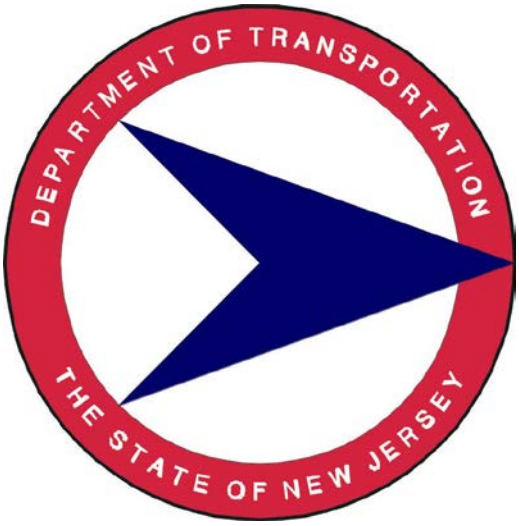
New Jersey Department of Transportation



Traffic Mitigation Guidelines

2014

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Section 1 – Introduction

1.1 Purpose and Benefits of Traffic Mitigation Actions

The Department is committed to providing a network of transportation facilities that enables New Jersey residents, workers, and visitors to move efficiently within and through the State. Developing and maintaining a Statewide transportation network requires that the Department periodically upgrade and improve these facilities through construction projects. The Department's first priority is to complete these projects in a timely and cost-efficient manner. The Department recognizes, however, that construction projects inconvenience motorists traveling through the construction corridors and disrupt businesses located nearby, in some cases resulting in substantial user costs.

The safe and efficient flow of vehicles, pedestrians, and bicyclists through roadway construction areas has long been a concern to the Department for its impact on construction operations. Its importance has intensified as motorists, frustrated with the "normal" levels of congestion they face on ordinary days, have begun to complain about the inconvenience and costs of additional delays caused by roadway reconstruction activities. In addition, businesses complain that nearby construction activities negatively affect their operations and sales.

Traffic mitigation (TM) strategies offer benefits to the public, the Department, and other State and local agencies involved in construction projects. TM strategies can improve the flow of traffic through the construction area and along detour routes, minimizing the disruption to motorists and businesses. TM strategies can educate the public about the purpose of and plans for construction projects, helping to reduce citizen complaints and build goodwill for the Department. TM strategies also can encourage motorists to use transit and other alternate modes and educate travelers about the benefits of these modes. Some strategies support efficient and timely completion of construction projects, offering cost savings to the Department and minimizing the duration of disruption for motorists. Finally, TM strategies can reduce the number of incidents in construction corridors via speed incident detection and emergency response to reopen the route.

The Department has an interest in realizing traffic mitigation benefits for both itself and the traveling public whenever it is feasible and cost-effective to do so. However, it is difficult to eliminate all construction-related disruption. These Traffic Mitigation Guidelines help provide a customer-oriented approach to the implementation of roadway improvements.

1.2 Development Process of the Traffic Mitigation Guidelines

These Traffic Mitigation Guidelines were developed following a three-step research process. First, individual and group meetings and interviews were conducted with staff of divisions with an interest or potential role in TM activities, including, but not limited to:

- Division of Project Management
- Division of Project Planning and Development
- Bureau of Traffic Operations
- Bureau of Traffic Engineering
- Bureau of Statewide Planning
- Bureau of Capital Program Support
- Office of Communications

- Office of Community Relations
- NJ Transit

The purpose of these meetings was to explore the TM needs of the divisions, identify their existing TM responsibilities and approaches, identify any proposed efforts by the divisions to expand TM activities or improve TM planning, discuss opportunities to address TM within the current project development process, and identify other processes that would increase the visibility of TM in project development.

Second, the CPM Procedures Manual and other existing internal documents were reviewed to identify existing application of TM and possible additions that could facilitate more comprehensive consideration and application of TM. Third, the experience of other state transportation departments with TM planning and implementation was reviewed.

Following the meetings and review of documents, all divisions agreed that additional written TM guidelines could be useful to the divisions involved in these activities by establishing a formal procedure for integrating TM into project development and serving as a single source summary for how traffic mitigation is considered at each stage of the project planning process. It was agreed that it would be appropriate to prepare a stand-alone TM procedures document that would supplement the CPM Procedures Manual. The guidance would be distributed to all the divisions that have a role or interest in traffic mitigation as an overall framework for integrating traffic mitigation with existing project development activities.

It is expected that individual divisions, offices, and bureaus will develop additional instructions to guide their staff in the proper application of TM procedures and responsibilities established for their units. Additionally, it is anticipated that the information in this document would be referenced in the CPM Procedures Manual and addressed in tools used in the project development process, such as Quality Assurance Checklists, Project Scoping Checklists, Quality Assurance and Constructability reviews, Constructability Checklists, and Construction Progress Schedules.

1.3 Objectives of the Traffic Mitigation Guidelines

This document presents guidance for consistent and comprehensive consideration of traffic mitigation strategies for roadway reconstruction projects implemented by the Department. The objectives of the Traffic Mitigation Policy and Procedures and Guidelines are to:

- Balance the Department's need to minimize roadway construction costs with the need to minimize construction-related inconvenience for motorists and other stakeholders
- Ensure that traffic mitigation needs are addressed systematically and consistently in all projects
- Provide adequate lead-time for Departmental staff and outside partners charged with implementing traffic mitigation strategies to prepare for their responsibilities
- Maintain high visibility for TM throughout project planning and design
- Ensure that funding for traffic mitigation is considered early in the planning process and is programmed with design and construction monies
- Clarify roles and responsibilities for TM

These objectives will be accomplished through the implementation of a formal procedure for considering TM needs and options. This procedure will include the following activities, which are defined further in later sections of this document:

- During Concept Development, identify projects needing TM and the specific TM challenges of those projects
- In Feasibility Assessment, define an appropriate level of TM needed for each project, based on the expected impacts to road users and businesses, in terms of the expected delay during construction and other factors
- In Preliminary Design, select and document a set of TM strategies that are likely to meet traffic mitigation goals within TM cost guidelines established for the project
- Develop a draft TM implementation plan for the project
- Refine the initial set of TM strategies and the implementation plan as the project becomes more clearly defined through Final Design
- Finalize the TM plan as design nears completion
- Implement and evaluate the TM plan

The steps outlined above will involve many NJDOT units and outside parties whose expertise is needed or is beneficial for the development and implementation of TM programs. Traffic mitigation can be multi-faceted, multi-disciplinary, and multi-jurisdictional. These guidelines account for the fact that there is a complex interaction of strategies and partners and provide for coordination and communication among internal and external parties.

1.4 Organization of Traffic Mitigation Guidelines

The balance of this document is divided into five major sections following this introduction:

Section 2: Analysis of Need for Traffic Mitigation – Describes a process to assess the level of TM needed for a project and estimate order of magnitude costs for TM

Section 3: Guidelines for Selecting Traffic Mitigation Strategies – Presents a menu of TM strategies and indicates strategies that are appropriate and indicated for various project characteristics.

Section 4: **Integration of Traffic Mitigation Within the Existing Project Development Process** – Describes the approach to integrating TM within project development

Section 5: Traffic Mitigation Documentation – Describes components of and responsibilities for various TM documents

Section 6: Monitoring and Evaluation – Presents suggested evaluation measures and procedures for monitoring and evaluating the effectiveness of TM activities

Section 7: State-Level Procedures – Presents procedures that were created in response to the FHWA Work Zone Rule that identifies three strategic components: Policy, State-Level Procedures, and Project-Level Procedures.

Section 8: Project-Level Procedures – Presents procedures that were created in response to the FHWA Work Zone Rule that identifies three strategic components: Policy, State-Level Procedures, and Project-Level Procedures.

Section 9: Work Zone Safety and Mobility Policy – Presents policy created in response to the FHWA Work Zone Rule.

Section 10: Additional Resources – Presents websites providing examples and fact sheets.

Section 2 – Analysis of Need For Traffic Mitigation

2.1 Decision Process

Traffic mitigation decisions are, by necessity, made on a case-by case basis. Each project is unique. The extent and types of traffic mitigation strategies selected for a project will be determined by the characteristics of the project and the site in which it will be located. Additionally, some projects offer special traffic mitigation challenges and some strategies will be better able than others to accomplish these needs.

Some projects cause little disruption to motorists and will need nothing more than modest signage to inform motorists that construction is ahead. Other projects, especially those for which substantial travel delays are expected, might require numerous TM strategies, including strategies that divert traffic to alternate routes, provide new travel options, inform a wide audience of travelers about the construction, or alter construction procedures.

This section describes the types of project characteristics that can influence TM decisions and offers guidance on how to determine the general level of TM needed for a project and to estimate an order-of-magnitude TM cost. Following this section, guidance is presented for choosing individual TM strategies.

2.2 Project Characteristics Relevant to Traffic Mitigation

The number and mix of strategies included in a traffic mitigation program will depend on many factors, including the scope and duration of the project, the volume of traffic currently using the roadway, characteristics of the construction site, the construction activities that must be accomplished, and the travel alternatives available to motorists. A package of strategies must be chosen that will address the specific challenges for that project.

Many project characteristics could influence the need for traffic mitigation and the extent and type of traffic mitigation strategies chosen. Several characteristics are considered to be especially important. These include characteristics related to the level and type of impacts the project is likely to cause to motorists and to members of the community in which the project is located. These primary characteristics should be examined early in the TM process

Primary TM Project Characteristics

- Road User Cost of Staging
- Impacts to retail business
- Impacts to neighborhoods
- Impact on military and emergency response
- Impacts on access to major activity centers or employers
- Impacts on local/developer projects
- Constructability
- Political sensitivity

Other characteristics have a less direct relationship to TM but also might be useful to examine to help identify specific TM strategies that could be useful to implement. These secondary characteristics include the following:

Secondary TM Project Characteristics

- Duration of construction (months)
- Number of major construction stages
- Lane and ramp closures
- Type of roadway – Interstate, State, major arterial
- Average daily traffic (ADT) volume
- Seasonal recreational traffic volume increase
- Expected delay (vehicle hours per day) or queue length (miles)
- Distance covered by the project
- Level of urbanization in the construction area
- Proportion of trucks in the traffic mix
- Extent of public/media exposure
- Nearby projects – influence and impact
- Maintenance considerations
- Holidays and schools

2.3 Primary TM Project Characteristics

Road User Cost

Road user cost (RUC) is an economic measure of the impact of construction on motorists. It is calculated as the added vehicle operating costs and delay costs borne by highway users as a result of construction projects. These costs are a function of the timing, duration, scope, and characteristics of the construction project, and the volume and operating characteristics of the traffic affected. Road user cost is important in TM because it helps to define an appropriate expenditure for TM activities. A high RUC suggests a greater investment should be made in TM. But RUC also sets an upper limit for the TM investment. In general, the total cost of TM should not exceed the total RUC.

2.3.1 Impacts to Retail Businesses

Some construction projects will have a direct impact on retail businesses because they may make the businesses inaccessible, reduce parking areas, or divert traffic away from the business's locations. Roadway signage can be used to promote these businesses and indicate how they can be accessed. Construction strategies and some traffic control and operations strategies need to be particularly well-planned when businesses are affected, but strategies that reduce the duration of construction could be very appropriate.

2.3.2 Impacts to Neighborhoods

Construction projects also can create significant problems for residents in neighborhoods near the construction area. As for business, construction can hinder access and reduce parking. Construction strategies and some traffic control and operations strategies that minimize the flow of traffic through the area and/or reduce the duration of construction could be very appropriate.

2.3.3 Impacts on Military and Emergency Response

Construction projects can disrupt the ability to respond to emergencies. This should be considered when developing traffic staging plans, temporary detours, or changing access to residential and business areas.

2.3.4 Impacts on Access to Major Activity Centers or Employers

Construction areas that pass through or near major activity centers or employment areas can create substantial traffic back-ups, especially at peak travel times. Generally, the more commercial centers and employers are affected by construction, the more TM planning should emphasize public information, construction strategies, alternate routes, and Travel Demand Management (TDM). TDM strategies, such as rideshare incentives, transit improvements, and Park & Ride lots should receive emphasis when they can be targeted to major employment centers.

2.3.5 Constructability

Key characteristic which must be considered early on is the ability to construct a project in the manner envisioned. Soliciting input early on from individuals with construction expertise and the ability to consider abstract ideas in three dimensions are necessary to ensure that the project can be built as planned.

2.3.6 Political Sensitivity

Projects with high political sensitivity include those in which lawsuits are underway or threatened, or where political leaders and interest groups are taking highly visible positions either for or against the project. These projects require special emphasis on public information and motorist information. They also might require attention to alternate routes and lane and ramp closures proposed for the construction. Additionally, legislative offices should be kept informed of project progress through legislative liaisons and fax networks.

2.4 Secondary TM Project Characteristics

2.4.1 Duration of Construction (months)

The length of time construction is expected to last has a significant impact on both the extent of TM and the types of strategies chosen. Long projects generally can need and can justify a greater number of strategies and more aggressive strategies than can short-duration projects. Although capital improvements might be justified if they provide permanent improvements, large scale and capital intensive strategies are generally used only for large projects.

2.4.2 Number of Major Construction Stages

A multi-staged project can create frequent changes in the availability of and accessibility to the roadway, leading to motorist confusion. This suggests a greater emphasis on public and motorist information about scheduled lane and ramp closures. Multi-stage projects also might be appropriate for construction strategies, alternate route, and TDM strategies.

2.4.3 Lane and Ramp Closures

The need to close lanes or ramps can increase construction delay significantly. The greater the loss of capacity, the more TM will be needed. In these cases, strong consideration should be given to detours, incident management, and motorist information. Public information about the closures also should be considered to give motorists advance notice of the changes.

2.4.4 Type of Roadway

Interstates and State expressways typically warrant more extensive TM than do other roads because of their high traffic volume and critical function in the roadway network. The need to complete construction quickly while maintaining traffic flow suggests strategies that reduce the duration of construction as well as incident management strategies. Because more of the traffic on these roads comes from beyond local areas, motorist information also is likely to be important.

2.4.5 Average Daily Traffic Volume

The traffic volume (24 hour/7 day) through the corridor has an important influence on the level of TM needed. In general, the higher the volume, the more motorists affected, the greater the total cost of delay, and the greater the justification for TM investment. High volumes suggest the use of incident management, TDM, detours, and public information strategies.

2.4.6 Seasonal Traffic Volume Increase

Some highways experience significant increases in travel during certain seasonal recreational periods. If construction is scheduled on these roads during seasonally high volume times, more extensive traffic mitigation strategies could be required than during the lower volume time period.

2.4.7 Expected Delay (vehicle hours per day and per project duration) or Queue Length (miles)

Delay is a significant TM characteristic because it is a key measure of the degree of disruption to motorists. Experience suggests that some of the least costly TM strategies for reducing delay over the project period include incident management and contract incentive/disincentive strategies.

2.4.8 Project Distance (miles)

The length or breadth of the project can influence the types of traffic mitigation strategies chosen. Projects that extend over a large geographic area might warrant the use of detours and broad-based public information.

2.4 9 Level of Urbanization

The level of urbanization frequently is related to the ADT for the roadway. Projects in highly urban areas generally warrant higher levels of TM than do projects in suburban or rural areas and offer opportunities to implement broad-based public information, such as radio ads; this outreach is effective because the proportion of traffic that is local is usually high, and motorists can be reached relatively easily with print and electronic media. TDM strategies, such as additional transit and Park & Ride lots, also are more likely to be useful in urban areas where population densities are greater.

2.4.10 Significant Truck Volume

Projects with significant truck volumes can increase the need for TM because they increase vehicle delay. Where truck traffic will be heavy, attention should be focused on construction and detour strategies to divert trucks and on incident management strategies that have the capacity to handle large trucks and load spills. The volume of trucks also can affect the use of and selection of alternate routes.

2.4.11 Public and Media Attention

Some projects will attract considerable public and media attention because of the project location, duration, and expected delay. These projects deserve special attention to public information, motorist information, and incident management.

2.4.12 Nearby Projects

Consideration of construction planned for parallel routes or other projects in the vicinity is needed. The use of common detour routes may be problematic, so too the exponential increase in congestion caused by two projects along the same corridor.

2.4.13 Maintenance Considerations

Snow removal, mowing, and other maintenance duties during construction may complicate projects and detract from the overall traffic mitigation strategy.

2.4.14 Holidays and Schools

A special effort should be made to safeguard school bus routes, school crossings, and other needs of school children. Holiday shopping may impact traffic in the corridor and should be considered in the overall traffic mitigation strategy.

2.5 Level of Traffic Mitigation Appropriate To or Indicated By Project Characteristics

As a general rule, the extent of expected delay and RUC will be determining factors in the requisite TM level. They are fundamental TM measures because they capture the impacts of other variables, such as the traffic volume, length of construction, and proportion of trucks in the vehicle mix. Frequently, several of the characteristics described above will appear together in a project. For example, long duration projects often are completed in stages and result in extensive cumulative delays; projects on high volume roads often result in long delays; roads in highly urbanized areas generally carry high traffic volumes; and projects with high impacts to businesses/employment centers might be associated with political sensitivity. When multiple TM challenges exist, the level of TM likely should be elevated.

In order to best assess traffic impacts, accurate and current traffic data is needed. As such, the Division of Project Planning and Development (DPPD) will acquire 24 hour weekday and weekend truck/car counts for the project area. These should include mainline volumes and, if applicable, side street volumes at signalized intersections and detour routes. Turning movements at key intersections and interchanges shall be provided for peak hour periods. This data shall either be created by, or forwarded to, the Bureau of Transportation Data Development (TDD) which shall maintain a centralized data base of all traffic volume counts.

The evaluation of traffic volumes through various work zone capacities and detour routes will help the Designer understand traffic impacts associated with various lane closure alternatives. The Designer will evaluate the alternatives, on a 24 hour basis, to determine when there will be queues. **Exhibit 1** shows a sample capacity versus demand chart.

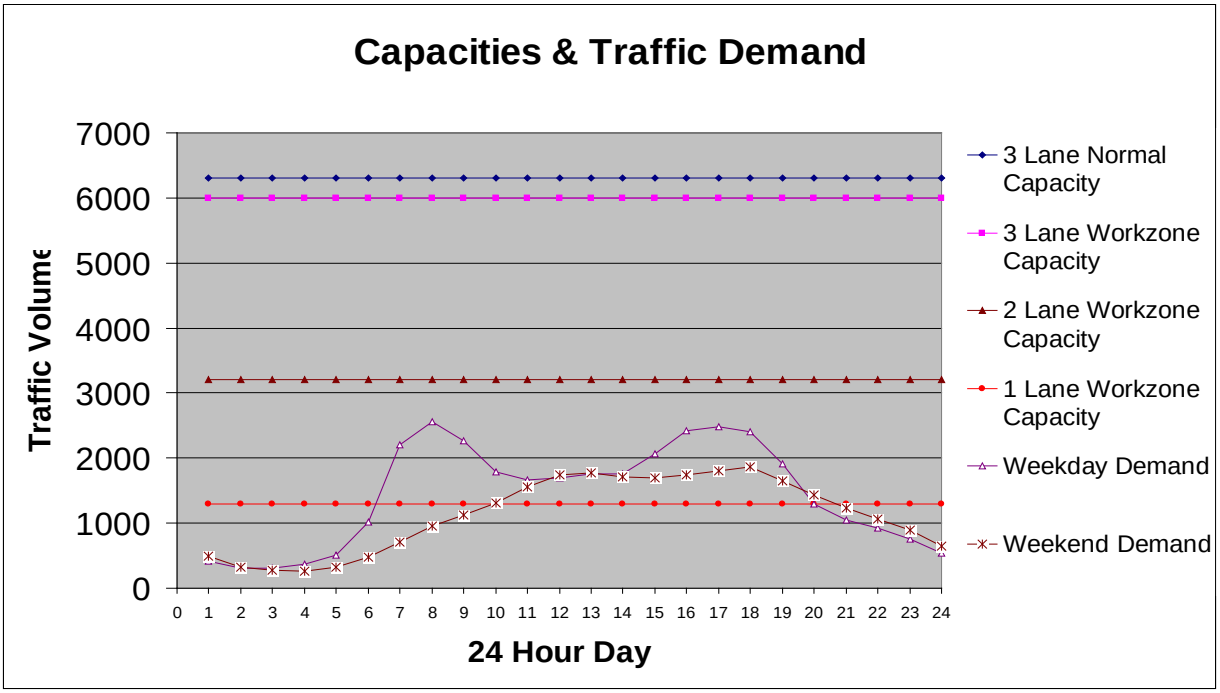


Exhibit 1

For evaluation of detours, the detour length and delay times shall be provided by the Designer. The NJDOT Road User Cost Manual provides greater detail in these matters.

The number of lanes available in a work zone plays a significant role in the work zone capacity. Work zone capacity charts are in the NJDOT Road User Cost Manual. Basic Work Zone Staging Scenarios in the manual provide the Designer with the ability to quickly evaluate minimum width requirements for various lane closure scenarios.

High impact projects are those projects that have traffic demands that exceed work zone capacities for a period of more than six hours per 24 hour day.

Moderate impact projects are those projects that have traffic demands that exceed work zone capacities for a period of zero to six hours per 24 hour day.

Low impact projects are those projects that have traffic demands that do not exceed work zone capacities during any time of the 24 hour day.

The Department recognizes the public does not like to experience traffic delays due to construction. Therefore, the Department should include an alternative that introduces no traffic queues (i.e. volumes are less than capacity) in its evaluation matrix. Common methods to avoid queues are modifying the allowable lane closure hours and utilizing shoulder areas as temporary lanes.

In the absence of accurate traffic data or in addition to the quantitative impact analysis, traffic impacts can also be assessed qualitatively.

Exhibit 2 provides a worksheet that may be used as a tool to identify impact level for a particular project. It provides space to note details for the primary project characteristics and to note secondary characteristics that might be important in selecting TM strategies.

The worksheet also includes a column to indicate the project level suggested by each characteristic individually and defines an overall project impact level drawn from the combination of the levels for various project characteristics. If many of the characteristics, or even a few of the primary characteristics, suggest the project has high impacts, the project likely should be classified at the higher level.

Not surprisingly, as the level of impact of the project increases, the level of TM needed and its likely cost also will increase.

Exhibit 2

Preliminary Traffic Mitigation Impact Worksheet

Project: _____	Overall Impact Assessment _____

Project Characteristic	Project Data (QUALITATIVE)	Project Impact Level
Primary Project Characteristics		
Road user cost		
Retail business disruption		
Neighborhood disruption		
Disruption to employers/activity		
Political sensitivity		
Impacts of local/developer projects		
Secondary Project Characteristics		
Duration of contract		
No. of construction stages		
Capacity reduction (%)		
Roadway type		
ADT		
Seasonal traffic increase		
Expected delay		
Project length		
Urbanization		
Truck volume		
Public/media attention		

2.5.1 Low Impact Projects

The TM needs for low impact projects generally can be adequately addressed by minimal and "standard" traffic controls used routinely in construction areas. These could include, for example:

- Fixed signs to alert motorists to the presence of construction activity ahead
- Traffic cones and temporary barriers to guide motorists through the construction area

Low Impact TM Costs

Low impact TM projects are generally assumed to have no additional costs beyond those incurred routinely for construction.

2.5.2 Moderate Impact Projects

For moderate impact projects, the standard TM strategies used in low impact projects should be applied and augmented. Additional strategies that might be appropriate for these projects could include:

- Enhanced traffic operations and control strategies, such as construction area screening, variable message signs, reduced travel speeds, temporary parking and turn restrictions, and pavement markings
- Modest public outreach targeted to residents, businesses, and community centers in the local area affected by the construction: for example, postings on web sites, and fax network for employers and others
- Detours without additional upgrades to alternate routes
- Construction activity restrictions/non-construction increases in capacity (e.g., narrow lanes) to minimize peak period delays
- Development of incident management plan to reduce delays caused by accidents
- Modest TDM strategies such as rideshare marketing

Moderate Impact TM Costs

Moderate impact TM projects rely primarily on strategies, such as public outreach, traffic operations and control, and TDM, which do not require construction of temporary infrastructure. These strategies generally have modest cost but may add 15% or more to the construction cost.

2.5.3 High Impact Projects

Finally, high impact projects will receive the most aggressive TM strategies. For longer duration projects, more costly strategies could be appropriate due to the high cumulative cost of delay and disruption. Thus, for these projects, some temporary capital improvements might be warranted to maintain capacity. Additionally, it becomes more important to deliver information to the public-at-large and to motorists traveling through the construction area, and to support the needs of businesses for employees and customer access. Therefore, in addition to the strategies noted above for lesser impact projects, critical impact projects might also warrant the following:

- Advanced traffic operations and control strategies, such as ramp metering, signal adjustments, reversible lanes, lane closure restrictions, and truck restrictions

- Extensive public outreach to the public-at-large and to targeted groups, including public information meetings, brochures, news releases, media advertising, appearances at community events, a public information center, and a telephone hotline
- Detours that require capital improvements to alternate routes
- Temporary capital improvements, such as crossovers, runarounds, temporary roadways, and temporary use of shoulders and median areas to maintain capacity
- Contracting strategies, such as A+B bidding, contractor incentive/disincentive provisions, lane rental provisions, and project consolidation
- Expanded TDM strategies such as temporary transit service, free bus service, Park & Ride lots, TDM information, and assistance to employers

High Impact TM Costs

High impact TM projects generally implement the most aggressive levels of TM strategies. However, in many cases the construction costs for these high impact projects are also high. Therefore, the TM strategies, as a percentage of the construction cost, are typically the same or less than moderate impact projects.

Section 3 – Guidelines for Selecting Traffic Mitigation Strategies

Section 2 presented a broad-brush approach to selecting categories of traffic mitigation (TM) strategies. The next step is to select specific strategies sufficient to meet TM goals established for the project. This section presents a menu of TM strategies and guidance for choosing effective and appropriate strategies.

The primary purpose of a TM program is to maintain an acceptable level of traffic flow and minimize travel delay experienced by motorists during construction. This is accomplished by reducing the volume of traffic through the construction area, reducing the duration of construction, and/or increasing the efficiency with which traffic flows through the area.

Many strategies can be used to help meet these objectives. The number and mix of strategies chosen will depend on many factors, including the scope and duration of the project, the volume of traffic currently using the roadway, characteristics of the construction site, the construction activities that must be accomplished, and the travel alternatives available to motorists. A package of strategies must be chosen that will offer the maximum benefit to motorists within an acceptable cost.

3.1 Menu of Transportation Mitigation Strategies

This section groups TM strategies into six categories, each with a different approach to TM. Individual strategies in each of these categories are described below:

- Construction and contracting
- Traffic control and operations
- Public information
- Motorist information
- Travel demand management (TDM)
- Incident management

3.2 Construction and Contracting Strategies

Construction and contracting strategies are strategies that can be implemented through contract documents during construction. They minimize traffic disruption by shortening the duration of construction and/or by ensuring that the maximum number of travel lanes remains open at critical travel periods. Strategies in this category include:

- Lane constriction
- Two-way traffic on divided roads
- Lane closure restrictions
- Runarounds and crossovers
- Temporary roadway improvements
- Project consolidation
- Lane rental
- A + B bidding
- Incentive/Disincentive
- Acceleration
- Value Engineering Change Proposals

3.2.1 Lane Constriction

This strategy reduces the width of one or more lanes to retain a greater number of lanes available to traffic. It should be noted that narrow lane width can reduce the facility's capacity and average speed, especially where there is significant truck traffic. The use of shoulders can help to reduce the reduction in width. If used for long-term applications, the current lane markings must be hidden and new markings applied to avoid confusing motorists.

3.2.2 Two-Way Traffic on Divided Facility

This strategy transfers traffic from a normally divided facility to a two-way operation on one roadway. This strategy requires special consideration in the planning, design, and construction phases. Because of safety concerns, it should be limited to projects in which construction cannot occur without closing lanes and where alternate routes are not available for detours; the use of temporary lanes or shoulders is impractical; and safety issues can be reasonably addressed.

3.2.3 Lane Closure Restrictions

This technique prohibits the contractor from closing lanes during certain days or hours of the day when disruption would cause particular difficulty to motorists or area businesses. If work continues beyond a deadline, a liquidated damage or disincentive payment could be deducted for each hour beyond the end time. A variation on this strategy is to allow lane closures only during nighttime hours. Additional factors should be considered before adopting this measure: noise and light impacts on surrounding communities, traffic impact of detours on surrounding communities, need for special nighttime permits, and worker safety. Nighttime work is most appropriate when traffic volumes drop substantially from day to night and/or when a longer continuous period of construction activity is needed. Also, lane closures should be specific to the area of work needed. Excessive lane closure lengths should not be permitted.

3.2.4 Runarounds and Crossovers

These strategies involves the total closure of a roadway in one or both directions and rerouting traffic to a temporary roadway constructed adjacent to the roadway and within the ROW or across a median of a divided highway to the opposite lanes.

3.2.5 Temporary Roadway Improvements

This strategy can include measures such as temporary use of a shoulder or median area as a travel lane or temporary removal of a median island to provide additional turning lanes at critical intersections. If shoulders are to be used as travel lanes, it might be necessary to upgrade the shoulder to support anticipated traffic loads.

3.2.6 Project Consolidation

This strategy promotes the consolidation of multiple, small projects planned for a single roadway or in a corridor to minimize the number of times construction activity must occur. This can be done through a single contract for all the work or individual contracts that are coordinated and scheduled together. This technique should be used during the concept development/planning stage, with consideration of projects proposed for completion over several years. To the extent possible, projects should be scheduled for completion within a single construction season.

3.2.7 Lane Rental Provisions

This strategy has been successfully employed in other states, but as yet, there is no approved specification in New Jersey. Lane rental provisions encourage contractors to schedule work to minimize lane closure time, to work during the lowest traffic times (when rental rates are lowest), and to be more productive when lanes are closed. In the project bid, the contractor specifies the number of hours lanes will be closed. The total bid is calculated as the actual construction cost plus the number of lane closure hours multiplied by a per hour lane use charge. Fees are charged for hours when lanes are closed and are applied against a lane rental "budget" included in the contract. If the contractor exceeds the number of hours for lane closures included in the contract, a disincentive payment is assessed against the contractor's fee.

3.2.8 A + B Bidding

A + B bidding is a form of cost-plus-time bidding that factors the duration of a construction project into the low price bid. Contractors submit bids comprised of two components: the "A" component includes the traditional cost of work to be performed under the contract; the "B" component is a "bid" of the total number of days the contractor estimates are required to complete the identified "B" portion of the project. The total bid, for award consideration only, is calculated as the "A" cost plus the "B" number of days multiplied by a road user cost per day factor. If the contractor exceeds the number of days bid, a liquidated damage is assessed for each day late.

This strategy is generally reserved for major impact projects that are of long duration and have multiple-stages or for projects where traffic inconvenience and delays must be held to a minimum or where road user costs are expected to be significant due to heavy current traffic volume/long project duration.

3.2.9 Incentive/Disincentive

The provision of incentives/disincentives in the contract afford the contractors the option of working more shifts in order to complete the work quickly, therefore earning an incentive payment for early completion, or of working at a slower pace, using fewer resources, forfeiting the incentive payment, and paying liquidated damages for later completion. A variable completion time may impact the overall traffic mitigation strategy and should be considered.

3.2.10 Acceleration

Construction acceleration is a strategy that can be used to minimize traffic impacts by minimizing the duration of the construction impact. By identifying in the bid documents that a specific project is to be completed in a very short duration, contractors are apprised that their bid will need to consider overtime, 24/7 work, or whatever it takes to get the job done in the minimum time.

3.2.11 Value Engineering Change Proposals (VECP*)*

This program allows the contractor to offer the State alternatives to the contract documents that are equal or better and provide a cost savings or reduced traffic impacts.

3.3 Traffic Control and Operations

The purpose of traffic control and operations devices is to guide motorists clearly and safely up to, through, and around construction areas. Effective traffic control increases safety and capacity and reduces stress for drivers. Some traffic control devices, such as barriers, also play a major role in protecting workers from vehicle crashes. The choice of appropriate traffic control devices is determined by sight distances, traffic speed, volume, and the type of work activity to be performed. Traffic control and operations strategies include:

- Physical barriers and channelizing devices
- Temporary reduced speed limit
- Flashing arrow signs
- Pavement markings
- Construction area screening
- Reversible lanes
- Alternate routes
- Signal adjustments
- Ramp metering
- Temporary parking and turn restrictions
- Moveable barrier
- Truck restrictions

3.3.1 Physical Barriers and Channelizing Devices

Physical barriers, such as concrete barriers, cones, and drums that separate traffic from the work area can enhance both motorist and construction crew safety. Additionally, channelizing devices can improve traffic flow by alerting motorists to construction activity ahead and giving them time to react to travel patterns changes. Special attention to snow removal should be considered when using permanent physical barriers.

3.3.2 Temporary Reduced Speed Limit

Reducing the maximum allowable speed might be needed or desirable if construction activity or needed TM strategies (e.g., lane closures or lane shifting) could constitute a hazard for motorists. A reduced speed might also be desirable if the normal maximum speed would constitute a hazard for construction workers.

3.3.3 Flashing Arrow Signs

These devices can be used to augment conventional traffic control devices where additional warning and directional information is required to control traffic movement through the construction area.

3.3.4 Pavement Markings

Pavement markings such as striping, reflective devices, raised pavement markers, and pavement marking arrows can be used to delineate the position of lanes and to designate travel directions. They are especially useful for lane shifting, crossover lanes, and runarounds or other situations in which the usual lanes have been adjusted.

3.3.5 Construction Area Screening

Screens that hide construction activity from the view of motorists can prevent gawking and rubbernecking, thus helping to maintain speeds past the construction and reduce the potential for crashes caused by motorist distraction.

3.3.6 Reversible Lanes

This strategy is useful when there is strong directional traffic peaking. These lanes require daily lane change set up, however, and thus have limited use. Safety also is a significant issue if the lanes cannot be separated easily by a movable barrier.

3.3.7 Alternate Routes

Alternate routes can be used when it is important to close the work area to perform certain construction tasks or when diverting traffic will substantially reduce traffic volumes. These strategies are most appropriate if there is available capacity on routes parallel to the road under construction and the routes can accommodate the mix of vehicles to be diverted. Detour routes might need to be upgraded and/or signal timing adjusted to increase capacity or improve traffic flow, making them more attractive to motorists. Coordination with local agencies also is essential.

If traffic will be detoured away from the construction, signage will be needed to inform motorists as to where the detour route begins, where it rejoins the road under construction, and where they are to make turns along the detour route. Signage also can be useful on non-turn sections of the detour route to reassure motorists that they are still on the detour and have not missed any turns.

3.3.8 Signal Adjustments

Consider changing traffic signal timing if capacity can be increased. Adding or deleting signal phases might be required for changes in travel patterns. Interconnecting traffic signals can help to move traffic through a construction area.

3.3.9 Ramp Metering

Traffic flow disruptions can occur at entrance and exit ramps. Ramp metering can be useful where it is necessary to restrict the amount of traffic entering a freeway for capacity or safety reasons. The buildup of queues of vehicles waiting to enter the freeway can have a domino impact for traffic congestion on intersecting roads, however, and must be considered in implementing this strategy. Ramp metering also can divert motorists to alternate routes so adequacy of capacity on nearby roads should be examined.

3.3.10 Temporary Parking and Turn Restrictions

One option to increase capacity is to restrict on-street parking, either all day or for peak periods only, to provide for an additional travel lane or to reduce traffic conflicts. It is important to address the concerns of on-street parking for local businesses. Restrictions on turns into driveways and at intersections might be useful or necessary for capacity/safety reasons. Restrictions can be during peak periods only or all day.

3.3.11 Moveable Barrier

As indicated above in “Reversible Lanes” the use of moveable barrier may be advantageous, especially if the morning and afternoon peaks have high directional traffic.

Moveable barrier should be considered in these situations and provisions for operational costs included.

3.3.12 Truck Restrictions

Truck restrictions can increase capacity by both removing some vehicles from the construction area and by increasing the travel speed for the remaining vehicles. It is important with this strategy to identify alternate routes that are suitable for truck traffic.

3.4 Public Information

Public information is designed to educate and inform the public about the project, both before it begins and while it is ongoing. It is an essential component of any TM plan and offers several benefits to the project and to motorists. It gives motorists an opportunity to avoid construction sites and frustration and lost time, reduces traffic volumes in the construction area, reduces complaints from drivers who do use the route, and raises public confidence that the Department is well-organized and efficient. Strategies in this group include communication and public outreach tools such as:

- Fax network
- Web pages
- Newsletters and brochures
- Information letters
- Community/employer meetings
- News releases/media alerts
- Telephone hotline
- Paid advertisements and PSAs
- Posters and billboards
- Speakers' bureau
- Public information center
- Highway advisory radio (pre-construction)

3.4.1 Fax Network

An effective information strategy in New Jersey is fax network through which information on road, lane, and ramp closures are announced. All eight New Jersey TMAs (Transportation Management Association) provide this service to employers, retail businesses, community groups, libraries, and other organizations who in turn post or distribute the information to employees, customers, and visitors. Some TMAs also provide this information through e-mail to these groups and to individuals who request to be notified.

3.4.2 Web Page

The population-at-large is increasingly turning to the internet as a source of information. The Department includes information on a commuter-oriented web page (www.njcommuter.com) about current and upcoming construction projects, including planned lane closures. Several of New Jersey's TMAs also post construction information on their web pages for projects located in their service areas and provide links to the Department and to other TMAs for information on projects located in other areas.

3.4.3 Newsletters and Brochures

Brochures and newsletters are versatile communication tools that can provide information in an attractive, informal format. Both can educate readers about the purpose and benefits of the project, describe the timeline for the work, present tips for avoiding construction, and provide information on TDM services available in the corridor. A map in the brochure or newsletters efficiently conveys the scope of the project, detours, and phases of construction. Newsletters, which are typically larger in size than brochures and frequently have multiple issues, also can carry articles or stories on construction progress. Newsletters and brochures can be useful handouts or mailings for businesses, residents, event planners and community groups but are expensive to produce and become dated quickly.

3.4.4 Information Letters

Direct mail is an easy way to communicate with targeted populations, such as businesses, legislators, and local officials, about the project start date. They can be mass-mail form letters or customized to each recipient.

3.4.5 Community Involvement Meetings/Public Meetings/Employer Meetings

Open, public meetings, held both during project development and construction, offer the public an opportunity to learn about the project and ask questions of DOT staff. This strategy can include general meetings or meetings with targeted groups such as businesses, homeowner, and community groups. In the planning and design stages, these meetings can provide DOT with important information for selecting TM strategies. During construction, they can be used to alert the public of construction activities and progress, reducing complaints about traffic disruption.

3.4.6 News Releases/Media Alerts

The Department's Press Office uses news releases to announce the start and end of all types of projects as well as construction milestones. Primary targets are print and electronic news media and traffic reporters, who can pass the messages on to their audiences, and transportation-related internet web sites. News releases also can be sent to businesses, county and municipal officials, and state and local police. Briefer media alerts can be used to notify newspapers about upcoming temporary construction activities such as lane and ramp closures. Some newspapers will include closure notices in the paper.

3.4 7 Telephone Hotline

A round-the-clock toll-free hotline can be established to inform the public about construction schedules, lane or street closures, and transportation alternatives. Tape-recorded messages can be used if they are updated frequently, but personal operators might be appropriate for large projects or to provide return calls for questions that the taped message does not answer. For moderate impact projects, the hotline information service can be included on the Department's existing 1-800-NJROADS hotline.

3.4.8 Paid Advertisements and Public Service Announcements

Newspaper and radio advertising and PSAs can be used to convey the main messages of a project's communication plan. They are useful to alert the public that the project will be starting, offer messages about safety in the construction area, and provide information on

ridesharing and transit services. For radio ads and PSAs, planning is necessary because ads and PSAs must be scripted, recorded, and distributed.

3.4.9 Posters and Billboards

Posters and billboards can be used to announce the start of a major project. Posters may be placed in businesses, public buildings, libraries, community centers, recreational facilities, and other locations that substantial numbers of people visit or pass through. They are most often professionally designed and printed by commercial printers. In view of their high cost, billboards are rarely used, except on heavy volume arterial routes leading to the construction area. They also have limited use because the message must be brief and, over time, motorists have a tendency to ignore them. Planning is very important because billboard leasing must be done in advance and design, printing, and posting are performed by a commercial firm. Smaller, moving “billboards” also can be placed on the sides of transit buses.

3.4.10 Speakers Bureau

This strategy arranges for staff who are knowledgeable about the project to speak to business and community groups, public officials, and the public. Designated speakers can be drawn from Community Relations staff, the Project Manager, the Resident Engineer, Traffic Mitigation Team members, TMAs, and others who are involved with planning and implementation of the TM plan.

3.4.11 Public Information Center

A public information center can be established near the construction site. The center can distribute information about the project, display maps of the construction area and mock-ups of the completed project, and provide information about transportation alternatives. As an alternative, Community Relations staff sometimes holds information centers in public spaces during project development.

3.4.12 Highway Advisory Radio (pre-construction)

Using low frequency broadcast channels, HAR offers motorists an in-vehicle opportunity to obtain detailed information about future projects in the vicinity and information about alternate routes and other TDM strategies that they could consider using during construction.

3.5 Motorist Information

Information provided to motorists within and in the vicinity of the construction area can alert motorists to delays caused by construction activity and give advance notice of changing operating conditions. The following strategies and tools help to divert traffic to alternate routes during delay periods and improve traffic flow for motorists who remain in the project area:

- Variable message signs
- Pre-construction signage
- Closed circuit TV (CCTV)
- Highway Advisory Radio
- Advance Information Panel Size
- Variable Message Signs

3.5.1 Variable Message Signs

Real-time motorist information provided by VMS play a valuable role in raising awareness and improving safety and traffic flow. VMS can be used for traffic warnings and to alert motorists to upcoming routing changes and lane and ramp closures. They are especially useful where traffic speed drops substantially, significant delays are expected, alignment or surface conditions change, ramps or lanes are closed ahead, or a crash or incident has occurred. VMS used to alert motorists to lane or exit ramp closures might need to be located well in advance of the construction zone or exit if the best alternative route is reached via an earlier exit than the one that is closed or before the start of the construction zone.

3.5.2 Pre-construction Signage

Signage can be used prior to the start of construction to inform motorists that construction will be starting. This will help them plan for regular travel through the area during the construction period. These signs, which could be in the form of variable message signs or fixed message signs, can provide a phone number for travel assistance, similar to the POOL number now posted to inform motorists of ridesharing services.

3.5.3 CCTV

The need to visually observe and record traffic flow and congestion is critical to the proper management of Variable Message Signs and Highway Advisory Radio. When considering the use of VMS and HAR, the use of CCTV should be considered, as well.

3.5.4 Highway Advisory Radio (HAR)

Using low frequency broadcast channels, HAR offers motorists an in-vehicle opportunity to obtain up-to-date, detailed information about current road conditions to supplement information obtained from signage within the construction area. HAR can result in increased diversion of traffic to alternate routes during periods of high volume and during incidents. Fixed or variable message signs alert motorists to the availability and frequency of the radio messages. The adequacy of broadcast quality must be assessed before choosing this strategy.

3.5.5 Advance Information Panel Signs

These signs can be used to give motorists information about construction on a different but nearby route. These signs are advantageous where a large number of motorists could be affected by the construction or where it is useful or necessary to inform motorists to avoid a construction area.

3.6 Travel Demand Management (TDM)

The objective of travel demand management strategies is to maximize the capacity of the roadway by shifting some motorists from driving alone to multi-occupant modes such as carpools, vanpool, and transit; shifting the time at which motorists travel to less congested times; and eliminating the need for the trip to be made. Often, TDM strategies implemented by employers and TMA' are more effective than those implemented regionally so participation of these partners in the TM plan is highly desirable. TDM strategies include:

- Rideshare marketing

- Rideshare incentives and support services
- Transit incentives and support services
- Transit service enhancements
- Park & Ride lot expansion
- Employer outreach

3.6.1 Rideshare Marketing

The purpose of this strategy, which often is part of a comprehensive public information and outreach campaign, is to encourage motorists who cannot divert to other routes to find others with whom they can carpool or vanpool. It includes such tools as brochures and media advertising promoting ridesharing and informing motorists where they can obtain rideshare matching assistance.

3.6.2 Rideshare Incentives and Support Services

Rideshare support services such as ride matching services and Guaranteed Ride Home programs and financial incentives, such as subsidies, discount coupons, or reduced fee carpool parking, can encourage motorists to rideshare rather than drive alone. To be most effective for TM purposes, these strategies must be accompanied by infrastructure strategies, such as Park & Ride lots, ramp metering that gives preference to carpools and vanpool, and preferential carpool and vanpool parking. The benefits of these strategies can outlive the construction period if some of the motorists who begin ridesharing continue ridesharing after the construction is completed.

3.6.3 Transit Incentives and Support Services

Transit support services such as schedule information, Guaranteed Ride Home, on-site sales of transit passes, and financial incentives, such as free or discounted transit and free parking at train stations and Park & Ride lots can encourage motorists to use transit. As with rideshare strategies, increases in transit ridership that occur during the construction can continue after construction ends.

3.6.4 Transit Service Improvements

Increasing the frequency and coverage of transit service in the corridor or on parallel corridors offers motorists new alternatives to driving themselves. If service is operated on the construction route, it can reduce riders' frustration over delays. If the service is on a parallel route, it can result in a travel time saving over the time they would have spent traveling along the construction route. Where train service parallels the construction route, shuttle buses from Park and Ride lots to the train stations may be able to divert some traffic from auto to train, improving traffic flow through the construction area. In areas where traffic volume is high, however, it is important to assess whether the rail system has capacity to handle the extra rail riders anticipated and if sufficient rail Park & Ride lot spaces are available. If rail capacity is available, but Park & Ride lot capacity is constrained, shuttles from more distant Park & Ride lots might be appropriate.

3.6.5 Park & Ride Lot Expansion

Improvements to existing lots and the construction of new temporary or permanent lots adjacent to the project corridor can offer convenient meeting places for commuters who are willing and able to rideshare or utilize pick-up points for buses. Because of the cost of

construction, this option is most appropriate where Park & Ride lot capacity is warranted in the absence of the construction and where the new lots are expected to be utilized after construction ends. For temporary lots, spaces might be leased from shopping centers, churches, and other organizations that have primary use of the spaces at times other than during the day. Because numerous tasks, such as identifying, arranging the lease, obtaining insurance, and developing transit links, must be accomplished to institute a temporary lot, planning for this strategy should be started well in advance of the construction start date.

3.6.6 Employer Outreach

Employers are important partners in TM efforts because they can have substantial influence over how employees travel to work through incentives they offer and workplace policies they establish. This strategy provides information and assistance to employers to encourage them to implement TDM actions such as telecommuting and flextime that eliminate vehicle trips; distributing information about the construction project and TDM options to their employees; participating in commute-oriented events; and encouraging employees to use alternative modes for commuting.

3.7 Incident Management

Significant experience with construction projects nationwide has shown that crash rates tend to increase in construction zones because construction activity and unfamiliar and constrained roadway conditions confuse and distract motorists. Some traffic operations and control strategies help to reduce the number of incidents that occur. Incident management strategies are designed to detect and clear incidents quickly. Increased attention to incident management is especially valuable for complex traffic plans with detours and lane closures; areas with current high crash rates/high traffic volumes; nighttime construction; and projects with a large number of truck movements. Incident management strategies include the following:

- Incident management plan
- On-site tow vehicles
- Enhanced police presence
- CCTV/Traffic monitoring station

3.7.1 Incident Management Plan/Event Planning

A fundamental TM strategy is a plan for managing and clearing incidents when they occur and for managing traffic around major events occurring in the vicinity of the construction area. An incident management plan typically will define a method to detect incidents quickly; establish appropriate diversion routes; define the roles assigned to fire, rescue, State and local police, and other emergency response personnel in responding to the incident; and define the actions to be taken to clear the incident. Additionally, the plan will identify the location for stores of movable traffic control devices that will be used during an incident and for traffic control during events.

Event plans should include the schedule for planned events and traffic control measures to be used. Both incident management plans and event plans must be developed cooperatively with emergency personnel and local officials and agencies within the vicinity of the construction area.

3.7.2 On-Site Tow Vehicles

Quick response to incidents is essential to restoring traffic flow; one useful strategy is to station tow trucks within the construction area, either all day or during peak periods, to remove disabled vehicles quickly from the area. This strategy should be considered where a crash or breakdown would seriously impair traffic flow and when emergency pull-outs are not available or spaced far apart.

3.7.3 Enhanced Police Presence

Police patrols within the construction area can help to ensure that vehicles do not exceed the posted speed limits. On-site, dedicated presence of police also can enhance detection and response to incidents. Additionally, the presence of a parked police vehicle with lights flashing can alert motorists to upcoming construction areas and slow traffic within the area, helping to eliminate crashes and the delays they cause.

3.7.4 CCTV / Traffic Monitoring Station

For large or long-term projects, a traffic monitoring station can provide immediate notification of incidents through closed circuit television and counter loops along the roadway corridor connected though phone lines or communication cables. The detectors also can be useful to measure traffic flow variables as part of an evaluation. It can be difficult to maintain the counters during construction, however, especially if lane shifting is expected.

3.8 Appropriate Strategies by Project Category and Project Characteristic

As mentioned earlier, the level of TM applied should be matched to the severity of the travel delay and disruption caused by the project. Too little TM will lead to an unacceptable level of delay and complaints from motorists and businesses. But too much TM will divert resources from other projects.

This section explains which groups of strategies are most useful to address various project categories and project characteristics and which individual strategies provide the necessary level of emphasis or aggressiveness for each project category.

Table 1 illustrates how project characteristics influence TM strategies. This is intended to suggest which of the six TM strategy areas likely will be needed in the package of TM strategies chosen.

Table 2 indicates at which of the four project impact levels various strategies are typically considered, in other words, the level of aggressiveness they are likely to represent. For example, some strategies, such as traffic information fax network, are appropriate for all four levels, while others, such as A+B bidding and traffic monitoring station, generally are reserved for high traffic impacts.

Table 2 also highlights specific project characteristics, for example, high expected delay or high political sensitivity, that suggest the strategy might be particularly effective/ needed for a particular project. For example, construction area screening might be particularly needed if the crash rate is expected to increase substantially due to construction activity where lanes must be closed, the roadway has a high ADT, and the project will be of a long duration. Additionally, because the cost of screening is a function of the length of the construction area, the length of the project area might also be a consideration in choosing or not choosing this strategy.

Table 1

Potentially Useful Categories of Traffic Mitigation Strategies by Project Characteristic

Project Characteristic	Traffic Mitigation Strategy Categories					
	Construction and Contracting	Traffic Control and Operations	Public Information	Motorist Information	Travel Demand Management	Incident Management
Primary Characteristics						
High road user cost	■	■	■	■	■	■
High impact for retail/business	■		■	■		
High impact for neighborhoods	■		■	■		
Many affected employers			■		■	
Constructability						
High political sensitivity	■		■			■
Secondary Characteristics						
Long construction	■	■	■		■	■
Multiple construction	■	■	■	■	■	
Lane and ramp closures	■	■	■	■	■	■
Interstate/multi-lane freeway	■	■		■		■
High traffic or truck volumes	■	■	■	■	■	■
High seasonal traffic increase	■	■	■	■		■
High expected delay	■	■	■	■	■	■
Long project distance	■		■		■	
High level of urbanization	■	■	■	■	■	■
High media attention	■		■	■		■
Nearly Projects	■		■	■		■

Table 2

Appropriate Traffic Mitigation Strategies by Project Type and Project Characteristic

Traffic Mitigation Strategy	Project Traffic Impact			Guiding Project Characteristics/Special Considerations
	Low	Mod.	High	
Lane conscription				High road user cost (RUC), high expected delay, no alternate routes available
Two-way traffic on divided roads				High expected delay, lane closures, need attention to signage and barriers/channelizing
Lane closure restrictions				High RUC, high peak volume, high expected delay, lane and ramp closures, no alternate route
Runarounds and crossovers				Long duration, high RUC, high expected delay, lane closures
Temporary roadway improvements				Long duration, high RUC, high expected delay, lane closures
Project consolidation				Long duration, complex staging, lane and ramp closures, high political sensitivity, high business impact
Lane rental				Lane and ramp closures, high RUC, no alternate routes, high political sensitivity, high business impact
A + B bidding				Long duration, complex staging, interstate, high traffic volume, high delay, lane and ramp closures, no alternate routes, high political sensitivity, high business impact
Incentive/Disincentive				High RUC , no ROW or utility issues
Acceleration				Long duration, high RUC, high expected delay, lane closures
Physical barriers/ channelizing devices				Lane closures, high truck percentage, lane conscription or runarounds/crossovers used
Temporary reduced speed limit				Lane and ramp closures
Flashing arrow signs				Lane and ramp closures, interstate (through traffic)
Pavement markings				Lane or ramp closures
Construction area screening				Lane closures, high traffic volume, long duration
Reversible lanes				Lane closures, long duration, high expected delays
Alternate routes				Lane/ramp closure, high expected delay
Signal adjustments				Long duration, high traffic volume, high expected delay
Ramp metering				Lane or ramp closures, high traffic volume, high expected delay, long duration
Temporary parking/turn restrictions				Lane closures, high traffic volume, high expected delay
Moveable barrier				Highly directional AM/PM Traffic
Truck restrictions				High proportion of trucks in mix, lane or ramp closures, alternate route exists
Fax network				High business/employer impact, lane and ramp closures, complex staging

Table 2 (cont.)

Appropriate Traffic Mitigation Strategies by Project Type and Project Characteristic

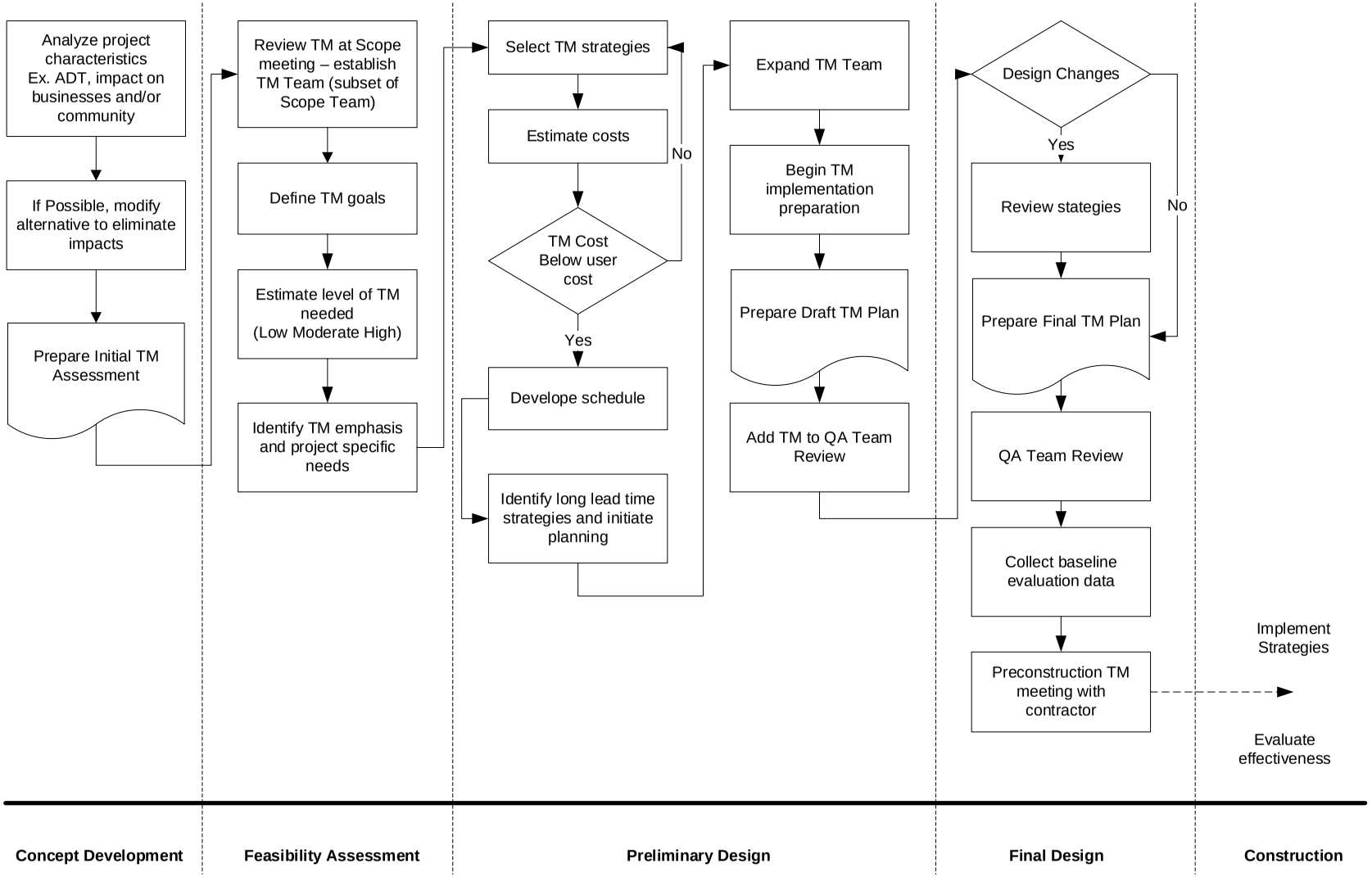
Traffic Mitigation Strategy	Project Traffic Impact			Guiding Project Characteristics/Special Considerations
	Low	Mod.	High	
Web page	■	■	■	Complex staging, lane and ramp closures
Newsletters and brochures		■	■	High public/media exposure, high businesses impact, long duration, complex staging, lane closures
Community/employer meetings		■	■	High public/media exposure, high political sensitivity, complex staging/alternate routes, high businesses impacts
Information letters		■	■	High public/media exposure, high political sensitivity, complex staging/alternate routes, high businesses impacts
News releases/media alerts		■	■	High business impact, high public/media exposure, high political sensitivity, complex staging, long duration
Telephone hotline		■	■	High public/media exposure
Paid advertisements and PSAs			■	High political sensitivity, complex staging, high businesses impact, alternate routes used
Posters and billboards			■	Long duration, construction on interstate/regional road, high traffic volume
Speakers bureau			■	High political sensitivity, high business impact, long duration
Public information center			■	Complex staging, high public/media exposure, urban area, construction near activity center, long duration
Variable message signs		■	■	Complex staging, alternate routes, high expected delay, lane and ramp closures, high traffic volume
Pre-construction signage		■	■	High traffic volume, high expected delay, urban area
CCTV		■	■	High expected delay
Highway advisory radio			■	Complex staging, alternate routes, high expected delay, lane and ramp closures, high traffic volume, long duration
Advanced information panel signs			■	High traffic volume, high expected delay, interstate
Rideshare marketing		■	■	High employer impact, high expected delay
Rideshare incentives/support services		■	■	High employer impact, high expected delay, high traffic volume, urban/suburban area
Transit incentives/support services			■	High employer impact, high expected delay, high traffic volume, urban/suburban area
Transit service enhancements			■	High employer impact, high expected delay, high traffic volume, long duration, long project distance
Park & Ride lot expansion			■	High employer impact, high expected delay, long duration, long project distance

Table 2 (cont.)

Appropriate Traffic Mitigation Strategies by Project Type and Project Characteristic

Traffic Mitigation Strategy	Project Traffic Impact			Guiding Project Characteristics/Special Considerations
	Low	Mod.	High	
Employer outreach				High employer impact, high expected delay, high traffic volume, urban/suburban area
Incident management plan				No alternate route, high traffic volume, high proportion of trucks, long project distance, high political sensitivity
On-site tow vehicles				No alternate route, high traffic volume, high proportion of trucks, long project distance, lane closures
Enhanced police presence				High traffic volume
CCTV/Traffic Monitoring Station				No alternate route, high traffic volume, long duration, limited project distance, high political sensitivity

Exhibit 3
Traffic Mitigation Steps by Project Development Phase



Section 4 - Integration of Traffic Mitigation within project Development

The preceding sections have described methods and tools the Department can use to assess the need for TM and the level of TM strategies needed. This section describes a more specific discussion of how the Department can integrate these methods and tools into the existing capital project planning process.

The Department develops and implements capital projects through a five-phase process:

- Phase 1 – Concept Development
- Phase 2 – Feasibility Assessment
- Phase 3 – Preliminary Design
- Phase 4 – Final Design Phase
- Phase 5 – Construction

These phases involve a wide range of planning, analysis, engineering, budgeting, and scheduling activities needed to identify, plan, design, and build roadway improvements. The phases take projects from broad ideas and concepts to final engineering plans that guide construction activities. Each of these phases has a role to play in traffic mitigation. The traffic mitigation activities of each phase are described below, and **Exhibit 3** illustrates the basic steps to be accomplished in each of the phases.

4.1 Concept Development

4.1.1 Overview of Existing Activities

The purpose of Concept Development is to develop and deliver to Feasibility Assessment, a description of well-defined purpose and need and possibly recommend a concept that has been environmentally screened and for which community support has been established. In this first stage of project development, staff will:

- Identify the transportation problem to be solved, establish its geographic scope, and evaluate the need for the project. Most of this work is preceded with a Tier 2 Screening that may supply this information
- Identify the Stakeholders
- Demographics including minority populations and low income populations in the project area
- Evaluate alternative multi-modal strategies and fulfill CMS requirements
- Define potential concepts and their limits for short and long-term improvements
- Identify implementation priorities
- Define complementary improvement strategies to a highway improvement concept
- Examine context sensitive design/aesthetic opportunities
- Estimate order of magnitude costs
- Initiate community involvement with stakeholders, culminating in consensus on the needs and range of solutions

In their early exploratory activities, staff perform background research and collect data, such as traffic counts, origin/destination distribution, transit availability, travel time data, land use, and other data on characteristics of the roadway, area, environment and/or corridor in which the project will be implemented.

Next, staff meets with local officials, staff of agencies, and members of the public in the communities affected by the potential project to identify their needs and preferences, and to conduct field research and other studies to define future transportation needs for the area. Third, staff may define one or more conceptual solutions that address the purpose and need, gauge community position, and develop an order of magnitude cost estimate. Staff then compiles all data in the Concept Development report, which is used as the foundation of Feasibility Assessment.

4.1.2 TM Activities in Concept Development

At this stage, projects are not well-defined, but some of the project characteristics identified earlier in this paper are known, such as current traffic volumes, crash data, extant substandard roadway features, degree of urbanization, and community impacts. Thus, during Concept Development, it is possible to estimate the impacts likely to be experienced by the public during construction, identify projects that might need or benefit from TM strategies beyond basic traffic control, and propose an initial assessment of the level of TM that might be needed and the general categories of TM strategies that are likely to be effective.

4.1.3 In Concept Development, four TM activities will occur:

Analyze Data on Project Characteristics That Will or Could Influence the Need for TM

This step will involve the collection and review of project characteristic data, such as that described in Section 2 of this document. These data will be analyzed to determine the level of traffic and community impacts the project would likely cause. Section 2 offers broad guidelines for defining traffic mitigation levels from project characteristic data. The lead engineer of the Division of Project Planning and Development will fill out the Preliminary Traffic Management Impact Worksheet (Exhibit 2) and include it in the Concept Development Report. If a project is determined to be a low impact project, no additional TM activity is required.

4.1.4 Introduce Concepts to Eliminate or Lessen Impacts

Community outreach and involvement meetings offer an opportunity to assess the community's sensitivity to impacts and mitigation options that could gain community acceptance. The Department's Public Involvement Action Plan (PIAP) ensures that communities and other stakeholders are given forums at which projects can be meaningfully discussed.

4.1.5 Identify TM Emphasis Areas

At this phase of project development, it is not possible to identify specific TM strategies, but TM emphasis areas will be identified. For example, the areas of emphasis could be secondary use of public information and incident management strategies, with primary use of traffic controls and operations. To the extent that specific strategies within these categories appear to be required or strongly indicated, they should be noted as well. Additionally, project specific needs that are not common to all projects will be noted. These needs will be considered when developing TM strategies related to methods and scheduling of construction.

4.1.6 Document TM Recommendations

Finally, the TM recommendations will be documented for use by Scope Development in an "Initial TM Assessment." This assessment, which will be prepared for each study, will be included as a chapter in the Concept Development Report and as a TM guide during the Feasibility Assessment. For projects that bypass Feasibility Assessment, the Initial TM Assessment will be provided to the Project Management Group for Preliminary Design. In either case, the Assessment will indicate:

- Summary of the project characteristics described in Section 2 (Worksheet shown in Exhibit 2) with emphasis on the traffic and community impacts of construction
- Identification of issues for which special TM attention may be warranted

Although traffic mitigation needs can be only loosely defined in this phase, examination of TM needs during this early phase is advisable for several reasons. First, introduction of TM into Concept Development permits time for some public input to be solicited as part of the Community Involvement process. Second, some TM strategies require extended lead-time, i.e. addition of NJ Transit bus lines, for development and implementation and should be identified at the earliest possible phase so planning can begin. Third, through community outreach meetings, it will be possible to test early in the process the acceptability of TM solutions to address community impacts. Finally, it is possible that some project concepts would result in unacceptable levels of delay for motorists or other impacts to the community that cannot be cost-effectively mitigated. These impacts then can be included in the analysis and decision-making process conducted through Feasibility Assessment and Preliminary Design.

4.2 Feasibility Assessment

4.2.1 Overview of Existing Activities

During Feasibility Assessment, DPPD performs engineering and environmental analyses and community outreach to determine whether concept alternatives submitted with the Problem Statement can be feasibly evolved into a project. This step is, in essence, a fatal flaw analysis intended to prevent flawed concepts from proceeding to Preliminary Design. It is during this phase that the multi-disciplinary Scope Team is assembled to identify and resolve issues related to the purpose and need developed in Concept Development. The team will discuss alternatives, analyze physical deficiencies, and review the environmental screening.

At the end of Feasibility Assessment, DPPD prepares a report that identifies the initially preferred alternative and the rationale for choosing this alternative over the others available, and any outstanding issues in need of resolution. In addition, a Scope Statement for Preliminary Design, which defines the required levels of effort for various design units, is developed.

The final steps of this stage are the selection of a recommended alternative and the preparation of the Project Transfer Package that will be submitted to the Division of Project Management. This Package identifies the Recommended Scheme with construction and right-of-way cost estimates; documents the public involvement process; provides environmental documentation; and includes design and cost summaries for any preliminary engineering work performed.

4.2.2 TM Activities in Feasibility Assessment

It is during Feasibility Assessment that TM development will begin in earnest. During this stage, traffic mitigation issues will be included in the discussions at Scope Team meetings. In addition, for projects designated as high impact projects, a core Traffic Mitigation Planning Team (TM Team) will be formed as a subset of the Scoping Team. The purpose of the TM Team is to bring together all internal and external entities with a potential role in traffic mitigation activities to ensure that 1) TM planning is consistent across all projects, 2) each involved organization is aware of the TM activities of the others, and 3) TM activities are implemented and coordinated in the most cost-effective manner.

At this stage, meetings are conducted to introduce community stakeholders to the alternative recommended to address their problem and to solicit their feedback as to its acceptability. The degree of community involvement varies from one project to another, but all involve some public discussion of both the impacts of the finished project and the costs and impacts experienced during construction.

TM Teams also might be established for some moderate impact projects if it appears that multiple strategies will be included. These multiple strategies could necessitate the participation of several outside organizations as well as significant coordination among internal offices. Traffic mitigation for projects with low impacts generally will be addressed sufficiently through Project Scope Meetings held during Feasibility Assessment with minor follow-up of a few internal entities.

4.2.3 Core TM Team Members

When the TM Team is first established, it will be comprised of "core" members, that is, internal and some outside organizations whose involvement is central to the development of the TM plan. Some internal entities will be represented on all TM Teams. During the Preliminary Design phase, the TM Team may be expanded.

The core members of the TM Team may include the groups listed below and other interested parties:

- Division of Project Planning and Development
- Division of Project Management (Project Manager)
- Traffic Mitigation Advocate
- Bureau of Traffic Operations
- Bureau of Traffic Engineering
- Bureau of Traffic Signals & Safety Engineering
- Bureau of Statewide Planning
- Office of Communications
- Community Relations
- NJ Transit
- Affected city/county agencies (e.g., Public Works or Transportation Department)
- Local Transportation Management Associations
- TRANSCOM
- State Police
- Division of Research and Technology
- Bureau of ITS Engineering
- Regional Construction
- Bureau of Construction Engineering

- Operations – Data Resources
- Regional Operations
- Federal Highway Administration

The TM Team will have primary responsibility for expanding on/adjusting the recommendations included in the Initial TM Assessment prepared during Concept Development. The TM Team will perform three major activities:

1. Define the TM Goals for the Project

This step will identify the qualitative and quantitative goals and objectives for the TM program. For example, possible goals/objectives might be to:

- Provide work zone speed reductions of 10 mph compared to pre-construction speed limit
- Reduce traffic volumes by X%
- Decrease average daily traffic by Y vehicles during peak period
- Maintain LOS D or better
- Reduce expected delay by Z%
- Keep average delay per vehicle to less than X minutes during the peak period
- Maintain vehicle-person throughput by increasing auto occupancy and transit ridership
- Promote public awareness
- Keep congestion no worse during construction than before
- Mitigate community impact
- Maximize safety of workers and the traveling public
- Keep road user costs below X dollars per day

These goals/objectives serve several purposes. First, they direct TM resources toward the strategies that are most likely to achieve these goals and away from other TM strategies that do not. Second, they focus attention of everyone involved with project development on the expected and desired results. And third, to the extent that the goals/objectives are quantifiable, they establish targets against which the impacts of possible packages of TM strategies can be assessed during the selection process and provide a measurement standard against which to evaluate the TM effectiveness.

2. Select TM Strategies

Next, the project characteristic data will be reviewed to determine, in broad terms, the level of TM (high, moderate, or low) that will be needed to mitigate construction delays and other impacts and to flag concepts for which motorist/community impacts during construction might be a fatal flaw.

The TM Team will expand on the recommendations provided in the Initial TM Assessment using strategy selection guidance in this document and drawing on their knowledge of the impacts of strategies within their areas of expertise.

This initial set of strategies then will be analyzed to determine if it is expected to be sufficient to meet the TM goals established during Feasibility Assessment. This step might require that additional technical analyses, for example, computer simulation of delay or

queue length under various conditions of capacity reduction and traffic control, estimates of crash potential, and estimates of trip reduction and route diversion from TDM and public information strategies, be performed. Additional outside research, such as survey/focus groups, might be considered to estimate the impacts of public information, motorist information, and TDM. If the analysis shows that the initial set of strategies is not sufficient to meet the goals, additional or different strategies should be analyzed, in an iterative process, until one or more TM strategies packages has been identified that will meet the goals.

3. Estimate TM Costs

At this point, a preliminary analysis will be undertaken, to estimate the total cost of the package and to compare that cost against the TM benefit to be achieved, with benefit defined as the cumulative road user cost (calculated as defined in the NJDOT Road User Cost Manual) estimated for the project. Although road user cost does not capture all impacts to all groups, it can serve as a useful starting point when determining an acceptable cost for the TM package. Costs to other stakeholders, such as retail businesses and employers, might also be estimated and considered when determining a total cost for the TM program.

The Department might decide that motorists/businesses should bear a portion of the cost of the improvement by accepting some degree of delay and disruption. If so, the acceptable TM cost will be proportionately below the road user cost. Road user costs at least should be considered the upper limit on TM program costs. If improvements are required to other facilities, such as road widening or intersection improvements for detours, these may be justified based on road user benefits.

If the TM package cost is considered too high relative to the benefits obtained, some TM strategies can be eliminated from the package or replaced with less costly strategies.

4.3 Preliminary Design

4.3.1 Overview of Existing Activities

Several significant TM components will occur during Preliminary Design, including refinements to the strategies and development of the Draft TM plan. During the design phase, TM implementation also can begin. It will become the responsibility of the Designer to incorporate into design plans the recommendations for strategies, such as detour routes and temporary roadway improvements that require construction activities. At this same time, the TM Team can begin to plan for implementation of strategies, such as public information and TDM, that are implemented outside the conventional design process.

4.3.2 TM Activities in Preliminary Design

4.3.3 Expand Core TM Team

Up to this point, TM planning has been primarily the responsibility of internal staff, with a few outside parties involved as needed. For moderate impact projects, this core TM Team probably will be adequate, but the TM Team almost certainly should be expanded during Final Design at least six to nine months before the start of construction for high impact projects, especially if the project has very high community impacts. The role of these

additional members will be to help finalize the TM plan and participate in strategy implementation. Supporting members of the TM Team might include the following:

- Office of Communications
- Other transit operators
- Elected officials of affected city/county
- Transportation authorities (e.g., Parkway, Turnpike)
- Local Police
- Emergency services
- Business representatives
- Activity centers (e.g., arenas, shopping centers) that will experience major impacts
- Consultants working on TM implementation activities

Additionally, for high impact projects, subgroups of the TM Team may be established to focus on specific topics such as traffic operations, public information, and TDM. These subgroups can meet separately from the rest of the TM Team to address issues that relate only to their responsibilities.

4.3.4 Initiate Implementation Planning

As noted earlier, some strategies will require long planning, construction, or implementation lead-time. Planning for these strategies should be started during Preliminary Design to ensure they are in place when construction on the main project begins. If local agencies or other groups are to be involved in implementing these strategies, any cost-sharing agreements should be implemented quickly so that the agencies and other groups are given adequate time to complete their responsibilities.

4.3.5 Prepare Draft TM Plan

The next TM step will be to develop a draft Traffic Mitigation Plan (TM plan), which will accompany other project documentation into Final Design Development. This TM plan, which will be developed by the core TM Team, will be more detailed than the Initial TM Assessment prepared under Concept Development. It will include the following components:

- Recap of project characteristics (from Initial TM Assessment) with emphasis on the traffic and community impacts of construction
- Results of analyses conducted to select TM strategies
- Detailed description of individual TM strategies selected and their application/installation
- Approximate TM implementation schedule with critical components noted
- Responsibilities of the Department, contractor, and other outside parties
- Detailed estimate of TM costs, sources of funding (if outside contributions will be obtained), and cost-benefit assessment
- Proposed monitoring and evaluation activities

4.3.6 Estimate TM Costs

At this point, a second analysis step will be undertaken, in the same manner as was done during Feasibility Assessment, to refine the cost of the package and to compare that cost against the TM benefit to be achieved. With a more detailed cost analysis, the cost benefit

comparison should be re-evaluated; if the TM package cost is considered too high relative to the benefits obtained, some TM strategies may be eliminated from the package and replaced with less costly strategies.

4.3.7 Define TM Schedule

In this step, a schedule will be developed for implementing TM strategies. The schedule should indicate when strategies will be installed, initiated, or placed into service but also should identify strategies that have long lead-time requirements. These strategies might include improvements to other road facilities; strategies for which equipment must be ordered and installed; and strategies, such as planning of bus service and construction of Park & Ride lots, for which implementation requires the assistance of outside partners.

4.4 Final Design

4.4.1 Overview of Existing Activities

During Final Design the construction plans are finalized and community relations activities, project budgeting, scheduling, and contractor selection tasks are completed to prepare for the start of construction.

4.4.2 TM Activities in Final Design Development

By the time Final Design begins, TM planning is nearly complete. The strategies, costs, and implementation plan should have been developed. During Final Design, the details of the TM plan are refined and solidified to prepare for construction. The major activities that occur for TM during Final Design Development are the following:

4.4.3 Incorporate TM plans during Quality Assurance (QA) Team Review

In this step, planned TM strategies also will be included in discussions during Constructability Reviews to ensure that the selected TM strategies are consistent with project phases and efficient construction operation and management, and that no significant constructability issues have been overlooked.

4.4.4 Adjust TM Plan for Design Changes

It is expected that the final design plans will closely follow the Project SOW, on which the TM plan is based. It is not uncommon, however, for the SOW to be modified due to some factor that could not be predicted during Scope Development or even during Preliminary Design. These design changes might affect the types or level of effort on one or more of the TM strategies included in the Draft TM plan. The TM planning Team will be consulted if design choices suggest a modification is appropriate or needed. In most cases, these changes will be minor and will be easily incorporated, with small adjustments, into the draft TM plan. But in cases where the design changes are extreme or substantial, it might be necessary to return to the TM strategy selection and analysis process first conducted during Scoping.

4.4.5 Prepare Final TM Plan

The next TM step in Final Design is to finalize the TM plan. The Final TM plan, which will be developed by the core members of the TM Team and reviewed by the expanded group, will include similar components to those included in the Draft TM plan. However, a higher level of definition with a focus on what, how, when, and by whom TM activities are to be accomplished is expected. The TM plan will include:

- Recap of project characteristics
- Results of analyses conducted to select TM strategies
- Detailed description of individual TM strategies selected and their application/installation
- TM implementation schedule with critical components noted
- Responsibilities of the Department, contractor, and other outside parties
- Detailed estimate of TM costs and sources of funding (if outside contributions will be obtained)
- Monitoring and evaluation activities

4.4.6 Review TM Plans during QA Team Review

Again, the QA Team will review the planned TM strategies during Constructability Reviews.

4.4.7 Collect Evaluation Baseline Data

This TM activity occurs as Final Design is being completed and the start of construction nears. In this step, various members of the TM Team will collect data on current conditions, relevant to the TM strategies in their area, to allow a comparison against the same conditions during the construction process.

4.5 Construction

4.5.1 Overview of Existing Activities

During the Construction phase all components of a Transportation Management Plan should be completed or implemented.

4.5.2 TM Activities during Construction

4.5.3 Preconstruction Conference

The final step in the TM plan development process occurs after the construction contractor has been selected, i.e. when the contractor meets with Departmental staff during the preconstruction meeting. Discussion of each phase of work and the provisions to maintain traffic during each phase. The Department should require the contractor to designate a Traffic Control Coordinator responsible, on a 24-hour basis, for TM activities.

4.5.4 Value Engineering

Changes to the TM plan proposed by the contractor can be submitted as Value Engineering proposals. The Department is under no obligation to accept the proposed change. Review and consideration of such a proposal will follow the specified VE process. A special attention to commitments made to external stakeholders shall be made in the evaluation of a VE proposal or a change that will affect a TM plan. The VE proposal may need to include public outreach efforts in order to ensure that external stakeholders' interests are upheld.

The preceding parts of this section described TM activities that occur before construction begins. The majority of these activities cover planning, although some modest implementation, such as construction of Park & Ride lots, also can occur during these pre-construction stages. During construction, the emphasis shifts to implementation of TM strategies, following the TM plan finalized in Final Design, and the evaluation of the effectiveness of the strategies in meeting TM goals.

As construction proceeds, it is possible that some adjustment of TM strategies might be needed. For example, a mid-project evaluation could show that the implemented strategies were not having the desired results or were unnecessary or underutilized. This might suggest that new strategies or modified versions of the existing strategies should be implemented during construction. For this reason, TM Team members responsible for strategy implementation and evaluation will monitor strategy performance and review results of interim evaluations and recommend strategy adjustments to the TM Team and the Project Manager.

Further, it is possible that the project itself could change during construction, for example, to incorporate VE proposals submitted by the contractor or due to other factors unrelated to the performance of the existing TM strategies. In such cases, the TM Team will assess the impact of the changes on the appropriateness and likely effectiveness of the TM strategies implemented previously and will make recommendations to the Project Manager. These recommendations could include modifications to the TM strategies. Alternatively, if the project changes would require TM strategies that conflict with agreements made with external stakeholders, the TM Team could instead recommend that the proposed project changes not be implemented.

Section 5 - Traffic Mitigation Documentation

The traffic management strategies to be applied during a project must be documented along the development process to establish a point of reference for subsequent steps and, ultimately, to guide implementation of the strategies. The Traffic Mitigation Guidelines, which has focused attention primarily on those projects for which significant TM activities will be necessary, has mentioned several required TM documents. These documents are summarized here, along with guidance regarding when they are needed and the components to be included.

5.1 Traffic Mitigation Documents

Three primary documents will be prepared for TM activities: Initial TM Assessment, Draft TM plan, and Final TM plan. These documents will be prepared during Concept Development, Initial Design Development, and Final Design, respectively. Each will be progressively more detailed than the previous document as the details of the project become more certain and the TM strategies more defined.

It is important to note that the level of TM documentation needed for a project will vary, depending on the level of TM to be applied. It is important that TM concepts be considered for all projects; however, many projects will have little or no TM impact - - it is not the Department's intent to expend resources on documentation when it is not needed. The following is a discussion of the use and components of the three documents, along with an indication of the projects for which these reports will be prepared.

5.1.1 Initial TM Assessment

TM recommendations defined during Concept Development will be documented in the "Initial TM Assessment." This assessment report will be included as a chapter in the Concept Development Report, part of the package to be provided to Scope Development. The purpose of the Assessment is to identify the likely need for TM and the project issues that affect the need for TM.

The Assessment will include the following sections:

Project Characteristics

Summary of the project characteristics described in Section 2 of this document (TM Impact Worksheet shown in Exhibit 1) with emphasis on the traffic and community impacts of construction

TM Issues

Identification of issues for which special TM attention may be warranted

A TM Assessment will be prepared for each project concept, but the level of detail and the length of the report will vary with the level of project impact. The Assessment prepared for a low impact project is likely to be very short with little more than a brief explanatory attachment to the Preliminary Project TM Impact Worksheet shown in Exhibit 1. Assessments for projects with more significant levels of TM impact will be more

substantive as they need to provide more detailed guidance for TM consideration in Scope Development.

5.1.2 Prepare Draft TM plan

The second TM document to be prepared is the Draft TM plan, which will be prepared during Preliminary Design. This Draft TM plan will be developed by the TM Team, with various members of the team preparing individual sections of the plan that relate to their areas of expertise. The Project Management Group will be responsible for coordinating TM plan development. The TM plan will be more detailed than the Initial TM Assessment and will include the following components:

Introduction – Brief description of the project (location, project need/objectives, and proposed improvements)

Project Characteristic - Recap of project characteristics (from Initial TM Assessment) with emphasis on the traffic and community impacts of construction

Analysis Results - Results of analyses conducted to select TM strategies, including delay simulations, estimate of road user costs, analyses of strategy effectiveness, public surveys, crash rate simulations, and any other analyses

TM Strategies - Detailed description of individual TM strategies selected and discussion of how they will be applied/installed. TM strategies are to be grouped into three categories: Public Information, TDM, and Operations (including strategies for construction and contracting, traffic control and operations, motorist information, and incident management).

Implementation Schedule - Approximate TM implementation schedule with planning and implementation milestones noted for critical components

Planning and Implementation Responsibilities - Responsibilities to be performed by the Department, contractor, and other outside parties

TM Costs - Detailed estimate of TM costs, sources of funding (if outside contributions will be obtained), and cost-benefit assessment

Evaluation – Outline of proposed monitoring and evaluation activities

A Draft TM plan will be established for all high impact projects. A TM plan will be developed for moderate impact projects that include some or several of the following characteristics:

- High traffic volume for the type of roadway
- Significant detrimental impacts on mobility for local or through traffic
- Significant reduction in capacity through lane, ramp, or intersection closures
- Alternate routing will be necessary
- Timing will negatively affect activity centers or other events held within the corridor
- Significant impact on local communities and businesses

5.1.3 Prepare Final TM plan

The third TM document is the Final TM plan. This TM plan also will be developed by the core members of the TM Team and will be reviewed by members of the expanded TM Team, if additional members have been added beyond the core membership. The Final TM

plan will be organized in the same manner as the Draft TM plan and include similar components to the Draft TM plan. The Final TM plan will reflect any design changes made during Design Development and a higher level of definition of each plan component, with a particular focus on implementation: how, when, and by whom TM plan activities will be accomplished.

The specific components of the Final TM plan will include:

Introduction – Brief description of the project (location, project need/objectives, and proposed improvements)

Project Characteristic – Recap of project characteristics with emphasis on the traffic and community impacts of construction

Analysis Results – Results of analyses conducted to select TM strategies, including delay simulations, estimate of road user costs, analyses of strategy effectiveness, public surveys, crash rate simulations, and any other analyses

TM Strategies – Detailed description of individual TM strategies selected and discussion of how they will be applied/installed

Implementation Schedule – Approximate TM implementation schedule with planning and implementation milestones noted for critical components

Planning and Implementation Responsibilities – Responsibilities to be performed by the Department, contractor, and other outside parties

TM Costs – Detailed estimate of TM costs and sources of funding (if outside contributions will be obtained)

Evaluation – Definition of the evaluation measures to be used to evaluate TM effectiveness and a detailed description of the monitoring and evaluation activities to be performed, including baseline data collection, surveys to be conducted, traffic counts, delay measurement, crash/incident tracking, and any other evaluation activity.

The Final TM plan will be provided to all members of the TM Team, other Departmental entities with an interest/ need to be informed of the planned TM activities, outside parties that will participate in implementation, and the contractor performing the construction. If any design changes are made during construction that affect any part of the TM plan, Construction shall inform the Traffic Mitigation Advocate's Office.

5.1.4 References to Traffic Mitigation in Other Project Planning Documents

The purpose of this document is to present a broad framework for incorporating TM planning and implementation into the existing capital projects planning process. It is expected that individual NJDOT units will develop additional instructions to guide their staff in the proper application of TM procedures and responsibilities established for their units. Additionally, the procedures described in this document are to be referenced in the CPM Procedures Manual and addressed in tools used in the project development process, including Quality Assurance Checklists for Initial and Final Design; Project Scoping Checklists; Quality Assurance/Constructability Reviews; Constructability Checklists; and the Construction Progress Schedule.

Section 6 - Monitoring and Evaluation

Once construction has begun, it is important to monitor the progress and use of individual strategies, track the costs of the strategies, and evaluate their effectiveness in mitigating impacts caused by the construction. Monitoring will allow fine-tuning of strategies - - adjusting or augmenting them if they are not producing the necessary and desired results. For example, ridership counts on temporary transit vehicles might show that buses are underutilized suggesting additional marketing might be needed. Alternatively, the counts might show that the buses are very crowded suggesting additional bus runs should be operated. Similarly, monitoring of delay time on alternate routes might indicate that revised signal timing or additional police enforcement will be needed to use these routes most effectively.

Evaluation of the successes and problems encountered also will provide feedback to guide the development of traffic mitigation activities for future projects and help avoid future problems. Although no two projects are completely alike, many similarities will exist across projects. Results of the traffic mitigation findings of one project will be useful input to the development of TM plans and the allocation of TM resources for other projects.

TM plan evaluations will focus on the performance of both individual TM strategies and overall performance of the construction corridor or facility. Evaluation should be based on measures of effectiveness that are tied to the TM goals set for the project and use methodologies and measuring tools generally recognized and accepted in the discipline covered by the evaluation. Various evaluation measures are appropriate for assessing corridor and strategy performance. This section suggests key measures and associated measuring methods. Various Departmental units will have a role in collecting and interpreting evaluation data. The Traffic Mitigation Policy document identifies these units and the TM strategies they will be responsible for evaluating.

Baseline data will be collected prior to the start of construction, and most evaluation data will be collected during the construction phase of the project; however, for some evaluation activities, post-construction evaluation also might be appropriate, as noted below.

6.1 Corridor Performance

6.1.1 Evaluation Measures

Corridor performance is the “bottom line” of evaluation. Key evaluation measures for both construction facilities and alternate routes include:

- Traffic volumes (within the corridor and on parallel routes)
- Traffic flow (LOS, delay time, length of delay period)
- Vehicle occupancies
- Bicycle and pedestrian traffic in corridor
- Crash rates and severities and incident frequency
- Project duration/acceleration

These measures should be assessed regularly during construction and be assessed for both peak and off-peak times. Measurements should be made before, during, and after construction to examine short- and long-term impacts. For TM plans for high impact projects, evaluation also should track at least some of these measures on non-affected

corridors of similar type of roadway for control purposes in order to rule out the effects of exogenous factors, such as gasoline prices, on the observed results.

6.1.2 Data Collection Methods

Various methods can be used to evaluate corridor performance. Standard machine counting or video procedures can be used to make traffic counts. Several methods can be used to estimate vehicle occupancy. Direct observation is the most direct and accurate method to measure occupancy in slow-moving traffic. Another method is to include occupancy questions in a standard origin and destination survey which is mailed to users of the construction facility who have been identified through license plate monitoring. It can be difficult, however, to obtain a sample that is representative of the total traffic population. Past experience with response rates and confidence levels should determine the necessary sample size for statistical confidence.

6.2 Strategy Performance

6.2.1 Construction/Contracting Strategies

6.2.2 Evaluation Measures

Some construction strategies can be evaluated by comparison with conditions prior to implementing the strategy and with conditions on similar facilities without the strategies in place. For example, lane and ramp closures and two-way traffic on divided highways can be evaluated based on traffic, delay, and accident conditions prior to and after implementation, taking care to control for before/after factors through a non-construction, control facility of similar type and traffic. Controls are important as traffic volumes and accident rates can change for other reasons, especially if the project extends over several years.

Contract management strategies such as A + B bidding can be evaluated by comparing project or phase duration to the anticipated projected schedule and the time it took to complete similar projects or phases in other areas. Lane rental can be evaluated similarly, by comparing the number of hours lanes were projected to be closed to the actual number. When evaluating incentives and disincentives, it is important to estimate all possible benefits and costs. For example, the potential of finishing the project early must be tempered by other factors, such as delay and crash risk. If large delays results from a “fast track” approach, these negative effects must be considered in the evaluation as well.

6.2.3 Data Collection Methodologies

The mechanisms for evaluating travel impacts of lane and ramp closures and two-way traffic on divided highways are similar to those for tracking general corridor performance, as noted earlier in this Section. Standard machine counting or video procedures can be used to make traffic counts. Vehicle occupancies can be measured by direct observation or video, and through surveys, as noted before. VMT can be assessed through survey questions asking about trip length. The same cautions about sample size also apply here. Delay and speeds can be measured through “floating or test car” procedures.

6.2.4 Traffic Control and Operations

6.2.5 Evaluation Measures

As with construction strategies, many traffic control strategies can be evaluated by comparison with conditions prior to implementing the strategy and with conditions on similar facilities without the strategies in place. Reversible lanes, ramp metering, and truck restrictions, for example, can be evaluated based on volume of traffic, delay, and accident conditions prior to and after implementation. Other strategies, such as temporary reduced speed, barriers and channelizing devices, and construction area screening also can be measured through assessment of delay; speed also can be used to assess the effectiveness of these strategies. Strategies that affect routes off the corridor, such as ramp metering, alternate routes, and temporary parking restrictions, potentially affect not only the construction route but also parallel routes, in essence relocating traffic congestion. Therefore, similar evaluation measures of delay, volume, and speed on these routes also should be measured.

Typical measures evaluated for these strategies include:

- Traffic volumes and peak traffic counts (construction and parallel routes)
- Vehicle throughput
- Vehicle occupancy counts
- Bicycle and pedestrian traffic in construction area
- Travel delay and travel time
- Crash rates

6.2.6 Data Collection Methodologies

Data collection tools for traffic control and operations are similar to those used to measure the overall corridor performance. These include standard machine counting or video procedures for traffic counts; direct observation and occupancy questions on surveys to assess vehicle occupancy; and timed runs in a “floating or test car” to assess travel time or average travel speed.

For channelizing devices, reduced speed limits, and flashing arrow signs, direct observation of motorist behavior might be most useful to determine the degree to which travel change is occurring. Video recording also could be useful to determine to what degree traffic is slowing or diverting as requested. Observation over longer periods of time can be used to reveal patterns of change, such as times of heavy traffic vs. light traffic conditions or daytime vs. nighttime behavior.

6.2.7 Public Information

6.2.8 Evaluation Measures

Public information serves two purposes in traffic mitigation. First, it informs the public about the purpose of the project and generates and maintains public support for the project. Second, it encourages changes in travel behavior during the project to minimize delay and accidents. The principal objectives of public information monitoring are to determine 1) is the public getting accurate information? and 2) is the information changing travel behavior?

Evaluation measures that can be used to determine the availability and accuracy of information generally focus on identifying the sources used by the public to obtain information and the perceptions they form toward various aspects of the project. For example, typical evaluation measures might include:

- Percentage of public-at-large and motorists in corridor who are aware of the project
- Motorists' perception of the reason the road is under construction
- Percentage of public-at-large and motorists in corridor who are aware of alternate routes and alternate modes of travel
- Sources (brochures, traffic reports, news articles, etc.) used by motorists to learn about the project
- Public perceptions regarding clarity, availability, and usefulness of information
- Number of requests for information (web site hits, customer service phone calls, etc.)

For the second objective, change in travel behavior can be measured by

- Percentage of motorists in the corridor who change their time of travel or their route
- Number of travelers who rideshare in the corridor
- Number of travelers who bicycle or walk in the corridor
- Transit load factors/ridership in the corridor compared to a pre-construction baseline

6.2.9 Data Collection Methodologies

Determining how well information is distributed and understood can be established by tracking the number of information requests and the level of media attention, and by conducting surveys and focus groups with members of the public-at-large and with the motorists who use the corridor. Telephone survey and mail-out surveys can be directed toward travelers identified through license plate monitoring. Another method is the repeat panel, in which a group of travelers is periodically surveyed on their awareness throughout the project.

Surveys can be used to determine any changes in motorist behavior as a result of the information. Travelers who respond to awareness surveys can be grouped by their level of awareness to determine if those with higher awareness levels were more likely to change their travel patterns. Another method is to ask those making travel changes why they have done so, what sources of information they received, and what information relative to other factors influenced their decision.

Questions about both awareness and behavioral change must be structured carefully. Questions should begin by tapping unprompted recollection of messages and information about the project. When recollection has been established, additional questions can be used to probe specifically about the sources of information, perceptions formed as a result of the information, and the helpfulness of the information.

6.2.10 Motorist Information

6.2.11 Evaluation Measures

Motorist information strategies, including signing and highway advisory radio, can be evaluated on the same basis, and by using some of the same evaluation measures, as for public information. Here, however, the first evaluation objective is whether or not

motorists are aware of the information transmitted and whether the information is useful to specific on-road decisions they are making while they are in the construction corridor.

6.2.12 Data Collection Methodologies

Two appropriate evaluation methods include a survey of motorists in the corridor and direct observation of motorist behavior. As with evaluation of public information strategies, mail or telephone surveys can be targeted to travelers using the corridor. Questions can be asked about whether the motorist tuned in to the highway advisory radio or if they noticed the variable message signs. Questions also can be asked about how travelers responded to the information received.

Follow up questions might be asked of motorists who said they did not hear advisory radio or read the sign. For example, they could be asked if they did not know about the radio or did not believe the information would be useful. Motorists who use the HAR could be asked about the message content, accuracy (considering current conditions), and length. For variable message signs, evaluation might focus on patterns of sign recognition to determine effectiveness. Perhaps signs highlighted with arrow boards get higher recognition than those that do not. Evaluation also could ask about motorists' lane location to determine if they were able to see and read the signs clearly from various lanes.

Another method to evaluate effects of motorist information is through observation. Presuming the requested behavior change is relatively soon after the message, observers can determine the degree to which travel change is occurring. Video recording also could be useful to determine to what degree traffic is slowing or diverting as requested. Observation over longer periods of time and some weeks after message signs have been installed can be used to reveal patterns of change, such as daytime vs. nighttime behavior or times of heavy traffic vs. light traffic conditions.

6.2.13 Demand Management

6.2.14 Evaluation Measures

The effectiveness of TDM strategies can be measured indirectly through improvements to traffic flow; but, in general, they are measured through usage and the number of vehicles they remove from the construction corridor. To determine vehicle reduction, it is necessary to identify the previous mode used for travelers who are using rideshare modes and transit. It is important, however, not to assume that every non-SOV traveler is new to that mode. Some alternate mode users will have been using an alternative before construction began. For example, the implementation of temporary bus service can attract some travelers who were previously carpooling. Other measures of TDM success are the share of travelers using alternative modes and the average occupancy of vehicles using the corridor. Typical evaluation measures for TDM strategies include:

- Train and bus ridership
- Number of new carpools and vanpools
- Alternative mode share, vehicle occupancy
- Park & Ride lot usage
- Number of requests for rideshare information

6.2.15 Data Collection Methodologies

Various methods can be used to determine the effect of TDM strategies on corridor performance. One way to measure the effectiveness of general ridesharing campaigns is to survey a sample of rideshare applicants following a promotion in order to determine if the campaign, or a specific incentive provided in the corridor, influenced the applicant to submit an application or to change modes. Specific new services, such as transit enhancements and Park & Ride lots, can be measured through ridership or usage counts. Additionally, on-board or intercept surveys can be used to identify prior mode, trip length, and other variables related to vehicle trip reduction and VMT reduction.

Employer-based TDM actions also might be assessed to determine the contribution of telecommuting and other employer actions to vehicle trip reduction. The usual tool for assessing employer program effectiveness is an employee survey in which current travel patterns and previous travel patterns are compared. The result of the survey is an assessment of the reasons for any changes in patterns.

6.2.16 Incident Management

6.2 17 Evaluation Measures

The key strategies included in incident management are designed to detect and respond to accidents. Thus, incident management should be evaluated on the basis of how well it reduces response and removal time for accidents and incidents. Incident frequency also might be measured if it is measured over a long period of time or measured against comparable incident rates for equivalent-type, non-construction corridors. Evaluation measures for these strategies could include:

- Number of accidents/incidents
- Ratio of incidents per traffic volume within construction zone to other freeways
- Incident response/clearance time
- Delay time during incidents

6.2.18 Data Collection Methodologies

Incident detection is more difficult to measure than response time because the actual moment the incident starts can be difficult to assess. Detection can be measured most easily where video surveillance records an accident or shoulder stop. By providing a “real time” basis for the incident and by reviewing logs of the State Police and other emergency services, it is possible to determine how long after the actual incident the detection occurred. Response and removal time can be assessed by comparing the log time of the incident detection with the arrival on the scene, as recorded by the police or responding emergency service, and the time at which the roadway is cleared of the incident, again as recorded on police logs.

Section 7 – State-Level Procedures

7.1 Purpose

The State-Level Processes and Procedures provide a systematic approach for addressing and managing the safety and mobility impacts of work zones.

7.2 Overview

The safe and efficient flow of vehicles, pedestrians, and bicyclists through construction work zone areas is a major Department concern. Its importance has recently been echoed by the Federal Highway Administration as is evidenced in the September 9, 2004 rulemaking on Work Zone Safety and Mobility. All states are to be in compliance with this Rule by October 12, 2007. This document addresses the program level procedures, and works in conjunction with the Work Zone Safety and Mobility Policy, the Work Zone Safety and Mobility Project-Level Procedures, the Traffic Mitigation Guidelines, and other Department procedures.

7.3 Processes and Procedures

7.3.1 Traffic Mitigation Advocate

The TM Advocate manages TM Policies and Procedures to ensure that the Department's traffic mitigation goals of safety and mobility are realized. The position of Traffic Mitigation Advocate has been established under the Assistant Commissioner of Capital Program Management.

The Traffic Mitigation Advocate is responsible for overseeing:

- Work Zone Policy & Procedure Development & Implementation
- Work Zone Assessment and Management
- Work Zone Data Evaluation
- Work Zone Safety and Mobility Training Programs
- Work Zone Safety and Mobility Process Review

Additionally, the Traffic Mitigation Advocate will strive for continuity of TM strategies from Concept Development through Construction, as projects are transferred from one phase to the next.

The TM Advocate should have the following qualifications and skills:

- Understanding of a great range of TM techniques
- Knowledge of project delivery schedules and alternate project delivery methods
- Understanding of activities of major NJDOT units with a role in traffic mitigation and the project delivery process
- Sensitivity to the needs of the traveling public and impacted communities, and an ability to build acceptable balanced solutions
- Understanding of project management tools and techniques used by Capital Program Management, such as road user costs, cost estimating, value analysis, and design decision tools

The TM Advocate will also play a supportive role in traffic mitigation areas led by the Subject Matter Experts and will:

- Review Department procedures manuals, design guides, standard specifications, and other applicable documents and incorporate the details of the adopted TM Policy and Procedures into these documents where applicable
- Modify Traffic Mitigation Policy and Procedures as needed to adapt to any modifications to the current project delivery process and update to reflect current industry practices or innovative strategies
- Address, as necessary, Traffic Mitigation related procedures for Operations and Maintenance, Local Aid, and permit construction projects

7.3.2 Work Zone Assessment and Management

The TM Advocate will assist the lead unit responsible for a specific project delivery phase by:

- Serving as a subject matter expert and advisory on traffic mitigation topics and as an advocate for developing and implementing programmatic traffic mitigation strategies throughout the project delivery process. The Advocate will serve to resolve conflicts between units during concept development, project scoping, design, and construction.
- Assisting Project Manager to facilitate and coordinate TM activities conducted by other units and assist with the preparation of draft and final TM plans.
- Maintaining on-going dialogue with other transportation agencies to ensure that traffic mitigation strategies are considered for all transportation facilities impacted by all transportation projects and that project schedules are coordinated among agencies to avoid unnecessary conflicts.
- Assisting Local Aid, and Maintenance and Operations to make recommendations for traffic mitigation strategy.

7.3.3 Work Zone Data Evaluation

Field observations will include utilizing the latest available traffic information to help determine the impacts to traffic.

If shoulders or lane closures are proposed that will generate queues, road user cost calculations may be performed to determine the operational impacts in terms of average costs per day, queues, lengths, and travel delays.

Work Zone Set-ups shall follow Department standards. In addition, only NCHRP 350 approved safety items will be considered acceptable.

Historical work zone crash data shall be maintained and evaluated for possible work zone safety improvements.

7.3.4 Work Zone Safety and Mobility Training

Construction and work zone personnel shall be trained in work zone safety as per Department guidelines as it relates to implementation, operation, inspection, and enforcement.

Designers shall be provided with guidelines and standards to properly develop safe and efficient work zones.

Periodic training updates that reflect changing industry practices and Department processes and procedures shall also be provided.

Section 8 – Project-Level Procedures

8.1 Purpose

The Project-Level Procedures provide guidance and identify key steps to be addressed on individual projects from Planning through Construction to ensure work zone impacts are managed in accordance with the Work Zone Safety and Mobility Policy.

8.2 Overview

Work zone safety and mobility impacts will vary depending on the work zone, location, duration, and roadway capacities and volumes.

The responsible parties involved vary with the subject matter and the project phase:

Subject	Responsible Party
Overall Policy	Traffic Mitigation Advocate
Traffic Volumes	Transportation Data Development
Concept Development/Feasibility Assessment	Project Planning and Development
ITS Solutions	ITS Engineering
Preliminary & Final Design	Designer
Road User Costs/Project Delivery Method	Road User Solutions/Value Management
Work Zone Employee Safety	Employee Safety
Traffic Control Plan	Traffic Signal and Safety Engineering
Allowable Lane Closure Hours	Traffic Operations
Public Information	Communications/Traffic Operations
Construction	Construction Services
Project Delivery	Project Management (Project Manager)
Plans, Specifications & Estimate	Project Management/Designer
Evaluation	Traffic Mitigation Advocate

Exhibit 4 outlines key steps involved in the development of a Transportation Management Plan to address work zone safety and mobility concerns.

Work Zone Safety and Mobility Key Steps

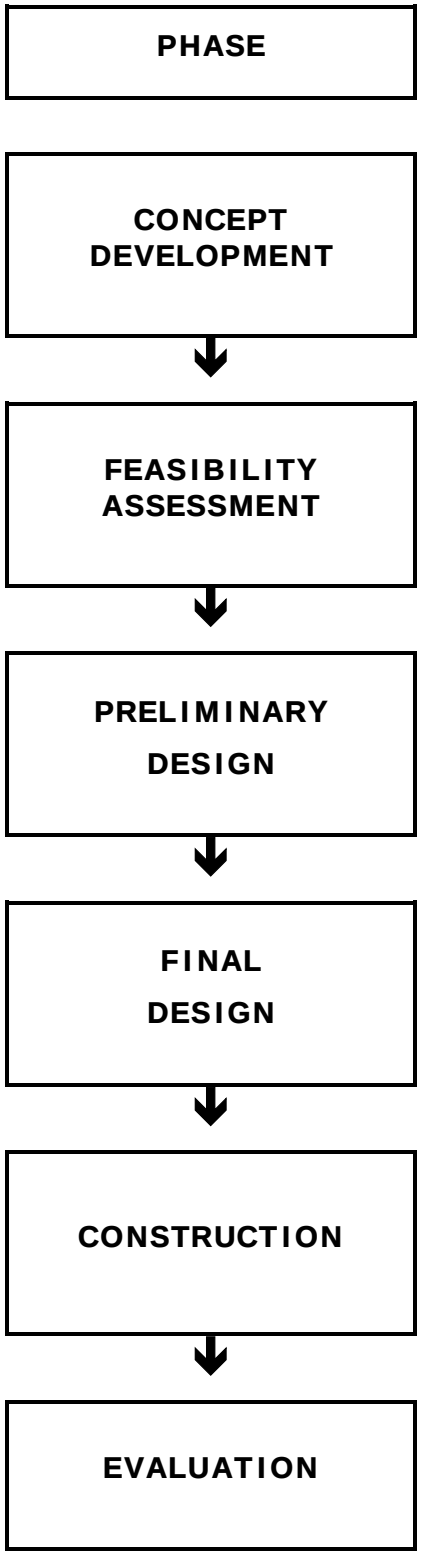


Exhibit 4

The Transportation Management Plan should be developed with input from stakeholders and interested parties. The extent of this outreach will generally increase as the anticipated impacts increase. Stakeholders may include public officials, police, fire, schools, emergency medical services, other transportation agencies, transit providers, utilities, business communities, and other interested parties.

Traffic mitigation efforts are required during each major project development phase. The units involved will change as the project evolves from Planning through Construction. The key units involved in planning, project development, design, and construction shall consistently and comprehensively apply traffic mitigation strategies to provide safe, efficient, cost effective work zones for both construction and the traveler. Any questions or comments in regards to policies or procedures should be directed to the Traffic Mitigation Advocate.

Each unit has their own procedures that are continually being refined. Many topics discussed here have procedures that are contained elsewhere by other units. The procedures shall be supported and supplemented by, but not limited to, the following documents:

- Work Zone Safety and Mobility Policy NJDOT
- Work Zone Safety and Mobility State-Level Procedures
- NJDOT Road User Cost Manual
- NJDOT Traffic Mitigation Guidelines
- FHWA Work Zone Rule -23 CFR Part 630, September 9, 2004
- NJDOT Work Zone Set-Up Guide
- NJDOT Capital Project Procedures, Design Manual, Specifications, Construction Details, and Sample Plans

Road user costs tend to become significant when the traffic volumes exceed capacity. Road user costs exist due to any delays, whether work zone related or not. As an example, Exhibit 5 shows the cost of a one minute delay for 10,000 vehicles.

Traffic mitigation strategies should be considered when the benefits of reduced road user costs exceed the increased construction and related mitigation costs. In work zones, the NJDOT's Road User Cost Manual values are the differential road user costs of added vehicle costs and delay costs created by the queues and reduced speeds caused by the work zone.

Clearly, road user costs can be significant. When comparing design and construction costs to road user costs, the road user costs should typically be weighted within the range of 10-25% of the calculated road user cost value.

$ Cost of Delay

Vehicles per Day	% Trucks	Delay/ Vehicle (minutes)	$ Road User Cost/Day	$ Road User Cost/Year	$ Present Worth Cost for 20 years (at 4% discount rate)
10,000	10	1	2150	780,000	10.6 million
10,000	50	1	2650	970,000	13.1 million

Note: Values based on 2006 cost rates. To calculate costs for 20,000 vehicles per day, multiply costs by two. To calculate costs for two minute delay, multiply costs by two.

Exhibit 5

8.3 Processes and Procedures

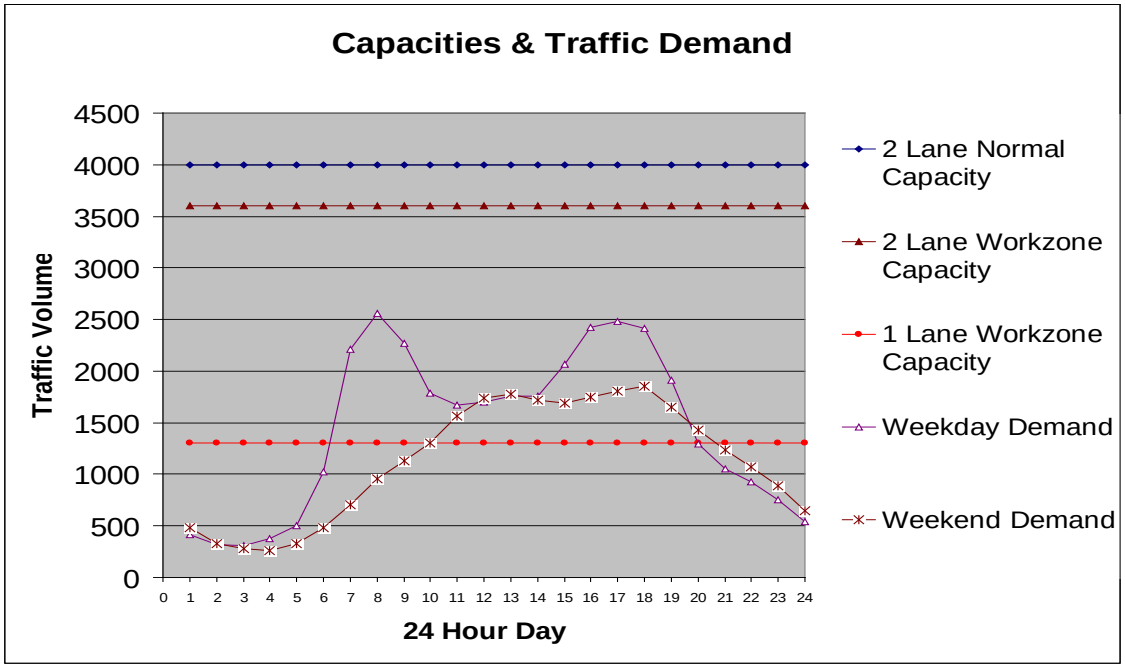
Capital Program Management procedures are outlined below. The Operations and Local Aid groups have their own procedures that follow the Work Zone Safety and Mobility Policy and State-Level Procedures guidelines.

8.3.1 Concept Development (Feasibility Assessment if Pipeline 1 or 2 project)

The analysis of traffic volumes and capacities is foundational for the development of traffic mitigation strategies. The Division of Project Planning and Development (DPPD) shall acquire 24 hour weekday and weekend truck/car counts for the project area. These should include mainline and detour route volumes and, if applicable, side street volumes at signalized intersections. Turning movements at key intersections and interchanges shall be provided for peak hour periods. This data shall either be created by, or forwarded to, the Bureau of Transportation Data Development (TDD) which maintains a centralized data base of all traffic volume counts.

8.3.2 Feasibility Assessment

The evaluation of traffic volumes through various work zone capacities and detour routes will help the Designer understand traffic impacts associated with various lane closure alternatives. The Designer will evaluate the alternatives on a 24 hour basis to determine when there would be queues. Exhibit 6 shows a sample Capacity versus Traffic Demand chart. The Department's Subject Matter Expert is the Road User Solutions Unit from the Bureau of Smart Solutions & Value Management.



Capacity versus Traffic Demand Illustration

Exhibit 6

For evaluation of detours, the average detour length and delay times shall be determined by the designer. The NJDOT Road User Cost Manual provides greater detail in these matters.

The number of lanes available in a work zone plays a significant role in the work zone capacity. Work zone capacity charts are in the NJDOT Road User Cost Manual. Basic Work Zone Staging Scenarios in the manual provide the designer with the ability to quickly evaluate minimum width requirements for various lane closure scenarios.

The Department recognizes the public does not like to experience traffic delays due to construction. Therefore, in its evaluation matrix, the Department should include an alternative that introduces no traffic queues (i.e. volumes are less than capacity). Common methods to avoid queues are modifying the allowable lane closure hours and utilizing shoulder areas as temporary lanes. If this “no congestion” scenario can be cost effectively accommodated and becomes the initially preferred alternative, the work zone will have Low Impacts.

8.3.3 Preliminary Design

For projects that will have anticipated queues, the Designer shall utilize the NJDOT Road User Cost Manual to provide a preliminary analysis of the actual road user costs. There are a multitude of traffic mitigation strategies that are available. Depending on the project location and severity of the anticipated impacts, different strategies will be appropriate and the most cost effective. Mitigation strategies may be temporary in nature or provide permanent improvements.

Typical strategies include limited lane closure hours, shoulders as lanes, liquidated damages for lane occupancy and road user charges, intelligent transportation services (ITS) including real time traffic information, movable barrier, temporary roads and bridges, temporary traffic signals, detours, accelerated construction, pre-cast items, and A + B or Incentive/Disincentive contracts focusing on key construction stages with high anticipated congestion. Additional strategies would include police traffic directors, Park-and-Ride or public transit options, public outreach, and website information.

Sometimes it is prudent to tolerate higher road user costs for short periods to improve safety, quality, and construction durations. Center work zones, for example, should be avoided whenever possible. Also, surface courses typically last longer when echelon paving is used to reduce the number of cold longitudinal joints. Therefore, longer allowable lane closure hours may be appropriate during final paving operations.

Projects with no anticipated queues are considered Low Impact Projects. A Traffic Control Plan will be provided to ensure safe Transportation Operations. The Public Information component will primarily be through contact of applicable local officials, static and variable message signing, and timely web site information.

For Moderate and High Impact projects that will have anticipated queues, the Designer shall work with the Project Manager, Traffic Operations, and Road User Solutions to determine if additional strategies and involvement from additional units are required.

High Impact Projects are those projects that have traffic demands that exceed work zone capacities for a period of more than six hours per 24 hour day.

Moderate Impact Projects are those projects that have traffic demands that exceed work zone capacities for a period of zero to six hours per 24 hour day.

Low Impact Projects are those projects that have traffic demands that do not exceed work zone capacities during any time of the 24 hour day.

If it is determined that additional strategies are required, the first step is to involve interested parties such as the Designer, Project Manager, Road User Solutions, Federal Highway Administration (FHWA), Traffic Engineering, Construction Services, Freight and Intermodal Coordination, Communications, and Traffic Operations. A current project construction cost estimate and traffic related data from the Feasibility Assessment Report would be evaluated to determine if a Traffic Impact Report is necessary. The report is not necessary if a plan and direction can be agreed upon without it.

Traffic Impact Reports, when deemed necessary, may be submitted with the text portion as part of the Preliminary Design Submission. On High Impact projects with complex traffic issues, a separate Traffic Impact Report may be beneficial as determined by the Designer, Project Manager, Traffic Operations, and Road User Solutions.

Information in a Traffic Impact Report includes:

- The existing traffic volumes and capacity data on the roads likely to be substantially impacted. The potential impacts of the construction on traffic through the project and along any detours. (Much of this information should be available from the Concept Development or Feasibility Assessment Report).

- Project recommendations for traffic mitigation, e.g. nighttime work; restricted hours of operation; number of lanes available for traffic; width of lanes; requirements for alternating traffic; staging requirements; temporary traffic signal timings and restricted turning movements; extra widening for better stage construction; movable barrier; temporary bridge; detours or alternate routes for pedestrians, bicyclists, or motorists; alternative project delivery methods such as A+B Bidding and Incentive/Disincentive contracts; temporary traffic signals; traffic directors; multiple crews; pre-cast and pre-fabricated construction; advanced utility work; real time traffic information; project website; and public information efforts.
- Additional project recommendations that go beyond traditional plans and specifications, e.g. park and rides; shuttle buses; flextime; additional transit services; interagency coordination with NJ Transit, NJ Turnpike, Port Authority, railroads and utilities; hyper-build approaches; etc.

8.3.4 Evaluation of Traffic Impact Report

- At a minimum, the Designer, Traffic Operations, Road User Solutions, and the Project Manager should evaluate the Traffic Impact Report. If applicable, other potentially involved units include the FHWA, Community Relations, Public Education and Marketing, and the Commissioner's Office. Road user costs are the result of road user costs per day multiplied by the number of days. Alternatives that cost-effectively reduce these costs are the ones most worth considering.
- It shall be the Department's responsibility to be aware of nearby construction projects that could further impact traffic. The Program Manager should be aware of how this project and project schedule may be impacted by nearby Capital Program Management, Maintenance, and Access projects as well as projects by other Agencies.

8.3.5 Final Design

The components of a good TM plan shall be finalized at this time. The work zone capacities should be maximized to cost effectively minimize work zone congestion. Every effort should be made to avoid having uncontrollable utility work on the critical path of any work stage when volumes exceed capacities.

- The Traffic Control Plan shall allow for safe and efficient travel through the work zone. Standard closures shall be included in the contract documents based on Department, AASHTO, and MUTCD criteria.
- The Transportation Operations component must be completed. Allowable lane closure hours should be finalized. Alternative project delivery methods such as A+B and I/D should be finalized by Road User Solutions, Traffic Operations, the Designer, and Project Manager. The lane occupancy and road user charge values shall be finalized by Road User Solutions and the Designer. These shall be incorporated into the specifications by the Designer and Quality Assurance Team Leader.
- The Public Information component must be completed. Construction information in regards to lane closures, detours, delays, etc. should be available to the public and linked to the NJDOT commuter information website.
- Community outreach plans and interagency coordination efforts and plans should be finalized.
- Compatibility with other construction projects should also be verified.

- The Plans, Specifications and Estimate (PS&E) for a project may contain Traffic Control Plan requirements in a combination of method and performance based specifications. Method based specifications may consist of a combination of individual and lump sum pay items. Alternatively, performance based specifications may be used. In this option, mobility performance criteria, such as delay, queue length, or travel time through the work zone, may be used. These may be most appropriate for establishing conditions for when contractors desire to increase the allowable lane closure hours available to them to complete their work.

8.3.6 Operations Projects

Operations Projects include Permit initiated projects, State contracted work, and In-house Maintenance work. Concept Development and Feasibility Assessment are limited to working with Statewide Traffic Operations to determine allowable lane closures and time frames. Traffic Control Plans are implemented via the standard NJDOT Traffic Control Plans and Specifications. All lane closure schedules and plans are coordinated and approved by Statewide Traffic Operations prior to construction. During construction of Permit-initiated and State contractor projects, In-house staff has the ability to inspect and enforce the proper implementation of traffic control plans to help insure proper set-up and safety. Permit contractors and state contractors follow the minimum criteria for work zone safety guidelines as defined in the current edition of the NJDOT Work Zone Set-Up Guide. In-house maintenance workers must follow the minimum criteria of the Work Zone Set-Up guide and Safety Manual prepared by NJDOT.

8.3.7 Local Aid Projects

Local Aid projects will be self-certified to ensure compliance with the NJDOT Work Zone Safety and Mobility Policy.

8.3.8 Construction

The safe, efficient, and cost effective construction of the project is the ultimate goal of the project efforts. Work Zone Set-ups shall follow NJDOT Work Zone Safety Set- up Guide, Current Edition (Mobile, Short Duration & Short Term Stationary Work); Standard Roadway Construction/Traffic Control/Bridge Construction Details, Current Edition (Intermediate Stationary & Long Term Stationary Work); MUTCD, Current Edition; or a Traffic Control Plan designed and signed by a traffic engineer. All Standards must be maintained throughout the project. Opportunities to reduce congestion via staging modifications or temporary signal timing changes should be considered. Sometimes the construction staging will be affected by traffic mitigation strategies offered by the contractor. If a contractor wants to change any lane closures or times, they must first receive approval through the Resident Engineer and Traffic Operations. Traffic Operations shall seek Road User Solutions assistance when road user cost calculations are required to make a change determination.

The Resident Engineer shall keep Traffic Operations and other interested parties informed of construction, scheduling, and lane closures. The website www.njcommuter.com shall be the primary means used to provide lane closure information.

8.3.9 Public Information

Real time motorist information via static and variable roadway signing, the 511 phone system, Highway Advisory Radio, and the internet (e.g. www.njcommuter.com and www.trips123.com) can provide significant traveler benefits. Advertising campaigns and other marketing strategies may also be necessary for projects with major impacts. Traffic Operations will lead this effort.

8.3.10 Evaluation

To effectively manage the traffic mitigation program, the Road User Solutions Unit shall track or gather the following information:

A. Design

- Values of road user cost calculations for all projects (lane occupancy and road user charges and average delay times)
- Average delay times and queue lengths based on road user cost calculations
- Values of all lane occupancy and road user charges used for project specifications
- Type of project delivery method for all projects
- Phases of work utilizing alternative project delivery methods such as Incentive/Disincentive and A + B Bidding, corresponding dollars per day, and construction phase durations

B. Construction/Traffic Operations

- Construction start dates, original Substantial Completion date and adjusted Substantial Completion date
- Original completion days and actual completion days for any Incentive/Disincentive or "B" stages in Incentive/Disincentive or A + B projects
- Frequency and duration of contractors closing lanes beyond the allowable lane closure hours or completion dates
- Lane Occupancy, road user charge, and liquidated damages collected
- Payment for Incentives
- Reports of accidents

C. Traffic Control Plan Reviews

Annual Traffic Control Plan (TCP) reviews will be initiated by the TCP Review Team Coordinator of Traffic Signal and Safety Engineering. This will consist of multi-disciplinary teams making field visits to project sites throughout the State. The Coordinator will prepare a report on observations and recommendations.

D. Process Review

Every two years the Traffic Mitigation Advocate shall meet with the FHWA and other interested parties to assess the effectiveness of the work zone safety and mobility procedures. Lessons learned shall be incorporated into policies, processes, and procedures as necessary to make improvements.

8.3.11 Training

All Designers are required to be familiar with work zone safety and mobility strategies, and the application of the Road User Cost manual. Training classes and seminars will be developed on an as needed basis.

Construction personnel shall be trained in work zone safety as per Department guidelines.

Section 9 – Work Zone Safety and Mobility Policy

Policy & Procedure 815

I. PURPOSE

To establish a Policy for the consistent and comprehensive application of work zone safety and mobility from planning through construction for Federal-aid highway projects. This policy shall conform to FHWA Final Rule on Work Zone Safety & Mobility 23 CFR Part 630 Subpart J published in the Federal Register on September 9, 2004.

II. DEFINITIONS

Federal-aid Highway – A highway eligible for assistance under Title 23 United States Code (USC) other than a highway classified as a local road or rural minor collector. Projects on federal-aid highways may be administered by the owner (NJDOT), developers, or other agencies.

Highway Workers – Highway workers include, but are not limited to, personnel of the contractor, subcontractor, NJDOT, utilities, and law enforcement, performing work within the right-of-way of a transportation facility.

Mobility – Mobility is the ability to move from place to place and is significantly dependent on the availability of transportation facilities and on system operating conditions. With specific reference to work zones, mobility pertains to moving road users efficiently through or around a work zone area with a minimum delay compared to baseline travel when no work zone is present, while not compromising the safety of highway workers or road users. The commonly used performance measures for the assessment of mobility include delay, speed, travel time, and queue lengths. These are affected by traffic volumes, capacity, and access control.

Project Manager (PM) – The PM has the responsibility and authority for implementing the Transportation Management Plan (TMP) and other safety and mobility aspects of the project.

Public Information (PI) – The PI component of the Transportation Management Plan (TMP) includes communication strategies to inform affected road users, the appropriate public entities, area residences and businesses, and the general public about the project and its expected work zone impacts. The PI component varies depending on the project characteristics. It may include such things as information on the project characteristics, expected impacts, closure details, real time traffic information, and commuter alternatives.

Safety – Safety is a representation of the level of exposure to potential hazards for users of transportation facilities and highway workers. With specific reference to work zones, safety refers to minimizing potential hazards to road users in the vicinity of a work zone and highway workers at the work zone interface with traffic. The commonly used measures for highway safety are the number of crashes or the consequences of crashes (fatalities and injuries) at a given location or along a section of highway during a period of time.

Significant Projects – Federal-aid highway projects, regardless of funding source, which occupy a location for more than three days with either intermittent or continuous lane closures shall be considered significant.

Temporary Traffic Control Plan (TTC) – A TTC plan describes TTC measures used for facilitating road users through a work zone or an incident area. The TTC plan plays a vital role in providing continuity of reasonably safe and efficient road user flow and highway worker safety through work zones, or when incidents temporarily disrupt normal road user flow. The TTC plan shall be consistent with the MUTCD, AASHTO Roadside Design Guide, and NJDOT standards. In developing and implementing the TTC plan, pre-existing roadside safety hardware shall be maintained at an equivalent or better level than existed prior to project implementation. The TTC plan shall either be a reference to specific TTC elements in the MUTCD, approved standard TTC plans, or be designed specifically for the project.

Traffic Mitigation (TM) – Traffic mitigation is the management of motor vehicle, bicycle, and pedestrian traffic to provide work zone safety and reduce user costs.

Traffic Mitigation Advocate (TM Advocate) – The TM Advocate facilitates the management of TM Policies and Procedures in the Department.

Transportation Management Plan (TMP) – The TMP consists of strategies to manage the work zone impacts of a project. The scope, content, and degree of detail may vary based on the expected work zone impacts. A complete TMP, required for significant projects, consists of the Temporary Traffic Control Plan (TTC) and addresses the Transportation Operations (TO) and Public Information (PI) components.

Transportation Operations (TO) – The TO component of the TMP identifies strategies that will be used to mitigate impacts of the work zone on the operation and management of the transportation system within the work zone impact area. Typical TO strategies may include such things as demand management, corridor/network management, safety management and enforcement, and work zone traffic management. The scope of the TO component varies depending on the project characteristics, and the transportation operations and safety strategies.

Work Zone – A work zone is an area of a highway with construction, maintenance, or utility work activities. A work zone extends from the first warning sign or TTC device to the End Road Work sign or last TTC device.

Work Zone Crash – A work zone crash is a traffic crash in which the first harmful event occurs within the boundaries of a work zone or its affected area. This includes crashes occurring on approach to, exiting from or adjacent to work zones.

Work Zone Impacts – Work zone impacts refer to work zone-induced deviations from the normal range of transportation system safety and mobility. These impacts may extend beyond the physical location of the work zone itself and affect other highway corridors or other modes of transportation. The extent of the work zone impacts may

vary based on factors such as road classification, area type (urban, suburban, and rural), traffic and travel characteristics, type of work being performed, time of day/night, and complexity of the project.

III. POLICY

The systematic consideration and management of work zone impacts shall be undertaken, as a minimum, on all federally funded projects and projects that are on the Federal-aid highway system. Work zone impacts and traffic mitigation strategies shall be addressed throughout the various stages of project development. Guidance, procedures, and processes, developed in partnership with the FHWA, will be utilized.

The Department is committed to providing a network of transportation facilities that enables the public to move safely and efficiently throughout the State. Developing and maintaining a statewide transportation network requires periodic upgrades and improvements to these facilities through construction projects. The Department's first priority is to complete these projects in a timely, cost-efficient, and safe manner. However, it is recognized that construction work zone impacts might inconvenience the public, in some cases resulting in delays, road user costs and disrupted businesses.

Work zone impacts are affected by traffic volumes and capacities. Therefore, a volume to capacity analysis should be evaluated for roadways within the project limits affected by the construction to help determine the level of impacts.

For significant projects, a Transportation Management Plan (TMP) will be developed to address safety and mobility impacts. For non-significant projects, a TMP may consist of only the TTC plan, although the TO and PI components should be considered as well. Benefits of the TMP for the public and the Department may include:

- Improved motor vehicle, bicycle, and pedestrian traffic flow through the construction area and along detour routes, minimizing disruptions
- Educated public concerning the purpose of and plans for construction projects, helping to reduce citizen complaints and build goodwill for the Department
- Encouraged use of transit and other alternate modes, and travelers educated about the benefits of these modes
- Efficient and timely completion of construction projects, offering short and long term cost savings, while minimizing the disruption for motorists
- Reduced number of incidents in construction corridors
- Enhanced incident detection and emergency response

The TMP should be developed in consultation with interested parties. Interested parties may include public officials, local stakeholders, other transportation agencies, utility companies, and transit providers. The extent of the outreach and development will generally increase as the anticipated impacts increase.

IV. ROLES AND RESPONSIBILITIES

The Department as a whole shall provide reasonable, sensible, and responsible work zone safety and mobility for highway workers and the traveling public.

Transportation Management Plans are generally multi-dimensional. The plans and TM activities might encompass numerous mitigation strategies, cross municipal boundaries, and require participation of many Departmental Divisions and entities external to the Department, depending on the project impacts and location. Each of these entities must understand its role and responsibilities, the roles of other groups, and how and when the roles interact.

The TM Advocate will help develop and maintain policy to provide continuity. The Project Manager will ensure that TMP activities are coordinated from planning through construction. A consistent approach during all project phases should preserve TMP decisions, unless warranted by design changes. The Project Manager will ensure the balance of constructability, schedule, budget, safety, road user impacts, and the community through leadership and collaboration.

V. GOALS

The work zone safety and mobility goals are to:

- Balance the Department's need to minimize roadway construction costs with the need to minimize construction-related inconvenience for motorists, bicyclists, pedestrians, local residents, businesses, and other stakeholders
- Provide a high level of safety for workers and the public
- Ensure that traffic mitigation needs are addressed systematically in all projects
- Provide adequate lead-time for the Department and outside partners to implement traffic mitigation strategies
- Ensure that the cost of traffic mitigation is included in project cost estimates and that funding is provided
- Provide the contractor adequate access to complete the work efficiently while meeting the quality requirements of the contract
- Establish measurable design and construction criteria for the improvement of safety and mobility in the work zone.

VI. AUTHORITY

Federal Register, Title 23 Highways, Code of Federal Regulations (CFR), Part 630 – Preconstruction Procedures, Subpart J – Work Zone Safety and Mobility

Section 10 – Additional Resources

Work Zone Rule Examples may be found at
http://www.ops.fhwa.dot.gov/wz/resources/final_rule/examples.htm

Best Practices Fact Sheets may be found at
http://www.ops.fhwa.dot.gov/wz/practices/factsheets/factsheets.htm

Road User Cost Manual may be found at http://www.state.nj.us/transportation/eng/documents/RUCM/