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CHAPTER EIGHTY-ONE

TRANSPORTATION MANAGEMENT PLANS

81-1.0 GENERAL

81-1.01 Purpose

A transportation management plan (TMP) is an overall strategy for accommodating traffic during construction. The TMP not only must address the alternatives confined to the project site, but it must also evaluate the impact traffic will have on the entire corridor. The TMP will address the proposed traffic control plan, alternative traffic control applications, the effect traffic will have on other facilities, local concerns, cost effectiveness of various alternatives, etc. For large projects, a TMP team may be organized during the preliminary engineering stage to study the traffic control alternatives and their effect on the corridor.

The TMP includes the traffic control plan (TCP). The major differences between a TMP and a TCP is that the TCP focuses on the maintenance and protection of traffic within the construction zone; the TMP addresses project-related impacts throughout the project corridor and sometimes beyond. In general, the designer will be responsible for incorporating the TMP objectives into the TCP. Changes made during the preparation of the TCP will affect the overall TMP. For example, a lane closure which causes large queues on a freeway may cause traffic to divert to a nearby urban arterial. This may require signal coordination, lane widening, turn restrictions, etc., on the arterial to improve its capacity. Chapter Eighty-two discusses INDOT criteria for TCPs. If the TMP was not developed during the preliminary engineering stage, it will be the designer's responsibility to ensure that a reasonable transportation management strategy has been incorporated into the traffic control plans.

81-1.02 Application

A formal transportation management plan will not be required on most projects constructed by the Department. However, the concepts presented in this Chapter should be considered on all projects. A formal TMP, including a TMP team, may be considered on projects that have one or more of the characteristics as follows:

1. the project scope of work consists of major reconstruction or new construction (e.g., 4R Interstate projects);

2. high traffic volumes;

3. urban/suburban areas;

4. where there may be significant detrimental impacts on mobility for either through or local trips in the corridor;

5. where the facility's capacity will be significantly reduced (e.g., lane, ramp or interchange closures);

6. where alternate routing will be necessary (e.g., detour routing for hazardous materials);

7. where there will be significant impacts on local communities and businesses (e.g., emergency vehicles, school buses);

8. where timing and seasonal impacts may be significant; and/or

9. where there will be significant grade changes.

Where a series of proposed projects are along the same corridor or along corridors of close proximity, a single TMP covering all projects should be used. If circumstances prohibit a single TMP, the individual TMPs should be coordinated.

81-1.03 TMP Development

81-1.03(01) Procedure

Where a TMP is used, the following procedure will generally be observed.

1. TMP Determination. The Preliminary Engineering Studies Section, with input from the Districts, Program Development and Pavement Design, will determine if there is a need for a TMP during the scoping process. The Preliminary Engineering Studies Section will collect the initial data and conduct the initial analyses to determine whether or not a TMP will be required.

2. TMP Team Selection. Once it has been determined that a TMP is required for the project, the Preliminary Engineering Studies Section will initially recommend who the TMP team representatives will be, based on the purpose, goals and constraints of the TMP. Section 81-1.03(02) lists the members for a typical TMP project.

3. TMP Team Responsibilities. Section 81-1.03(03) discusses several of the TMP team responsibilities during the scoping process, project design and construction. The expected level of traffic impacts will dictate the extent and nature of the TMP team responsibilities.

4. Preliminary Engineering Studies Report. The Environment, Planning and Engineering Division's Preliminary Engineering Studies Section will incorporate the TMP recommendations into the Engineer's Report. If improvements are required to other facilities (e.g., widening of detour routes), it is important that these improvements be implemented as soon as practical prior to construction of the mainline facility. Local agencies should be provided sufficient opportunity to complete their improvements before construction begins. Agreements may be necessary between the State and local agencies to determine cost sharing arrangements and/or approval of a local road as an alternate route.

5. Design. During the design phase, it will be the designer's responsibility to implement the recommendations of the TMP team. The designer may be required to collect additional data and conduct additional analyses, as necessary. The TMP team should be consulted when design and TCP decisions dictate a revision to the proposed TMP. During this project stage, representatives from local agencies, businesses, homeowner associations, etc., may be added to the TMP team.

6. Construction. The TMP will be implemented during construction. Any significant proposed changes to the TMP by the district or the contractor must be reviewed with the TMP team prior to implementation. For larger projects, the district will generally appoint a TMP coordinator for the project. In some cases, a public relations campaign may be required to begin prior to construction. During construction, the district will be responsible for collecting data on the TMP so that the TMP Team can prepare a report on the successes and failures of the TMP. See Item 7 below to determine the applicable data to be collected.

7. Final Report. Upon project completion, the TMP Team will prepare a report identifying the successes and failures of the TMP. This report should discuss the following:

   a. an overall statement reflecting the usefulness of the TMP;
   b. where changes were necessary to correct oversights in the TMP;
   c. what changes were made to the original plan and if they were successful;
   d. public reaction to the TMP;
   e. the average delay time encountered (e.g., average queues, slowdowns);
   f. identification of the peak loading times;
   g. frequency of legitimate complaints and the nature of the complaints;
   h. types of accidents that occurred during construction;
   i. suggested improvements or changes for similar future projects; and
   j. what areas of the TMP were successfully implemented.

81-1.03(02) TMP Team

A well-balanced TMP team is an important ingredient for a successful project. The variety of disciplines represented presents an effective liaison group to meet the various needs of a TMP. Depending on the project logistics, the team composition may vary from project to project. The Environment, Planning and Engineering Division's Preliminary Engineering Studies Section will typically determine the team's composition. The TMP team may include representatives from the entities as follows:

1. Design Division, Speciality Projects Group (traffic design units),
2. Environment, Planning and Engineering Division, Environment Assessment Section,
3. Design Division,
4. District Traffic Section,
5. District Development Section,
6. District Construction Section,
7. Traffic Control Review Committee,
8. FHWA,
9. Local government (county and/or city),
10. Program Development Division,
11. Office of Communications, and
12. others as deemed necessary (e.g., State Police, hospitals, etc.).

81-1.03(03) TMP Team Responsibilities

The anticipated traffic impacts will dictate the extent and nature of the TMP team's responsibilities. These may include all or part of the following functions.

1. collecting data (e.g., traffic counts, accident history, roadway geometrics, proposed developments, operating speeds);

2. conducting analyses (e.g., capacity analyses, traffic impact studies, safety studies, queuing analysis);

3. reviewing design alternates;

4. reviewing traffic control alternates;

5. reviewing the adequacy of alternate routes (e.g., geometrics, capacity, safety, structural);

6. reviewing on-site and off-site traffic operational improvements (e.g., signal improvements, parking restrictions);

7. reviewing construction phasing and scheduling alternates;

8. determining the cost of various options and improvements;

9. determining which options are the most cost effective;

10. coordinating with local officials and businesses;

11. coordinating funding and timing with other projects within the corridor;

12. coordinating the design with other TMP plans in the region;

13. planning for emergency responses (incident management);

14. planning rideshare and transit strategies;

15. providing recommendations for the Preliminary Engineering Studies Report;

16. reviewing design and TMP changes made by the designer to ensure they meet the TMP objectives;

17. reviewing proposed changes made by the contractor or project engineer during construction; and

18. evaluating and preparing a report on the successes and failures of the TMP after construction.

81-1.04 Public Relations/Information

For a TMP to be successful, it often requires public involvement and revision of their traveling habits. The following discusses how the public can become informed and involved in the TMP.

1. Public Relations Campaign. It is important that the public be informed initially and be kept informed in a timely manner to ensure that the TMP will work. Consider the following elements of a public relations campaign where significant impacts to traffic are expected.

a. information to news media,
b. television advertisements,
c. radio advertisements,
d. brochures to be passed out to motorists at key locations,
e. information given to motorists at rest areas and welcome centers, and/or
f. contacting local businesses with large numbers of affected employees or customers.

2. Car and Van Pooling. Car and van pooling campaigns may be considered where it could be expected to reduce the number of vehicles through a work zone and where it appears practical to expect a successful campaign.

3. Charter Buses. Charter buses may be considered where it could be expected to draw a large number of users along a corridor and where it can be shown to be more cost effective than other alternates.

4. Transit Incentives. Transit incentives provided to transit customers and companies may be considered where it can be shown to be more cost effective than other alternates.

81-2.0 TRAFFIC CONTROL MANAGEMENT

81-2.01 Terminology

The following definitions are used to define the time length for work zones.

1. Long-Term Stationary Work Zone. A construction, maintenance or utility work site that requires traffic control in the same location and where the activity takes longer than 3 days.

2. Intermediate-Term Stationary Work Zone. A construction, maintenance or utility work site that requires traffic control in the same location and occupies a location from overnight to 3 days.

3. Short-Term Stationary Work Zone. A construction, maintenance or utility work site that requires traffic control in the same location and where the activity takes from 1 to 12 hours.

4. Short-Duration Work Zone. A construction, maintenance or utility work site that occupies a location up to 1 hour.

5. Mobile Work Zone. A construction, maintenance or utility work site that is continuously being moved during the period when work is actively in progress.

81-2.02 Work Zone Type

There are several basic work zone types that may be considered in a TMP. Note that work sites which are completely off the roadway and do not disrupt traffic are not addressed because they will generally not have a major effect on traffic. The following presents a description for each of the work zone applications.

1. Lane Constriction. This work zone type is configured by reducing the width of one or more lanes to retain the number of lanes normally available to traffic. An example of lane constriction is shown in Figure 81-2A. This application is the least disruptive of all work zone types, but it is generally only appropriate if the work area is mostly outside the normal traffic lanes. It should be noted that narrow lane widths may reduce the facility's capacity, especially where there is significant truck traffic. The use of shoulders as part of the lane width will help reduce the amount of lane width reduction that may be required. Where this application is applied for long-term work zones, the current lane markings must be obliterated to avoid motorist confusion. Section 82-3.02 discusses the minimum lane widths that must be provided.

2. Lane Closure. This work zone type closes off one or more normal traffic lanes. A lane closure example is shown in Figure 81-2B. Capacity and delay analyses may be required to determine whether serious congestion will result from lane closures. In some cases, use of the shoulder or median area as a temporary lane will help mitigate the problems arising from the loss in capacity. Upgrading or replacement of existing pavement or placement of temporary pavement may be necessary.

3. One-Lane, Two-Way Operation. This work zone type involves utilizing one lane for both directions of traffic. Figure 81-2C illustrates a one-lane, two-way operation work zone. Flaggers or signals are normally used to coordinate the two directions of traffic. Signing alone may be sufficient for short-term work zones on very low-volume, 2-lane roads. This work zone type is generally only applicable for low-volume roads or short-term work zones. INDOT has developed a computer program WORK, which determines the expected delays and queues for this work zone type.

4. Runaround. This work zone involves the total closure of the roadway (one or both directions) where work is being performed and the traffic is rerouted to a temporary roadway constructed within the highway right-of-way. A runaround example is shown in Figure 81-

2D. This application may require the purchase of temporary right-of-way and usually requires extensive preparation of the temporary roadway.

5. Intermittent Closure. This work zone type involves stopping all traffic in one or both directions for a relatively short period of time to allow the work to proceed. This application is illustrated in Figure 81-2E. After a specific time, depending on traffic volumes, the roadway is re-opened and all vehicles can travel through the area. This application is normally only appropriate on low-volume roadways or during time periods where there are very low volumes (e.g., Sunday mornings).

6. Use of Shoulder or Median. This work zone type involves using the shoulder or the median as a temporary traffic lane. Figure 81-2F illustrates an example of using the shoulder and median. To use this technique, it may be necessary to upgrade the shoulder to adequately support the anticipated traffic loads. This technique may be used in combination with other work zone types or as a separate technique.

7. Crossover. This work zone type involves routing a portion or all of one direction of the traffic stream across the median to the opposite traffic lanes. This application might also incorporate the use of shoulders and/or lane constrictions to maintain the same number of lanes. Examples of crossovers are shown in Figure 81-2G. Section 82-3.0 discusses the geometric design criteria that should be used to develop crossovers. Item 8 below addresses two-way traffic on a normally divided facility.

8. Two-Way Traffic on Divided Facility. This work type involves transferring traffic from a normally divided facility to two-way operations on one roadway. This application requires special consideration in the planning, design and construction phases. This application should only be used if one or more of the following apply.

   a. alternate suitable detours are unavailable or are not cost effective,
   b. the use of temporary lanes or shoulders are impractical,
   c. construction cannot reasonably occur with one lane open,
   d. construction time will be significantly reduced using this option,
   e. all safety issues can be reasonably addressed, or
   f. pavement and shoulder structures can be reasonably upgraded.

   A crossover as discussed in Item 7 above will typically be required for this application. Section 82-6.02 discusses the design issues relative to designing two-way applications (e.g., maximum length). If this application is used, opposing traffic must be separated with positive barriers, drums, cones or vertical panels throughout the length of the two-way operation. Section 83-3.0 discusses the channelization devices that may be used with this layout. One construction technique involves the reconstruction of the shoulder to allow it to be used as a travel lane. When traffic is shifted to two-way operation, the availability of the

shoulder lane as a third lane provides for an improved buffer between the bi-directional traffic and may facilitate emergency access.

9. Detour. This work zone type involves total closure of the roadway (one or both directions) where work is being performed and rerouting the traffic to existing alternate facilities. This application is particularly desirable when there is unused capacity on roads running parallel to the closed roadway. Note that, in addition to maintaining official detours, INDOT may be required to repair a county highway being used as an unofficial detour, per current detour policy.

81-2.03 Work Zone Traffic Control Strategy

Selection of the appropriate work zone type represents one of the most significant elements of a control strategy. Other elements of a control strategy that should be considered include length of the work zone, time of work, number of lanes, width of lanes, traffic speeds and right-of-way. Considering these and other factors, reasonable alternates can be narrowed to a selected few for further review. Typically, only a small number of feasible work zone alternates will emerge for a particular project and, in many cases, only one may be practical. Identification of these alternates at an early stage in the planning process can reduce significantly the analysis effort necessary.

Figure 81-2H provides guidelines for identifying feasible work zone alternates based on roadway type, lane closure requirements, shoulder width, traffic volume, and the availability of right-of-way and detour routes. However, it should be recognized that every work zone location will have a wide variation of conditions and that an all-inclusive selection matrix is not practical.

In using Figure 81-2H, local policy and regulations should be recognized. Many jurisdictions have adopted safety regulations and public convenience policies as safeguards against the unacceptable impacts of work zones. These regulations and policies may impose additional constraints regarding the types of control strategies that can be implemented. Knowing these constraints can help eliminate infeasible alternates from consideration. The public convenience policies or local regulations may specify peak hour restrictions, access requirements, noise level limitations, material storage and handling, excavation procedures, work zone lengths and number of traffic lanes that must remain open.

81-3.0 TRANSPORTATION MANAGEMENT PLAN STRATEGIES

In addition to the traffic control strategies discussed in Section 81-2.0, the following sections provide brief summaries of the various TMP strategies that may be considered during the

development of a TMP. These strategies must be reviewed and adjusted to meet each project location and situation. It should be noted that the strategies discussed in these sections are not all inclusive and that other options may be applicable for the location under consideration.

81-3.01 Construction Phases

How a project is constructed can greatly impact the traffic flow through the work area. The following sections discuss some of the basic construction phases for freeways.

81-3.01(01) Reconstruction by Halves (Sides)

This approach involves the reconstruction of all lanes in one direction while the opposing lanes share the same roadway with traffic in the other direction. This basic concept is illustrated in Figure 81-3A, Reconstruction by Halves (Sides). For 6-lane facilities, traffic is generally restricted to two lanes in each direction. This may require using the shoulders, reducing the lane widths and/or providing minor widening. Under certain circumstances, depending on the median width and shoulder configuration, the inner lane of the two-way operation may not be readily accessible in the event of emergencies. Providing for emergency turnouts and/or emergency vehicle access at appropriate intervals on the segment under construction may be considered. Some advantages and disadvantages of this strategy include the following:

1. Advantages.

    a. It provides an effective work area.
    b. Generally, workers are well separated from the traffic stream.
    c. Work site access can be arranged with minimal interference from the general traffic flow.

2. Disadvantages.

    a. Crossovers are required.
    b. There is a need for positive separation of the traffic streams.
    c. There are potential emergency access problems in the inner lane.
    d. There may be special problems at interchanges with traffic crossing the work zone.

81-3.01(02) Parallel/Adjacent Reconstruction

This approach usually involves a variety of lane closure sequences. A typical sequence of this approach is as follows, which is also illustrated in Figure 81-3B, Parallel/Adjacent Reconstruction.

1. First, the existing shoulders are widened and strengthened.

2. Traffic is shifted to the shoulders to allow construction of the inner lanes and any median reconstruction.

3. Traffic is then shifted to the newly constructed inner lanes to allow reconstruction of the outer lanes.

4. After construction is completed, traffic is returned to the normal travel lanes.

A key advantage of this strategy is that traffic need not cross over the median and does not operate in a two-way operation. Some of the disadvantages include the following:

1. Typically, it provides a more constrained work area for the contractor.
2. Work crews are generally closer to moving traffic.
3. Access to the construction zone typically involves entry and exit from the travel lanes.

For 6-lane facilities, the facility is generally reduced to 2-lanes in each direction and the above sequence is used. When closing the middle lane, it is preferable to keep the two through lanes on the same side of the construction zone (e.g., by using the shoulder) versus splitting the two lanes on either side of the construction zone.

81-3.01(03) Serial/Segmental Reconstruction

This strategy consists of permitting only short segments of the facility to be under construction at one time. This also requires one or more of the other concepts for traffic accommodation. An example of this application may include a bridge deck replacement where each segment can be completed within a 12-hour time period. This concept is illustrated in Figure 81-3C, Serial/Segmental Reconstruction.

The advantages of this approach include relatively short work zones and few, if any, interchanges are impacted at any one time. One of the more serious disadvantages of this strategy is that the overall time period that the facility is under construction may be lengthened considerably because the construction for each segment will proceed independently. Therefore, the exposure to the potentially hazardous conditions of a work zone for both the traveling public and the work force may be substantially greater than could be the case with one of the other strategies.

81-3.01(04) Complete Closure

In some circumstances, complete closure of the facility or closure of one direction of travel may be an effective strategy. This strategy may also be effective for only certain hours of the day (e.g., 8 p.m. to 6 a.m. on weekdays and from 8 p.m. to 8 a.m. on weekends). Some of the advantages and disadvantages of this strategy include the following:

1. Advantages.

    a. Increases the safety for construction workers.
    b. Generally provides cost and time savings.
    c. Reduces the overall travel impacts to the public due to reduced construction time.

2. Disadvantages.

    a. Potentially significant short-term travel impacts to the public.
    b. Potential increase in traffic congestion on other routes.
    c. May need to construct a detour/runaround.
    d. Potential adverse impact on businesses due to trip suppression (not enough traffic).
    e. Potential adverse impact to businesses on alternate routes (too much traffic).

81-3.01(05) Combinations

Often, a combination of construction sequences is the best strategy. For example, reconstructing existing shoulders prior to the initiation of parallel construction activities. The following sequence of construction could be as follows:

1. Phase A. Reconstruct shoulders as appropriate to allow one side of the roadway to accommodate four lanes.

2. Phase B. Shift traffic to the four available lanes on one side of the roadway.

3. Phase C. Shift traffic to the newly constructed side of the roadway using the additional reconstructed shoulder lane.

Other combination type construction sequences involve the reconstruction of interchanges where both sequential and parallel activities may occur simultaneously. Ramps are typically reconstructed in a sequential arrangement, involving closure during construction with temporary detours to adjacent or alternate freeway access points.

81-3.02 On-Site Strategies

81-3.02(01) Traffic Control Devices

The following are several traffic control device applications that may be considered when developing a TMP.

1. Changeable Message Signs. These devices may be used where static sign messages are not sufficient to handle the changing conditions of a work zone (e.g., lane closures, ramp closures, to advise motorists of conditions for which they will need to possibly react).

2. Additional Informational Panel Signs. These signs may be used to give the motorist additional information about a work zone. The message on these signs should be pertinent to the likely conditions the motorist will encounter.

3. Signal Interconnect. Consider interconnecting traffic signals where the benefit of moving traffic through a work zone more efficiently would be enhanced by adding interconnection between the traffic signals on the system.

4. Signal Timing. Traffic signal timing changes should be considered for all traffic signals within a work zone for which capacity improvements can be gained. Adding or deleting of signal phases may be required for changes in travel patterns.

5. Highway Advisory Radio. Consider using highway advisory radio where changing work zone conditions make it important to give the motorist a longer, more accurate message than could be obtained through the use of signs or other means. This option requires additional information and signing to alert motorists.

6. Temporary Work Site Speed Limit Signs. A reduced regulatory speed limit may be warranted where work activity may constitute a hazard to traffic, especially for lane closures. The *Indiana Statutes* permit INDOT to establish reduced work site speed limit without an official action. Section 83-2.03 presents the criteria for establishing speed limit signing in construction zones.

7. Flashing Arrow Signs. In construction areas, flashing arrow signs are used to supplement conventional traffic control devices. They are typically warranted where additional warning and directional information is required to assist in merging and controlling traffic through and around the work activity. Section 83-2.07 provides additional guidance for the use of flashing arrow signs in construction zones.

81-3.02(02) Capacity

Each construction site will affect the capacity of the existing facility. The extent the roadway is occupied for work and safety purposes will determine the number of strategies required to compensate for the loss of capacity. Some of the following capacity strategies may be considered when developing a TMP.

1. Temporary Parking Restrictions. One option to increase capacity is to restrict on-street parking which can be used to add an additional lane or to reduce traffic conflicts. However, the concerns of on-street parking for local businesses must be addressed. These restrictions can be during peak periods or for 24 hours/day.

2. Restriction of Trucks. Restriction of trucks may increase the facility's capacity. However, consideration must be given to local and/or State ordinances and the availability and suitability of alternate routes that the restricted trucks would be required to take.

3. Turn Restrictions. Turn restrictions should be considered where it may be necessary for capacity and/or safety reasons. The turn restrictions can be at intersections and/or driveways. Turn restrictions can be during peak periods or for 24 hours/day.

4. Reversible or Contra-Flow Lanes. Consider the use of reversible or contra-flow lanes where there is a strong peaking traffic distribution. The use of these lanes may be limited in use due to the cost of providing and maintaining the daily changes required. There also may be safety considerations which will need to be evaluated if reversible lanes are contemplated.

5. High-Occupancy Vehicle (HOV) Lanes. HOV lanes may be considered where dedicated lanes for high-occupancy vehicles are available and it is desired to discourage use of single-occupancy vehicles. The use of HOV lanes can be during peak periods or for 24 hours/day. Due to the lack of driver familiarity with HOV lanes in Indiana, it is unlikely that the use of HOV lanes will be appropriate.

6. Ramp Metering. Ramp metering may be considered where it is necessary to restrict the amount of traffic entering a freeway for capacity and safety reasons. Ramp metering may be used during peak periods or for 24 hours/day. The impact of ramp metering on an intersecting road will also need to be considered (e.g., traffic backup).

7. Six-Lane Facilities. Where three lanes cannot be maintained in both directions, determine if three lanes can be provided in one direction with two lanes in the other direction.

81-3.02(03) Other

In addition to the above sections, the following provides several other on-site strategies that may be considered when developing a TMP.

1. Ramp Closures (Short/Intermediate Term). Short- or intermediate-term ramp closures may be necessary for construction purposes. If closures are required, additional signage will be necessary to forewarn the motorist. It is recommended to post signs on the affected ramp two weeks in advance to advise motorists of the closure date(s) and/or periods of the day the ramp will be closed.

2. Ramp Closures (Long Term). Long-term ramp closures may be necessary to construct or to improve traffic flow on the mainline road. Local access and business impacts should be considered before deciding on a long-term ramp closure. Also consider the user costs for a detour route and the capacity and safety impact of the detour route. Two adjacent ramps should not be closed at the same time unless necessary for safety reasons.

3. Incident Management. Consider the use of on-site tow trucks for freeway work zones with limited or no shoulders available. They should also be considered where an accident or break-down would seriously impact the roadway and cause significant backups and delays.

4. Special Materials. Examine the use of fast track concrete, precast items or other special materials where traffic restrictions must be minimized (e.g., ramps, intersections).

5. Lane Rental by Contractor. In this application, a contractor formulates its bid around the number of hours that it expects to keep a number of lane-miles closed and, then, can make or lose money if the actual number is higher or lower than the bid. This concept has not had wide spread use in Indiana.

6. Police Patrols for Speed Control. Police patrols in work zones may be required to ensure vehicular speeds are at or below the posted speed or for other safety reasons. Because this requires a special funding mechanism and special provisions, the designer will need to coordinate this with the Operations Support Division.

7. Incentives/Disincentives. Consider adding incentive/disincentive provisions to minimize the time a facility may be affected by construction. Section 81-3.05 discusses when incentive/disincentive provisions should be considered.

8. A + B Bidding. When the impact of the construction on traffic is significant, the designer should consider using the A + B bidding incentive. Section 81-3.06 provides information on A + B bidding.

81-3.03 Off-Site Strategies

Where construction will significantly impact the traffic flow away from the work zone, the following off-site strategies may be considered in the TMP.

1. Advance Informational Panel Signs. These signs may be used to give the motorist additional information about a work zone that is ahead or on a different route. These signs should be considered where it is advantageous to give this information to a large number of motorists or where it is necessary to inform motorists of an alternate route to avoid a congested work zone.

2. Changeable Message Signs. These devices can be used to give the motorist information needed to be prepared for upcoming changing conditions or information about how to avoid a condition. These devices may be considered where static messages are generally not appropriate.

3. Signal Interconnect. Consider interconnecting traffic signals where moving traffic through an alternate route corridor more efficiently would be enhanced by adding interconnection between traffic signals on the alternate route system.

4. Signal Timing. Traffic signal timing changes for all traffic signals on an alternate route may be necessary due to the added traffic expected to use the route. Additional phases may be necessary to accommodate the expected traffic flows.

5. Capacity Improvements. Additional improvements on the alternate route may be necessary for capacity reasons to handle the expected diversion of traffic. Examples of capacity improvements include additional pavement widths, adding turn lanes, removal of parking, turn restrictions and truck restrictions.

6. Trailblazing to Attractions and Points of Interest. Trailblazing may be necessary to guide motorists to attractions and points of interest in those circumstances where the normal route is closed or seriously restricted, or where an alternate route to the attraction or points of interest would assist traffic through the work zone.

81-3.04 Scheduling

Project scheduling can greatly affect the overall success of the TMP. For example, restrictive scheduling may be required to facilitate the opening of a highway prior to a special event. When determining a construction schedule, the following should be considered.

1. Short Schedule. A schedule to minimize construction activities and disruption to traffic may be required if motorist user costs are expected to be excessive. However, short schedules may increase the cost of the project.

2. Longer Schedule. A longer schedule of construction activities may be cost effective if it does not significantly increase the adverse impact to the motorists. The contractor may offer to provide a lower price for a longer schedule.

3. Time of Day / Day of Week Restrictions. These types of restrictions may be necessary if the work zone capacity would not accommodate the expected demand during the peak periods and other measures are not as cost effective. For example, night work may be required to allow longer work hours than can be provided between morning and afternoon peaks and to decrease the excessive traffic delays or congestion associated with lane closures during the daytime.

4. Project Staging. Project staging or completing smaller portions of a construction project one portion at a time may be necessary to limit disruption to traffic. However, construction activity in the same area over several seasons should be discouraged.

5. Combining with Other Work. Projects within a corridor may be combined or scheduled at the same time where practical, pending available funding, to minimize impacts to the motoring public.

81-3.05 Incentive/Disincentive Justification

Incentive/disincentive provisions are used to minimize the time a facility may be affected by construction. The contractor is provided additional funds if the project is completed early or is assessed damages if the project is not completed on time. Due to administrative concerns of implementing this clause, limit incentive/disincentive provisions to projects that have one or more of the characteristics as follows:.

1. high traffic volumes, generally found in urban areas,
2. completes a gap in the highway facility,
3. severely disrupts traffic or highway services,

4. significantly increases road user's costs,
5. significantly impacts adjacent neighborhoods or businesses,
6. replaces a major bridge that is out of service, and/or
7. includes lengthy detours.

Figure 81-3D consists of the Department's worksheet for determining the appropriate incentive/disincentive amount. An editable version of this form may also be found on the Department's website at www.in.gov/dot/div/contracts/design/dmforms/. The designer should note that, due to the time required for the Central Office to process the incentive/disincentive request, this justification should be forwarded to the Contracts and Construction Division's Contract Services Manager as soon as practical.

81-3.06 A + B Bidding

Where the impact of the construction zone work site is significant, A + B bidding incentive may be used to encourage the contractor to minimize these impacts by reducing the exposure time. A + B bidding consists of two parts as follows:

1. Part A. The total dollar amount to complete the work.

2. Part B. The total dollar amount based on peak and non-peak lane closure periods and the total contract days proposed by the contractor to complete the work.

Part A is determined using the contractor's unit prices and the estimate of quantities determined by the Department. Part B is established by adding together the costs for each of the following:

1. Peak lane closure periods = (No. periods) x (cost / lane / period)
2. Non-peak lane = (No. periods) x (cost / lane / period)
3. Contract days = (No. days) x (cost / day)

The contractor is required to estimate the number of periods the facility will be closed during peak and non-peak hours and the overall number of calendar days required to complete the contract. The cost for each of the above items is determined by the Department and is the same for all bidders.

A + B bidding is only used for comparison purposes to determine a successful bidder. It is not used to determine payments to the contractor. A + B bidding is commonly used in conjunction with incentive/disincentive clauses discussed in Section 81-3.05. Before adding the A + B bidding special provision to a contract, the designer should coordinate its use with the Operations Support Division and the district construction engineer.

81-4.0 COST-EFFECTIVE ANALYSES

81-4.01 General

For many projects, there may be more than one option that will address the problem of traffic during construction. To determine the most appropriate option, the user will need to compare the benefits and costs of each to determine the most appropriate option. Chapter Fifty provides information on economic analyses relative to benefit/cost analysis and safety cost analysis. The user should review Chapter Fifty in conjunction with the following sections to determine which option will be the most cost effective.

Some projects may not have alternate methods of maintaining traffic. In these cases, the user cost calculations will generally not be required. However, for projects with incentive/disincentive clauses, the user costs must still be determined.

There are several computer programs available which the designer may use to determine the cost effectiveness of the various options and alternates. For freeways, INDOT typically uses the QUEWZ program. The Department's application of this program is further described in Section 81-4.03.

81-4.02 Cost Evaluations

81-4.02(01) On-Site

When determining the cost for on-site options (e.g., runarounds, lane closures, shoulder use), the designer needs to consider the following:

1. right-of-way costs (temporary and permanent),
2. additional construction costs,
3. effect on wetlands,
4. vehicular delay,
5. user costs (including detour user costs),
6. accident potential, and
7. driving time.

When determining the effect of each on-site option, the designer also needs to consider the effect the selected option will have on unofficial detours (i.e., detours which drivers select on their own to

avoid the construction area). The designer should refer to the current INDOT Detour Policy in regard to the unofficial local detours.

81-4.02(02) Detours

For all official detours and unofficial detours, the designer must determine the total cost of the detour. Unofficial detours are those routes which the driver selects on his or her own to avoid delay or the construction work areas. To determine the daily detour user costs, use the following equations:

1. Detour User Cost = (Cost in Lost Time) + (Cost in Extra Distance Traveled)

2. Cost of Lost Time = (No. of vehicles detoured) x (increase in travel time per vehicle, h) x (value of motorist's time)

3. Increase in travel time = (length of detour, mi / average detour travel speed, mph) - (length of the construction zone, mi / average travel speed through the construction zone, mph)

4. Cost in Extra Travel Distance = (net increase in length of travel, mi) x (vehicle operating expense),

   Where:

   The net increase in length of travel distance is the difference between the detour and non-detour distances.

   The value of motorist time not only considers lost wages but also lost free time. A value from $10 to $15 per hour is typically used.

   The vehicular operating expense includes fuel, maintenance, and depreciation costs, and is typically set at $0.25 per mile.

In addition to the above detour user costs, the designer must add the cost for any improvements needed to the detour route (e.g., repaving, pavement widening, signal improvements). The designer should also consider the effect the detour will have on the community and local businesses.

<u>81-4.03 QUEWZ Program</u>

On freeway projects, the Department uses the computer program QUEWZ to determine the queues and user costs that are associated with work zone lane closures. Based on the type of lane closures, traffic volumes, time schedules, etc., the program will provide the user with the expected queue length and estimated user costs. The Environment, Planning and Engineering Division's Environment Assessment Section may use this program during the preliminary engineering stage to compare the various options. The designer may use this program to ensure the proposed traffic control plan is still cost effective. The program user should review the user's manual to determine how to use the program.

81-4.03(01) Inputs

The user must provide inputs into the program as follows:

1. lane closure configurations,
2. the schedule of work activities (e.g., work activity hours, lane constriction hours), and
3. the traffic volumes approaching the freeway segment.

The program provides default values for the following:

1. cost update factor,
2. percentage of trucks,
3. speeds and volumes at various points on a speed-volume curve,
4. capacity of a lane in the work zone,
5. maximum acceptable delay to motorist, and
6. critical length of queue.

To obtain meaningful results, the designer should consider revising the default values to meet the site location. For example, it should be noted that the program assumes that for queues longer than 20 minutes that some drivers will divert. To account for actual queues and the corresponding user costs, the designer may need to adjust the 20-minute time frame to meet the project situation. The designer should review the user's manual to determine if the default values are applicable to the location under consideration.

81-4.03(02) Outputs

QUEWZ has two output options: road user cost and lane closure schedule. The road user cost output option analyzes a specified lane closure configuration and schedule of work activities and provides estimates of traffic volumes, capacities, speeds, queue lengths, diverted traffic and

additional road user costs for each hour affected by the lane closure. The lane closure schedule option summarizes the hours of the day when a given number of lanes can be closed without causing excessive queuing.

In addition to the values obtained from the program, supplemental user cost calculations may be required where changes are expected based on existing traffic patterns and volumes. Supplemental calculations for detours are typically required where an exit or entrance ramp within the construction zone (including those using crossovers) will be closed and where the designer judges that the QUEWZ program is not properly estimating the full amount of diverting mainline traffic.

Experience has shown that additional detour user cost calculations should be conducted for the following:

1. Where exit ramps are closed. Experience has shown that most or all of this traffic will divert from the mainline before the construction zone. Therefore, the exit ramp volumes should be deleted from the input mainline volumes before using QUEWZ and appropriate detour calculations performed.

2. Closed entrance ramps may or may not lead to changes in the input values for QUEWZ. Additional detour calculations will be required for any expected diversions.