10.14.1 Taper Length Criteria for Work Zones

Type of Taper	Taper Length
UPSTREAM TAPERS	
Merging Taper	L Minimum
Shifting Taper	1/2 L Minimum
Shoulder Taper	1/3 L Minimum
Two-way Traffic Taper	100 ft. Maximum
DOWNSTREAM TAPERS	
	100 ft. per lane (use is optional)

Formulas for L are as follows:

For speed limits of 40 mph or less:

$$L = WS^2/60$$

For speed limits of 45 mph or greater:

$$L = WS$$

"L" is the length of the taper in feet

"W" is the width of lateral transition in feet

"S" is the posted regulatory speed for the work zone.

10.14.2 Intersecting Road Signing and Signals

Signing for the control of traffic entering and leaving work zones by way of intersecting highways, roads and streets shall be adequate to make drivers aware of work zone conditions. Under no condition will intersecting leg signing be less than a "Road Work Ahead" sign. The designer should remember to include these signs in the estimated quantity for Construction warning signs.

Existing traffic signal operations that require modification in order to carry out work zone traffic control shall be as approved by the District Traffic Operations Engineer (DTOE). If lane shifts occur, signal heads may have to be adjusted to maintain proper position. The DTOE should also determine the need for temporary traffic detection for traffic actuated signals. The TCP should include all necessary signal adjustments.

10.14.3 Sight Distance to Delineation Devices

Merging (lane closure) tapers should be obvious to drivers. If restricted sight distance is a problem (e.g., a sharp vertical or horizontal curve approaching the closed lane), the taper should begin well in advance of the view obstruction. The beginning of tapers should not be hidden behind curves.

10.14.4 Pedestrians and Bicyclists

10.14.4.1 Pedestrian Considerations

Where an existing pedestrian way is located within a work zone, it must be maintained.

There are three threshold considerations in planning for pedestrian safety in work zones on highways and streets:

1. Pedestrians should not be led into direct conflicts with work site vehicles, equipment or operations.
2. Pedestrians should not be led into direct conflicts with mainline traffic moving through or around the work site.
3. Pedestrians should be provided with a safe, convenient travel path that replicates as nearly as possible the most desirable characteristics of sidewalks or footpaths.

Pedestrian accommodations through work zones must include provisions for the disabled. Temporary traffic control devices for vehicular traffic should not be allowed within the pedestrians' travel path.

At transit stops, provisions should be made to ensure passengers have the ability to board and depart from transit vehicles safely.

Signing should be used to direct pedestrians to safe street crossings in advance of an encounter with a work zone. Signs should be placed at intersections so pedestrians, particularly in high-traffic-volume urban and suburban areas, are not confronted with midblock crossings.

10.14.4.2 Bicycle Considerations

When an existing bicycle way is located within a work zone, it must be maintained.

There are several considerations in planning for bicyclists in work zones on highways and streets:

1. Bicyclists should not be led into direct conflicts with mainline traffic, work site vehicles, or equipment moving through or around traffic control zones.
2. Bicyclists should be provided with a travel route that replicates the most desirable characteristics of a wide paved shoulder or bike lane through or around the work zone.
3. If the work zone interrupts the continuity of an existing shared use path or bike route system, signs directing bicyclists through or around the work zone and back to the path or route should be provided.
4. The bicyclist should not be directed onto the same path used by pedestrians.

10.14.5 Superelevation

Horizontal curves constructed in conjunction with temporary work zone diversions, transitions, and crossovers should have the required superelevation. Under conditions where superelevation is not used, the minimum radii that can be applied are listed in the ***Table 10.14.2***. Superelevation must be included with the design whenever the minimum radii cannot be achieved.

Table 10.14.2 Minimum Radii for Normal 0.02 Cross Slopes

SPEED (mph)	MINIMUM RADIUS (feet)
65	3130
60	2400
55	1840
50	1390
45	1080
40	820
35	610
30	430

10.14.6 Lane Widths

Existing lane widths of through roadways should be maintained through work zone travel ways wherever practical. The minimum widths for work zone travel lanes shall be 10 ft. for all roadways other than Interstate. On Interstate highways the minimum width for work zone travel lanes shall be 11 ft. except at least one 12 ft. lane in each direction shall be provided.

10.14.7 Lane Closure Analysis

The lane closure analysis is a process used by designers to calculate the peak hour traffic volume and the restricted capacity for open road and signalized intersections. The analysis will determine if a lane closure should or should not be allowed and the time of day or night a lane closure could occur without excessive travel delay.

For all projects under reconstruction, the existing number of lanes shall remain open to traffic when construction is not active.

For widening or major reconstruction on Limited Access facilities, the Traffic Control Plan will keep the existing number of traffic lanes open at all times throughout the duration of the construction project.

Closing a traffic lane on Interstate or Limited Access facilities can have a significant operational impact in terms of reduced capacity and delay. There will be no daytime lane closures allowed on Florida's Turnpike unless it is approved in writing by the Deputy Executive Director and Chief Operating Officer. Other districts have adopted similar policy for Interstate daytime lane closures; therefore, it is recommended the Designer verify the District's lane closure policy at the beginning of the design process.

No lane closures in excess of one work day shall be permitted on Limited Access construction where only two traveled lanes in one direction exist. If it becomes necessary to have a long-term lane closure on a four lane Interstate, sufficient documentation shall be provided to the District Secretary for her/his approval.

Chapter 22 of the ***Highway Capacity Manual 2000***, titled "***Freeway Facilities Methodology***" contains a capacity reduction procedure appropriate for lane closures on Limited Access facilities and other freeways. The Designer may use the ***HCS2000*** method in lieu of the procedure described in this chapter of the ***PPM***. The ***HCS2000***

method considers the intensity of the work activity, the effects of heavy vehicles and presence of ramps. For certain freeway segments it will result in a lower capacity than the lane closure analysis described in the ***PPM***.

Exhibit 10-A includes the lane closure analysis worksheets and two sample analyses. The sample ***Lane Closure Worksheet*** (***Exhibit 10-A, Sheet 3 of 11***) has been cross-referenced to the ***Lane Closure Symbols and Definitions*** sheets (***Exhibit 10-A***, ***Sheets 1 & 2 of 11***) with circled numbers. The circled numbers correspond to the numbers of the symbols and definitions. The symbols and definitions sheets show the designer where to find the necessary information to fill out the lane closure worksheet.

Fill out the top part of the lane closure worksheet and complete the formulas to calculate the hourly percentage of traffic at which a lane closure will be permitted (see ***Exhibit 10-A, Sheets 6 & 8 of 11***). Transfer these percentages to the graph on the ***Lane Closures 24 Hour Counts*** sheet (***Exhibit 10-A, Sheet 5 of 11***). Draw a line across the graph representing the percentage for both open road and signalized intersections (see ***Exhibit 10-A, Sheets 7 & 9 of 11***). Plot the hourly percentages (hourly volume divided by total volume) on the graph. Any hourly percentage extending above the restricted capacity percentage lines for open road or signalized intersections indicated lane closure problems The bottom of the graph gives times for AM and PM. By coordinating the lane closure problem areas to the time of day, a designer knows when to restrict lane closure.

Many of Florida's roadways have directional peak hour traffic volumes, with inbound morning traffic, and outbound afternoon traffic. Doing a composite lane closure analysis would in many cases require night work. However, if a separate lane closure analysis is calculated for inbound and outbound separately, a lane closure may be allowed and the contractor could work in daylight hours, (See ***Exhibit 10-A, Sheets 10 & 11 of 11***).

Exhibit 10-A Lane Closures
Sheet 1 of 11

Symbols and Definitions

1. **ATC** = Actual Traffic Counts. Use current traffic counts. Traffic counts can be obtained from the Office of Planning, or you may need to get traffic counts done. The designer needs hourly traffic volumes with a total traffic volume for a 24-hour period (see ***Exhibit 10-A, Sheet 7 of 11***).

2. **P/D** = Peak Traffic to Daily Traffic Ratio. Highest hourly volume divided by the total 24-hour volume. Convert the percentage to a decimal on the Lane Closure Worksheet (see ***Exhibit 10-A, Sheet 7 of 11***).

3. **D** = Directional Distribution of peak hour traffic on multilaned roads. This factor does not apply to a two-lane roadway converted to two-way, one-lane. The directional distribution can be obtained from the Office of Planning.

4. **PSCF** = Peak Season Conversion Factor. Many counties in Florida have a significant variance in seasonal traffic. The designer should use the PSCF for the week in which the actual traffic count was conducted. The Office of Planning has tables showing Peak Season Conversion Factors for every county in Florida. (See sample table of values on ***Exhibit 10-A, Sheet 4 of 11***).

5. **RTF** = Remaining Traffic Factor is the percentage of traffic that will not be diverted onto other facilities during a lane closure. Convert the percentage to a decimal on the Lane Closure Worksheet. This is an estimate that the designer must make on his own, or with help from the Office of Planning. Range: 0% for all traffic diverted to 100% for none diverted.

6. **G/C** = Ratio of Green to Cycle Time. This factor is to be applied when lane closure is through or within 600 ft. of a signalized intersection. The Office of Traffic Engineering has timing cycles for all traffic signals.

7. **V** = Peak Hour Traffic Volume. The designer calculates the peak hour traffic volume by multiplying the actual traffic count, times peak to daily traffic ratio, times directional factor, times peak seasonal factor, times remaining traffic factor. This calculation will give the designer the expected traffic volume of a roadway at the anticipated time of a lane closure.

Exhibit 10-A Lane Closures, Sheet 2 of 11

Symbols and Definitions (Continued)

8. **C** = Capacity of a 2L, 4L or 6L roadway with one lane closed, and the remaining lane(s) unrestricted by lateral obstructions. The capacity of a 4L or 6L roadway is based on lane closure in only one direction (see Lane Closure Capacity Table on ***Exhibit 10-A, Sheet 3 of 11***).

9. **RC** = Restricting Capacity of the above facilities by site specific limitations detailed in the Traffic Control Plans (TCP) which apply to travel lane width, lateral clearance and the work zone factor. The work zone factor only applies to two lane roadways (see the tables on ***Exhibit 10-A, Sheet 4 of 11*** to obtain the Obstruction Factor and Work Zone Factor).

10. **OF** = Obstruction Factor which reduces the capacity of the remaining travel lane(s) by restricting one or both of the following components: Travel lane width less than 12 ft. and lateral clearance less than 6 ft. (see TCP and Obstruction Factor Table in ***Exhibit 10-A, Sheet 4 of 11***).

11. **WZF** = Work Zone Factor (WZF) is directly proportional to the work zone length (WZL). The capacity is reduced by restricting traffic movement to a single lane while opposing traffic queues. The WZF and WZL only apply to a two lane roadway converted to two way, one lane (see the Work Zone Factor Table on ***Exhibit 10-A, Sheet 4 of 11***).

12. **TLW** = Travel Lane Width is used to determine the obstruction factor (see TCP and the Obstruction Factor Table on ***Exhibit 10-A, Sheet 4 of 11***).

13. **LC** = Lateral Clearance is the distance from the edge of the travel lane to the obstruction. The lateral clearance is used to determine the obstruction factor (see MOT plans and Obstruction Factor Table on ***Exhibit 10-A, Sheet 4 of 11***).

Exhibit 10-A, Lane Closures, Sheet 3 of 11

LANE CLOSURE WORKSHEET

FINANCIAL PROJECT ID:_____ FAP NO.:_____

COUNTY:_____ DESIGNER:_____

NO. EXISTING LANES:_____ SCOPE OF WORK:_____

Calculate the peak hour traffic volume (V)

V=ATC (1) X P/D (2) X D (3) X PSCF (4) X RTF (5) = (7)

LANE CLOSURE CAPACITY TABLE

Capacity (C) of an Existing 2-Lane – Converted to 2-Way, 1-Lane = 1400 VPH
Capacity (C) of an Existing 4-Lane – Converted to 1-Way, 1-Lane = 1800 VPH
Capacity (C) of an Existing 6-Lane – Converted to 1-Way, 2-Lane = 3600 VPH

Factors restricting Capacity:

TLW (12) LC (13) WZL (11) G/C (6)

Calculate the Restricted Capacity (RC) at the Lane Closure Site by multiplying the appropriate 2L, 4L, or 6L Capacity (C) from the Table above by the Obstruction Factor (OF) and the Work Zone Factor (WZF). If the Lane Closure is through or within 600 ft. of a signalized intersection, multiply the RC by the G/C Ratio.

RC (Open Road) = C (8) X OF (10) X WZF (11) = (9)

RC (Signalized) = RC (Open Road) (9) X G/C (6) = (9)

If V ≤ RC, there is no restriction on Lane Closure
If V > RC, calculate the hourly percentage of ADT at which Lane Closure will be permitted

$$\text{Open Road \%} = \frac{\text{RC (Open Road) (9)}}{\text{(ATC (1) X D (3) X PSCF (4) X RTF (5))}} = \_\_\_\_\_\%$$

Signalized % = Open Road % _____ X G/C (6) = _____ %

Plot 24 hour traffic to determine when Lane Closure permitted. (See ***Exhibit 10-A, Sheet 5 of 11***)

NOTE: For Existing 2-Lane Roadways, D = 1.00.
Work Zone Factor (WZF) applies only to 2-Lane Roadways.

For RTF < 1.00, briefly describe alternate route_____

Exhibit 10-A, Lane Closures, Sheet 4 of 11

Lane Closures – Capacity Adjustment Factors
Peak Season Conversion Factor (PSCF) Sample

1998 Peak Season Factor Category Report for Tropic County							
WK	Dates	SF	PSCF	WK	Dates	SF	PSCF
9	02/22 – 02/28/98	1.14	1.48	15	04/05 – 04/11/98	0.86	1.12
10	03/01 – 03/07/98	1.04	1.35	16	04/12 – 04/18/98	0.87	1.13
11	03/08 – 03/14/98	0.94	1.22	17	04/19 – 04/25/98	0.90	1.17
12	03/15 – 03/21/98	0.83	1.08	18	04/26 – 05/02/98	0.93	1.21
13	03/22 – 03/28/98	0.84	1.09	19	05/03 – 05/09/98	0.96	1.25
14	03/29 – 04/04/98	0.85	1.11	20	05/10 – 05/16/98	0.99	1.29

Obstruction Factors (OF)

Lateral Clearance (LC) (feet)	Travel Lane Width (TLW) (feet)			
	12	11	10	9
6	1.00	0.96	0.90	0.80
4	0.98	0.94	0.87	0.77
2	0.94	0.90	0.83	0.72
0.0	0.86	0.82	0.75	0.65

Work Zone Factors (WZF)

WZL (ft.)	WZF	WZL (ft.)	WZF	WZL (ft.)	WZF
200	0.98	2200	0.81	4200	0.64
400	0.97	2400	0.80	4400	0.63
600	0.95	2600	0.78	4600	0.61
800	0.93	2800	0.76	4800	0.59
1000	0.92	3000	0.74	5000	0.57
1200	0.90	3200	0.73	5200	0.56
1400	0.88	3400	0.71	5400	0.54
1600	0.86	3600	0.69	5600	0.53
1800	0.85	3800	0.68	5800	0.51
2000	0.83	4000	0.66	6000	0.50

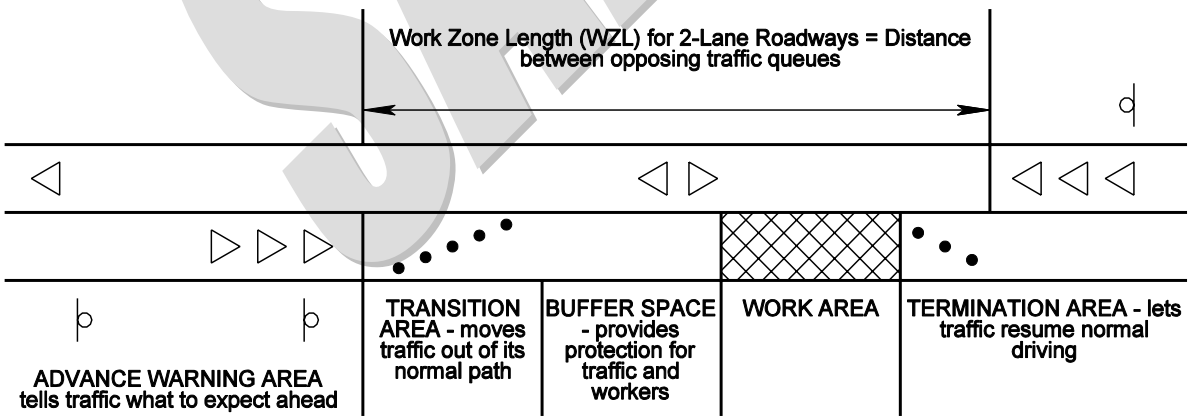


Exhibit 10-A, Lane Closures, Sheet 5 of 11

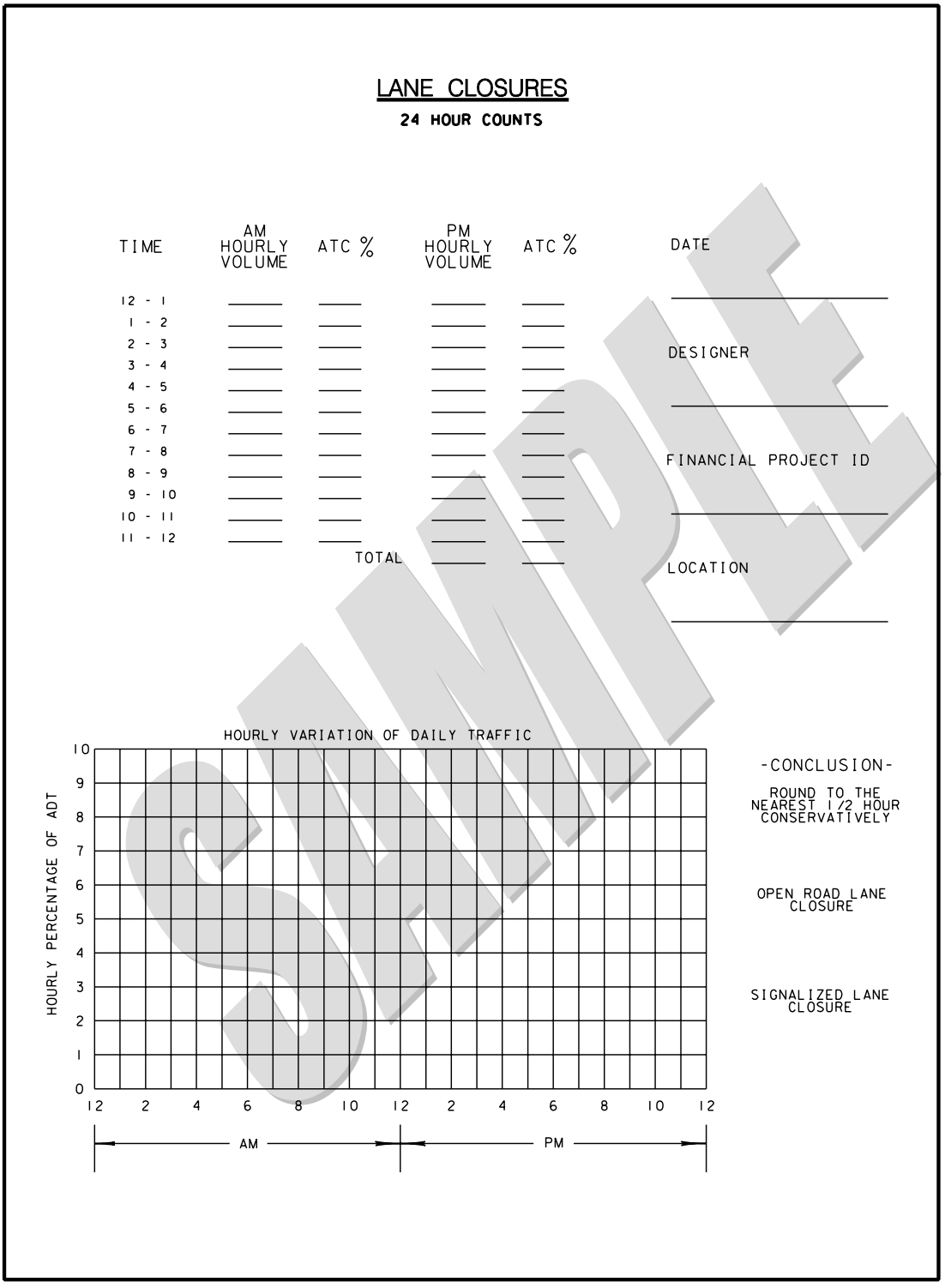


Exhibit 10-A, Lane Closures, Sheet 6 of 11

LANE CLOSURE WORKSHEET

FINANCIAL PROJECT ID: ***123456-7-89-10*** FAP NO.: ***NA***

COUNTY: ***Tropic*** DESIGNER: ***Yates***

NO. EXISTING LANES: ***2*** SCOPE OF WORK: ***Widen and Resurface***

Calculate the peak hour traffic volume (V)

V=ATC ***15000*** X P/D ***0.083*** X D ***NA*** X PSCF ***1.17*** X RTF ***0.75*** = ***1092***

LANE CLOSURE CAPACITY TABLE

Capacity (C) of an Existing 2-Lane – Converted to 2-way, 1-Lane = 1400VPH
Capacity (C) of an Existing 4-Lane – Converted to 1-way, 1-Lane = 1800VPH
Capacity (C) of an Existing 6-Lane – Converted to 1-way, 2-Lane = 3600VPH

Factors restricting Capacity:

TLW ***10*** LC ***4*** WZL ***2100*** G/C ***0.64***

Calculate the Restricted Capacity (RC) at the Lane Closure Site by multiplying the appropriate 2L, 4L, or 6L Capacity (C) from the table above by the Obstruction Factor (OF) and the Work Zone Factor (WZF). If the Lane Closure is through or within 600 ft. of a signalized intersection, multiply the RC by the G/C Ratio.

RC (Open Road) = C ***1400*** X OF ***0.87*** X WZF ***0.82*** = ***999***

RC (Signalized) = RC (Open Road) ***999*** X G/C ***0.64*** = ***639***

If V ≤ RC, there is no restriction on Lane Closure
If V > RC, calculate the hourly percentage of ADT at which Lane Closure will be permitted

$$\text{Open Road \%} = \frac{\text{RC (Open Road) } 999}{(\text{ATC } 15000 \times \text{D } 1.00 \times \text{PSCF } 1.17 \times \text{RTF } 0.75)} = 7.59\ \%$$

Signalized % = Open Road % ***7.59*** X G/C ***0.64*** = ***4.86*** %

Plot 24 hour traffic to determine when Lane Closure permitted. (See ***Exhibit 10-A, Sheet 7 of 11***)
NOTE: For Existing 2-Lane Roadways, D = 1.00.
Work Zone Factor (WZF) applies only to 2-Lane Roadways.

For RTF < 1.00, briefly describe alternate route: ***25% of existing traffic diverted on Bullard Blvd., north on Newhall Lane, then east on Xanders Expressway.***

Exhibit 10-A, Lane Closures, Sheet 7 of 11

LANE CLOSURES

24 HOUR COUNTS

TIME	AM HOURLY VOLUME	ATC %	PM HOURLY VOLUME	ATC %
12 - 1	160	1.1	960	6.4
1 - 2	90	0.6	830	5.5
2 - 3	30	0.2	810	5.4
3 - 4	25	0.2	1080	7.2
4 - 5	30	0.2	1190	7.9
5 - 6	130	0.9	1240	8.3
6 - 7	525	3.5	930	6.2
7 - 8	1135	7.6	680	4.5
8 - 9	910	6.1	530	3.5
9 - 10	870	5.8	425	2.8
10 - 11	825	5.5	365	2.4
11 - 12	960	6.4	270	1.8
		TOTAL	15,000	100

P/D = .083

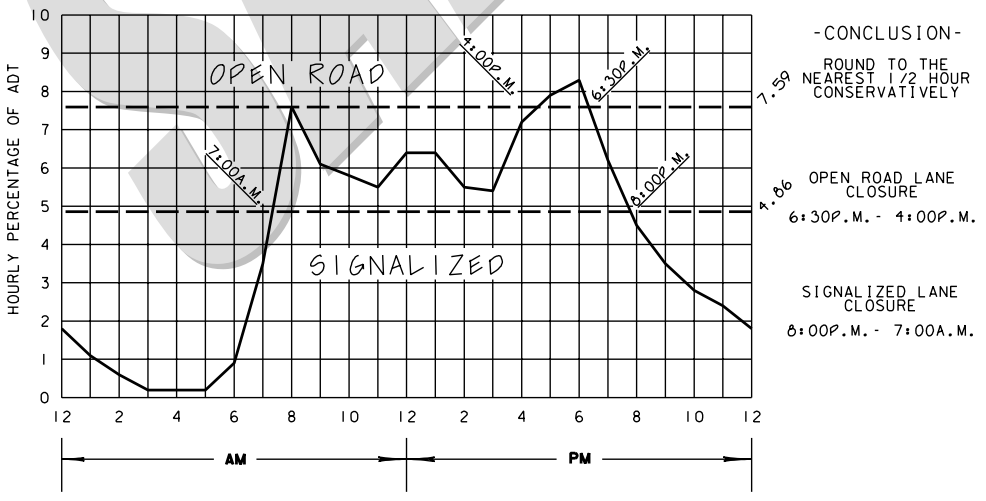
DATE
APR 19, 1998

DESIGNER
YATES

FINANCIAL PROJECT ID
123456-7-89-10

LOCATION
BUCK LAKE RD.

HOURLY VARIATION OF DAILY TRAFFIC



-CONCLUSION-

ROUND TO THE NEAREST 1/2 HOUR CONSERVATIVELY

OPEN ROAD LANE CLOSURE
6:30P.M. - 4:00P.M.

SIGNALIZED LANE CLOSURE
8:00P.M. - 7:00A.M.

Exhibit 10-A, Lane Closures, Sheet 8 of 11

LANE CLOSURE WORKSHEET

FINANCIAL PROJECT ID: ***123456-7-89-10*** FAP NO.: ***NA***

COUNTY: ***Tropic*** DESIGNER: ***Giddens***

NO. EXISTING LANES: ***4*** SCOPE OF WORK: ***Resurface***

Calculate the peak hour traffic volume (V)

V=ATC ***30000*** X P/D ***0.083*** X D ***0.55*** X PSCF ***1.17*** X RTF ***1.00*** = ***1602***

LANE CLOSURE CAPACITY TABLE

Capacity (C) of an Existing 2-Lane – Converted to 2-way, 1-Lane = 1400VPH
Capacity (C) of an Existing 4-Lane – Converted to 1-way, 1-Lane = 1800VPH
Capacity (C) of an Existing 6-Lane – Converted to 1-way, 2-Lane = 3600VPH

Factors restricting Capacity:

TLW ***11*** LC ***6*** WZL ***NA for 4L*** G/C ***0.74***

Calculate the Restricted Capacity (RC) at the Lane Closure Site by multiplying the appropriate 2L, 4L, or 6L Capacity (C) from the table above by the Obstruction Factor (OF) and the Work Zone Factor (WZF). If the Lane Closure is through or within 600 ft. of a signalized intersection, multiply the RC by the G/C Ratio.

RC (Open Road) = C ***1800*** X OF ***0.96*** X WZF ***1.00*** = ***1728***

RC (Signalized) = RC (Open Road) ***1728*** X G/C ***0.74*** = ***1279***

If V ≤ RC, there is no restriction on Lane Closure
If V > RC, calculate the hourly percentage of ADT at which Lane Closure will be permitted

$$\text{Open Road \%} = \frac{\text{RC (Open Road) } 1728}{(\text{ATC } 30000 \times \text{D } 0.55 \times \text{PSCF } 1.17 \times \text{RTF } 1.00)} = 8.95\ \%$$

Signalized % = Open Road % ***8.95*** X G/C ***0.74*** = ***6.62*** %

Plot 24 hour traffic to determine when Lane Closure permitted. (See ***Exhibit 10-A, Sheet 9 of 11***)
NOTE: For Existing 2-Lane Roadways, D = 1.00.
Work Zone Factor (WZF) applies only to 2-Lane Roadways.

For RTF < 1.00, briefly describe alternate route: ***NA***

Exhibit 10-A, Lane Closures, Sheet 9 of 11

LANE CLOSURES

24 HOUR COUNTS

TIME	AM HOURLY VOLUME	ATC %	PM HOURLY VOLUME	ATC %
12 - 1	320	1.1	1920	6.4
1 - 2	180	0.6	1660	5.5
2 - 3	60	0.2	1620	5.4
3 - 4	50	0.2	2160	7.2
4 - 5	60	0.2	2380	7.9
5 - 6	260	0.9	2480	8.3
6 - 7	1050	3.5	1860	6.2
7 - 8	2270	7.6	1360	4.5
8 - 9	1820	6.1	1060	3.5
9 - 10	1740	5.8	850	2.8
10 - 11	1650	5.5	730	2.4
11 - 12	1920	6.4	540	1.8
		TOTAL	30,000	100

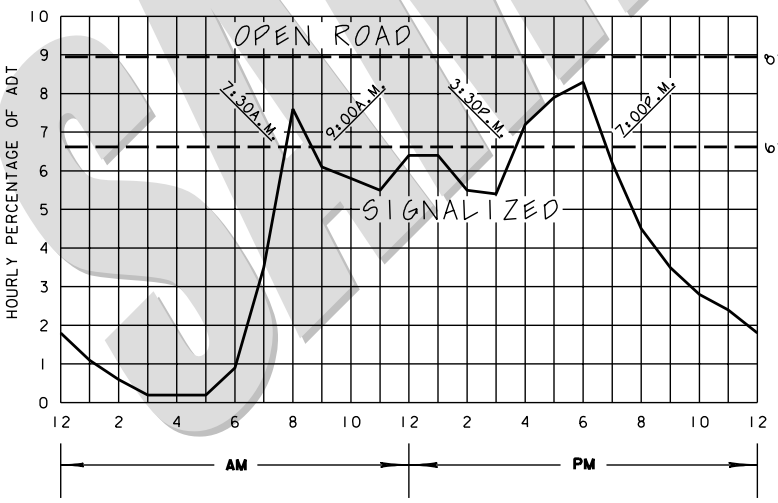
DATE
APR 19, 1998

DESIGNER
GIDDENS

FINANCIAL PROJECT ID
123456-7-89-10

LOCATION
BUCK LAKE RD.

HOURLY VARIATION OF DAILY TRAFFIC



-CONCLUSION-

ROUND TO THE NEAREST 1/2 HOUR CONSERVATIVELY

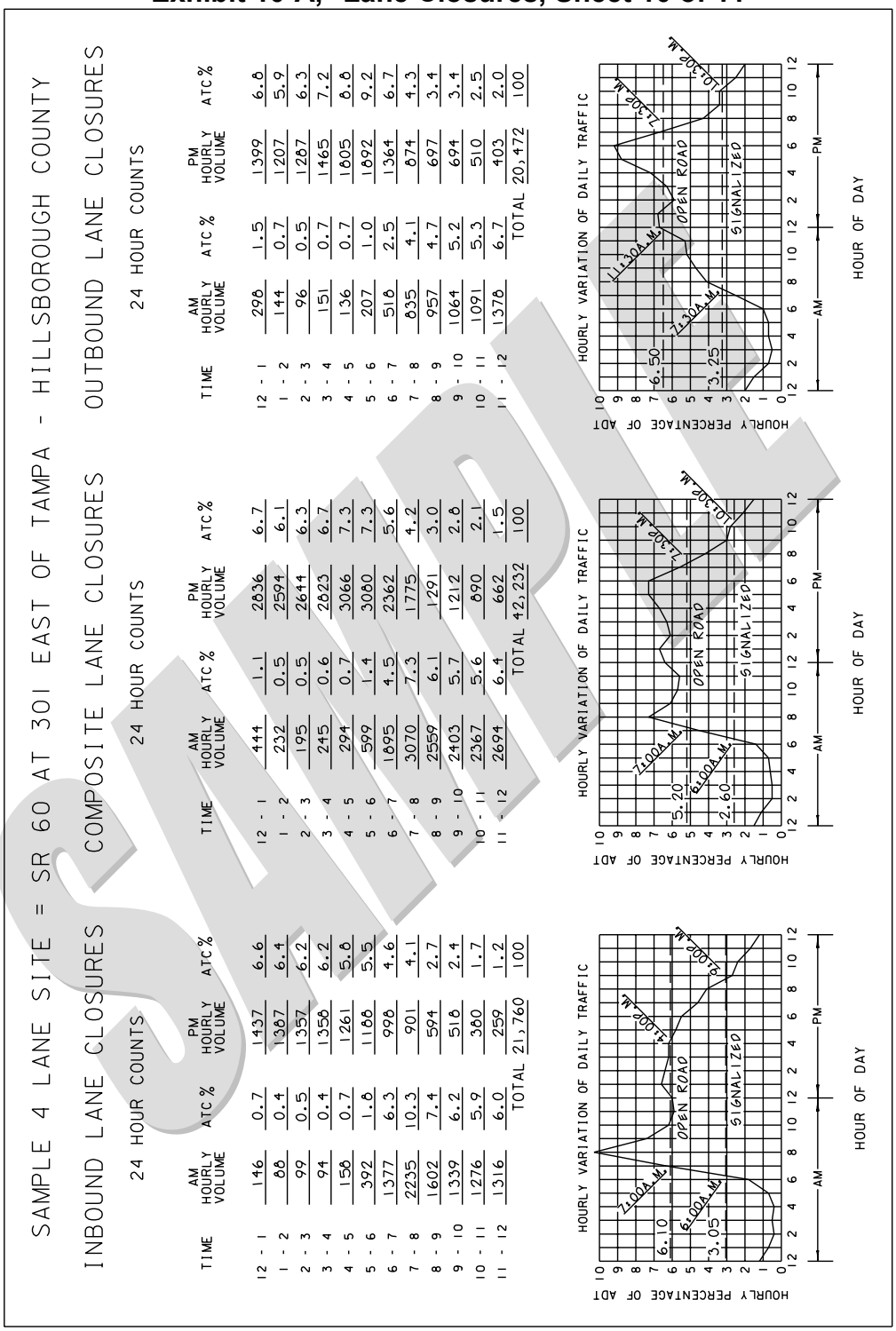
OPEN ROAD LANE CLOSURE

NO RESTRICTION

SIGNALIZED LANE CLOSURE

9:00A.M. - 3:30P.M.
7:00P.M. - 7:30A.M.

Exhibit 10-A, Lane Closures, Sheet 10 of 11



SAMPLE 4 LANE SITE = SR 60 AT 301 EAST OF TAMPA - HILLSBOROUGH COUNTY

INBOUND LANE CLOSURES COMPOSITE LANE CLOSURES OUTBOUND LANE CLOSURES

24 HOUR COUNTS

TIME	AM HOURLY VOLUME	ATC %	PM HOURLY VOLUME	ATC %
12 - 1	146	0.7	1437	6.6
1 - 2	80	0.4	1387	6.4
2 - 3	99	0.5	1357	6.2
3 - 4	94	0.4	1356	6.2
4 - 5	158	0.7	1261	5.8
5 - 6	392	1.8	1186	5.5
6 - 7	1377	6.3	998	4.6
7 - 8	2235	10.3	901	4.1
8 - 9	1602	7.4	594	2.7
9 - 10	1339	6.2	518	2.4
10 - 11	1276	5.9	380	1.7
11 - 12	1316	6.0	259	1.2
		TOTAL	21,760	100

24 HOUR COUNTS

TIME	AM HOURLY VOLUME	ATC %	PM HOURLY VOLUME	ATC %
12 - 1	444	1.1	2836	6.7
1 - 2	232	0.5	2594	6.1
2 - 3	195	0.5	2644	6.3
3 - 4	245	0.6	2823	6.7
4 - 5	294	0.7	3066	7.3
5 - 6	599	1.4	3080	7.3
6 - 7	1895	4.5	2362	5.6
7 - 8	3070	7.3	1775	4.2
8 - 9	2559	6.1	1291	3.0
9 - 10	2403	5.7	1212	2.8
10 - 11	2367	5.6	890	2.1
11 - 12	2694	6.4	662	1.5
		TOTAL	42,232	100

24 HOUR COUNTS

TIME	AM HOURLY VOLUME	ATC %	PM HOURLY VOLUME	ATC %
12 - 1	298	1.5	1399	6.8
1 - 2	144	0.7	1207	5.9
2 - 3	96	0.5	1287	6.3
3 - 4	151	0.7	1465	7.2
4 - 5	136	0.7	1805	8.8
5 - 6	207	1.0	1892	9.2
6 - 7	518	2.5	1364	6.7
7 - 8	835	4.1	874	4.3
8 - 9	957	4.7	697	3.4
9 - 10	1064	5.2	694	3.4
10 - 11	1091	5.3	510	2.5
11 - 12	1378	6.7	403	2.0
		TOTAL	20,472	100

Exhibit 10-A, Lane Closures, Sheet 11 of 11

LANE CLOSURE WORKSHEET SUMMARY LANE SAMPLE WITH SIGNIFICANT AM-PM PEAKS SAMPLES = INBOUND (WB), COMPOSITE (EB & WB), OUTBOUND (EB) SITE = SR 60 @ US 301 EAST OF TAMPA, HILLSBOROUGH CO.			
COMPONENT	INBOUND	COMPOSITE	OUTBOUND
ADT	21,760	42,232	20,472
P/D	0.103	0.073	0.092
D	1.00	0.60	1.00
PSCF	1.17	1.17	1.17
RTF	1.00	1.00	1.00
V	2622	2164	2203
TLW	12	12	12
LC	0	0	0
C	1800	1800	1800
OF	0.86	0.86	0.86
RC (OPEN ROAD)	1548	1548	1548
G/C	0.50	0.50	0.50
RC (SIGNAL)	774	774	774
% OPEN ROAD	6.10	5.20	6.50
% SIGNAL	3.05	2.60	3.25
LANE CLOSURE	7:00 AM	7:00 AM	11:30 AM
(OPEN ROAD)	4.00 PM	7:30 PM	7:30 PM
LANE CLOSURE	6:00 AM.	6:00 AM	7:30 AM
(SIGNAL)	9:00 PM.	10:30 PM	10:30 PM

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10.14.8 Detours, Diversions, and Lane Shifts

A **detour** is the redirection of traffic onto an alternate route, using state roads, county roads, or city streets, to bypass the work zone. A **diversion** is a special detour onto a temporary roadway adjacent to the existing or permanent roadway. A **lane shift** is the redirection of traffic onto a section of the permanent roadway or shoulder.

Detour signing is usually done under the direction of the traffic engineer who has authority over the roadway to be used. The detour should be signed clearly so drivers can traverse the entire detour and return to the original roadway. When detours are required, the geometry of the detour route should be compared against the type of traffic being routed through the detour. For example, detouring of traffic which includes large trucks and transit vehicles will require certain pavement widths, turning radius, and overhead clearance (including low power lines, span wires, and low hanging tree limbs). The structural capacity of the detour pavement should also be considered.

The designer has two methods of paying for diversions: by (1) using the "special detour" lump sum pay item or (2) using the lump sum Maintenance of Traffic (MOT) pay item. When the special detour pay item is used, the work and quantities included for pay under the item are to be tabulated and noted in the plans. The special detour pay item is intended to be used in all situations where traffic is shifted one lane width or more onto temporary pavement.

A Diversion, which is to be signed as a lane shift, may be paid for under Special Detour, Pay Item 102-2 (Lump Sum). The ***Basis of Estimates Handbook*** should be referenced to make sure that the appropriate items are included in this lump sum.

TCPs shall include sufficient detail for diversion geometry. Diversions should be designed with shoulders (2 ft. min.) whenever practical. The radius of curvature and taper lengths shall be shown. Diversions should be designed and operated as close to the normal speed as possible. When speed reductions are necessary, the reduction should be in accordance with the ***Design Standards, Index 600.*** The recommended minimum radius of curvature (without superelevation) for diversions is shown in ***Table 10.14.2***.

10.14.9 Above Ground Hazards

An above ground hazard is anything that is greater than 4 inches in height and is firm and unyielding or doesn't meet breakaway requirements. For treatment of an above ground hazard, see the ***Design Standards, Index 600***.

10.14.10 Drop-offs in Work Zones

Acceptable warning and barrier devices for traffic control at drop-offs in work areas are detailed in the ***Design Standards, Index 600***.

The designer should anticipate drop-offs that are likely to occur during construction and provide the appropriate devices. For those projects where barrier wall would be needed and yet it is not practical, such as highly developed urban areas where numerous driveways exist, the designer should consider adding plan notes that require conditions be returned to acceptable grade by the end of the day's operation.

10.14.11 Narrow Bridges and Roadways

Simultaneously working on both sides of a bridge (bridge widening, etc.) or roadway may be hazardous due to the narrow widths of some bridges and roads. Consideration should be given to specifying that work be done only on one side at a time, particularly on high speed roadways. In some situations, the installation of barrier wall on both shoulders can totally eliminate any shoulder or refuge area. The designer should consider whether or not this restriction of the effective width is acceptable and consistent with the desired operational ability of the facility.

10.14.12 Existing Highway Lighting

If the project has existing highway lighting, the designer shall prepare a specification that completely describes what is to be done with the existing lighting during all phases of construction. Give detailed information on any poles that have to be relocated or any new conduit or conductors that would have to be installed. A field survey should be conducted to establish the condition of the existing system and what responsibility the contractor will have in bringing the existing lighting system back to an acceptable condition.

The designer should use the appropriate pay items and quantities for all work to be done for maintaining existing lighting throughout construction.

10.14.13 Work Area Access

The TCP may need to include a work area access plan, if necessary. This is a constructibility issue in which the designer addresses the question of how the contractor is to get materials and equipment into the work area safely. This is a particularly critical issue on high speed facilities (such as the Interstate) where barrier wall is used to protect median work areas. Some consideration may be given to the design and construction of temporary acceleration and deceleration lanes for the construction equipment.

10.14.14 Railroads

Railroad crossings that are affected by a construction project must be evaluated to ensure that the Traffic Control Plan does not cause queuing of traffic across the railroad tracks. Evaluate the Plan's signal timing, tapers, lane closures and distance to intersections as compared to projected peak traffic volumes. The effects of the traffic control plan on interconnected traffic signals and railroad signals must be evaluated to avoid conflicting or ineffective signal controls.

10.14.15 Pay Items and Quantities

The ***Basis of Estimates Handbook*** contains detailed instructions on calculating many of the MOT quantities.

10.15 Speed Zoning

10.15.1 Regulatory Speeds in Work Zones

Regulatory speeds should be established to route vehicles safely through the work zone as close to normal highway speed as possible. Traffic Control Plans (TCPs) for all projects must include specific regulatory speeds for each phase of work. This can either be the posted speed or a reduced speed. The speed shall be noted in the TCPs: this includes indicating the existing speed if no reduction is made. By virtue of ***Florida Statute 316.187***, all regulatory speeds must be established on the basis of a traffic and engineering investigation. Designers should only reduce speed when the temporary geometry requires it. The justification for establishing work zone regulatory speeds different from normal speed limits must be included in the project file. The TCP and the project file will suffice as the traffic and engineering investigation.

When field conditions warrant speed reductions different from those shown in the TCP, the contractor may submit to the project engineer for approval by the Department, a signed and sealed study to justify the need for further reducing the posted speed or the engineer may request the District Traffic Operations Engineer (DTOE) to investigate the need. It will not be necessary for the DTOE to issue regulations for regulatory speeds in work zones due to the revised provisions of ***Florida Statute 316.0745(2)(b)***.

Regulatory speed signs in rural areas (Interstate and Non-Interstate) are to be preceded by a "Reduced Speed Ahead" sign positioned as follows:

Interstate (Rural)	-	1000 ft. in advance
Non-Interstate (Rural)	-	500 ft. in advance

Urban areas, ordinarily do not require an advance sign, however, the sign may be included at the designer's option.

The regulatory speed and “Reduced Speed” Ahead signs are to be paid for under the pay item for Construction Work Zone Signs (per each per day).

If the existing regulatory speed is to be used, consideration should be given to supplementing the existing signs when the construction work zone is between existing regulatory speed signs. For projects where the reduced speed conditions exist for greater than 1 mile in rural areas (Non-Interstate) and on Rural or Urban Interstate, additional regulatory speed signs are to be placed at no more than 1 mile intervals.

Engineering judgment should be used in the placement of additional signs. For urban situations (Non-Interstate), additional regulatory speed signs are to be placed at a maximum of 1000 ft. apart.

The regulatory speed should not be reduced more than 10 mph below the posted speed, and never below the minimum statutory speed for the class of facility, without the approval of the District Traffic Operations Engineer and the appropriate District Director (See the ***Design Standards**, **Index 600**).*

To ensure credibility with motorists and enforcement agencies, temporary regulatory speed signs shall be removed or covered as soon as the conditions requiring the reduced speed no longer exist. Once they are removed or covered, the speed existing prior to construction will automatically go back into effect unless new speed limit signing is provided for in the plans. On projects with interspaced work activities (such a interstate resurfacing) speed reductions should be located in proximity to those activities which merit a reduced speed, and not “blanketed” for the entire project.

The TCP phase notes shall indicate when to remove the regulatory reduced speed limit signs.

When the regulatory speed is changed in a work zone, the permanent speed limit signs are to be removed or covered during the period when the work zone regulatory speed zones are in effect.

10.16 Law Enforcement Services

Work zones may require law enforcement services to protect both the workers and motorists during construction or maintenance activities. The need for these services should be considered during the development of the Traffic Control Plans. The service needed could involve a Speed and Law Enforcement Officer for speed and traffic law enforcement, a Traffic Control Officer for traffic control, or a combination of the two.

A contractual agreement between the FDOT and the Florida Department of Highway Safety and Motor Vehicles (DHSMV) was entered into for the use of Speed and Law Enforcement Officer (Central Office Statewide Contract) to exclusively enforce the speed limit in specified work zones. (REF. ***Contract #B-8970***) Each district has also been encouraged to enter into contractual agreements with local law enforcement agencies to provide additional resources for the use of a Speed and Law Enforcement Officer (District Contract).

Traffic Control Officers are to be used for traffic control only as described in ***Specification 102***. The Traffic Control Officer may be acquired from local law enforcement agencies or the Florida Highway Patrol. Such Traffic control law enforcement services shall not include patrolling or speed enforcement. The use of Traffic Control Officers may be called for on a project that also uses Speed and Law Enforcement Officers.

10.16.1 Use of Speed and Law Enforcement Officers

The Department has determined that construction or maintenance activities that divert, restrict, or significantly impair vehicular movement through work zones may require patrolling by a Speed and Law Enforcement Officer specifically for speed and law enforcement to provide a safer environment for both workers and motorists. A Speed and Law Enforcement Officer may also be warranted, for the safety of the motorists, through some work zones during times when construction or maintenance activities are not in progress.

Conditions to consider for the use of Speed and Law Enforcement Officer may include, but not be limited to:

1. A work zone requiring reduced speeds
2. Work zones where barrier wall is used adjacent to through traffic
3. Night time work zones

4. Areas with intense commuter use where peak hour traffic will require speed enforcement
5. A work zone in which workers are exposed to nearby high speed traffic
6. Work zones similar to the ***Design Standards, Indexes 609, 613, 616, and 651***

10.16.2 Use of Traffic Control Officer Law Enforcement

There are certain construction activities that impede traffic flows such that supplemental traffic control is desirable. Uniformed law enforcement officers are respected by motorists; therefore, it may be in the best interest of the situation to utilize Traffic Control Officer law enforcement as a supplement to traffic control devices to assist the motorists and provide a safer work zone.

By specification, conditions for the use of Traffic Control Officer law enforcement shall be:

1. Traffic control in a signalized intersection when signals are not in use.
2. When ***Index No. 627*** of the ***Design Standards*** is used on Interstate at nighttime and required by the plans.
3. When pacing/rolling blockade is used.

10.16.3 Coordination, Documentation and Payment

On each individual project, the designer and/or the project manager shall coordinate with the district construction office to determine if law enforcement services will be justified. If possible the associated law enforcement commander shall also be included in the coordination.

Once the determination has been made that law enforcement will be used on a project, the designer/project manager and the construction engineer shall develop supporting documentation for each MOT phase including the conditions requiring the law enforcement services, the number of personnel, the man-hours, and any other requirements that may be established. The supporting documentation for Speed and Law Enforcement Officer and Traffic Control Officer law enforcement will be kept separate.

The documentation for Speed and Law Enforcement Officer will be shown in the

Computation Book only and there will be no reference made to these services in the plans except as shown on the Summary of Pay Items Sheet.

Speed and Law Enforcement Officer can be used on non-limited access highways provided that the District Director of Operations has approved its use.

Speed and Law Enforcement Officer will be paid for under pay item 999-102-xxa - Speed and Law Enforcement Officer (Do Not Bid) HR.

For Traffic Control Officer law enforcement, the TCP shall clearly indicate the intended use of the officer(s) during each phase of construction, the need for the service, the number of officers needed, and the required man-hours. Traffic Control Officer law enforcement will be paid for under pay item 102- 14 - Traffic Control Officer HR. Complete documentation that complies with the TCP shall be included in the Computation Book.

The initial coordination between the designer/project manager and construction shall take place prior to Phase II. The final determination of man-hours and final documentation shall be accomplished at the same time that construction days are set.

10.16.4 Other Uses of Law Enforcement

The contractor may choose to use law enforcement services beyond the details of the TCP for situations that assist with mobilization, demobilization, MOT setup, and other instances where he prefers the use of law enforcement.

The contractor is responsible for the coordination of these uses and will be included under the Lump Sum Maintenance of Traffic pay item. These contractor required services are not to be included in the Department's contract pay items for law enforcement services.

10.17 Motorist Awareness System (MAS)

The purpose of a Motorist Awareness System (MAS) is to increase the motorist awareness of the presence of active work and provide emphasis on reduced speed limits in the active work area. A MAS is created by using a combination of several different traffic control devices to draw attention to the legal speed and inform the motorist of his vehicle speed. Descriptions of some MAS devices are provided below. The ***Design Standards***, ***Index 670***, provide details on the most effective combination and placement of MAS traffic control devices.

The Department's goal is to achieve the same respect for Work Zones that School Zones currently receive. The key in achieving this respect is to discontinue blanket speed limit reductions in work zones, increase enforcement, and to remove the MAS when the conditions requiring it no longer exist and restore the speed limit within the limits of the project to the posted speed limit. Specifically, MAS components are to be activated when the lane closure is setup and deactivated when the lane closure is taken down. All MAS components shall be moved outside of the clear zone or to be shielded by a barrier or crash cushion when not in use.
The MAS shall be used if all of the following conditions exist:

1. Multilane facility
2. Posted speed limit is 55 mph or greater
3. Work operation requires a lane closure
4. Workers are present

Designers should consult with experienced construction personnel on the likelihood of excessive speeds in the work zones for their projects. If the designer wants to modify the standard drawing for the MAS, special details on the setup of the MAS must be developed and included in the plans. In addition the designer must work with the resident construction office to perform and document a speed study prior to and after setting up the MAS. The results of the speed study shall be forwarded to the State Construction Office. If a speed reduction is documented on several projects, a standard will be developed for the modified MAS setup.

The following is a list of some of the devices that are used as part of a Motorist Awareness System.

10.17.1 Portable Regulatory Signs (PRS)

The purpose of this device is to highlight the regulatory speed for the work zone. A portable regulatory sign is a portable trailer that has the regulatory speed sign mounted with flashing lights on each side of the sign. The lights are used to draw the driver's attention to the regulatory speed.

10.17.2 Radar Speed Display Unit (RSDU)

The purpose of this device is to display the motorist's work zone speed. A radar speed display unit is a portable trailer that displays the speed of approaching motorists on a LED display panel. The radar mounted on the unit detects the speed. A regulatory sign with the posted speed is mounted above the LED display panel. The unit is fitted with a device, which counts the number of vehicles passing the Radar Speed Display Unit. The counter device is capable of:

1. Digital readout of the number of vehicles passing the radar speed display unit.
2. Digital readout of the number of vehicles exceeding the speed limit shown on the radar speed display unit.

The device can be set that only speeds greater than the work zone speed are displayed.

10.17.3 Highway Advisory Radio (HAR)

This is a radio transmitter mounted on a portable trailer, which can be set up in the work zone to advise motorists through their car radio of work zone information. Notice of lane closures, reasons for delays, advance warning of work zones, etc. let motorists know what to expect while driving through the work zone. A Changeable (variable) Message Sign (CMS) is used in conjunction with the HAR to inform the motorist of the AM frequency to tune to on their car radio. The HAR can generally transmit messages in a 2.5 mile radius. It is very important that the messages broadcast be up to date and reflects actual work zone conditions.

The HAR is not an integral device of a typical MAS setup but may be considered for complex projects. Use of a HAR should be in accordance with the Department's ***Highway Advisory Radio System User Manual***. This manual is available from FDOT Maps and Publications. HAR use is restricted to daytime hours, and to the immediate vicinity of areas identified in the HAR manual.

The District Public Information Officer should be consulted prior to use of this device on a project.

10.17.4 Safety Warning Transmitter (SWT)

The purpose of the SWT is to transmit a message to drivers with radar detectors that have the capability of receiving messages from a transmitter. The SWT can transmit to a radar detector an audible alert such as a “beep”, a LED text message, or a synthesized voice message, depending on the type of radar detector a motorist has. This device is a small unit, which can be attached to any other traffic control device within the work zone. The effectiveness of this device is limited to motorists with radar detectors so it is not considered an integral part of a motorist awareness system.

10.17.5 Speed and Law Enforcement Officer

The use of moving officers on a random basis, in conjunction with the other MAS devices, has proven to be effective. See ***Section 10.16*** for additional information.

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