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Safety, Mobility, and Cost Benefits of Closing One Direction of the Interstate in Rural Areas During Construction Work

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16. Abstract

With specific regard to interstates in the rural area, Indiana Department of Transportation (INDOT) has expressed a need for research that sheds light on this Maintenance of Traffic (MOT) issue so the agency [INDOT and the contractor] can make informed decisions regarding the crossover sections versus the closure in one direction with detour roads. A number of studies have investigated the advantages and disadvantages of various MOT strategies; however, there is no specific study that can help INDOT traffic engineers and design engineers make decisions by comparing direct and indirect benefits of crossovers and detours (full lane closures). This research examined the advantages and disadvantages of entirely closing one direction of traffic over traditional work zone techniques (such as partial lane closure through median crossover) from the perspectives of the agency, road users, and the community. In the case of full closure, the study (a) examined the alternative MOT strategies and best practices through an extensive literature review and survey of agencies (b) investigated risk, benefit, and costs associated with selected detour routes (c) validated the identified critical factors through case studies in Indiana and at other states, and (d) implemented best practices in an expected project to evaluate the safety, mobility, and cost benefits of closing one direction.

Through the literature review and four case studies, eleven KPIs for MOT strategy developments were identified. This study prioritized these KPIs through the survey questionnaire. The top five KPIs are (1) safety, (2) mobility, (3) budget constraint, (4) project duration, (5) complexity of project sites. Based on these KPIs and other findings presented in Section 4.3.3, this study has proposed a comparison tool for predetermined MOT strategies in the form of a flow-chart. This tool is followed by the scores or weights associated with each KPI. These scores are normalized—i.e., the most important KPI which is safety, has the maximum weightage 1 and rest of the KPIs are weighed relatively. INDOT has a set of editable documents which are references for making MOT decisions. This proposed flow-chart tool will "walk" the INDOT team through the use of these spreadsheets corresponding to the identified KPIs through this study. It will be at the discretion of the INDOT team as to which KPIs are relevant to the situation at hand. Therefore, the flow-chart tool is flexible to incorporate the dynamic nature of MOT strategy selection.

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crossover, full closure, detour, maintenance of traffic

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EXECUTIVE SUMMARY

Introduction

The Indiana Department of Transportation (INDOT) expressed a need to investigate Maintenance of Traffic (MOT) at rural interstates, so the agency and contractor can make informed decisions on whether to establish crossover sections versus closing one direction with detouring. A number of studies have investigated the merits and demerits of various MOT strategies. However, INDOT's traffic and design engineers desire detailed guidance in the form of a framework that compares the direct and indirect benefits of crossovers and detours (full lane closures). This research examined the advantages and disadvantages of closing entirely one direction of traffic over traditional work zone techniques (such as partial lane closure through median crossover). This was done based on Key Performance Indicators (KPIs) that reflect the perspectives of the agency, road users, and the community. In the case of full closure, the study (1) examined the alternative MOT strategies and best practices through an extensive literature review and survey of agencies (2) investigated the risks, benefits, and costs associated with potential detour routes (3) validated, from case studies in Indiana and at other states, decision factors that can be considered critical for the analysis, and (4) implemented the identified best practices in an actual road project in Indiana, to evaluate the safety, mobility, and cost benefits of closing one direction.

Findings

Through the literature review and four case studies, eleven KPIs for MOT strategy developments were identified. The results of the questionnaire survey of highway agencies helped prioritize the KPIs. The top five KPIs are (1) safety, (2) mobility, (3) budget constraint, (4) project duration, and (5) complexity of project sites. The findings of the case studies and the nationwide-distributed survey questionnaire suggest that the adoption of a well-defined and objective framework for choosing appropriate MOT strategies can be beneficial to all project stakeholders (the agency, road users, and the community). The survey and interview results suggest that the implementation of carefully-design MOT strategies leads to fewer complaints from road users and construction workers and enhances overall project safety.

Implementation

This study evaluated the benefits of closing one direction of an interstate road section located in a rural area. Based on these KPIs and other findings presented in this report, a tool (flow chart) was developed to facilitate the comparison of pre-determined prospective MOT strategies. The case study demonstrated that it is feasible to use the developed flow-chart tool and the identified KPIs to provide guidance for INDOT staff in their routine tasks of using spreadsheets for MOT strategy evaluation and selection. The INDOT staff have discretion to choose which KPIs are relevant to the project in question. It is anticipated that implementation of the framework will contribute to faster execution of projects, reduced the cost of temporary traffic control, and ultimately lower overall project costs.

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CHAPTER 1. INTRODUCTION

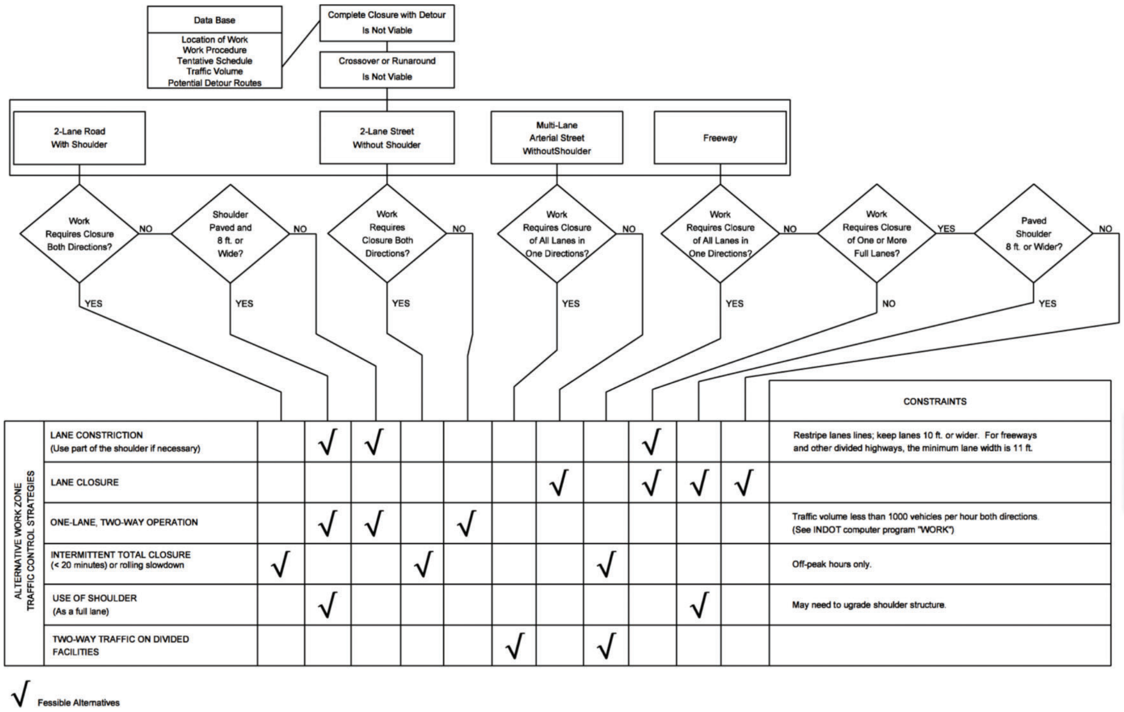
1.1 Background and Problem Statement

Maintenance of Traffic (MOT) at highway work zones is a transportation management activity that seeks to control traffic movements during construction projects in a manner that is economical and safe for road users and construction workers. The Indiana Department of Transportation (INDOT) uses various MOT strategies for road maintenance projects, as indicated in the agency's design manual (INDOT, 2013). This includes a chart to identify feasible MOT strategies based on the job site conditions and constraints associated with a specific project (Figure 1.1).

One of the commonly-used MOT strategies for highway work zones is the crossover design. With this strategy, it is relatively easier to manage work zone capacity constraints compared to any other MOT strategies such as off-site detours and alternate routing (Mallela & Sadasivam, 2011). Bham and Hicks (1998) investigated the effect of crossovers and partial lane closure based on different work zone conditions and capacities. Benekohal et al. (2010) developed a crossover model by estimating work zone capacity based on thirteen different traffic conditions. However, crossovers can be more expensive compared to other MOT strategies because it involves the construction of temporary lanes and traffic control devices such as signs and pavement markings, and temporary barrier walls (INDOT, 2013).

Furthermore, crossover design can pose hazardous conditions to road users and construction workers because it requires drivers to shift lanes multiple times, decrease speeds frequently, and drive close to the job sites (Carrick et al., 2008). According to INDOT personnel and police reports, serious crash accidents have often offered at multiple crossover sites including the I-65 at Jackson and Bartholomew counties. Therefore, proper traffic controls need to be carefully developed and deployed to mitigate any potential safety risks associated with crossovers.

Contractors, in particular, have expressed concerns about lane closures and backups where traffic merges at approaches to crossovers. These are critical to the road user safety and the safety of construction crews (Schneider, 2019; Yang et al., 2015). As part of decision criteria for evaluating the effectiveness of MOT strategies including crossovers, road user cost has been used. Also, several studies have used road user cost analysis as a basis, not only to evaluate the effects of the full lane closure and detour strategies (Adams, 2005; Antonucci et al., 2005; Mallela & Sadasivam, 2011; Yang et al., 2009) but also to minimize the total cost of projects including work zone traffic control under different site conditions (Bai et al., 2013; Borchardt et al., 2009; Jiang & Adeli, 2003; Qiao et al., 2019). Nemeth & Rouphail (1983) also suggested strategies for traffic control at freeway work sites. However, most of these studies had focused on freeways in urban areas where multiple detour options are available. Only one research study (Gallo et al., 2012) investigated detour plans in rural areas. They assessed the effectiveness of a hybrid strategy for detours electronic signage at the driving lane to increase the number of detouring



												CONSTRAINTS
LANE CONSTRICTION (Use part of the shoulder if necessary)		√	√						√			Restripe lanes lines; keep lanes 10 ft. or wider. For freeways and other divided highways, the minimum lane width is 11 ft.
LANE CLOSURE							√		√	√	√	
ONE-LANE, TWO-WAY OPERATION		√	√		√							Traffic volume less than 1000 vehicles per hour both directions. (See INDOT computer program "WORK")
INTERMITTENT TOTAL CLOSURE (< 20 minutes) or rolling slowdown	√			√				√				Off-peak hours only.
USE OF SHOULDER (As a full lane)		√								√		May need to ugrade shoulder structure.
TWO-WAY TRAFFIC ON DIVIDED FACILITIES						√		√				

Figure 1.1 Chart for the identification of a feasible work zone type (traffic maintained adjacent to the work area) (INDOT, 2013).

vehicles and trucks were made to use the highway and cars were made to detour onto parallel roads.

1.2 Research Needs

With regard to rural interstate detouring, particularly outside of Indianapolis, INDOT has expressed a need for research that sheds light on the MOT issue. That way, the agency can make informed decisions regarding crossover versus closing in one direction with detour routes. A number of studies have investigated the advantages and disadvantages of various MOT strategies; however, to date, no specific study provides results that can help INDOT's traffic and design engineers make rural interstate decisions by comparing the direct and indirect benefits of crossovers and detours (full lane closures). Hence, INDOT seeks a guideline to preliminarily identify appropriate locations and road segments of interstates where closing one direction or crossovers are feasible. The solution is not expected be a "one size fits all" but rather will be influenced by site conditions and the nature of the specific interstate segment in terms of the traffic volume and availability of detour routes of reasonable length and geometric characteristics. It is acknowledged that the final answer to this problem should be developed after duly accounting for the perspectives and concerns of the key stakeholders (the agency, road users, and the community).

1.3 Objectives

The main objectives of the study are to (1) document best practices that evaluate benefits of closing one direction of interstate in rural areas for maintaining maximum capacities of traffic volumes while considering constraints of each MOT strategy such as bridges, turning radius, signals, exit ramps and pedestrian crossing, (2) help INDOT district traffic and design engineers to implement the documented best practices, and (3) provide guidelines/framework to help INDOT engineers in decision making.

1.4 Scope of Work

This research examines the advantages and disadvantages of closing entirely one direction of traffic over traditional work zone techniques (such as partial lane closure through median crossover) from the perspectives of the agency (e.g., INDOT and contractors), road users, and the community. The research (1) examined the alternative MOT strategies and best practices through an extensive literature review, (2) performed case studies to identify critical factors to investigate risk, benefit, and costs associated of selecting interstate detour routes, (3) conducted a survey questionnaire of agencies to validate the identified critical factors, and (4) identified rural interstate sections where closures are possible due to availability of alternative routes. This study focused on a single interstate corridor at a time. The study performed literature reviews, including the 2002 INDOT-sponsored research study of the Hyperfix project in Indiana (Sinha et al., 2004), national surveys, and selected case studies with surveys and interviews to investigate best practices. Furthermore, this study developed a worksheet which can be used to help INDOT district traffic and design engineers in implementing the best practices. The documented best practices and the developed worksheet are designed to do the following.

- Facilitate comparison of the safety, mobility, and cost benefits of closing one direction and of crossover.
- Be implementable to projects in all districts in the State of Indiana.
- Be applicable to interstate projects in rural areas (outside of I-465) with two-lane or four-lane detour route options.
- Be in conformity with the existing design manual; and
- Be capable of facilitating assessment of the options using multiple KPIs such as mobility, safety, cost, schedule, and quality.

1.5 Report Organization

This report consists of seven chapters. Chapter 1 presents the research background and needs followed by the scope of work, and objectives. Chapter 2 summarizes the literature review conducted, which include the federal and state work zone planning procedures, existing maintenance of traffic (MOT) strategies, and road user cost analysis methods. Chapter 3 describes the case studies of full road closure of interstate roads. In Chapter 4, the data collected and analyzed from questionnaire and interviews. Chapter 5 explains the framework and algorithm of the decision-making tool of closing one direction. Chapter 6 examines the MOT strategies that were designed for the I-65 widening project carried out in the Seymour District in Indiana based on the proposed framework. Chapter 7 concludes the report with a summary of the key results and the study's limitations and recommendations for future research.

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

The main purpose of the literature review is to identify KPIs and risk factors that have been used to compare the advantages and disadvantages of feasible MOT alternatives in Indiana and other states. The choice and implementation of an appropriate detour strategy based on the different critical criteria, e.g., presence of school zones, necessitates a comprehensive review of the current design manuals. In this regard, the *Indiana Design Manual 2013*, Chapter 503 (which introduces various MOT strategies for freeways) was reviewed. Also, INDOT's *2017 Interstate Highway Congestion Policy* (IN.gov, n.d.) has been studied to determine the conditions under which interstate route congestion occurs. These resources bring about an overview of the MOT alternatives and road user cost, respectively. The capacity of work zones is one of the main factors that cause road delay, (and as a result, increased road user costs). The final subsection of this chapter introduces the strategies implemented by the various DOTs to estimate road capacity at work zones.

2.2 Work Zone Planning Procedure and Strategies

2.2.1 Introduction

The *Indiana Design Manual 2013* Chapter 503, Transportation Management Plan (TMP) presents an overall strategy to accommodate traffic during road work. In this plan, work zone safety is suggested on the basis of the Code of Federal Regulations (CFR) 23 CFR 630 Subparts J and K by Federal Highway Administration (FHWA). Policies for work zone safety and mobility are also accessible through the INDOT Work Zone Safety webpage.

The TMP procedure, highway congestion policy (HCP), work zone capacity analysis, and traffic control strategies are presented in the following subsections.

2.2.2 Transportation Management Plan Procedure

The INDOT TMP is designed on the basis of project "significance." Projects are defined as either significant or non-significant in the TMP. According to this manual, all interstate system projects within the boundaries of a designated traffic management area that occupy a location for more than 3 days with either intermittent or continuous lane closures are considered significant. After confirming a project's significance, the TMP team is responsible for deciding the transportation management strategy to be implemented for the project. As the plan becomes finalized, the TMP team prepares a report submitted with final tracings for inclusion in the project file. This report includes the Temporary Traffic Control Plan (TTCP), Transportation Operations Plan (TOP), Public Information Plan (PIP), and Maintenance of Traffic Plan (MTP) sheets.

According to Chapter 503 of the *Indiana Design Manual 2013*, every highway project needs an MOT design. Typically, the MOT design is started as early as the project planning phase and completed at the end of the project, and even sometimes continues after the project completion until the traffic stabilizes. As recommended by the *Indiana Manual on Uniform Traffic Control Devices* (IMUTCD), MOT designs should make provision for construction workers and road users, including persons with disabilities, in deference to the Americans with Disabilities Act of 1990 (ADA).

A project on the public influences the type of Transportation Management Plan to be selected and implemented. Every TMP consists of a Temporary Traffic Control Plan (TTCP). However, Transportation Operations Plan (TOP) and Public Information Plan (PIP) may be required or encouraged depending on the impact on the public. Projects that have a significant impact require all three elements of a TMP (that is, TTCP, TOP, and PIP). Non-significant projects require only a TTCP, but a TOP and a PIP are encouraged.

A *significant project* is defined as a project that creates consistent work zone impacts higher than what is considered acceptable based on INDOT policy and engineering assessment. Typically, all interstate projects within a designated *Traffic Management Area* and continue for more than 3 days with either intermittent or continuous lane closures are deemed significant. Other criteria influence the classification of a project as significant. These may include but not limited to the following.

1. New construction or major construction.
2. A project with traffic volumes greater than 12,000 AADT or 30,000 AADT for a two-lane highway and multilane highway, respectively.
3. The project location, an urban versus suburban versus rural area.
4. Existence of any need for alternate routes to be used due to highway capacity reduction.
5. Significant adverse impact on local communities and businesses.
6. Interstate projects that need an exception to the *Interstate Highway Congestion Policy*.

Any other project that does not fit into the description of a significant project can be classified as a *non-significant project*. Below is the list of areas/counties included in the Indiana traffic management area. Projects that are located at the following locations for more than 3 days are categorized as having a significant impact on the public.

1. Cincinnati (all of Dearborn County).
2. Evansville (all of Vanderburgh and Warrick counties).
3. Fort Wayne (all of Allen County).
4. Gary (all of Lake, La Porte, and Porter counties).
5. Indianapolis (all of Marion, Boone, Hamilton, Hancock, Hendricks, Johnson, Madison, and Shelby counties).
6. Louisville (all of Clark and Floyd counties).
7. South Bend/Elkhart (all of St. Joseph and Elkhart counties).

Factors that should be examined when deciding the viability of a full closure include the following.

1. *Availability of detour routes:* Before a full closure would be considered viable, there has to be at least one detour route capable of accommodating the traffic from the closed road. The number of lanes should be checked, and the check should include the turning lanes and their capacities.
2. *Duration of project:* If the construction project is for a short period, usually less than 3 days, then having a detour route would not be justified, particularly if the detour routes need some improvements before they can be used.
3. *Additional travel time and distance:* The delays from detour routes should be within the acceptable/tolerable levels. Additional travel time and extra travel miles may cause road users' frustrations.
4. *Access management:* Full closures of highways, access to certain local businesses, residents, and schools might be cut off. This might affect the sources of income,

particularly for local businesses (e.g., how they would get their deliveries and how their customers would get to them).

5. *Location of project:* This has to be considered because a complete closure in a rural area would differ from one in an urban area. For instance, there are several alternative detour routes available in an urban area, which makes it easier to go ahead with it, unlike rural areas.

2.2.3 Highway Congestion Policy

INDOT's *Interstate Highway Congestion Policy* (IHCP) applies to all construction or maintenance activities that require the closure of (or restrictions to) one or more lanes on an interstate highway. IHCP also addresses shoulder closures. The policy is available at the IHCP webpage at https://www.in.gov/indot/safety/work-zone-safety/interstate-highways-congestion-policy/ (last accessed on December 30, 2020). The purpose of this policy is two-fold. First, the policy aims to schedule work activities outside of periods of peak demand for an Interstate highway to minimize road user delay, reduce the likelihood of end-of-queue crashes, and estimate the impacts such as appropriate mitigation measures may be taken.

Where applicable, the policy is reviewed, and queuing analysis is performed early during the project design stage and confirmed early in plan development. It is preferred to develop an MOT plan that complies with the pre-approved closure and restriction schedule(s) for the segment(s) involved. However, that may not always be feasible. Exceptions to the policy are considered on a project-by-project basis. Resources for documenting and submitting a policy exception request are available from the IHCP webpage under the heading Cover Letters and Exception Request Templates. Exception requests made during design should be submitted as soon as possible, but no later than 3 months before final tracings submittal. The approved IHCP Exception is typically uploaded to INDOT's Electronic Records Management System (ERMS). The approved closure schedule and any additional conditions must be included in RSP 801-T-216, Lane Closures, and incorporated into the contract documents.

For other policy exceptions, the required documentation and approval varies by type of work, e.g., contract work in progress, permit work, ITS repair, and maintenance. In addition, the policy considers certain types of activities to be emergency repairs that do not need policy exceptions.

The material available at the following appendices in the IHCP is insightful and provides detailed information on specific projects and procedures (https://www.in.gov/indot/3383.htm as last accessed on December 30, 2020).

- Appendix A: Emergency and Urgent Repairs
- Appendix B: Preapproved Interstate Closure and Restriction Times
- Appendix C: Policy Exceptions
- Appendix D: Traffic Measurement and Reporting

2.2.4 Work Zone Capacity

Travel delay, which is used in estimating the travel delay cost, is one of the key performance indices that influence the type of Maintenance of Traffic (MOT) alternative chosen for a work zone. The capacity of a work zone is the main factor that determines the road user delays, which is then expressed as a road user cost (specifically, the travel delay cost). The FHWA has funded several research projects to develop work zone modeling tools that are used to estimate the work zone capacity. The modeling tools used for estimating work zone capacity are selected based on five criteria: functionality, results, time, training, and cost.

Generally, the different state transportation agencies use different programs, software, and spreadsheets to estimate this travel delay. The most basic one is the Highway Capacity Manual (HCM) software, which estimates the delays bases on the road capacities and the traffic volume. Other simulation programs, software, and spreadsheets used include QuickZone, Rutgers Interactive Lane Closure Application (RILCA), OkDOT) Capacity Spreadsheet and Synchro. NJDOT uses the Rutgers Interactive Lane Closure Application (RILCA) and QuickZone to plan short-term and long-term lane closures. Also, Ohio DOT, Wisconsin DOT, Washington DOT, Utah DOT, North Carolina DOT, Maryland SHA, CFLHD, and Pennsylvania DOT all use Quick Zone. Engineers are equipped with information on the acceptable lane closure hours from the work zone capacities estimated by the appropriate modeling tool (Ozbay & Bartin, 2008).

In general, when the estimated delay exceeds the acceptable/tolerable delay, this might lead to driver frustration. As a result, transportation agencies try to select the MOT strategy with the least delay. Also, agencies such as ALDOT believe in constructing work zones that discourage queue formations to ensure maximum capacity and minimum road user delays, but this approach is costly. Therefore, ALDOT does its lane closure analysis using the Oklahoma Department of Transportation (OkDOT)'s Capacity Spreadsheet (Batson et al., 2009). OkDOT practices typically involve lane narrowing to a greater extent than full-road closures because the available detour routes (in the case of full-closure) add more delay time compared to lane narrowing.

2.2.5 Traffic Control Strategies

The traffic control strategies that are provided in the *Indiana Design Manual 2013* are (1) complete road closure with detour; (2) lane closure on a multi-lane highway; (3) lane closure on a two-lane road; (4) lane shift; (5) median crossover; (6) split median crossover; (7) runaround (road closure with diversion); (8) runaround which may involve construction of a temporary bridge; (9) shoulder work with lane constriction; and (10) temporary road closure. Among these options, the present study focuses mainly on the first (complete road closure with detour) and the fifth (median crossover) to determine the conditions under which each option should be chosen.

The first option, complete road closure with detour, involves assigning detour routes. This is a desirable and feasible option where access to properties on the closed route can be maintained and where there is unused capacity on roads that comprise an alternative route, or the alternative route can be modified/improved to accommodate additional traffic. This is important because, in some cases, improvements or modifications on the detour route might be necessary. These improvements/modifications include signal phasing adjustments, on-street parking prohibition, turn movement prohibition, posted speed limit alteration, temporary widening for turn lanes, temporary signalization in intersections, reversible lane installation, and pavement replacement. Requests for interstate main line closures (full-closure) require FHWA Indiana Division Administrator approval.

The fifth option, i.e., median crossover, involves routing all of one direction of the traffic stream across the median to the opposite traffic lanes. This application may also incorporate a shoulder or lane shift to maintain the same number of lanes. Examples of median crossovers are provided in the *Indiana Manual on Uniform Traffic Control* (IMUTCD), Chapter 6H. For an interstate route or a divided highway, transferring traffic from a divided facility to two-way operations on one roadway should be used only if one or more of the following conditions are satisfied: (1) crossover is allowed by the *Interstate Highway Congestion Policy* (IHCP), or an exception is possible; (2) an alternate route is unavailable/ not cost-effective for the interstate, and (3) pavement and shoulder structures can accommodate traffic in their existing state or be reasonably upgraded to do so. Factors that must be checked and considered by INDOT engineers in evaluating the viability of each of the strategies mentioned above are explained in Section 2.05(02) of the *Indiana Design Manual 2013,* Chapter 503.

Complete closure of a segment may be the best alternative where other freeways are available for detouring to increase drivers/workers' safety by reducing the interaction between them. However, traffic control strategies for rural interstate projects without alternate interstate or freeway routes should start with a crossover or runaround. If this is not viable, then the traffic is maintained adjacent to the work area.

Comprehensive analysis is submitted to FHWA Divisional Office as a process for a request of closure. It is required that such analysis should be aligned with FHWA's requirement as stated in Law 23 CFR 658. This federal law requires all the vehicles covered under the law to be able to travel on the National Network at acceptable conditions as approved by FHWA. The following steps are suggested for application: (1) analysis of the impact on interstate commerce, (2) analysis and recommendation of any alternative routes that can safely accommodate commercial motor vehicles of the dimensions and configurations described in CFR658.13 and CFR658.15 and serve the area in which such segment is located, and (3) evidence of consultation with the local governments in which the segment is located as well as the Governor or the Governor's authorized representative of any adjacent State that might be directly affected by such deletion or restriction.

2.3 Work Zone Impact on the Motorists and Workers

2.3.1 Introduction

Due to the significant impact of work zones on the road users and workers, the necessity of considering these two aspects is undeniable. According to the *Indiana Design Manual 2013*, Chapter 503, an analysis of the impact on the motorists and workers in work zones should be performed. In the first step, the project's significance should be determined, and in case the significance is not apparent, queuing analysis and traffic impact should be performed. Therefore, in this chapter, road user cost estimation and queueing analysis are discussed to provide the reader a general understanding of these two concepts and their computations.

2.3.2 Road User Cost Estimation

User costs are estimated to analyze the advantages/disadvantages of the traffic control strategies for an interstate project. There may be more than one option that addresses the problem of work zone traffic congestion during construction. As such, the benefits and costs of each option should be compared against other factors such as constructability, construction time, construction cost, and motorists/worker safety to determine the most appropriate option. This user cost analysis is also a guide for establishing an incentive/disincentive clause amount (to which INDOT imposes a cap).

With the aim of road closure viability assessment, two main aspects should be evaluated: (1) the route's ability to safely accommodate commercial vehicles assessed and (2) the added travel time (delay) along the detour, which leads to an increase in road user cost. Therefore, in estimating the detour cost based on *Indiana Design Manual 2013*, Chapter 503, the following should be calculated.

- Detour User Cost = ((Cost in Lost Time) + (Cost in Extra Distance Traveled)).
- Cost of Lost Time = (No. of Vehicles Detoured) × (Increase in Travel Time per Vehicle) × (Value of Motorist Time).
- Increase in Travel Time = (Length of Detour / Average Detour Travel Speed) – (Length of Work Zone / Average Travel Speed through Work Zone).

- Cost in Extra Travel Distance = (No. of Vehicles Detoured) × (Net Increase in Length of Travel) × (Vehicle Operating Expense).
  Where the net increase in length of travel distance is the difference between the detour and non-detour distances.

The FHWA report on road user cost (Mallela & Sadasivam, 2011) throws light on road user cost analysis for the work zone. It defines road user delay cost as any extra cost incurred by the road users and the community during ongoing construction work. These costs include user delay costs due to additional travel time, vehicle operating costs (VOC), and crash costs. These road user costs are discussed further in this section. Other costs cannot be easily monetized and might be considered qualitatively, such as noise, local business impacts, and inconvenience to the local community. The evaluated mobility, safety, environmental, business, and local community impacts associated with the work zone serve as the basis for the road user cost computation. At every phase of the project development process, the road user cost needs to be computed from the planning phase right to the construction/implementation phase. The following key steps constitute the road-user cost analysis process for the work zone.

1. Collect data for work zone impact assessment.
2. Estimate the impacts associated with the work zone.
3. Calculate the unit costs related to each impact type.
4. Estimate the road-user cost components, considering the specific project.

1. Travel Delay Costs. Travel delay costs are estimated by calculating the additional delay caused by the work zone activities and the average value of time. The delays are estimated for personal travel, business travel, truck travel, and freight inventory. Also, the average value of time, that is, the unit cost of time ($/hr) of travel time, is also estimated for the individual road users.

The Value of Time (VOT) considers the lost wages and lost free time. The US Department of Transportation (USDOT) estimates this value to be anywhere from $9 to $30 per hour per vehicle (varies based on local trips vs. intercity travel, personal vs. business). Values of time have been proposed in various research reports and journal papers. An average value of $16 per hour per vehicle is used in this study. Moreover, Vehicle Operating Expense (VOE) includes maintenance, repairs, insurance, fuel, registrations, licenses, inspections, parking, and tolls (these standard amounts do not include personal property taxes) costs. The most recent IRS Standard Mileage Rates, $0.575 per mile for 2020, should be used. The final calculation for travel delay costs is the addition of VOT and VOE.

Figure 2.1 illustrates the components involved in calculating travel delay costs.

2. Vehicle Operating Costs (VOC). Vehicle operating costs are the expenses incurred by road users due to vehicle usage. VOCs vary based on the degree of vehicle use and also depend on mileage. It includes all running costs associated with the vehicle's operation, such as fuel, tire, and oil. It excludes fixed costs such as insurance and financing. VOC can be estimated based on the following components.

- Fuel consumption
- Engine-oil changes
- Tire-wear
- Repair and maintenance
- Mileage-related depreciation

Figure 2.2 shows the components involved in the calculation of VOC.

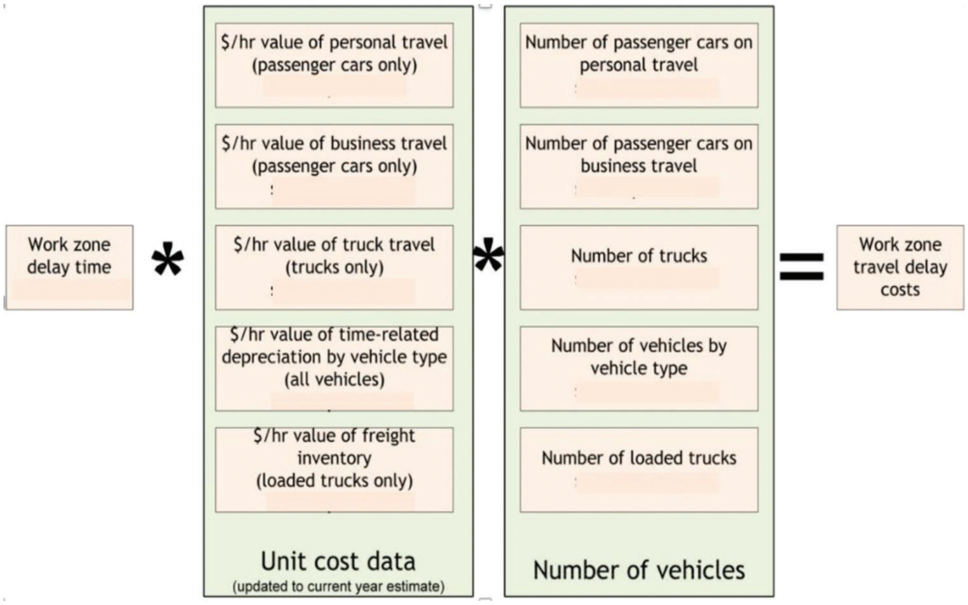


Figure 2.1 Components involved in the calculation of travel delay cost (Mallela & Sadasivam, 2011).

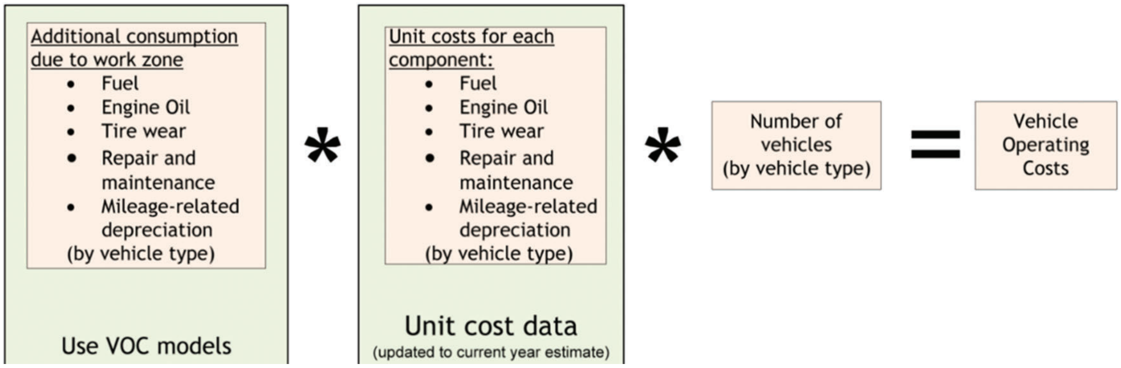


Figure 2.2 Components involved in the calculation of VOC (Mallela & Sadasivam, 2011).

3. Crash Cost. Crash costs are estimated based on the expected change in crash rates due to the work zone activities. The associated crash-related elements for road-user costs include the following.

- Crash rate and frequency at work zones: Crash rate represents the number of crashes observed along a road segment during the work zone activities and normalized to the roadway segment length and traffic volume over the same period. The crash rate normalizes the number of crashes based on the length of the road segment and time (typically in years) only.

$$CR = \frac{A \quad 10^6}{T \quad L \quad AADT \quad 365} \qquad \text{(Eq. 2.1)}\leftarrow$$

  Where,
  CR = number of crashes per million vehicle miles of travel (crash rate).
  A = average number of crashes along the roadway segment for the analysis period.
  T = duration of the analysis period (years).
  L = length of the roadway segment being considered (miles).
  AADT = annual average daily traffic (in both directions).

- Crash severity rating: This refers to the extent of injury associated with a crash. Crashes can be classified under the following categories in terms of severity.
  - Fatal crash: a crash in which there is at least one death within a certain period following the crash.
  - Injury crash: this is a non-fatal crash that typically only involves bodily injuries.
  - Property damage only (PDO): crashes that cause damage to only properties and do not involve bodily injury or death.
- The unit cost of crashes involves two types of cost: human capital cost and total costs. The human capital cost covers costs directly related to the accident, such as property damage, medical care, compensations, and legal costs. In comparison, the total cost has to do with intangible costs such as physical and mental suffering, diminished quality of life, and permanent disfigurement.

For projects that utilize a complete closure with detour, an analysis may be needed to select the best detour route(s) when more than one viable route is available. This analysis may involve only a simple calculation to estimate the additional travel time. The *Highway Capacity Manual* and associated Highway Capacity Software (HCS) may be used to estimate travel times for various roadway types. For projects that utilize a crossover or runaround, a traffic impact analysis may be needed to determine the number of lanes that need to be maintained in each direction of travel to eliminate or reduce delay.

2.3.3 Queueing Analysis

Queueing is the study of traffic where demand exceeds capacity. Queues can be formed in several common conditions, e.g., bottlenecks, stop signs, behind the red lights, and work zones. Delay for every individual vehicle can be obtained via the arrival/departure rate pair data. Using the Input/Output (I/O) queueing diagram (Figure 2.3), it is possible to calculate the delay for every individual vehicle as follows.

- The delay of the i^{th} vehicle is time of departure - time of arrival ($t_2 - t_1$). Total delay is the sum of the delays of each vehicle, which is the area in the triangle between the arrival ($A(t)$) and departure ($D(t)$) curves.

In practice, queue estimation is done by using specific software and manuals. In this domain, QuickZone 2.0 is acceptable. However, INDOT Queuing Analysis Tool (QAT) is the preferred method for estimating queues for exception requests to the IHCP. This tool can estimate the vehicular capacity through a work zone and calculate the queue length. With concurrence from the Work Zone Safety Office, Vissim and Synchro may also be used to support IHCP exception requests.

Regardless of the program used for the queuing analysis, diversions are not included in the primary analysis for exception requests. However, diversion estimation and its effect on the queue can be submitted by the INDOT engineer as a supplemental analysis. This may be the case, particularly in urban areas, as drivers often have the opportunity to divert as they become familiar with the work zone. The Work Zone

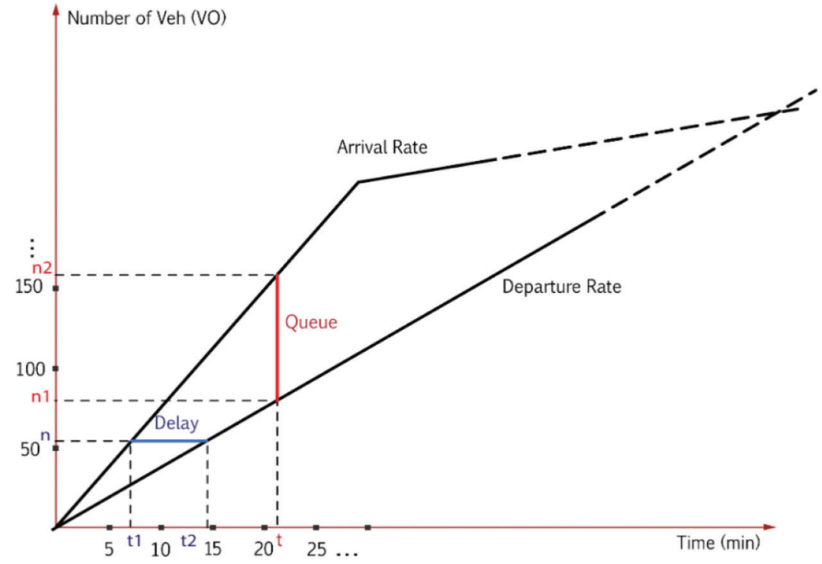


Figure 2.3 Input/Output (I/O) queuing diagram.

TABLE 2.1
Queuing analysis and its application

Queuing Analysis	**Application**
Reduction in capacity and any resulting queuing	Reduced lane/shoulder widths on a freeway
Reduction in capacity and corresponding Level of Service (LOS)	Reduced lane/shoulder widths on a non-freeway
Queue length	The initial location of portable transverse rumble strips when used for the back of queue warning

TABLE 2.2
Mitigation strategies

1	Restricting construction operations to off-peak traffic-volume hours or nighttime hours
2	Closing a ramp
3	Using alternate routes
4	Developing public relations strategies; or temporary widening for an extra lane or roadway capacity

Safety Office, the LPA, or the MPO may also guide how traffic is expected to respond to restricted conditions.

The outputs of queue estimation and detour cost evaluation serve as inputs for user cost evaluation. The outputs provide the user with the expected queue length and estimated user costs based on the type of lane closure, traffic volume, time schedules, and other inputs.

Table 2.1 presents examples of queuing analysis applications. For interstate projects, the maximum queue length and daily user cost should be estimated. The results of this analysis should be included with the proposed TMP and should be used to determine whether one or more of the mitigation strategies are practical. Table 2.2 presents the mitigation strategies.

In queueing analysis procedure for work zones, the following input and default values should be inserted as shown in Table 2.3. *Indiana Design Manual 2013,* Chapter 503 presents additional details and information on the practical aspects of queuing analysis.

2.4 Summary of the Chapter

This chapter summarizes the literature review on work zone planning procedures and strategies and work zone impact on motorists and workers. The work zone planning discussed the transportation management plan, the highway congestion policy, the capacity of a work zone, and the traffic control strategies.

In roadway construction in Indiana, INDOT typically plans project work zones using the procedures and guidelines stated in these three documents, *Indiana Design Manual 2013*, Chapter 503, *Interstate Highway Congestion Policy 2017*, and *Indiana Manual on Uniform Traffic Control Devices* (IMUTCD). The planning procedure begins with Transportation Management Plan (TMP) that includes a Temporary Traffic Control Plan (TTCP), a requirement for every project. Then, depending on the level of impact of the construction on the public, a Transportation Operations Plan (TOP)

TABLE 2.3
Practical aspects of queuing analysis

Input	Default values
Lane-closure configuration	Cost update factor
Schedule of work activities	Percentage of trucks
Traffic volume approaching the segment	Speed and volume at various points on a speed-volume curve
–	The capacity of a lane in the work zone
–	Maximum acceptable delay to the motorist
–	Critical length of queue

and a Public Information Plan (PIP) may be encouraged or required. Also, the viability of a full-closure was discussed in this chapter. All these are done using the highway congestion policy as a guideline, and eventually, one of the traffic strategies is selected as the best alternative.

The work zone impact on motorists' subsection covers road user cost estimation and queueing analysis. The road user cost is determined by travel delay cost, vehicle operating cost, safety cost, and other related factors. The main aspect of focus was the travel delay cost related to the capacity of the work zone based on the delay (additional travel time) caused by the work activities. This same congestion problem linked to work zone activities can lead to queuing of vehicles. INDOT's IHCP has clearly stated acceptable queue lengths and duration. To summarize, IHCP indicates repair work is temporarily suspended if safe to do so if queue length increases over 1.5 miles. Hence a queuing analysis has to be carried out.

The next chapter is dedicated to case studies and examines actual road projects where full closure of an interstate was carried out. In this regard, four road projects from different states were identified.

CHAPTER 3. CASE STUDIES OF FULL CLOSURE OF INTERSTATE

3.1 Introduction

This study performed case studies on implemented MOT designs and alternatives of closing one direction of highways in the US to validate the identified KPIs, develop analysis metrics, and document best practices, including lessons learned, constraints, and challenges. The case studies helped to investigate the following.

1. Types of projects that include crossover and detour plans for bridge maintenance or pavement rehabilitation.
2. How and why the locations of crossovers and detour routes were selected.
3. Initial project costs and road user costs of the selected designs and alternatives.
4. Safety concerns from both drivers and workers perspectives and any accidents reported.
5. Issues and challenges with regard to public acceptance.

3.2 Case Studies of Full Closure

Of the case studies identified, some involved urban interstate roads as the research team had difficulty finding examples of rural interstate roads where agencies had performed a full road closure in one direction. This can be attributed to rural interstate roads not having as many suitable detour routes as urban interstate roads. The following is the list of case studies discussed.

- I-95 in Wilmington, Delaware
- I-84 Banfield Freeway, Oregon
- I-65 (Emergency Closure) in Lafayette, Indiana
- I-70 in Indianapolis, Indiana

3.2.1 I-95 in Wilmington, Delaware

3.2.1.1 Introduction. The northeastern corridor is connected to the southern states by I-95 that passes through Delaware. This highway transports a substantial amount of passenger cars and truck traffic. In the year 2000, there was a major construction project on this route. The interstate road was over 30 years old and had experienced little maintenance in the years following up to the construction. The deterioration was severe due to increased loading caused by population growth along the Northeastern coast. The project involved rehabilitation of pavement, bridges, drainage system, lighting and safety features. It also included repair works on ten (10) interchange ramps. The project employed an MOT strategy that used full road closure of the I-95 route and provided I-495 as the detour route, as shown in Figure 3.1. Further details of the project are provided in Tables 3.1 and 3.2.

3.2.1.2 "The five elements of mobility." In the I-95 Wilmington, Delaware project, the Delaware Department of Transportation (DelDOT) decided to use a transportation management plan titled *The Five Elements of Mobility,* discussed below. However, the fifth element relates to "Traveling together," which is relevant to the present study, which focuses on rural interstates. The elements and their focus areas are listed as follows.

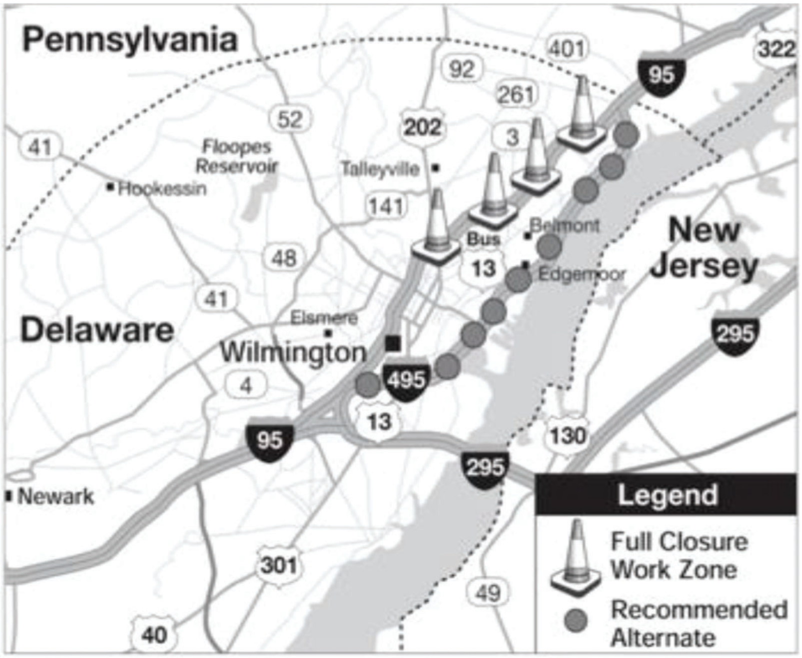


Figure 3.1 Detour routes for I-95 full closure.

TABLE 3.1
Project characteristics of I-95 full closure

Project Title	I-95 Wilmington, Delaware
Location	Wilmington, Delaware
Route Closed	I-95 (4-lanes)
Detour Route	I-495 (6-lanes)
Length	6.1 miles (24.4 lane miles)
ADT	100,000
% Trucks	11%
Scope of Work	Rehabilitation of pavement, bridges, drainage, lighting, and safety features, as well as 10 interchange ramps
Project Cost	$23.5 million
Duration	185 calendar days (April to October 2000)
User Delay Cost	$88,000/day
Reason for Full Closure	Expedite construction process and lessen the impact of rehabilitation on travelers

Capital Improvement Program (CIP) Coordination. This was a 6-year program that was put in place to coordinate projects that were already taking place on alternate routes before the start of the I-95 construction. DelDOT ensured that I-95 traffic was not diverted to roads that were already stretched at capacity due to concurrent road constructions. Scheduling and bundling of projects were the keys to smooth traffic management. Also, funds were provided to speed up work on some projects to ensure early completion.

Integrated Transportation Management System. The Traffic Management Center (TMC) was the headquarters for managing all traffic-related matters. Equipment such as cameras, detection devices, changeable message signs, and counting programs were deployed to improve traffic flows. Also, the use of the ITS application facilitated the monitoring of traffic flow. The TMC also adjusted traffic signals based on the information sent to them.

Public Information. With the anticipated impact of this project, the public information began 2 years before implementing the project. DelDOT created a cartoon character known as the “Traffic Creep” to create more awareness by developing games with that character and avoiding this Traffic Creep by using the detours provided. In addition, a new radio station was launched to ensure the widespread and constant distribution of traffic information on a 24-hour basis.

Transportation Management Improvement Projects. Road improvements were carried out before the construction to address congestion issues on the local routes. The road improvements included additional turning lanes, redesigning curb and pedestrian,

TABLE 3.2
Maintenance of traffic for I-95 full closure

MOT Strategy	The interstate was shut down completely, one direction at a time.
Project Details	DelDOT used rubblization to save time. Use of asphalt to eliminate cure time.
Incentive Package	Project divided into 4 phases, each phase with a $25,000 per day bonus or penalty for up to 10 days before or after completion.
Planning	1. The planning phase of the project began 4 years before the construction. There was a partnership with stakeholder. A Transportation Management Plan (TMP) titled *The Five Elements of Mobility* was developed. This TMP is comprised of the following. a. Public information b. Transportation Management Improvement (TMI) projects c. Integrated Transportation Management Systems (ITMS) d. Traveling together e. Capital Improvement Program (CIP) coordination)
MOT Planning	Capacity improvements were made on alternative routes and intersections, such as sequencing lights, adding turn lane capacity, and improving ramps.
Traffic Impacts	AADT of approximately 36,000 (25% of capacity). Level of Service (LOS) for I-95 and I-495 was D (approaching unstable flow) and A/B (reasonable free flow) respectively before the construction. LOS of I-495 dropped to C (with interchanges causing a majority of delay).
Benefits/Impacts/KPIs	1. Project duration reduced from 2 years to 185 days. 2. Safety of workers and travelers. 75% reduction in traveler and worker exposure. 3. MOT cost reduced from 10% to 2%, but factoring the TMP, full closure was more expensive; improvement to alternate routes contributed to cost. 4. Pavement built to highest standards, smoother surface, and quieter ride. 5. No noticeable increase in crashes. 6. Public sentiment was positive. 7. Congestion mitigation initiatives are permanent.
Lessons Learned	1. Prequalification of contractors was critical to the project success. 2. Beginning public outreach 2 years before project implementation. 3. Stakeholder support/buy-in (project personnel familiar with technical aspects of the projects were able to persuade and connect with the public better compared to external spokespersons). 4. Early involvement of the construction group during planning and design.

enhancing bus stop designs, emergency access ramps, and new interstate access connections.

3.2.2 I-84 Banfield Freeway in Portland, Oregon

3.2.2.1 Introduction. The road construction project on I-84, also known as Banfield Freeway, was implemented on two consecutive weekends on August 2 to 5 and August 9 to 12, 2002. The Oregon Department of Transportation (ODOT) designed the construction schedule earlier to the construction season in 2002, instead of the original schedule in 2005. The main reason for this schedule advance was to avoid or eliminate severe rutting on all lanes caused by age, heavy vehicle use, and studded tires. The rut contributed to a severe hydroplaning hazard, and the objective of the project was to increase road safety by asphalt paving, durable striping, replacement of three miles of 36-inch median barrier, and adjustments to more than 250 inlets and manholes embedded in the roadway. See Figure 3.2 for the detour routes of the I-84 closure. Table 3.3 and Table 3.4 provide further details about the project characteristics and rationale for MOT planning.

3.2.2.2 Elements of mobility

Traffic Management. Traffic modeling was used to "evaluate the overall traffic patterns and changes in traffic patterns with the directional closure on the I-84 freeway." This evaluation determined the impact on all major routes likely to carry the traffic diverted from I-84. ODOT also needed to identify mitigation measures that could be implemented to maintain proper traffic flow in the area.

1. Traffic conditions were analyzed in July before beginning the project. As a result, ODOT projected "before," "during," and "net change" in weekend peak period traffic on all routes in the corridor.
2. ODOT used the EMME/2 traffic assignment model 2 to assess traffic conditions, with peak-period traffic volumes as to the base condition.
3. An assignment showing traffic volumes in the work area for both eastbound and westbound traffic was prepared.

In addition, a “difference” assignment was developed to represent the net change in traffic on all alternate routes.

4. Five major routes were identified as receiving most traffic diversion in both directions during a full closure.
5. The EMME/2 model and existing traffic counts estimated that traffic resulting from the I-84 closure could increase as much as 500 to 700 vehicles per hour (vph) on each of these primary routes receiving the diverted traffic. In addition, other routes were expected to increase between 100 and 500 vph. These increased levels were comparable to existing weekday peak-period traffic levels. Therefore, signals on the alternate routes were set to weekday peak-period settings during the closures to accommodate the increased demand.
6. ODOT also developed several scenarios for the I-84 closure that included impacts on and resulting from possible I-5 closures for roadwork. Initial analysis showed ODOT that any simultaneous closures on the two roads should only be directional closures to maintain adequate traffic flow.
7. Based on subsequent analysis, ODOT concluded that eastbound I-84 could be closed during a southbound I-5 closure, and a westbound I-84 closure could occur with an I-5 northbound closure, with manageable impacts to area traffic.

Figure 3.2 Detour routes for the I-84 full closure.

Considered Stakeholders. The potential stakeholders that were considered in the project were the following.

- Emergency services
- Police
- Hospitals
- Schools
- Residents/commuters
- Public/citizen associations or groups
- Local businesses
- Port of Portland
- City of Portland
- Tri-met
- Oregon trucking firms
- Portland-metro cab companies
- Tourism bureaus
- Travel agents
- Special event planners
- The contractor working on I-5

3.2.2.3 Lessons learned from the implementation of the full road closure on I-84

1. *Cost-benefit:* Due to the shorter project duration, the additional cost of repair and rehabilitation of the official detour route was minimal and could accommodate the additional traffic flow. However, the availability of multiple alternatives made it possible to compare and assign the

TABLE 3.3
Project characteristics of I-84 full closure

Project Title	I-84 Banfield Freeway
Location	Portland, Oregon
Route Closed	I-84 (6-lanes roadway, 3-lanes each)
Detour Route	5 routes
Length	33 lane-miles
ADT	180,000
% Trucks	7%
Scope of Work	Asphalt paving, durable striping, replacement of three miles of 36-inch median barrier, and adjustments to more than 250 inlets and manholes imbedded in the roadway
Project Cost	$5 million
Duration	Two weekends (August 2 to August 5, and August 9 to August 12, 2002)
Reason for Full Closure	Avoid the hazard of hydroplaning for motorists traveling on the interstate

TABLE 3.4
Maintenance of traffic for I-84 full closure

MOT Strategy	The paving portion of the project was carried out under full closure (one direction at a time) over two weekends.
Project Details	Asphalt paving, durable striping, 4 miles of 36-inch median barrier, adjustment of more than 250 inlets.
Incentive Package	There was no incentive package in this project.
Planning	MOT planning: coordination with other agencies that would be affected; public outreach. 1. Personal telephone calls and direct mail to homes and businesses located in the corridor 2. Direct mail to taxi companies, tourism bureaus, and travel agents 3. Drive-time radio ads 4. Freeway variable message signs 5. A project website 6. A telephone information line 7. Media alerts/events 8. An information kiosk at a large local shopping mall
MOT Planning	The signals on the alternate routes were set to weekday peak-period settings during the closures to accommodate the increased demand; ODOT also developed several scenarios for the I-84 closure that included impacts on and resulting from possible I-5 closures for roadwork.
Traffic Impacts	Traffic data showed that the traffic volumes on Saturday and Sunday were approximately 80% and 75% of a typical weekday, respectively. The EMME/2 model and existing traffic counts estimated that traffic resulting from the I-84 closure could increase as much as 500 to 700 vehicles per hour (vph) on each of these primary routes receiving the diverted traffic. In addition, other routes were expected to increase between 100 and 500 vph. These increased levels were comparable to existing weekday peak-period traffic.
Benefits/ Impacts/KPIs	1. Duration reduced from 32 days to 4.7 days due to the implementation of full closure. As a result, the work which was distributed over the weekends could be performed in one go. 2. Budget saved (approximately $101,000) due to the shorter duration of the project—there were no additional costs involved in repair and rehabilitation of the detour route to accommodate the additional traffic. 3. A smoother ride was achieved, and safety increased because of the elimination of traffic-workers interaction.
Lessons Learned	1. The availability of alternate routes is critical to the success of a full road closure. 2. An agreement with the contractor on construction vehicle speeds within the work zone is necessary.

best detour route. This offset the additional costs involved in designing a crossover and allowed for a shorter project duration, which lowered the overall cost.

2. *Mobility and safety benefit:* Road users could shift swiftly through the detour route, making it easier for the workers and construction vehicles to work on the project site. Therefore, the KPI “contractor concerns” were satisfied with implementing full closure as the MOT strategy.
3. *Traffic control:* With clear roadways due to the elimination of normal road user traffic on the closed road, the construction workers may be tempted to operate construction vehicles at high speeds that could pose a hazard to other construction personnel working on the closed roadway.

3.2.3 I-65 in Lafayette, Indiana

3.2.3.1 Introduction. A 37-mile stretch of northbound I-65 was closed on August 7, 2015, in the interest of safety after construction crews worked to widen and rehabilitate the interstate between State Road 25 and SR 38 Tippecanoe County detected movement (settlement) in a supporting pier under the I-65 bridge over Wildcat Creek. Figure 3.3 provides additional details about the deployed detour route. Detailed project characteristics and the rationale behind MOT planning are explained in Table 3.5 and Table 3.6.

3.2.4 I-70 in Central Indiana

3.2.4.1 Introduction. Several projects that included full road closure were implemented on I-70 west of downtown Indianapolis in different years. In July 2019, INDOT had major construction work scheduled in Marion County during the week and on the weekend. As such, weekend road closures that included I-70 were considered. Figure 3.4 provides the exact project location. Detailed project characteristics and supporting reasons for MOT planning process are provided in Table 3.7 and Table 3.8.

3.3 Summary of Case Studies

Based on the observations made during the case studies, review of design manuals, and traffic management plans, Table 3.9 provides an overview of the practices which are worth emulating.

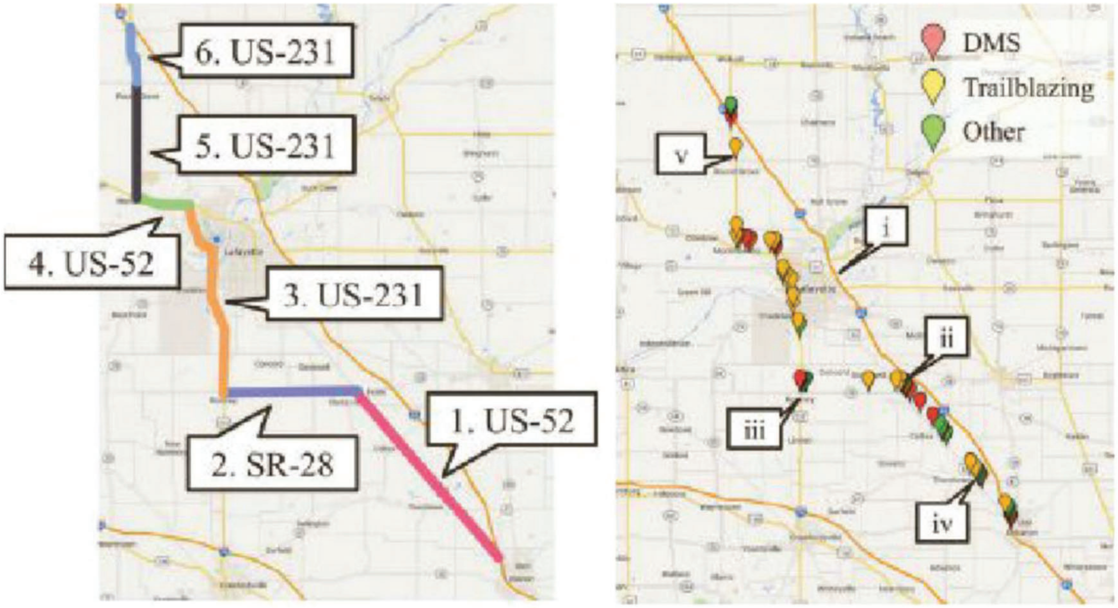
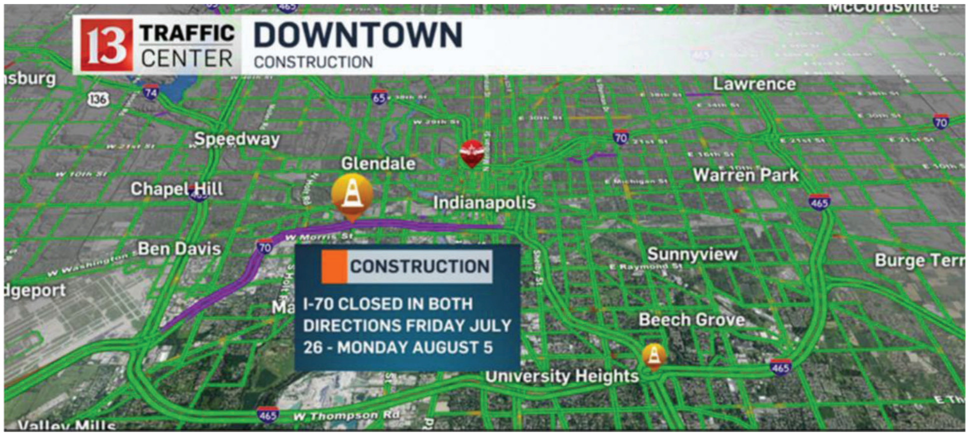


Figure 3.3 Detour routes (left) and placement of detour signs (right) (DMS, trailblazing, and others) (McNamara et al., 2015).

TABLE 3.5
Project characteristics of I-65 Lafayette, IN

Project Title	I-65 Lafayette, Indiana (emergency closure)
Location	Lafayette, Indiana
Route Closed	Interstate 65 section between SR 25 and SR 38
Detour Route	I-65 northbound traffic was detoured onto US 52, SR 28, and US 231 (these routes were selected because the other possible routes had construction work ongoing and had a reduced capacity, so they could not take the extra traffic from the I-65 closure)
Length of I-65	37 miles
Length of Detour	62 miles
ADT	24,000
% Trucks	40%
Scope of Work	To correct the settlement in the supporting pier under the I-65 bridge over Wildcat Creek
Duration	Approximately 31 days
Additional Length and Delay	From the detour routes, an extra 9 miles was added to the original route length, which contributed to an additional 25 minutes of travel time
Reason for Full Closure	The southbound bridge was too narrow to support bidirectional traffic. Cross over was not used because they could not get the barrier walls on time, and the cost involved was high



CONSTRUCTION
I-70 CLOSED IN BOTH DIRECTIONS FRIDAY JULY 26 - MONDAY AUGUST 5

Figure 3.4 I-70 project location in Indianapolis.

TABLE 3.6
Maintenance of traffic for I-65 Lafayette, IN

MOT Strategy	The interstate was shut down completely in one direction (northbound).
Project Details	Geotechnical construction crews installed micro piles, high-strength, small-diameter steel casings with rods and grout, through the footers of the existing center pier and deep into the soil to provide a long-term solution.
Planning	It was an emergency closure. As a result, there was not much time for planning.
Traffic Management	1. The detour over US 52, SR 28, and US 231 maximizes four-lane roads and minimizes traffic signals. To improve traffic flow on the detour, INDOT. 2. Deployed 15 dynamic message signs, and 40 trailblazing signs were marking the direction of the detour, and 19 other signs, including warning signs for traffic lights and work zones. INDOT mounted the dynamic message signs as far south as the Louisville metro area. 3. To address queuing issues, INDOT changed a four-way stop to a two-way stop at US 231 and SR 18 intersection. 4. To address capacity bottlenecks, INDOT constructed three temporary traffic signals. They initially installed two on US 52 at the intersection with SR 28 and SR 28 at US 231, then later on installed the third one on US 52 at SR 47. 5. INDOT installed cellular modems and deployed new timing plans to synchronize the traffic signals by retiming the signals on US 231 to prioritize the detour traffic. 6. Collaboration with other local agencies such as public safety officials and Purdue University to ensure a smooth traffic management. 7. Removed the stop sign for US 231 traffic at State Road 18 in White County. 8. Suspended construction where the detour rejoins I-65 in White County. 9. Continuous monitoring of traffic flow and adjusted US 231 signal timings. 10. INDOT pulled back barrels and barricades to the greatest extent possible on three other routes undergoing construction to help maintain maximum traffic flow. The routes included the following. a. I-74 west to I-57 north in Illinois. b. I-74 west to State Road 63 north to US 41 north to US 24 east. c. Keystone Parkway north to US 31 north to US 35 north to US 24 west. 11. Daily round-trip rail service was also made available between Indianapolis and Chicago with stops in Lafayette, Rensselaer, and Dyer.
Public Information	1. The general public had to do the following to get up to date information from INDOT concerning the construction. a. Follow INDOT on Twitter at (www.twitter.com/INDOT_WCentral or www.twitter.com/TrafficWise) to be kept updated throughout the construction period. b. Follow INDOT on Facebook at www.facebook.com/INDOTWestCentral or www.facebook.com/IndianaDepartmentofTransportation to keep road users posted. c. Dial 511 using a mobile phone or 800-261-ROAD (7623). d. Watch for dynamic message boards on interstates leading to I-65 northbound. e. On the web, visit http://indot.carsprogram.org or http://pws.trafficwise.org.
KPIs	1. In general, during a planning process, more KPIs are determined, but because this was an emergency project and planning was short, only a few KPIs were deemed critical and considered. The KPIs include the following. a. Availability of alternate detour routes that can accommodate the traffic from I-65. b. Additional travel time/delay caused by the detour route. c. Safety of workers and road users.
Benefits of Full Road Closure	1. To an extent, the overall delays were reduced but not that significant. 2. About safety, conflict points were minimized, and one fatal accident was recorded. 3. Maintenance crews were able to take advantage of the closure to perform extensive pavement and bridge patching which usually require night time closures.
Challenges faced for Full Road Closure	1. The major challenge faced by INDOT was moving traffic from a two-lane road to a one-lane road and still maintaining the desired traffic flow. 2. Another problem that was associated with the detours was right-to-turn movements. Left turns posed a challenge to some drivers, hence the need to mount traffic signals. 3. The capacities of the alternate routes were decreased due to the use of traffic signals to control existing traffic. As a result, the delays and vehicle queues had been increased. 4. Local businesses along the route still need supplies to be able to serve their customers. INDOT had to plan on how to accommodate deliveries to local businesses during the road closure.
Lessons Learned	1. Monitoring traffic and controlling traffic signal timings are very crucial for a successful traffic management. 2. The selection of an MOT strategy was a team effort between the Traffic Management Center (TMC) and District Deputy Commissioner (DDC). 3. The locals, who are familiar with the road, tend to select their preferred route rather than using the official detour route provided. 4. Drivers tend to pay attention more to overhead displays that give information. 5. INDOT reached out to trucking companies to tell them to reroute, which also helped with the traffic management.

TABLE 3.7
Project characteristics of I-70 Marion County, IN

Project Title	Road closure on I-70 West to downtown Indy
Location	Marion County, Indiana
Route Closed	I-70 in both directions between the South Split and I-465 near the airport on the west side of Indianapolis
Detour Route	Airport to Downtown: EB I-70 to SB&EB I-465 to NB I-65 Downtown to Airport: SB I-65 to WB&NB I-465 to WB I-70 Eastbound I-70: SB & EB I-465 to EB I-70 Westbound I-70: SB & WB I-465 to WB I-70
% Trucks	35%
Scope of work	INDOT completed a historic number of construction projects in the state's largest metro area in 2019 to resurface asphalt pavement, repair concrete, and rehabilitate bridges along major interstate routes
Duration	Full closure: July 26 to August 5
Reason for Full Closure	INDOT employs full closures to maximize the work in a short amount of time. In addition to paving work, maintenance crews take advantage of the full closures to clear out drains, fix guardrails, and change lights

TABLE 3.8
Maintenance of traffic for I-70 Marion County, IN

MOT Strategy	I-70 closed between downtown and I-465.
Project Details	1. INDOT invested more than $140 million to improve Indy metro area interstates and significantly reduce the number of potholes motorists experience moving forward. However, this project was only a part of the overall effort. 2. Contractors from Rieth-Riley Construction, Milestone Contractors, and E&B Paving resurfaced or repaired the road in this project. 3. 486 interstate lane miles were resurfaced or repaired, 277 lane miles were repaved with a new asphalt surface, and 209 lane miles of concrete pavement were repaired. 4. INDOT contractors rehabilitated 45 bridges in the Indy metro area in 2019. 5. This case study investigated construction projects between I-485 and I-65 junctions as shown in Figure 3.4.
Planning	1. The original plan was reportedly pushed back due to the rain in May and June. 2. The plan included a full closure of I-70 and restriction along with four other interstates. 3. The eastbound lanes of the interstate were reopened on August 5 as originally planned. 4. Weekend lane restrictions and weekend ramp closures.
Traffic Management	Detours: 1. I-70 closure: During the I-70 closure, drivers were encouraged to take I-465 EB to I-65 NB to get downtown or take I-65 SB to I-465 WB to get out of downtown. 2. Drivers were encouraged to take I-70 EB to I-465 SB to I-65 NB to get downtown from the airport.
Public Information	1. Social media: @INDOTEast on Twitter, Facebook, and Instagram. 2. Text and email alerts: alerts.indot.in.gov subscription. 3. INDOT Carsprogram Website: indot.carsprogram.org. 4. Calling INDOT for information: 1-800-261-ROAD (7623) or 511 from a mobile phone. 5. INDOT personnel's interviews: INDOT engineers interviewed different News Networks ahead of the start of the construction project to make people aware of the changes. 6. INDOT Mobile App.
Benefits of Full Road Closure	1. Project duration: Due to the implementation of full closures, a closed section of Westbound I-70 from downtown to I-465 reopened 2 days earlier than the original plan. As a result, the total length of the project decreased. 2. Safety: Completing maintenance work during construction closures is safer for INDOT team members and saves both time and money for taxpayers and motorists. Indiana State Police partnered with INDOT and contractors to help protect motorists and highway workers throughout the construction season. New this year, Indianapolis Metropolitan Police Department officers and Hoosier Helpers also ensured safety in Indy area work zones. Officers and Hoosier Helpers were on patrol approaching work zones and at ramps to alert motorists of approaching construction and reduced speeds. IMPD officers also provided traffic control on local detour routes. 3. Quality: INDOT crews took advantage of lane closures to completed needed maintenance work, including the following. a. 7,070 miles in road sweeping b. 55 miles of crack sealing c. 2,044 yards of litter pickup d. 818 tons of material used for patches e. 3,895 tons of material used for spot paving f. Storm drain clearing g. Sign replacement h. Barrier wall/guardrail repair

TABLE 3.9

Summary of cost, safety, and mobility considerations for closures

Cost Considerations	1. Significant reduction in project duration is feasible, which may lead to low road user cost. 2. The cost involved in the MOT setup is reduced, but the excess cost could be incurred in the repair and maintenance of the selected detour route. However, a detailed cost-benefit analysis will be helpful as the implementation of closure reduces project time and cost. 3. Incentive packages and penalty clauses were mentioned to speed up the contractor's efforts. Moreover, additional funds can be spent to speed up project delivery.
Safety Considerations	1. Coordination in the state police, DOT, and the contractor is crucial in redirecting traffic from the work zone. 2. The number of crashes in the work zone is minimized compared to other MOT strategies, mainly when traffic and work are carried out in the same lane direction. However, it is critical to handle construction vehicle traffic if the detour route traffic is nearby. 3. Some TTCP devices like temporary signals are required on the detour route to accommodate for increased traffic. 4. Trucking companies can be requested to change routes beforehand to allow ample time for rerouting.
Mobility Considerations	1. Unlike urban areas, rural area interstates do not have many detour options. In addition, not all junctions could be used as the entry or exit points for the detour route due to limitations of vehicular capacity, the geometry of roads, and even jurisdictional issues. 2. However, it is advisable and valuable to use other state's interstate as a detour route in the neighboring projects. 3. As per Law 23 CFR 658, it is crucial to keep the mobility of trucking traffic at original travel conditions. 4. A smoother ride was achieved to the motorists due to minimal traffic-work zone interaction.

CHAPTER 4. DATA COLLECTION AND ANALYSIS

4.1 Introduction

Chapter 3 provided the research team with information from four case studies on previously-implemented MOT design strategies and alternatives. The information was used to validate the risk factors in the case studies, develop analysis metrics, and provide the team with everyday challenges and concerns associated with implementing these strategies. However, due to the lack of information on the case studies, some gaps were observed during the analysis. Therefore, the research team carried out a short survey questionnaire to obtain first-hand information from the engineers and decision-makers at other DOTs and other traffic organizational bodies. This chapter focuses on the structure of this questionnaire, the method used to distribute it among the target audience, and a detailed analysis of the results obtained.

4.2 Background of the Questionnaire

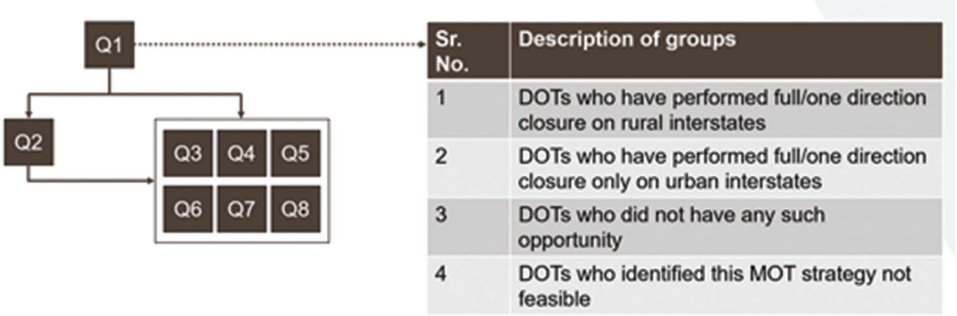
4.2.1 Development of Survey Questionnaire

The four case studies provided a greater understanding of the process involved in selecting alternate MOT strategies, particularly for interstate projects in rural areas. However, after studying the cases and collecting information readily available from the internet resources, the team felt the need to seek more information through a short survey of experts. The main objectives of the survey questionnaire were to (a) understand the preferences and reasoning of DOT engineers and other stakeholders to select between crossover strategy and full closure strategy in different settings, (b) identify potential drawbacks of full/one direction closure as compared to crossover design, (c) study if/how certain traffic thresholds are quantified by different DOTs and, (d) understand the relative importance of identified KPIs.

As a result, the team developed a survey questionnaire using Qualtrics Software. This questionnaire contained eight questions. The questionnaire first categorized participants based on whether they ever carried out full or one direction closure on an interstate project in a rural setting. Then, based on the response to the first question, further questions were asked (see Figure 4.1 for the detailed survey structure).

As mentioned above, the survey questionnaire comprised eight specific questions, each having a unique objective. Table 4.1 provides a summary of the survey questions. However, the entire survey questionnaire, along with the provided alternatives, is presented in the Appendix.

The first question was an important step in classifying the participant based on whether their agency had previously implemented any full/one direction closure on any rural interstate project. In total, four (4) classifications were named. The main objective for this classification was to have four (4) viewpoints in response to the questionnaire. The 4 classifications were (1) DOTs who had performed full/one direction closure in a rural area, (2) DOTs who had performed full/one direction closure in an urban area, (3) DOTs who never required full/one direction closure, and (4) DOTs who never found it feasible to implement such an MOT strategy. The rest of the questionnaire focused mainly on understanding different DOT's perspectives about crossover design against full/one direction closure strategy, the relative importance of the predetermined KPIs, and their threshold values. Lastly, the team identified stakeholders through literature review, and the questionnaire helped identify their exact role in



Sr. No.	Description of groups
1	DOTs who have performed full/one direction closure on rural interstates
2	DOTs who have performed full/one direction closure only on urban interstates
3	DOTs who did not have any such opportunity
4	DOTs who identified this MOT strategy not feasible

Figure 4.1 Structure of the questionnaire.

TABLE 4.1
Summary of the survey questions

Q1	Has your agency performed any full/one direction closure during rural interstate projects?
Q2	Why was not a full/one-direction closure feasible to your DOT?
Q3	What are your preferences in crossover vs. full/one direction closure MOT strategies in rural and urban area projects, respectively?
Q4	Which of the problems associated with a crossover design can be avoided by implementing full/one direction closure?
Q5	What is your agency's prescribed tolerance level for delays that occur due to detour routes?
Q6	What software applications or spreadsheet does the DOT use for queueing analysis?
Q7	What level of importance does the DOT assign to the mentioned KPIs in an urban and rural perspective?
Q8	What is the relative importance of the mentioned stakeholders in the detour planning process?

the detour planning and decision-making process. The team obtained input from the Study Advisory Committee to refine the preliminary questionnaire and make it more effective.

4.2.2 Distribution of Survey Questionnaire

The aim was to distribute the questionnaire within INDOT, AASHTO, FHWA, and other nationwide state DOTs. The first step of the questionnaire distribution was to obtain Institutional Review Boards (IRB) exemption from Purdue University. After the study was exempted from IRB review, the team reached out to the SAC members to help distribute the questionnaire. Since the SAC members were themselves working in INDOT, their help in distributing the survey questionnaire made it possible for them to reach a larger audience. The SAC members sent out a survey invitation email to all their colleagues in INDOT, AASHTO, and FHWA. The email also requested the participant to further pass on the survey questionnaire among their colleagues.

The Qualtrics Software stores all the responses in chronological order. These responses were later reviewed systematically, and the comments included by the survey participants were taken into consideration to prepare a detailed response and analyses section as explained below.

4.3 Survey Results

4.3.1 Responses

Overall, the survey received about 50 complete responses and 23 partial responses. This study analyzed only the complete responses, and inference from each question is represented with the graphical representation.

Figure 4.2 indicates that 54% of the total survey respondents had performed some sort of project that required the closure of full/one direction of a segment of rural interstate under their DOT. Particularly, New Jersey, North Carolina, Michigan, Missouri, Minnesota, Idaho, Connecticut, Utah, Iowa, Wisconsin, and Pennsylvania State DOTs have indicated they have performed closures on their interstates in rural area.

4.3.2 Analyses

Question 1 targeted the 4th group, i.e., the DOTs wherein full/one direction closure was never feasible. The objective was to identify the particular reasons for this. The response is indicated in Figure 4.3.

As seen in Figure 3.1, the unavailability of detour alternatives in rural areas accounts for over 57% of the causes leading to a full/one-direction closure being unfeasible. The second most crucial cause with over 28% agreement is that it is not manageable to handle the business impacts and the accessibility issues. Finally, urban areas are more suitable for a full/one-direction closure than rural areas due to more road density. However, only 14% indicated that it would be expensive for the DOT to accommodate the diverted traffic.

Question 2 plots the preference of the DOTs towards a crossover design strategy vs. a full/one direction closure approach for both urban and rural areas, respectively. In Figure 4.4, 0 indicates full preference towards crossover, 3 indicates an equal preference, and 5 indicates full preference towards full/one direction closure.

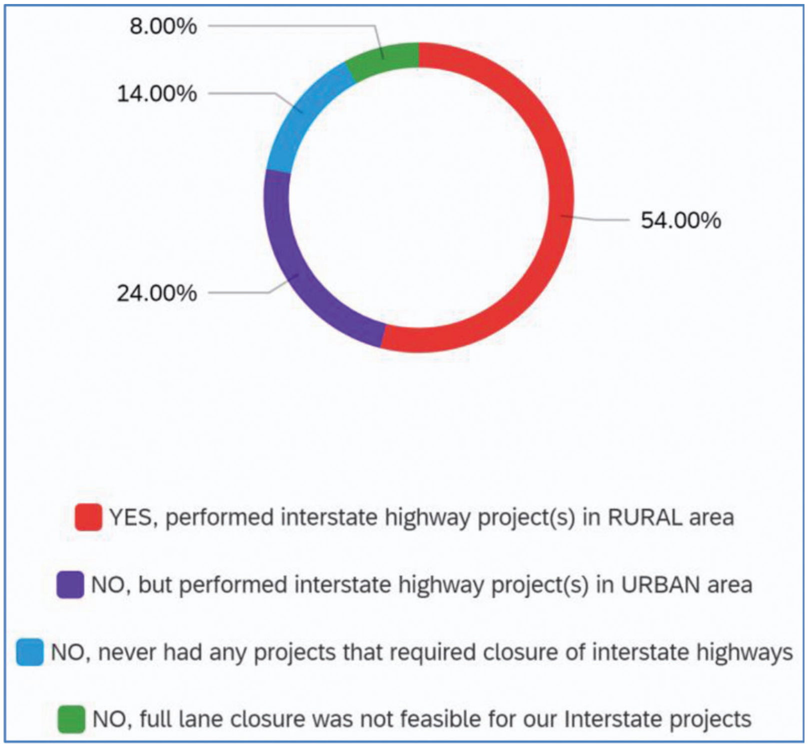


Figure 4.2 Four groups of responses.

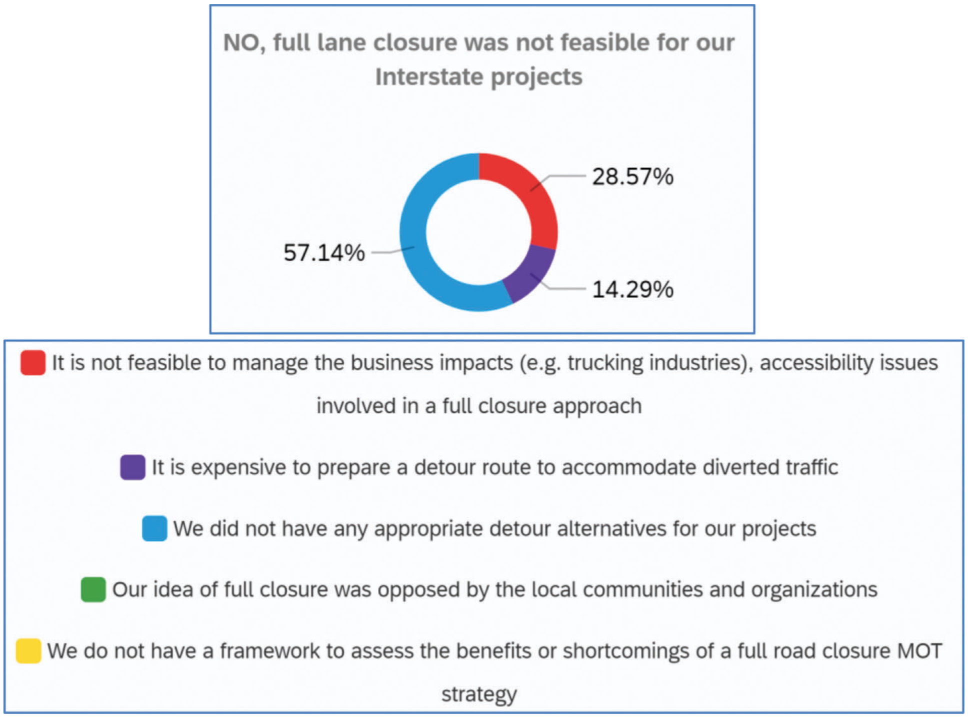


Figure 4.3 Reasons to not implement full/one direction closure.

The DOTs who had performed interstate highway projects in rural areas tend to be more inclined towards a crossover approach. This finding reinforces the previous observation about a full/one-direction closure approach being more suitable to an urban area setting. Interestingly, the DOTs who had performed full/one-direction closures in urban areas are more inclined towards continuing with the same in an urban setting but have an equal preference to both approaches in a rural setting. This led the research team to conclude

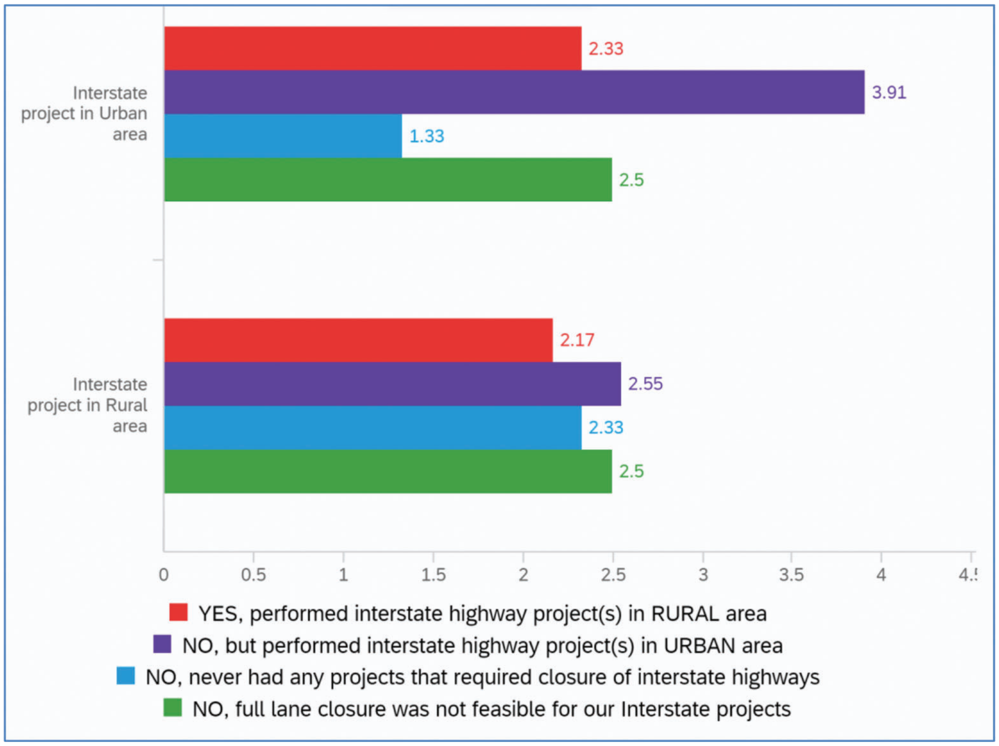


Figure 4.4 Preference profile of respondents to crossover or full/one direction closure.

that the availability of detour alternatives in a rural area is a major setback in its suitability for a full closure approach. However, if the DOT can identify a detour route with fair geometric suitability and excess traffic capacity, it is advisable to choose a closure, based on the summary of its benefits from the case studies.

Question 3 provides further justifications for this judgment. Below are some of the concerns observed typically for a crossover design approach. In addition, the survey questionnaire asked the survey respondents about their opinion regarding which of these concerns might be mitigated if their DOT rather uses a full/one direction closure approach.

As seen in Figure 4.5, the highest consensus among all the four groups is that the costs associated with the implementation of crossover design using temporary lanes, installation of temporary traffic control devices, etc., can be minimized a full/one direction closure approach. Next to the cost, is the safety concern to both the construction workers and the road users. About 23% of the total respondents agreed that the safety concerns would be minimized. Acknowledging that the potential detour route will be subjected to excess traffic volume, the survey response indicates that the impact would be less than the traffic and construction workers on the same road. This will also lead to lesser safety concerns being raised by the contractor. However, in some cases, the traffic flow and work zone may not be immediately adjacent to each other. This case does have lower safety concerns compared to traffic and work in the same direction. However, there still exists some risk of vehicle skidding and the availability of shoulder areas for use by emergency responders. Therefore, closure is still preferable if feasible at the project location. Overall, the project's duration would be considerably reduced, as indicated by about 21% of the respondents. However, the quality of the work delivered by the contractors seems less impacted by any MOT strategy.

Question 4 seeks information about the tolerance level thresholds generally accepted by different state DOTs to accommodate the additional travel time delays caused due to detouring traffic (see Figure 4.6).

A majority of the survey respondents mentioned that they did not specifically have any thresholds for accepting/rejecting a detour route based on the percent travel time delay caused due to that detour route. However, considering the respondents, those who had some threshold or acceptable level was about 10%–20% additional travel time. Achieving this tolerance level can be comparatively easier in the urban area due to multiple detour alternatives. At rural interstates, the distance between ramps and available detour options in the vicinity are limited. Therefore, it is not feasible to adopt the 10%–20% tolerance level threshold that is set for urban detour routes. However, the Excel file associated with this report (see https://doi.org/10.5703/1288284317345) explores available detour options for Indiana's rural interstates.

Question 5 involves the software packages commonly used to simulate traffic conditions for analysis when selecting alternate MOT strategies (see Figure 4.7).

During the literature review phase, case studies indicated that the QuickZone 2.1 work zone analysis

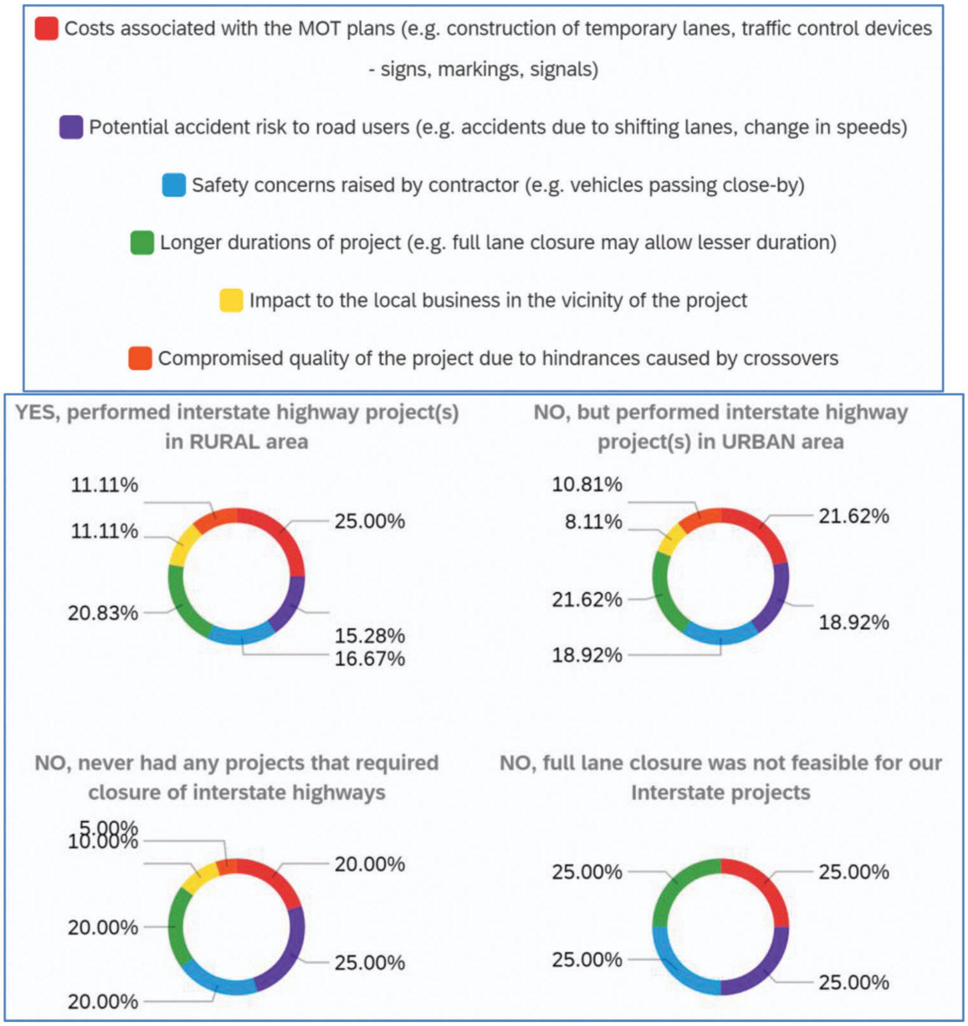


Figure 4.5 Advantages of full/one direction closure over crossovers.

software is popular among the DOTs. However, the answers to the question indicate otherwise, as only 16% of the responding DOTs use the QuickZone analysis tool. On the other hand, Syncro appears to be the most utilized software for traffic analysis purposes, followed by a customized spreadsheet for their state DOT. The popularity of Syncro could mainly be due to easy availability and brand recognition. One of the respondents mentioned the Queuing Analysis Tool (QAT) as their custom spreadsheet for estimating the impacts of closures on freeways.

Questions 6 and 7 listed a set of 11 Key Performance Indicators (KPIs) identified during the case studies. Again, there were 2 different viewpoints developed, i.e., from the perspective of DOTs who have performed full/one direction closure in a rural area vs. the DOTs who have implemented a similar MOT strategy but in an urban area. Figure 4.8 indicates the comparison between the level of importance they assign to each of the KPI on a scale of 1 to 5, 1 being least important and 5 being most important.

Overall, there was very little difference between the way both viewpoints assigned a level of importance to the KPIs. Safety is the most critical indicator in the selection of an MOT strategy. Here, safety refers to both driver and worker safety. Safety had average importance of 4.25 on a scale of 1 to 5. Mobility, i.e., the easy traffic flow, is the second most important KPI with an importance rating of 3.45 according to the respondents. Figure 4.8 presents the levels of importance of the rest of the KPIs. Road user cost was, on average, the least important KPI for the responding DOTs. One logical explanation behind this finding may be that road user cost is not an actual direct cost (cash) incurred to the DOT but is rather an indirect and in some cases, intangible measure. Secondly, user cost is incurred not by the agency but by the road users. Thirdly, user costs tends to be far higher than agency costs (in some cases, by a factor of 10) and therefore may skew the analysis outcomes unduly. Finally, there is lack of precision in user cost estimates. If estimated carefully and appropriately, the user cost may reliably indicate the degree of traffic disruption to the users but it is difficult to achieve such precision.

Question 8 focused on identifying different stakeholders involved in the entire detour planning process

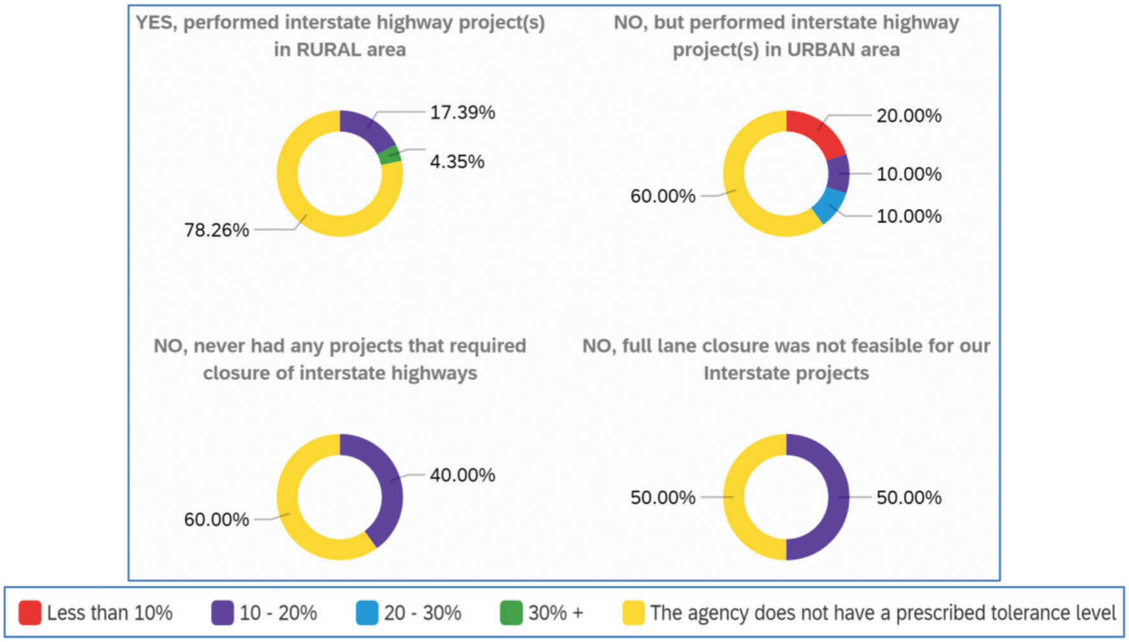


Figure 4.6 Acceptable detour-induced excess time tolerance level.

Figure 4.7 Popular traffic simulation tools.

(see Figure 4.9). It asked the participants to indicate the priority they assign to each stakeholder's opinion before finalizing any MOT strategy. The priority is on a scale of 1 to 5, with 1 being the least priority and 5 being the highest priority.

The emergency service providers followed by the law enforcement agencies are the two most important stakeholders in the detour planning process. Schools, local communities, and local businesses are of relatively secondary preference, followed by the trucking and tourism industry. Coordinating with the contractors performing any construction work in the vicinity is important during the planning stage of new projects.

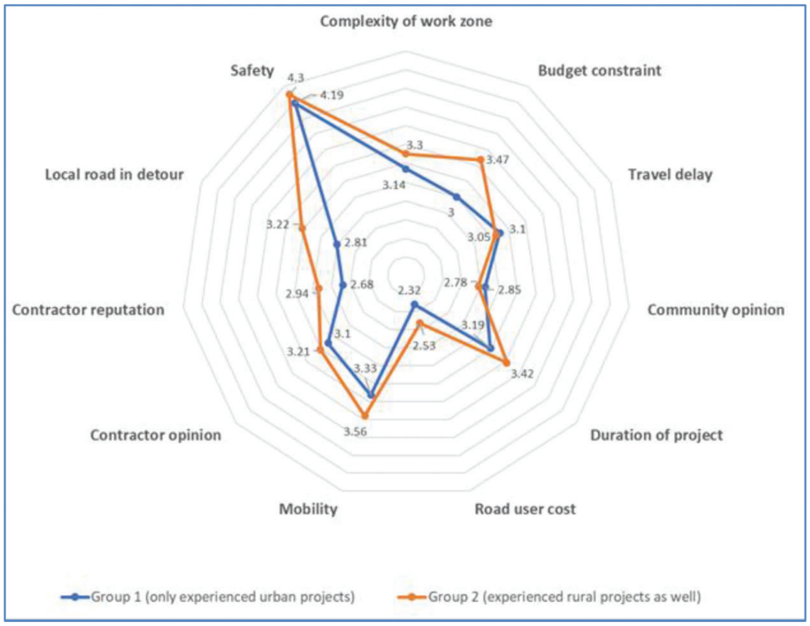


Figure 4.8 Spider-web diagram of the relative importance of KPIs.

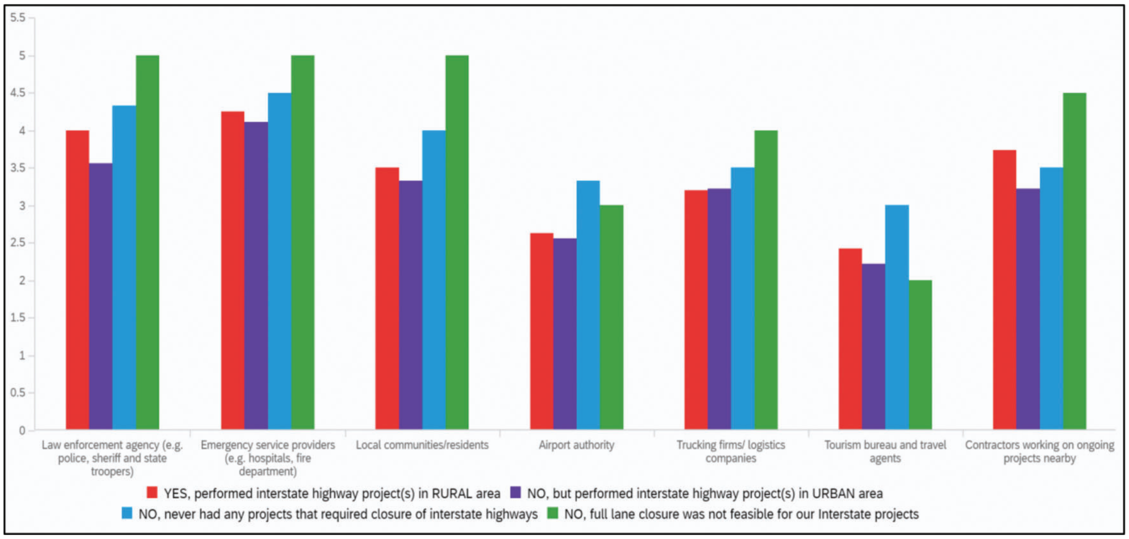


Figure 4.9 Importance of stakeholders in the detour selection process.

4.3.3 Findings

The survey questionnaire results matched the expectations of the team. These results filled the knowledge gaps that still persisted after the case studies. The above section enlists the questions and a detailed analysis of the results. The group-wise comparison initiated in Question 1 helped the research team address for different viewpoints. Table 4.2 presents a brief summary of the survey questionnaire findings.

Table 4.3 presents the mean response scores as observed through the survey questionnaire. Further detailed analysis of these results and their comparison to urban area workzones are presented in the next chapter.

4.4 Summary of the Chapter

This chapter provided answers to information gaps observed during the literature review and case study phase. It explained in detail the eight questions that were asked to INDOT, other state DOTs, FHWA, and AASHTO through a short survey questionnaire. Furthermore, exhaustive analysis and graphical representation of the responses were provided. The important and most crucial outputs of this step were: (1) preferences of multiple DOTs to implementation of crossover design as an MOT strategy vs. implementation of full/one direction closure, (2) the relative importance of the KPIs identified through the literature review, and (3) role played by predetermined

TABLE 4.2
Summary of survey questionnaire findings

1	The general preference of the DOTs is towards implementing crossover design over closing full/one direction rural interstates. However, it is the opposite in the case of urban interstates. Availability of detour alternatives is a significant concern in rural areas.
2	Costs associated with crossover design and potential safety concerns to both drivers and workers can be minimized if closing full/one direction of an interstate. All four groups had a similar viewpoint here.
3	Most of the DOTs do not have a preset threshold on acceptable tolerance levels for induced detour time. However, the detailed analysis indicated that 10%–20% is the usual acceptable level, but the DOTs try to keep it below an additional 10% of the original travel time.
4	Syncro is the most used traffic simulation software. However, 34% of the responding DOTs who have performed a full/one direction closure have a customized spreadsheet suitable to their needs. INDOT similarly has an editable spreadsheet.
5	The group that has experienced full/one direction closure on rural projects tends to assign higher importance to all the enlisted KPIs than those who have only experienced urban projects. One reason for this is that the easy availability of detour alternatives in urban areas simplifies the MOT design process. Safety is the most important KPI. The budget constraint was more important to the rural group than the urban group. Mobility was equally important to both. Community opinion was the least important KPI in the selection of an MOT strategy.
6	Law enforcement agencies and emergency service providers are the most important stakeholders in any given group. Adjacent project contractors should also be consulted in advance. Local communities, the trucking industry, and tourism were of secondary importance in the stakeholders' list.

TABLE 4.3
KPI mean response scores

KPIs for Rural Area Workzones	Mean Response Scores
Safety	4.30
The complexity of work zone layout and net available area	3.30
Budget constraint	3.47
Additional travel time/delay caused by MOT strategy	3.05
Potential increase/decrease in project duration with respect to MOT strategy	3.42
Daily road user cost	2.53
Mobility	3.56
Community opinions with selected MOT strategy	2.78
Contractor's opinions	3.21
Reliability on contractor's work performance ability and/or quality	2.94
Whether or not local roads are a part of the MOT strategy	3.22

stakeholders in the entire decision-making process. The next chapter develops a guideline for closing one direction of traffic for undertaking a rural interstate project based on the results of the case studies and survey questionnaire findings.

CHAPTER 5. GUIDELINE FOR CLOSING ONE DIRECTION

5.1 Introduction

All projects require a proper traffic management plan (TMP). The scope, content, and degree detail present in a TMP is expected to vary based on several factors associated with the work zone impacts. This chapter describes a proposed guideline for preliminarily assessing the safety, mobility, and cost benefits of closing one direction of interstate in rural areas. The *main objective* of this guideline is to help INDOT design engineers intuitively compare the predetermined temporary traffic control strategies (such as crossover vs. detour), for application during the process of project workzone traffic management and control plans. This guideline complements the INDOT traffic management and control plan procedures presented in the *Indiana Design Manual 2013*, Chapter 503-2.0 Traffic Management Plan and Chapter 503-3.0 Temporary Traffic Control Plan. The following sections describe the Key Performance Indicators (KPIs) used and details of the guideline procedures.

5.2 Key Performance Indicators (KPIs) and Risk Factors

This study identified eleven key performance indicators that can be considered when design engineers compare multiple traffic control strategies to compare predetermined temporary traffic control strategies. These KPIs were identified through the literature review, surveys. and interviews conducted as a part of this study. The identified eleven KPIs from the survey outcomes are the following.

1. Safety.
2. The complexity of work zone layout and net available area.
3. Budget constraint (e.g., project cost including MOT costs).
4. Additional travel time/delay caused by MOT strategy.
5. Potential increase/decrease in project duration concerning MOT strategy.

6. Daily road user cost (e.g., extra fuel cost, miles traveled and delayed).
7. Mobility (e.g., free-flow corridor to detour route).
8. Community opinions with selected MOT strategy.
9. Contractor's opinions (e.g., worker safety concerns, equipment logistics, site-layout).
10. Reliability on contractor's work performance ability and quality.
11. Whether or not local roads are a part of the mot strategy (e.g., roads under the same jurisdiction).

This study surveyed traffic and design engineers of state DOTs to generate information that helped prioritize the identified KPIs. Chapter 4 describes the details of the survey (see Questions 6 and 7). The traffic and design engineers assigned a score to each KPI depending on how important they consider it for MOT strategies. This study asked this question to eventually use the identified KPI scores as weight factors for the proposed guideline. Weight factors represent the relative importance of the KPIs and add these scores to give an overall score for each MOT strategy. Hence, traffic and design engineers would comprehensively compare the benefits of predetermined MOT strategies with these weight factors. The scores are absolute values between 0 (not considered) and 5 (most important). Each KPI score exhibited significant variation depending on survey responders' answers. Therefore, this study normalized the scores to adjust values measured on different scales to a notionally common scale ranging from zero to one. The equation to normalize the score is shown in Equation 5.1, and the scores and normalized scores for KPIs are shown in Table 5.1.

$$X_{new} = \frac{X - X_{min}}{X_{max} - X_{min}} \qquad \text{(Eq. 5.1)}$$

Where,

X_{min} = *Minimum KPI score achieved*
X_{max} = *Maximum KPI score achieved*
X = *KPI score*

These KPIs reflect the importance of projects in both urban and rural areas. These responses are evidential of the dynamics of KPI scores depending on the type/location of project in question. For example, the score of the KPIs, "Whether or not Local Roads are a Part of the MOT Strategy," shows a much higher number for projects in rural areas than projects in urban areas. This means that this KPI is more importantly considered when traffic and design engineers are working on projects in rural areas. It can be because projects in urban areas may have more various MOT strategies such as more available crossover sites and other interstate routes as detours. Table 5.2 shows the top five KPIs for projects in urban and rural areas. The top two KPIs (safety and mobility) are the same for both projects in urban and rural areas. Table 5.3 presents the priority list of KPIs for rural projects.

The budget constraint is identified as the third most important KPI for projects in rural areas. The factor for "Potential Increase/Decrease in Project Duration concerning MOT Strategy" is ranked as the third most important KPI for projects in urban areas, but it is ranked as the fourth most important KPI for projects in rural areas. The factor for "Complexity of Work Zone Layout and Net Availability Area" is ranked as 4th for urban projects and 5th for rural projects. The fifth most important KPI for the urban project is "Additional Travel Time/Delay caused by MOT Strategy." These top five prioritized KPIs for urban and rural projects are used as weight factors to compare the benefits

TABLE 5.1
Scores and normalized scores of KPIs for MOT strategy consideration

	Projects in Urban Areas		Projects in Rural Areas	
KPIs	**Score**	**Normalized Score**	**Score**	**Normalized Score**
Safety	4.19	1.00	4.30	1.00
The complexity of work zone layout and net available area	3.14	0.44	3.30	0.44
Budget constraint	3.00	0.36	3.47	0.53
Additional travel time/delay caused by MOT strategy	3.10	0.42	3.05	0.29
Potential increase/decrease in project duration with respect to MOT strategy	3.19	0.47	3.42	0.50
Daily road user cost	2.32	0.00	2.53	0.00
Mobility	3.33	0.54	3.56	0.58
Community opinions with selected MOT strategy	2.85	0.28	2.78	0.14
Contractor's opinions	3.10	0.42	3.21	0.38
Reliability on contractor's work performance ability and/or quality	2.68	0.19	2.94	0.23
Whether or not local roads are a part of the MOT strategy	2.81	0.26	3.22	0.39

Note: Red text numbers are the KPIs with higher ratings between urban vs. rural setting.

TABLE 5.2
Top five KPIs for projects in urban and rural areas

Rank	Projects in Urban Areas	Projects in Rural Areas
1	Safety	Safety
2	Mobility	Mobility
3	Potential increase/decrease in project duration concerning MOT strategy	Budget constraint
4	The complexity of work zone layout and net available area	Potential increase/decrease in project duration concerning MOT strategy
5	Additional travel time/delay caused by MOT strategy	The complexity of work zone layout and net available area

TABLE 5.3
Priority of KPIs for projects in rural areas

KPI	Priority
Safety	1
The complexity of work zone layout and net available area	5
Budget constraint	3
Additional travel time/delay caused by MOT strategy	8
Potential increase/decrease in project duration with respect to MOT strategy	4
Daily road user cost	11
Mobility	2
Community opinions with selected MOT strategy	10
Contractor's opinions	7
Reliability on contractor's work performance ability and/or quality	9
Whether or not local roads are a part of the MOT strategy	6

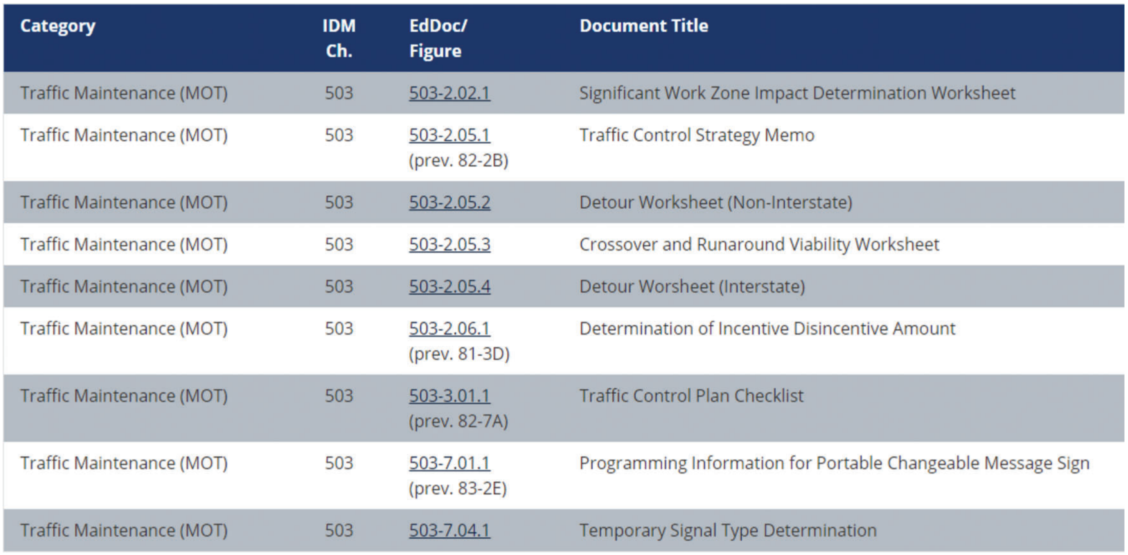
between different predetermined MOT strategies (e.g., crossover vs. detours).

5.3 Comparison Tool for Predetermined MOT Strategies

This study developed a comparison tool for predetermined MOT strategies. This tool utilizes decision-makers' input (e.g., traffic and design engineers' option) and the identified and normalized KPI scores as weight factors. Because this tool compares only predetermined MOT strategies concerning safety, mobility, cost, and other factors, the traffic, and design engineers need to develop available MOT strategies in advance using Chapter 503–Maintenance of Traffic of the *Indiana Design Manual 2013*. The details of the *Indiana Design Manual 2013* are discussed in Chapter 2 of this report (Sections 2.2 and 2.3). Then, after the traffic and design engineers develop traffic management plans (TMP) and temporary traffic control plans (TTCP) for their project, they can use this tool to compare strategies. This comparison tool uses multiple Indiana design manual editable documents to predetermine MOT strategies. Figure 5.1 shows the list of INDOT editable documents for traffic maintenance (MOT) which can be downloaded at the following link. Document 503-2.02.1 (Significant Work Zone Impact Determination Worksheet), 503-2.05.3 (Crossover and Runaround Viability Worksheet), 503-2.05.4 (Detour Worksheet (Interstate)), and 503.2.06.1 (Determination of Incentive Disincentive Amount) are used for the proposed procedure to compare MOT strategies.

Figure 5.2 shows the overall flowchart if traffic and design engineers need to compare predetermined crossover and detour strategies. This flowchart preliminarily helps the decision-makers to see if MOT strategies (e.g., crossovers and detour plans) can be compared. Project sites should meet certain conditions to consider full closure. The first step of this procedure is determining significant work zone impact using the editable document figure 503-2.02.1 Significant Work Zone Impact Determination Worksheet, shown in Figure 5.3. After determining significant work zone impacts, the engineers review jobsite conditions and project duration. In the following step, the engineers examine the technical aspects if crossovers could be deployed at the project site. Also, the duration of the project is double-checked. According to *Indiana Design Manual Editable Document 503-2.05.3* (crossover and runaround viability worksheet), if the project duration is less than 1 month, then a crossover is not viable, and in such cases, traffic is to be maintained adjacent to the work area or through alternate routes.

The next step is the check of predetermined crossover viability using the Crossover & Runaround Worksheet. The engineer develops a preliminary cost estimate for the crossover strategy using this document. Figure 5.4 shows the crossover and runaround worksheet and cost estimate forms.



Category	IDM Ch.	EdDoc/ Figure	Document Title
Traffic Maintenance (MOT)	503	503-2.02.1	Significant Work Zone Impact Determination Worksheet
Traffic Maintenance (MOT)	503	503-2.05.1 (prev. 82-2B)	Traffic Control Strategy Memo
Traffic Maintenance (MOT)	503	503-2.05.2	Detour Worksheet (Non-Interstate)
Traffic Maintenance (MOT)	503	503-2.05.3	Crossover and Runaround Viability Worksheet
Traffic Maintenance (MOT)	503	503-2.05.4	Detour Worsheet (Interstate)
Traffic Maintenance (MOT)	503	503-2.06.1 (prev. 81-3D)	Determination of Incentive Disincentive Amount
Traffic Maintenance (MOT)	503	503-3.01.1 (prev. 82-7A)	Traffic Control Plan Checklist
Traffic Maintenance (MOT)	503	503-7.01.1 (prev. 83-2E)	Programming Information for Portable Changeable Message Sign
Traffic Maintenance (MOT)	503	503-7.04.1	Temporary Signal Type Determination

Figure 5.1 List of INDOT's editable document for traffic maintenance (MOT). Note: The forms are at https://www.in.gov/dot/div/contracts/design/dmforms/.

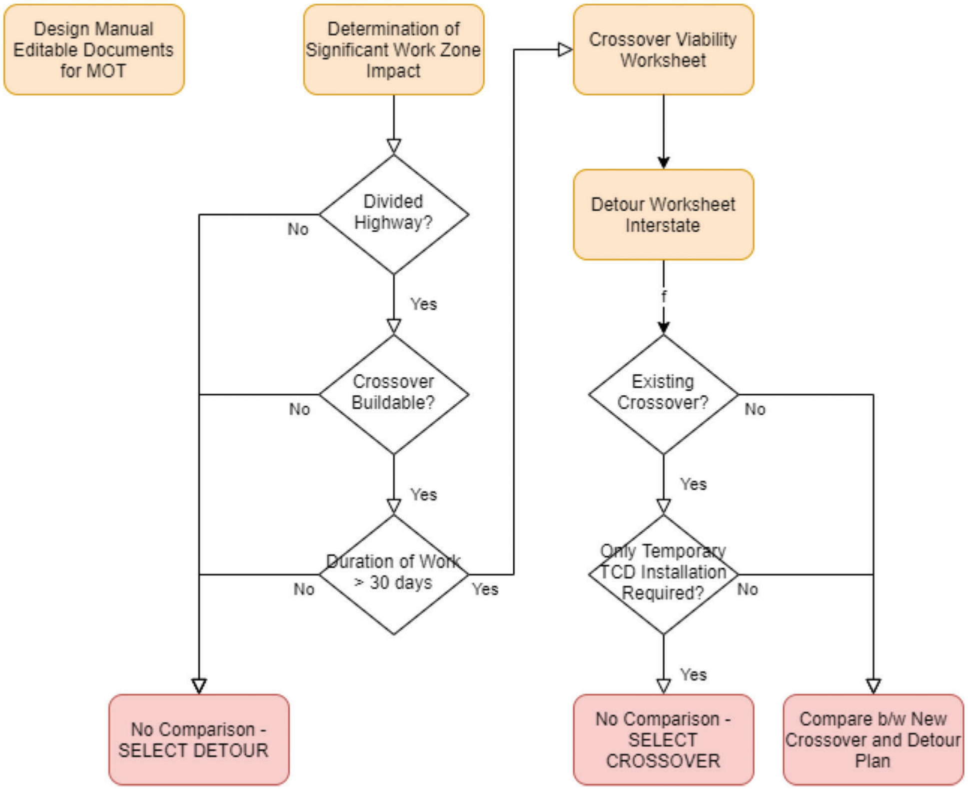
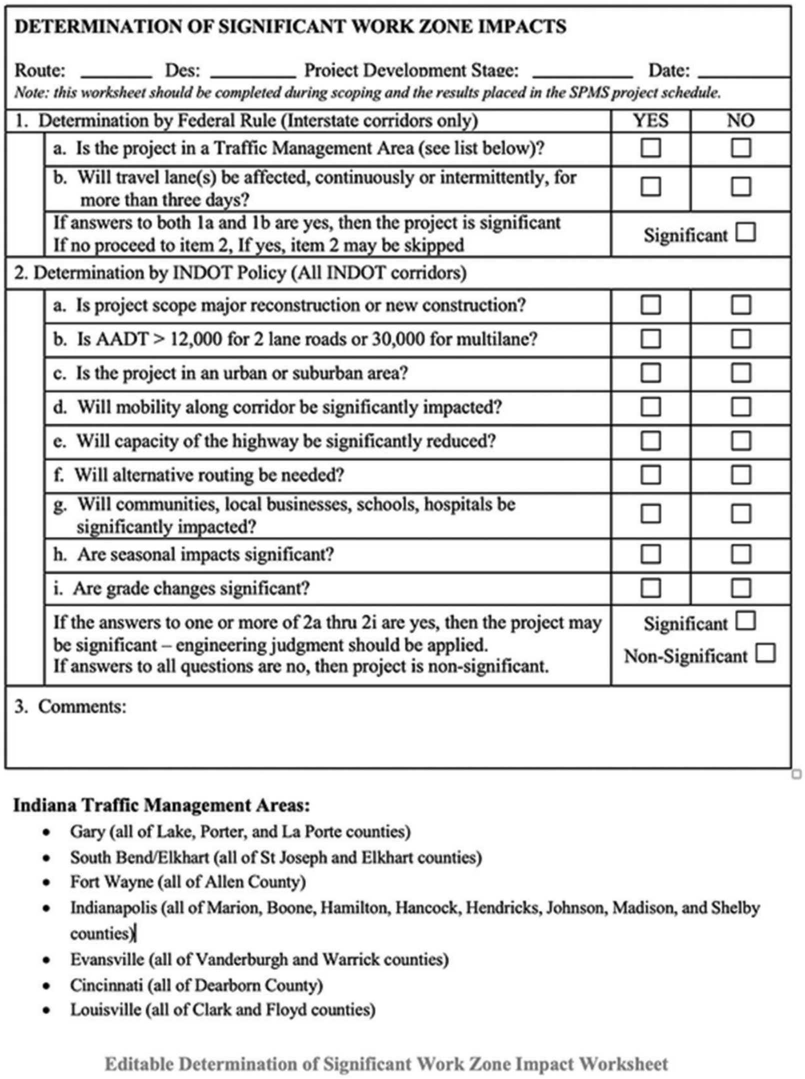


Figure 5.2 Flowchart of decision to compare MOT strategies.

After checking crossover viability and estimating crossover costs, the engineers double-check the existing crossover options to supplement new crossover options or reduce crossover implementation costs. If there is an existing crossover site and only required temporary traffic control devices (TCD) to utilize the existing crossover, the engineers would not need to compare two or more MOT strategies. Crossover options would be more feasible than detour plans. However, if there are no existing crossover sites or if INDOT needs to install more than just temporary TCD to existing crossovers, The engineers can use the proposed tool to compare two different strategies. Before using the tool, the engineers need to develop detailed detour plans using Worksheets for Determining the Viability of a Complete Closure with Detour on Interstate. The entire



DETERMINATION OF SIGNIFICANT WORK ZONE IMPACTS

Route: _______ Des: ________ Project Development Stage: __________ Date: ________

Note: this worksheet should be completed during scoping and the results placed in the SPMS project schedule.

	YES	NO
1. Determination by Federal Rule (Interstate corridors only)	YES	NO
a. Is the project in a Traffic Management Area (see list below)?	☐	☐
b. Will travel lane(s) be affected, continuously or intermittently, for more than three days?	☐	☐
If answers to both 1a and 1b are yes, then the project is significant If no proceed to item 2, If yes, item 2 may be skipped	Significant ☐	
2. Determination by INDOT Policy (All INDOT corridors)		
a. Is project scope major reconstruction or new construction?	☐	☐
b. Is AADT > 12,000 for 2 lane roads or 30,000 for multilane?	☐	☐
c. Is the project in an urban or suburban area?	☐	☐
d. Will mobility along corridor be significantly impacted?	☐	☐
e. Will capacity of the highway be significantly reduced?	☐	☐
f. Will alternative routing be needed?	☐	☐
g. Will communities, local businesses, schools, hospitals be significantly impacted?	☐	☐
h. Are seasonal impacts significant?	☐	☐
i. Are grade changes significant?	☐	☐
If the answers to one or more of 2a thru 2i are yes, then the project may be significant – engineering judgment should be applied. If answers to all questions are no, then project is non-significant.	Significant ☐ Non-Significant ☐	
3. Comments:		

Indiana Traffic Management Areas:

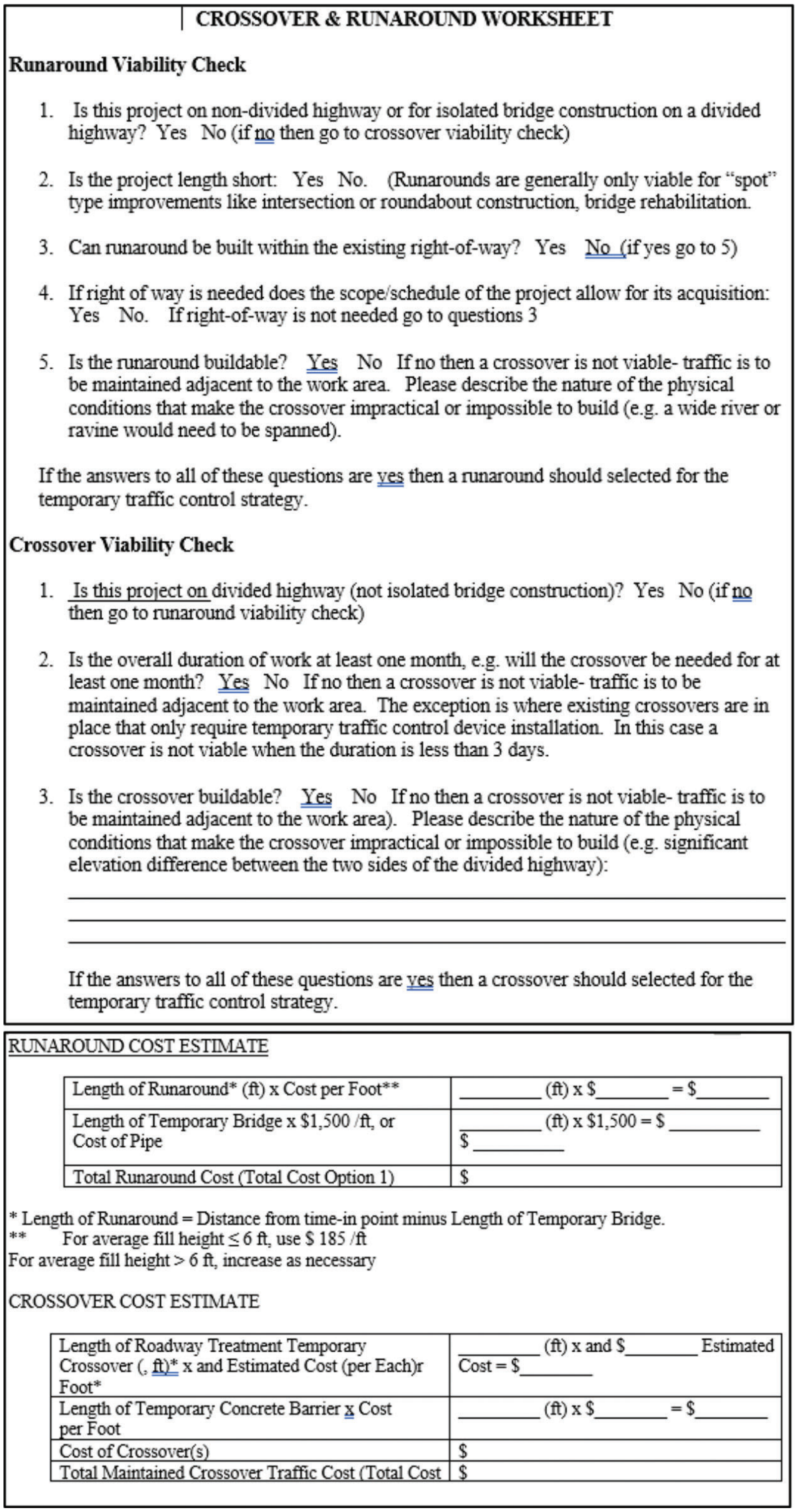
- Gary (all of Lake, Porter, and La Porte counties)
- South Bend/Elkhart (all of St Joseph and Elkhart counties)
- Fort Wayne (all of Allen County)
- Indianapolis (all of Marion, Boone, Hamilton, Hancock, Hendricks, Johnson, Madison, and Shelby counties)
- Evansville (all of Vanderburgh and Warrick counties)
- Cincinnati (all of Dearborn County)
- Louisville (all of Clark and Floyd counties)

Editable Determination of Significant Work Zone Impact Worksheet

Figure 5.3 INDOT editable document: significant work zone impact determination worksheet.

worksheets are shown in Appendix D. If the work does not affect the travel lanes of interstate, a closure with detour is not needed nor recommended. If the alternate route includes local traffic, the traffic and design engineers should carefully review and update section of this worksheet. This section reviews (1) capacity of the detour in existing condition, (2) existing traffic volumes on detour routes and legs including AM and PM peak hours, (3) displaced traffic volumes from the closed roadway to detour legs, (4) total traffic volumes on detour legs during construction, (5) volume to capacity during construction with detour legs, and (6) other concerns. The detour worksheet for interstate projects is shown in Appendix D.

When the traffic and design engineers need to compare the benefits between predetermined crossovers and detour plans, they use the proposed comparison tool shown in Figure 5.5. The tool utilizes top-five ranked KPIs safety, mobility, budget constraint, project duration, and complexity of project sites. Interestingly, Road User Cost (RUC) is not included in the top five KPIs. RUC is identified as the least important factor that engineers consider when they develop MOT strategies. Therefore, the proposed tool gives an option for the engineers to decide on the inclusion of RUC as a weight factor when comparing the predetermined MOT strategies. If the engineers opt to use RUC as the 6th weight factor, they need to go through the *Incentive/Disincentive Amount Determination Editable Document*. This document analyzes how much INDOT needs to consider incentive or disincentive based on determined road user costs of predetermined MOT strategies. The engineers need to assign a score of the negative aspects to each MOT strategy in the range between 1 and 5 for each KPI. For example, Figure 5.5 presents an example where engineer identifies that the predetermined crossover strategy has "severe negative aspects" in terms of safety factor, but the predetermined detour strategy has "moderate negative aspects." In other words, the predetermined crossover is less favorable compared to



CROSSOVER & RUNAROUND WORKSHEET

Runaround Viability Check

1. Is this project on non-divided highway or for isolated bridge construction on a divided highway? Yes No (if no then go to crossover viability check)
2. Is the project length short: Yes No. (Runarounds are generally only viable for “spot” type improvements like intersection or roundabout construction, bridge rehabilitation.
3. Can runaround be built within the existing right-of-way? Yes No (if yes go to 5)
4. If right of way is needed does the scope/schedule of the project allow for its acquisition: Yes No. If right-of-way is not needed go to questions 3
5. Is the runaround buildable? Yes No If no then a crossover is not viable- traffic is to be maintained adjacent to the work area. Please describe the nature of the physical conditions that make the crossover impractical or impossible to build (e.g. a wide river or ravine would need to be spanned).

If the answers to all of these questions are yes then a runaround should selected for the temporary traffic control strategy.

Crossover Viability Check

1. Is this project on divided highway (not isolated bridge construction)? Yes No (if no then go to runaround viability check)
2. Is the overall duration of work at least one month, e.g. will the crossover be needed for at least one month? Yes No If no then a crossover is not viable- traffic is to be maintained adjacent to the work area. The exception is where existing crossovers are in place that only require temporary traffic control device installation. In this case a crossover is not viable when the duration is less than 3 days.
3. Is the crossover buildable? Yes No If no then a crossover is not viable- traffic is to be maintained adjacent to the work area). Please describe the nature of the physical conditions that make the crossover impractical or impossible to build (e.g. significant elevation difference between the two sides of the divided highway):

If the answers to all of these questions are yes then a crossover should selected for the temporary traffic control strategy.

RUNAROUND COST ESTIMATE

Length of Runaround* (ft) x Cost per Foot**	________ (ft) x $________ = $________
Length of Temporary Bridge x $1,500 /ft, or Cost of Pipe	________ (ft) x $1,500 = $ __________ $ __________
Total Runaround Cost (Total Cost Option 1)	$

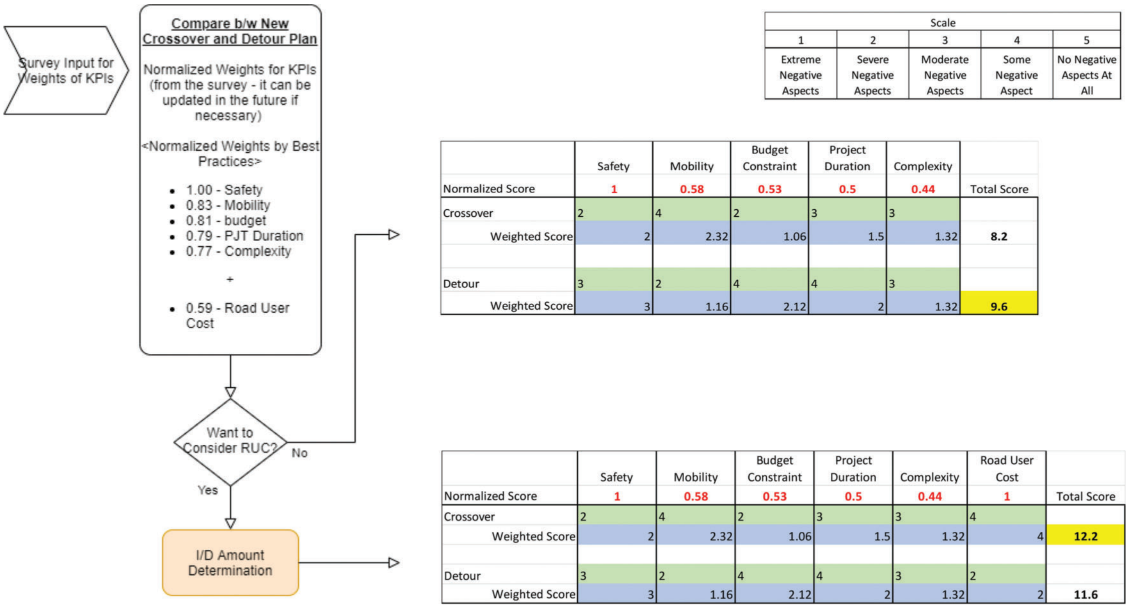
* Length of Runaround = Distance from time-in point minus Length of Temporary Bridge.
** For average fill height ≤ 6 ft, use $ 185 /ft
For average fill height > 6 ft, increase as necessary

CROSSOVER COST ESTIMATE

Length of Roadway Treatment Temporary Crossover (, ft)* x and Estimated Cost (per Each)r Foot*	_________ (ft) x and $________ Estimated Cost = $________
Length of Temporary Concrete Barrier x Cost per Foot	________ (ft) x $________ = $________
Cost of Crossover(s)	$
Total Maintained Crossover Traffic Cost (Total Cost	$

Figure 5.4 INDOT editable document: crossover and runaround worksheet.

the predetermined detour strategy in terms of safety. The engineers put their scale values into the green cells, and the tool multiplies these values with the normalized score of each KPI. Then, the tool aggregates these weighted scores for each predetermined MOT strategy. A strategy with a higher total score has greater benefits in terms of safety, mobility, budget constraint, project duration, and complexity.



Scale				
1	2	3	4	5
Extreme Negative Aspects	Severe Negative Aspects	Moderate Negative Aspects	Some Negative Aspect	No Negative Aspects At All

	Safety	Mobility	Budget Constraint	Project Duration	Complexity	
Normalized Score	1	0.58	0.53	0.5	0.44	Total Score
Crossover	2	4	2	3	3	
Weighted Score	2	2.32	1.06	1.5	1.32	**8.2**
Detour	3	2	4	4	3	
Weighted Score	3	1.16	2.12	2	1.32	**9.6**

	Safety	Mobility	Budget Constraint	Project Duration	Complexity	Road User Cost	
Normalized Score	1	0.58	0.53	0.5	0.44	1	Total Score
Crossover	2	4	2	3	3	4	
Weighted Score	2	2.32	1.06	1.5	1.32	4	**12.2**
Detour	3	2	4	4	3	2	
Weighted Score	3	1.16	2.12	2	1.32	2	**11.6**

Figure 5.5 Comparison results of the MOT strategies.

5.4 Summary of the Chapter

This chapter proposes a comparison tool for predetermined MOT strategies in terms of important Key Performance Indicators (KPIs). These KPIs are identified through a survey of INDOT and other state DOT engineers, and these KPIs are prioritized based on the inputs (ranges between 0 "Not Considered At All" and 5 "Most Important Factor"). The identified top five KPIs for MOT strategy development are: (1) safety, (2) mobility, (3) budget constraint, (4) project duration, and (5) complexity of project sites. Scores of these KPIs are normalized to use as a weight factor in the comparison tool for the predetermined MOT strategies.

This chapter also demonstrates the proposed comparison tool using the I-65 widening project conducted in the Seymour District in Indiana between 2018 and 2020. To demonstrate the comparison tool, this study (1) revised the project documents, (2) examined the planned and applied MOT strategies, (3) identified feasible detour routes for lane closure of the project, (4) evaluated the identified detour routes using INDOT editable documents, and (5) compared the applied MOT strategies (e.g., lane shifting) and the identified feasible detour routes for one directional lane closure. The analysis results and the comparison tool are presented in Appendix C. Furthermore, an Excel file of the tool is also provided as an addendum to this report (see https://doi.org/10.5703/1288284317345).

CHAPTER 6. ANALYSIS OF POTENTIAL DETOUR ROUTES OF INTERSTATES IN RURAL AREAS

6.1 Introduction

This chapter presents an analysis for rural interstates using capacity and site-specific analyses. For analyzing the potential detour routes, the examples in this chapter (1) identified the interstate sections in rural areas, (2) identified feasible detour routes per section (one direction only, NB or SB but not both simultaneously), (3) performed capacity and site-specific analyses for the identified feasible route, and (4) recommended potential detour routes by comparing the travel miles and time between existing crossover options and the identified detour options for one directional lane closure. Closure of both directions, i.e., traffic detouring from NB and SB sections would require a similar but separate analysis and might be technically more challenging (identifying feasible routes) compared with closing/detouring one direction only.

6.2 Potential Detour Routes for the Interstate

6.2.1 Sections of Interstates in Rural Areas

Information on job site conditions, location, and project durations are critical for determining detour routes. Since this study develops a generalized process, the research team split existing interstates into several sections. There are five interstates (non-toll roads) in Indiana, which are I-64, I-65, I-69, I-70, and I-74. This study divided each interstate into two to six sections depending on the number of existing ramps in each interstate. The number of ramps is the primary driver to determine the number of potential detour routes in each section. There will be too many potential detour routes to consider if there are too many ramps to exit/re-enter. Therefore, this study divided sections to contains ramps between five and eleven. As a result, this study decided to divide I-64 into two sections, I-65 into five sections, I-69 into six sections, I-70 into four sections, and I-74

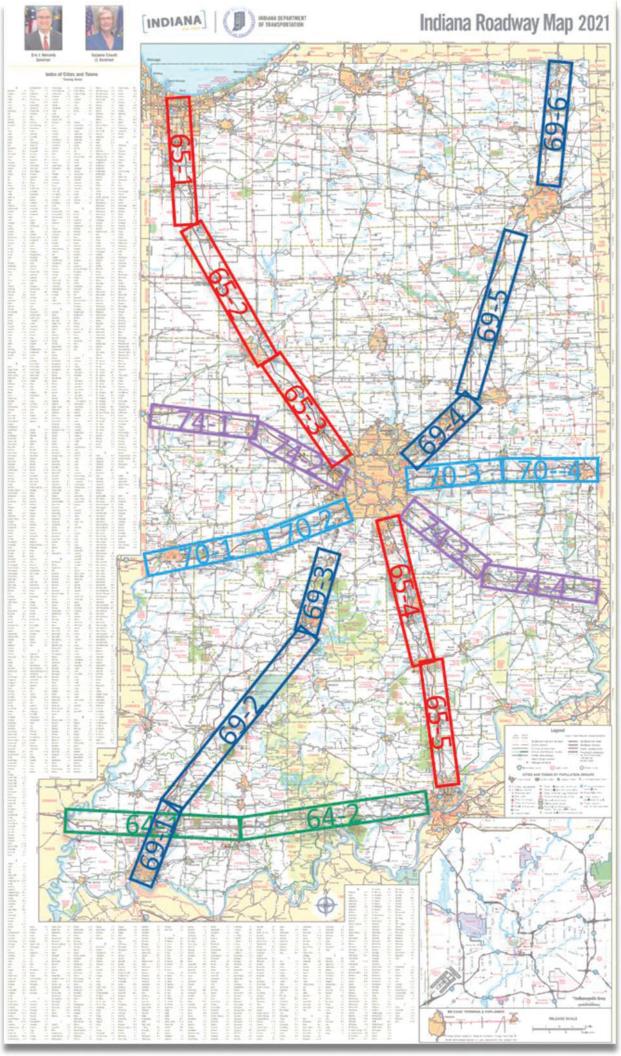


Figure 6.1 Locations of interstate sections in rural areas.

into four sections. Figure 6.1 presents the map locations of these sections, and Table 6.1 presents the details of each section.

6.2.2 Identification of Feasible Detour Routes

After dividing the sections, the research team identified feasible detour routes based on exit/re-enter ramps in each section and connected alternate routes. This study considers only state routes and US highway routes as feasible detour routes. It is noted that county roads and other routes can also serve as detour routes. However, their selection may pose complications because they are not under INDOT's jurisdiction. This subsection demonstrates how to use and interpret detour route tables in the tool, using I-70 section 4 as an example. Figure 6.2 shows the six exits/re-enter ramps and connected State and US highway routes associated with I-70 section 4 in Indiana. These six ramps are marked as white squares on I-70

In Section 4, I-70 is connected to SR 1, Centerville Rd, US 35, US 27, SR 227, and US 40. Except for Centerville Rd (a county road), other alternative routes can be identified to serve as detour routes. The study identified feasible detour routes based on these exits/re-enter ramps for both eastbound and westbound. For example, if the decision-makers select the first ramp (which goes to SR 1) as an exit ramp, they have four options for re-entering ramps: US 35, US 27, SR 227, and US 40 to I-70. This sequencing is shown in Figure 6.3. Similarly, if the decision-makers select the third ramp (which goes to US 35) as an exit ramp, they have three options for re-entering ramps from US 27, SR 227, and US 40 in this section. Each cell represents the identified detour route that exits the interstate and re-enters the interstate.

For example, when the decision-makers would like to see the detour route that exits to SR 1 and re-enters from US 35 to the interstate, the possible detour route is (1) SR 1-SR 38-US 35, which is shown in the second column and the first row in Figure 6.3. If there are multiple detour routes are available, the research team recommends selection of the superior option in terms of additional travel miles and time, by comparing the routes in Google Map. For instance, the SR 1-SR 38-US 35 route has shorter additional travel miles and time than the SR 1-US 40-US 35 route. Similarly, Figure 6.4 identifies detour routes for westbound section of I-70. With these detour route tables, the decision-makers will be able to quickly identify the best available detour routes between desire exit/re-enter ramps. Detour routes for other interstates and sections are shown in Appendix C.

6.2.3 Capacity and Site-Specific Analysis

Capacity and site-specific analyses were conducted for the identified detour routes. The capacity analysis is critical to see if the identified detour route can accommodate the traffic volumes in the existing detour routes and the traffic volumes from the interstate. For the capacity, this study utilized data from the INDOT Traffic Count Database System (https://indot.public.ms2soft.com/tcds/tsearch.asp?loc=Indot&mod).

This study determined the maximum AADT of the interstate section and used this data to estimate the total flow volume (vehicle per hour per lane) for the identified detour route using this system. In addition, the study referred to typical highway capacity to estimate capacities of the identified detour routes specified in the *Indiana Design Manual 503-2A*. This typical highway capacity (unrestricted parallel route used as a detour) is shown in Figure 6.5.

In Figure 6.5, urban, non-divided signalized highway capacity is estimated between 800 and 1,750 vehicle per hour per lane. The SR 1-SR 38-US 35 route is consistent with this roadway type, so it has a minimum 800 vehicle per hour per lane (veh/hr/ln) capacity, and maximum 1,750 (veh/hr/ln) capacity. The decision-makers can, finally, estimate the volume per capacity

TABLE 6.1
Details of ramps and sections of interstates in rural area

Interstate	Section	Direction	From	To	# of Ramps in the Section Including On/Off Ramps
I-64	Section 1	EB & WB	IL State Border	Dubois County (SR 162 on/off ramp)	9
I-64	Section 2	EB & WB	Dubois County (SR 162 on/off ramp)	New Albany County (I-265 junction)	9
I-65	Section 1	NB & SB	Lake County (I-90 junction)	Jasper County (SR 14 on/off ramp)	9
I-65	Section 2	NB & SB	Jasper County (SR 14 on/off ramp)	Tippecanoe County (SR 38 on/off ramp)	10
I-65	Section 3	NB & SB	Tippecanoe County (SR 38 on/off ramp)	Indianapolis (I-465 junction)	9
I-65	Section 4	NB & SB	Marion County Border	Jackson County (US 50 on/off ramp)	10
I-65	Section 5	NB & SB	Jackson County (US 50 on/off ramp)	New Albany County (I-265 junction)	9
I-69	Section 1	NB & SB	KY State Border	Gibson County (SR 68 on/off ramp)	10
I-69	Section 2	NB & SB	Gibson County (I-64 on/off ramp)	Monroe County (SR 37 on/off ramp)	10
I-69	Section 3	NB & SB	Monroe County (SR 37 on/off ramp)	Morgan County (SR 39 on/off ramp)	10
I-69	Section 4	NB & SB	Marion County Border	Delaware County (SR 32 on/off ramp)	9
I-69	Section 5	NB & SB	Delaware County (SR 32 on/off ramp)	Allen County (I-469 junction)	9
I-69	Section 6	NB & SB	Allen County (I-469 junction)	MI State Border	11
I-70	Section 1	EB & WB	IL State Border	Putnam County (US 231 on/off ramp)	7
I-70	Section 2	EB & WB	Putnam County (US 231 on/off ramp)	Marion County Border	5
I-70	Section 3	EB & WB	Marion County Border	Wayne County (SR 1 on/off ramp)	6
I-70	Section 4	EB & WB	Wayne County (SR 1 on/off ramp)	Putnam County (US 231 on/off ramp)	6
I-74	Section 1	EB & WB	IL State Border	Montgomery County (SR 32 on/off ramp)	6
I-74	Section 2	EB & WB	Montgomery County (SR 32 on/off ramp)	Marion County Border	6
I-74	Section 3	EB & WB	Marion County Border	Decatur County (US 421 on/off ramp)	8
I-74	Section 4	EB & WB	Decatur County (US 421 on/off ramp)	OH State Border	7

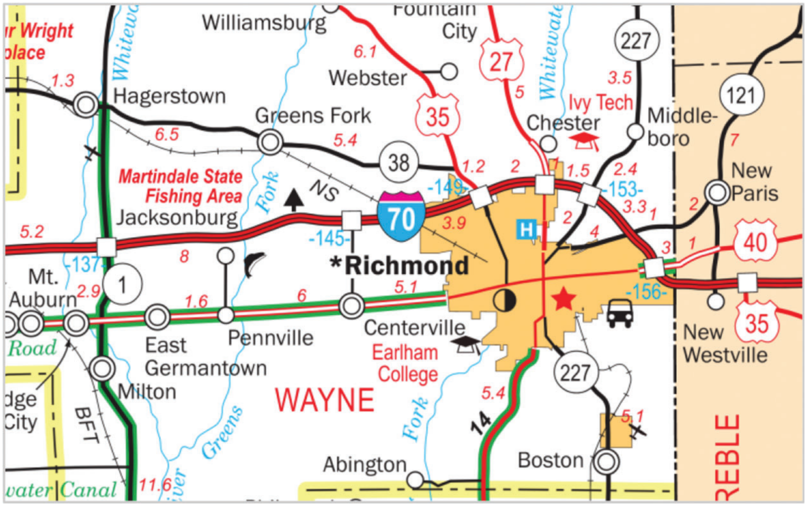


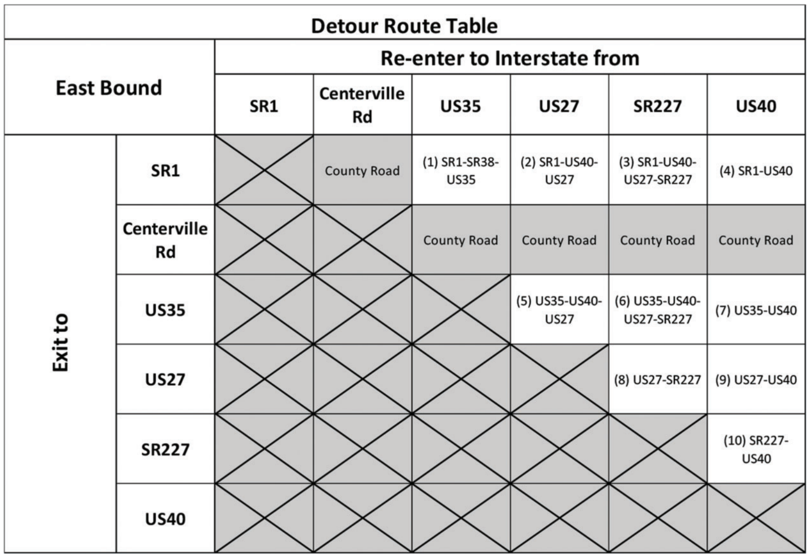
Figure 6.2 Six exit/re-enter ramps in I-70 section 4 in Indiana and one ramp in Ohio.

rate of the route using the estimated total volume and the capacity of the route. Figure 6.6 presents the capacity analysis results for the I-70 Section 4 eastbound. The indicated ADT represents the sum of the I-70 traffic added to the traffic existing on each detour segment. If the volume to capacity (V/C) ratio is great than 1, the identified route is not suitable to use as an alternate route. The table provides max, average, and min V/C values using min, average, and max capacity values. Finally, this study provides site-specific aspects for each identified route. These site-specific notes are based on the critical factors that were noted from the questionnaire survey and the interviews. Figure 6.7 presents the site-specific notes for the I-70 section 4 eastbound.

6.3 I-65 Lane-Addition Project in Seymour District, IN

6.3.1 Project Background and MOT Strategies Applied

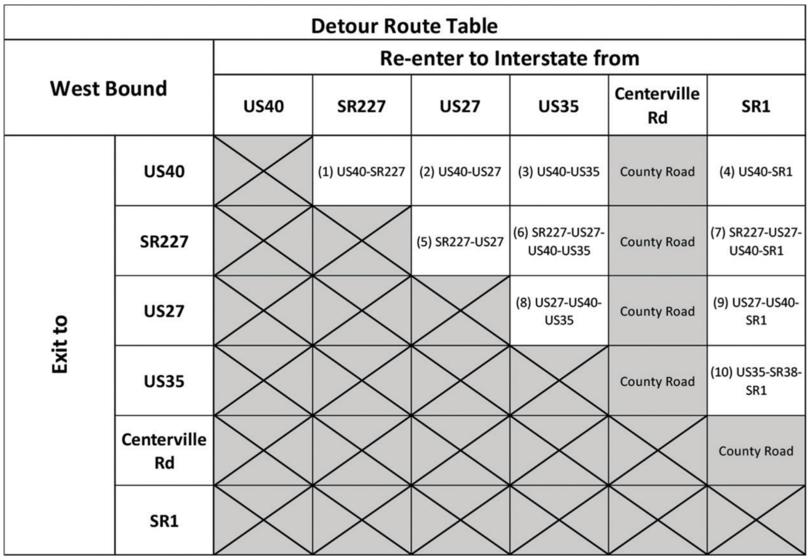
The section of I-65 between the City of Columbus and the City of Seymour in Indiana has been accommodating large volumes of vehicular and truck traffics. Recently, these volumes have increased rapidly. To improve mobility in the region for all motorists focusing on heavy traffic, INDOT decided to rebuild



Detour Route Table

East Bound		Re-enter to Interstate from					
		SR1	Centerville Rd	US35	US27	SR227	US40
Exit to	SR1	☒	County Road	(1) SR1-SR38-US35	(2) SR1-US40-US27	(3) SR1-US40-US27-SR227	(4) SR1-US40
	Centerville Rd	☒	☒	County Road	County Road	County Road	County Road
	US35	☒	☒	☒	(5) US35-US40-US27	(6) US35-US40-US27-SR227	(7) US35-US40
	US27	☒	☒	☒	☒	(8) US27-SR227	(9) US27-US40
	SR227	☒	☒	☒	☒	☒	(10) SR227-US40
	US40	☒	☒	☒	☒	☒	☒

Figure 6.3 Identified detour route on the eastbound of I-70 section 4.



Detour Route Table

West Bound		Re-enter to Interstate from					
		US40	SR227	US27	US35	Centerville Rd	SR1
Exit to	US40	☒	(1) US40-SR227	(2) US40-US27	(3) US40-US35	County Road	(4) US40-SR1
	SR227	☒	☒	(5) SR227-US27	(6) SR227-US27-US40-US35	County Road	(7) SR227-US27-US40-SR1
	US27	☒	☒	☒	(8) US27-US40-US35	County Road	(9) US27-US40-SR1
	US35	☒	☒	☒	☒	County Road	(10) US35-SR38-SR1
	Centerville Rd	☒	☒	☒	☒	☒	County Road
	SR1	☒	☒	☒	☒	☒	☒

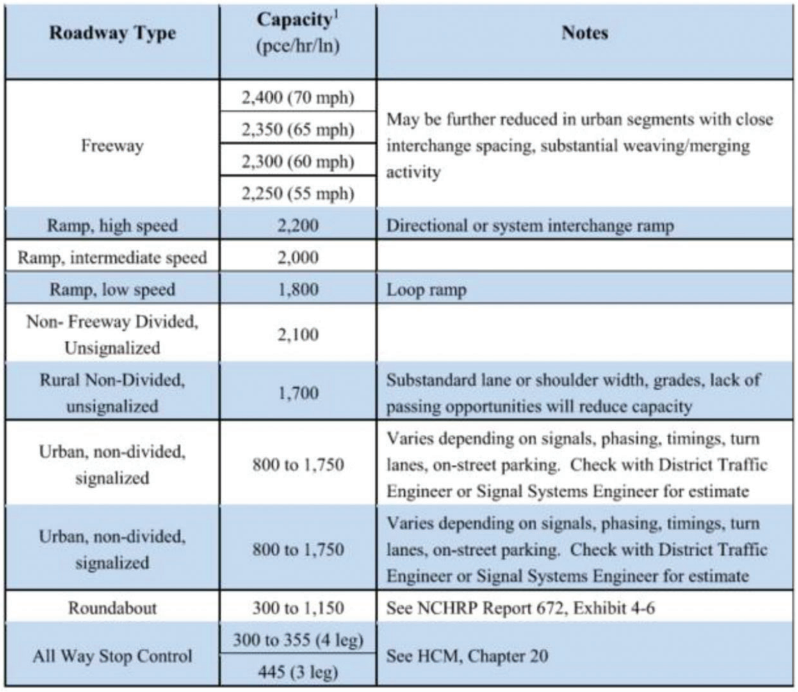
Figure 6.4 Identified detour route on the westbound of I-70 section 4.

I-65 as a 6-lane roadway between US Highway 50 and State Road 58 with repair/resurface of I-65 from SR 58 to the SR 46 exit at Columbus. The project was broken into three stages. The first stage was from Walesboro to just north of the Jonesville exit. Stage 2 was from the bridge of the East Fork White River to the US 50 exit. The last stage was the section between the two sections completed earlier and was completed last because it contained a number of bridge projects. Figure 6.8 presents the I-65 lane widening project map, and Table 6.2 summarizes the project characteristics. E&B Paving (the general contractor) made use of crossover, which was implemented by shifting the traffic onto the right shoulder and building the new travel lane in the median area. The contractors installed various traffic control equipment such as concrete barrier walls and message boards to protect the crews who worked in very close proximity to the passing traffic. Traffic signals were installed at the SR 58 exit, and a caution light was replaced with a traffic signal at the US 31/SR 250 intersection.

Furthermore, INDOT coordinated with law enforcement to increase police patrols for the drivers' awareness. There were no plans to close the lanes by providing detour routes. However, due to high frequency of crashes, the INDOT had to shut down the interstate for some periods.

6.3.2 *Identified Detour Routes of the Project*

The research team used this project as a case study to show where potential detour routes may be recommended instead of crossovers. The team focused only



Roadway Type	Capacity[1] (pce/hr/ln)	Notes
Freeway	2,400 (70 mph)	May be further reduced in urban segments with close interchange spacing, substantial weaving/merging activity
	2,350 (65 mph)	
	2,300 (60 mph)	
	2,250 (55 mph)	
Ramp, high speed	2,200	Directional or system interchange ramp
Ramp, intermediate speed	2,000	
Ramp, low speed	1,800	Loop ramp
Non- Freeway Divided, Unsignalized	2,100	
Rural Non-Divided, unsignalized	1,700	Substandard lane or shoulder width, grades, lack of passing opportunities will reduce capacity
Urban, non-divided, signalized	800 to 1,750	Varies depending on signals, phasing, timings, turn lanes, on-street parking. Check with District Traffic Engineer or Signal Systems Engineer for estimate
Urban, non-divided, signalized	800 to 1,750	Varies depending on signals, phasing, timings, turn lanes, on-street parking. Check with District Traffic Engineer or Signal Systems Engineer for estimate
Roundabout	300 to 1,150	See NCHRP Report 672, Exhibit 4-6
All Way Stop Control	300 to 355 (4 leg)	See HCM, Chapter 20
	445 (3 leg)	

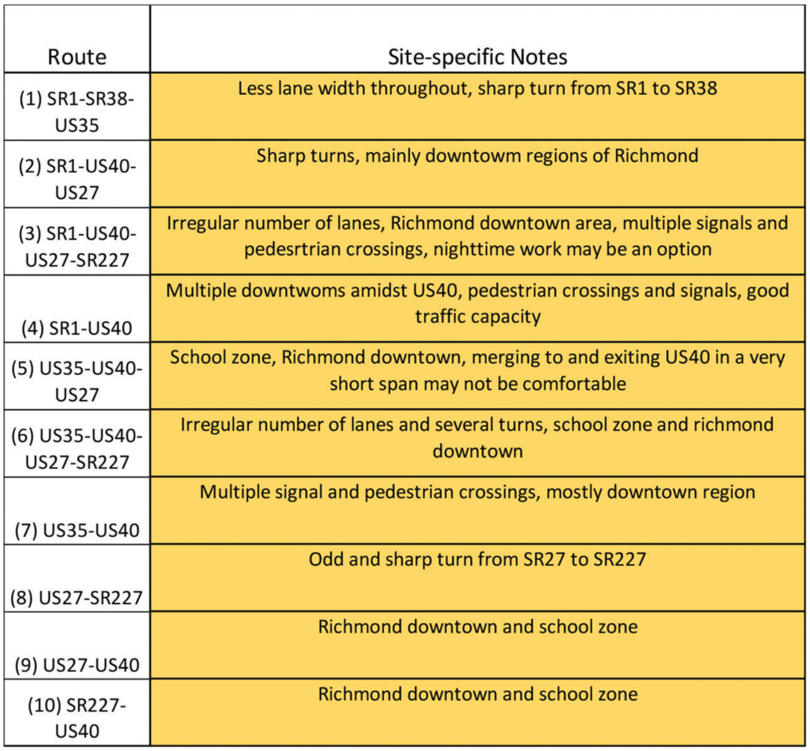
Figure 6.5 Typical highway capacity (unrestricted parallel route used as a detour).

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C
(1) SR1-SR38-US35	6764	1	1463	800	1275	1750	1.83	1.15	0.84
(2) SR1-US40-US27	4531	1	1370	800	1275	1750	1.71	1.07	0.78
(3) SR1-US40-US27-SR227	1137	1	1229	800	1275	1750	1.54	0.96	0.70
(4) SR1-US40	427	1	1199	800	1275	1750	1.50	0.94	0.69
(5) US35-US40-US27	6764	1	1463	800	1275	1750	1.83	1.15	0.84
(6) US35-US40-US27-SR227	4531	1	1370	800	1275	1750	1.71	1.07	0.78
(7) US35-US40	1137	1	1229	800	1275	1750	1.54	0.96	0.70
(8) US27-SR227	427	1	1199	800	1275	1750	1.50	0.94	0.69
(9) US27-US40	1958	1	1263	800	1275	1750	1.58	0.99	0.72
(10) SR227-US40	1137	1	1229	800	1275	1750	1.54	0.96	0.70

Figure 6.6 Capacity analysis results of I-70 section 4 eastbound.

on the length of the project between US 50 and SR 58 to identify feasible detour routes as an alternative strategy. The identified detour routes between US 50 and SR 58 were chosen based on both distance and time and the road types. Also, the number of right turns was taken into consideration, which will pose a challenge for truck drivers if the turning radius provided is not sufficient. Finally, the team tried as much as possible to choose detour routes that were parallel to the original route and avoided the use of county roads for long stretches as they typically lead to increased travel time due to their lower speed limits.

The teams used the INDOT editable documents to identified two detour options for a temporary closure of the I-65. The identified alternate routes include county roads which may not be practical for INDOT's



Route	Site-specific Notes
(1) SR1-SR38-US35	Less lane width throughout, sharp turn from SR1 to SR38
(2) SR1-US40-US27	Sharp turns, mainly downtowm regions of Richmond
(3) SR1-US40-US27-SR227	Irregular number of lanes, Richmond downtown area, multiple signals and pedesrtrian crossings, nighttime work may be an option
(4) SR1-US40	Multiple downtwoms amidst US40, pedestrian crossings and signals, good traffic capacity
(5) US35-US40-US27	School zone, Richmond downtown, merging to and exiting US40 in a very short span may not be comfortable
(6) US35-US40-US27-SR227	Irregular number of lanes and several turns, school zone and richmond downtown
(7) US35-US40	Multiple signal and pedestrian crossings, mostly downtown region
(8) US27-SR227	Odd and sharp turn from SR27 to SR227
(9) US27-US40	Richmond downtown and school zone
(10) SR227-US40	Richmond downtown and school zone

Figure 6.7 Site-specific notes for detours on I-70 section 4 eastbound.

TABLE 6.2
Project characteristics of I-65 lane widening project in Seymour, IN

Project Title	I-65 added travel lanes and rehabilitation between Columbus and Seymour
Location	Indiana
MOT Strategy	Crews shift traffic onto the right shoulder and build the new travel lane in the median area
Length of Rebuilding	14.25 miles
Daily Traffic	About 30,000
Truck Traffic	30% of Daily Traffic and significantly growing
Scope of Work	Rebuilding I-65 as a 6-lane roadway between US Highway 50 and SR 58 with repair/resurface of I-65 from SR 58 to the SR 46 exit at Columbus
Project Cost	$143 million
Duration	2.5 years, 2018–2020
Reason for Not Choosing Full Closure	Availability of shoulder with enough capacity to accommodate the existing traffic.
MOT Planning	1. Concrete barrier wall 2. Message boards 3. Extra signage 4. Truck traffic restricted to the left lane 5. Work requiring additional lane restrictions being completed at night 6. Increased law enforcement patrols 7. Advance communication of changing traffic patterns and worksite conditions
Problems Encountered and Lessons Learned	1. During construction, several wrecks forced the interstate to be shut down for periods 2. The unusually high amount of rainfall in the Seymour district made it more challenging for crews to carry out tasks in traffic conditions 3. A flexible work schedule is important in accommodating adverse or unexpected conditions

engineers. However, they are included for the demonstration purpose of these steps, as decision-makers may not include county roads for consideration. The potential detour routes and their locations on the map are shown in Figures 6.9 and 6.10.

The duration of the project was 30 months, and the added travel distance along the detours are 3.7 miles and 2.4 miles, respectively (Figure 6.11).

To complete section VI, VII, and VIII of the editable documents, the research team assumed that the pavement condition, bridge status, and load rating, and structure ratings and condition on detours are all "Good." For future projects, INDOT can use existing inspection data of those assets or inspect for more reliable detour evaluation. Section IX is about vertical clearance on the detour. It has been assumed that all detour routes have at least 15-ft. clearance. If there is less than 14-ft. clearance on the detour, INDOT needs to re-evaluate the detour routes. Sections VI, VII, VIII, and IX of the editable document are shown in Figures 6.12 and 6.13.

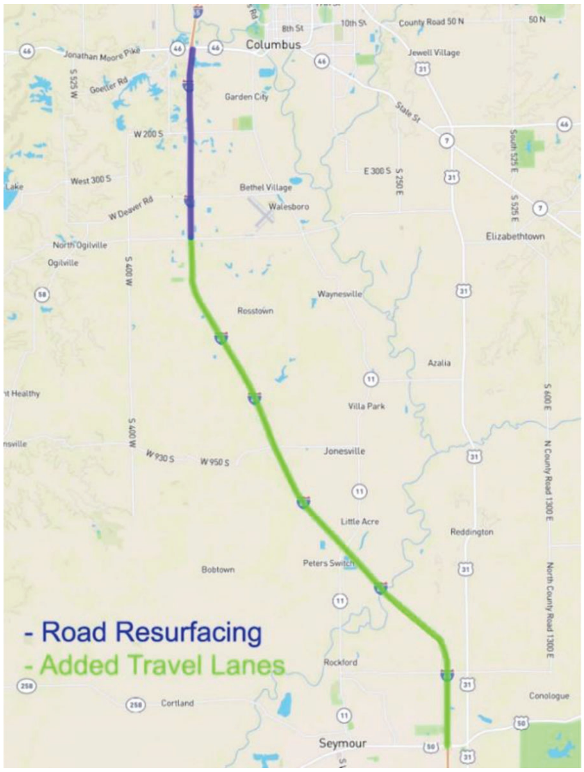
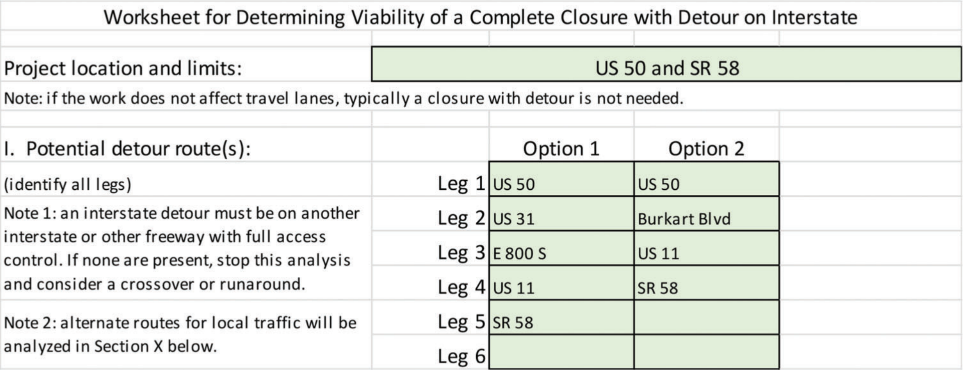


Figure 6.8 I-65 lane widening project map (INDOT: I-65 Added Travel Lanes and Rehabilitation between Columbus and Seymour) (IN.gov, n.d.).

The section X of the editable document consists of multiple parts to evaluate traffic volume capacities. Figure 6.13 and Figure 6.14 present information and data on the traffic volume to capacity ratios of the detour legs to the section X–A has been determined from IDM Figure 503-2A, and the section X–B and the section X–C (Figures 6.15 and 6.16) were determined using the INDOT traffic database (http://indot.ms2soft.com/tcds/tsearch.asp?loc=Indot&mod). Figures 6.15, and 6.16 and 6.18 provide details about sections X-B and X-C, and other considerations.

Section X–D and section X–E represents total traffic volumes on detour legs during construction and the volume-to-capacity during construction with detour legs as is, respectively. The total traffic volumes on detour legs were estimated based on the addition of the displaced traffic volumes from the closed roadway to the existing traffic volumes in the detour leg. For example, the total traffic volume of Option 1 and Leg 1 (which is US 50) is 1,886 because the existing traffic volume of this leg is 1,886 (Figure 6.17), with zero percentage of displaced traffic volumes from the closed road to detour legs.

Figure 6.19 describes the summary of findings for the detour routes. These detour options show similar section results except "Section III Travel Distance" and "Section X Traffic Volume to Capacity." The second option seems to be superior in terms of the detour travel distance, but it has a higher traffic volume to capacity.



Worksheet for Determining Viability of a Complete Closure with Detour on Interstate

Project location and limits:	US 50 and SR 58		
Note: if the work does not affect travel lanes, typically a closure with detour is not needed.			
I. Potential detour route(s):		Option 1	Option 2
(identify all legs)	Leg 1	US 50	US 50
Note 1: an interstate detour must be on another interstate or other freeway with full access control. If none are present, stop this analysis and consider a crossover or runaround.	Leg 2	US 31	Burkart Blvd
	Leg 3	E 800 S	US 11
	Leg 4	US 11	SR 58
Note 2: alternate routes for local traffic will be analyzed in Section X below.	Leg 5	SR 58	
	Leg 6		

Figure 6.9 Potential detour routes for I-65 project in Seymour, IN.

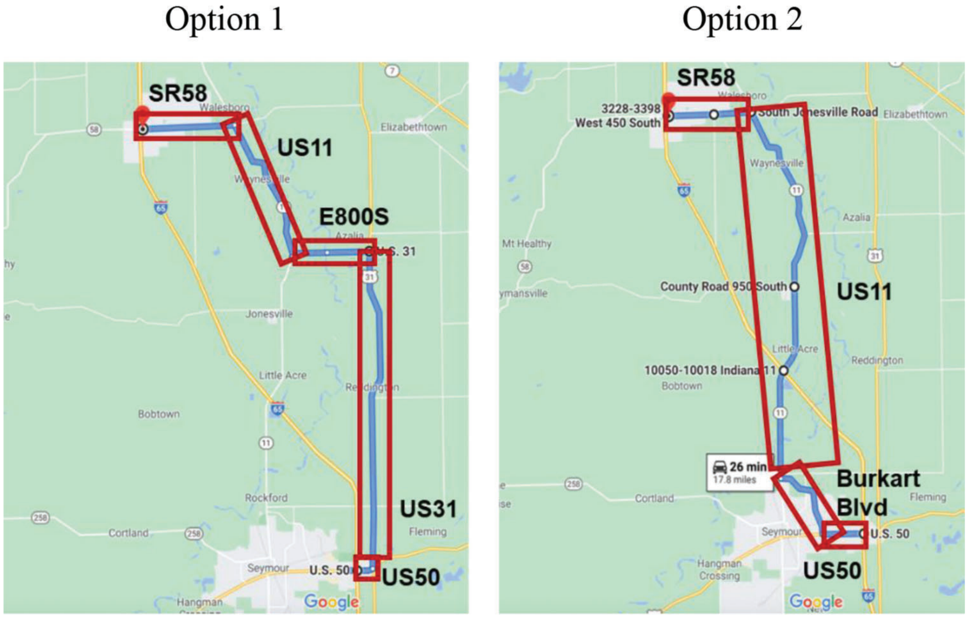
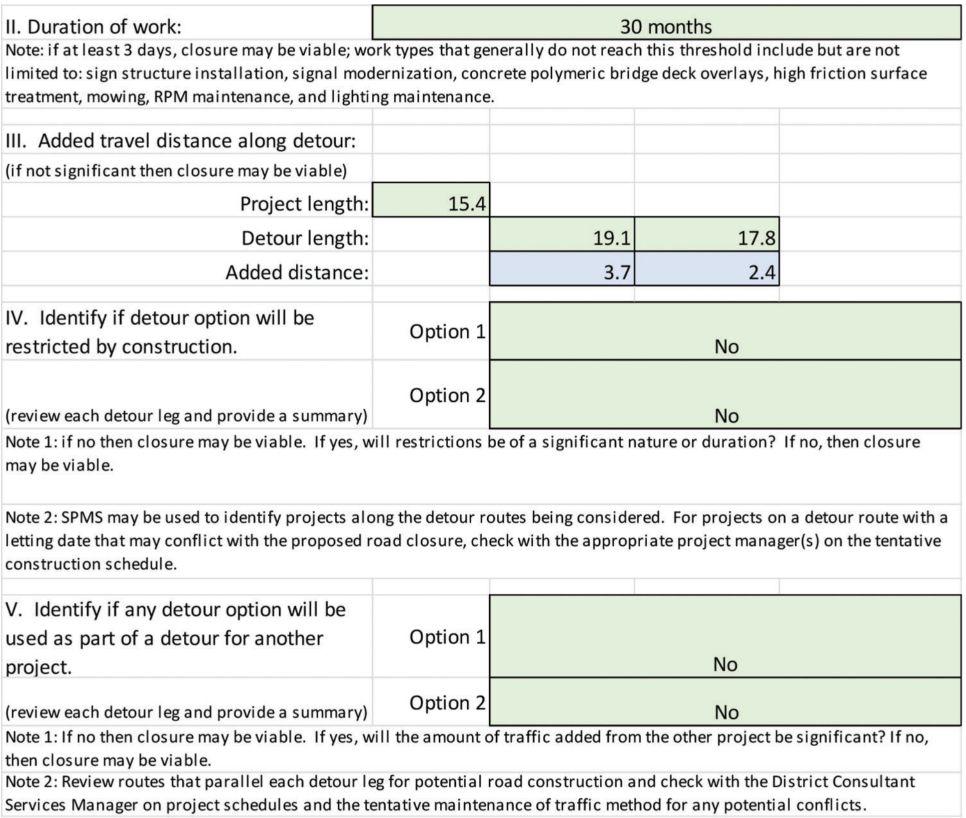


Figure 6.10 Identified detour routes for I-65 project in Seymour, IN.



II. Duration of work: 30 months

Note: if at least 3 days, closure may be viable; work types that generally do not reach this threshold include but are not limited to: sign structure installation, signal modernization, concrete polymeric bridge deck overlays, high friction surface treatment, mowing, RPM maintenance, and lighting maintenance.

III. Added travel distance along detour:

(if not significant then closure may be viable)

Project length:	15.4		
Detour length:		19.1	17.8
Added distance:		3.7	2.4

IV. Identify if detour option will be restricted by construction.

(review each detour leg and provide a summary)

	Option 1	No
	Option 2	No

Note 1: if no then closure may be viable. If yes, will restrictions be of a significant nature or duration? If no, then closure may be viable.

Note 2: SPMS may be used to identify projects along the detour routes being considered. For projects on a detour route with a letting date that may conflict with the proposed road closure, check with the appropriate project manager(s) on the tentative construction schedule.

V. Identify if any detour option will be used as part of a detour for another project.

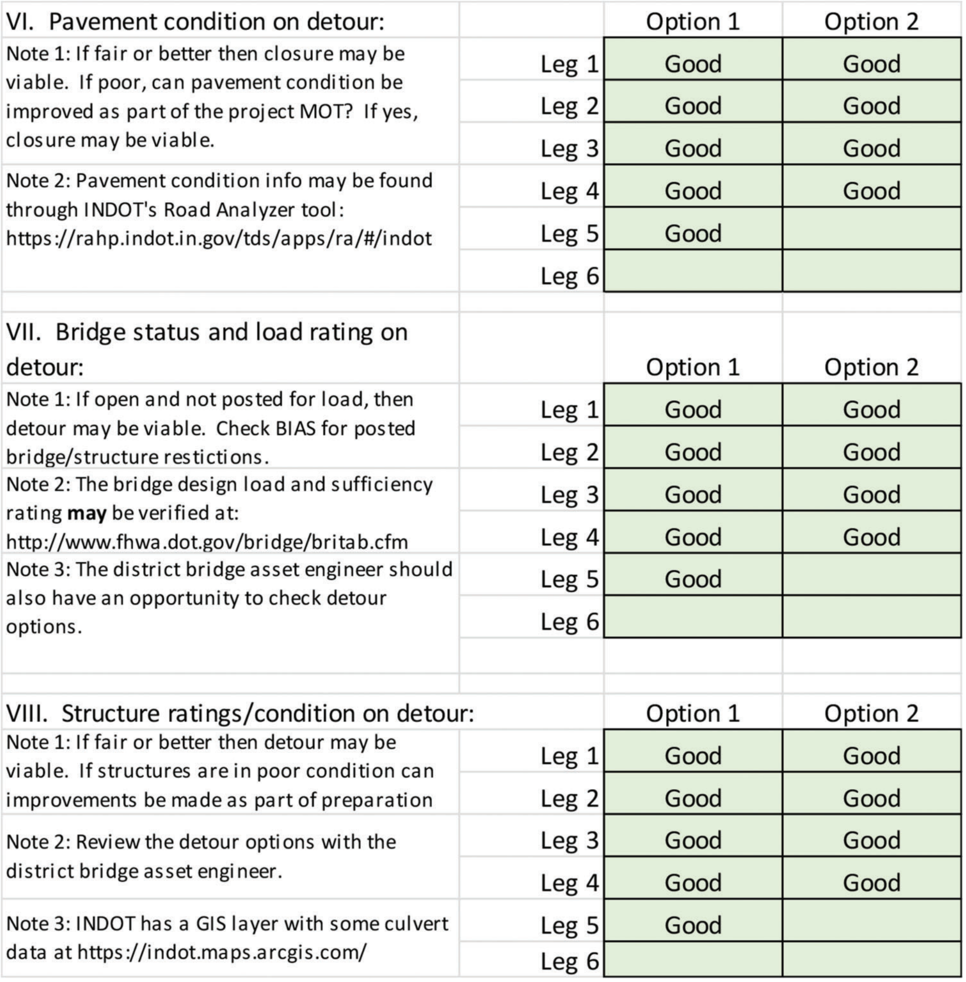
(review each detour leg and provide a summary)

	Option 1	No
	Option 2	No

Note 1: If no then closure may be viable. If yes, will the amount of traffic added from the other project be significant? If no, then closure may be viable.

Note 2: Review routes that parallel each detour leg for potential road construction and check with the District Consultant Services Manager on project schedules and the tentative maintenance of traffic method for any potential conflicts.

Figure 6.11 Duration of work and the added travel distance along with detours.

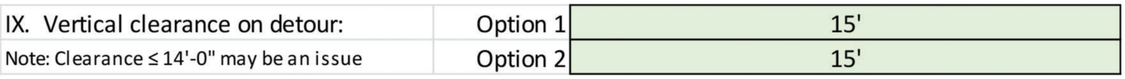


VI. Pavement condition on detour:		Option 1	Option 2
Note 1: If fair or better then closure may be viable. If poor, can pavement condition be improved as part of the project MOT? If yes, closure may be viable.	Leg 1	Good	Good
	Leg 2	Good	Good
	Leg 3	Good	Good
Note 2: Pavement condition info may be found through INDOT's Road Analyzer tool: https://rahp.indot.in.gov/tds/apps/ra/#/indot	Leg 4	Good	Good
	Leg 5	Good	
	Leg 6		

VII. Bridge status and load rating on detour:		Option 1	Option 2
Note 1: If open and not posted for load, then detour may be viable. Check BIAS for posted bridge/structure restictions.	Leg 1	Good	Good
	Leg 2	Good	Good
Note 2: The bridge design load and sufficiency rating **may** be verified at: http://www.fhwa.dot.gov/bridge/britab.cfm	Leg 3	Good	Good
	Leg 4	Good	Good
Note 3: The district bridge asset engineer should also have an opportunity to check detour options.	Leg 5	Good	
	Leg 6		

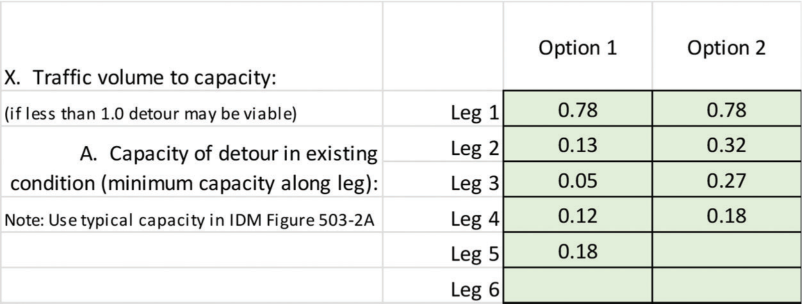
VIII. Structure ratings/condition on detour:		Option 1	Option 2
Note 1: If fair or better then detour may be viable. If structures are in poor condition can improvements be made as part of preparation	Leg 1	Good	Good
	Leg 2	Good	Good
Note 2: Review the detour options with the district bridge asset engineer.	Leg 3	Good	Good
	Leg 4	Good	Good
Note 3: INDOT has a GIS layer with some culvert data at https://indot.maps.arcgis.com/	Leg 5	Good	
	Leg 6		

Figure 6.12 Section VI, VII, and VIII of the editable documents (for pavement condition, bridge status and load rating, and structure ratings).



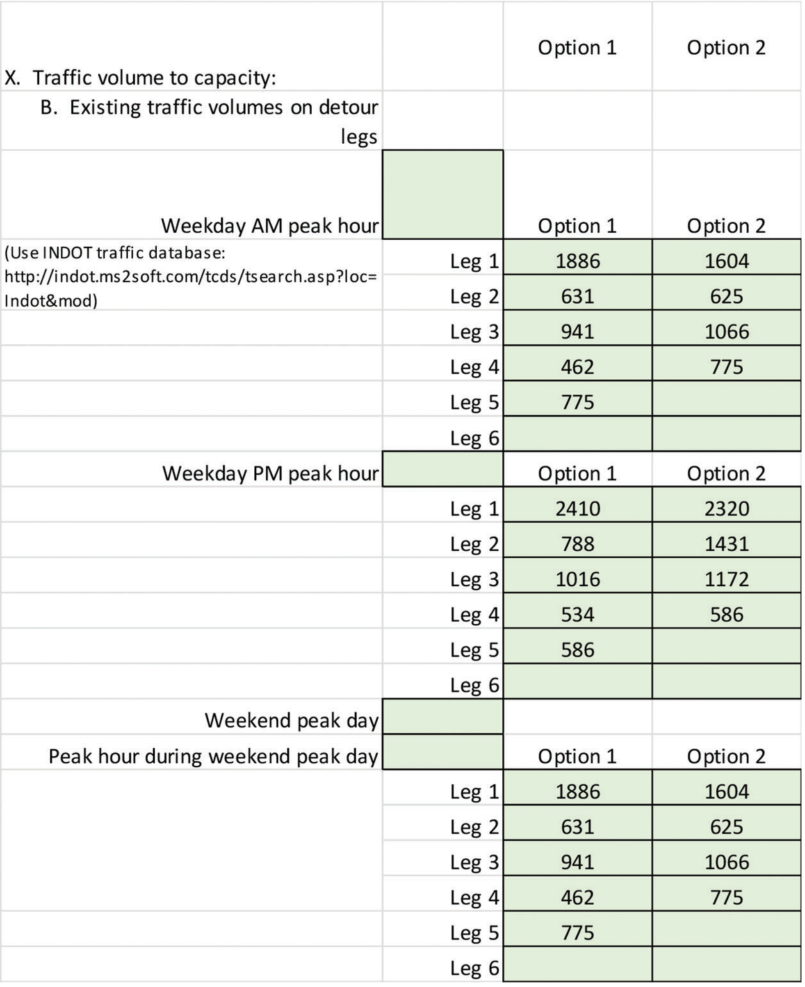
IX. Vertical clearance on detour:	Option 1	15'
Note: Clearance ≤ 14'-0" may be an issue	Option 2	15'

Figure 6.13 Section IX of the editable document (vertical clearance on detour).



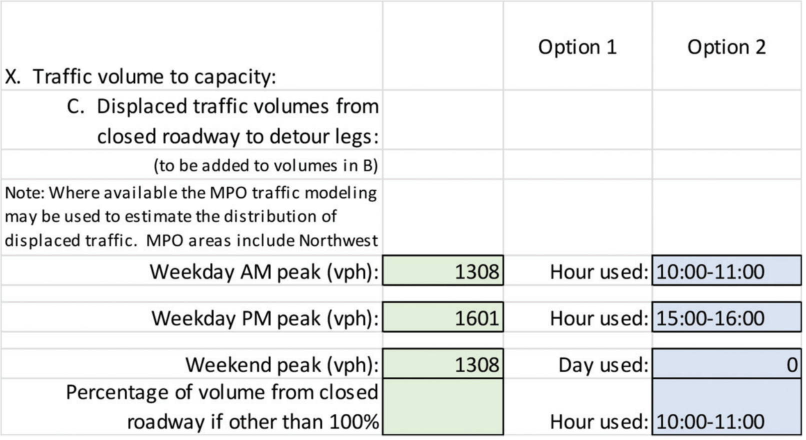
X. Traffic volume to capacity:		Option 1	Option 2
(if less than 1.0 detour may be viable)	Leg 1	0.78	0.78
A. Capacity of detour in existing condition (minimum capacity along leg):	Leg 2	0.13	0.32
	Leg 3	0.05	0.27
Note: Use typical capacity in IDM Figure 503-2A	Leg 4	0.12	0.18
	Leg 5	0.18	
	Leg 6		

Figure 6.14 Section X–A: Capacity of the detour in an existing condition.



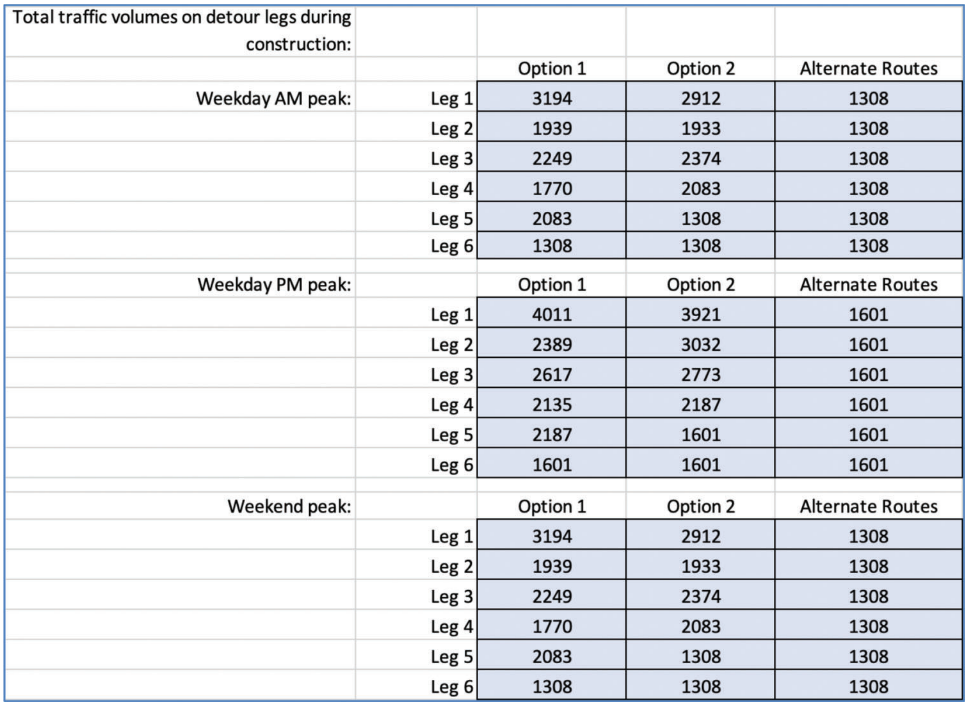
X. Traffic volume to capacity:		Option 1	Option 2
B. Existing traffic volumes on detour legs			
Weekday AM peak hour		Option 1	Option 2
(Use INDOT traffic database: http://indot.ms2soft.com/tcds/tsearch.asp?loc=Indot&mod)	Leg 1	1886	1604
	Leg 2	631	625
	Leg 3	941	1066
	Leg 4	462	775
	Leg 5	775	
	Leg 6		
Weekday PM peak hour		Option 1	Option 2
	Leg 1	2410	2320
	Leg 2	788	1431
	Leg 3	1016	1172
	Leg 4	534	586
	Leg 5	586	
	Leg 6		
Weekend peak day			
Peak hour during weekend peak day		Option 1	Option 2
	Leg 1	1886	1604
	Leg 2	631	625
	Leg 3	941	1066
	Leg 4	462	775
	Leg 5	775	
	Leg 6		

Figure 6.15 Section X–B: Existing traffic volumes on detour legs.



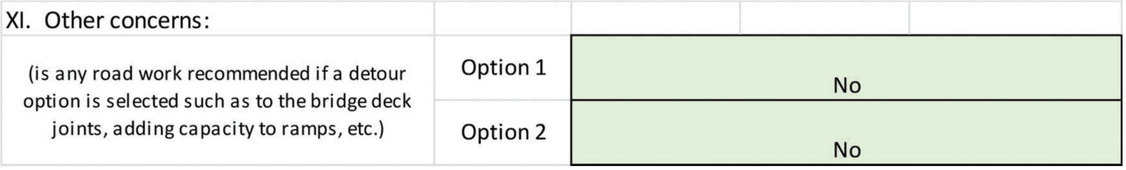
X. Traffic volume to capacity:		Option 1	Option 2
C. Displaced traffic volumes from closed roadway to detour legs:			
(to be added to volumes in B)			
Note: Where available the MPO traffic modeling may be used to estimate the distribution of displaced traffic. MPO areas include Northwest			
Weekday AM peak (vph):	1308	Hour used:	10:00-11:00
Weekday PM peak (vph):	1601	Hour used:	15:00-16:00
Weekend peak (vph):	1308	Day used:	0
Percentage of volume from closed roadway if other than 100%		Hour used:	10:00-11:00

Figure 6.16 Section X–C: Displaced traffic volumes from closed roadway to detour legs.



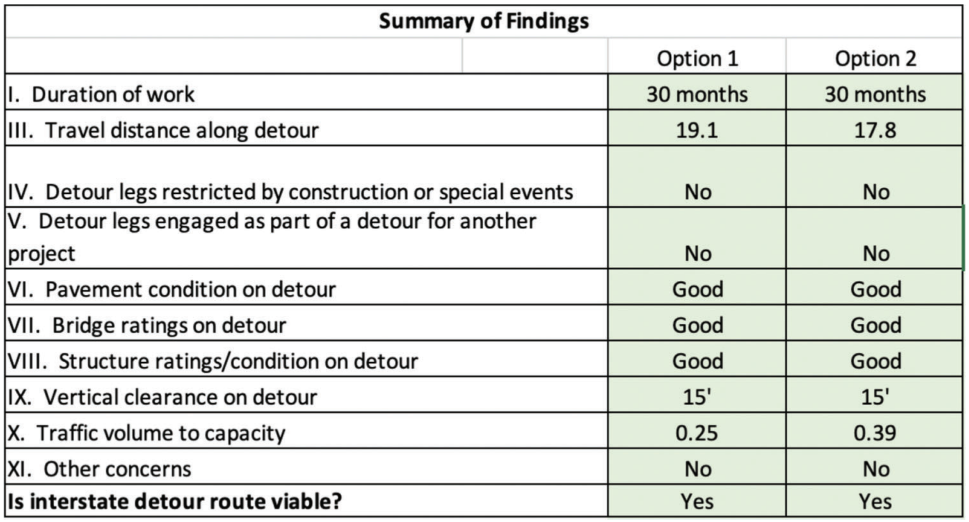
Total traffic volumes on detour legs during construction:				
		Option 1	Option 2	Alternate Routes
Weekday AM peak:	Leg 1	3194	2912	1308
	Leg 2	1939	1933	1308
	Leg 3	2249	2374	1308
	Leg 4	1770	2083	1308
	Leg 5	2083	1308	1308
	Leg 6	1308	1308	1308
Weekday PM peak:		Option 1	Option 2	Alternate Routes
	Leg 1	4011	3921	1601
	Leg 2	2389	3032	1601
	Leg 3	2617	2773	1601
	Leg 4	2135	2187	1601
	Leg 5	2187	1601	1601
	Leg 6	1601	1601	1601
Weekend peak:		Option 1	Option 2	Alternate Routes
	Leg 1	3194	2912	1308
	Leg 2	1939	1933	1308
	Leg 3	2249	2374	1308
	Leg 4	1770	2083	1308
	Leg 5	2083	1308	1308
	Leg 6	1308	1308	1308

Figure 6.17 Section X–D: Total traffic volumes on detour legs during construction.



XI. Other concerns:		
(is any road work recommended if a detour option is selected such as to the bridge deck joints, adding capacity to ramps, etc.)	Option 1	No
	Option 2	No

Figure 6.18 Section XI: Other concerns for the detours.



Summary of Findings		
	Option 1	Option 2
I. Duration of work	30 months	30 months
III. Travel distance along detour	19.1	17.8
IV. Detour legs restricted by construction or special events	No	No
V. Detour legs engaged as part of a detour for another project	No	No
VI. Pavement condition on detour	Good	Good
VII. Bridge ratings on detour	Good	Good
VIII. Structure ratings/condition on detour	Good	Good
IX. Vertical clearance on detour	15'	15'
X. Traffic volume to capacity	0.25	0.39
XI. Other concerns	No	No
Is interstate detour route viable?	Yes	Yes

Figure 6.19 Summary of findings from the editable documents.

CHAPTER 7. CONCLUDING REMARKS

7.1 Summary

The research has highlighted that Transportation Planning Management (TMP) is essential in selecting an MOT strategy for a construction work zone. The TMP consists of a Temporary Traffic Control Plan (TTCP), Transportation Operations Plan (TOP), and Public Information Plan (PIP). TTCP is a requirement for every construction project. In addition, depending on the level of impact (significant or non-significant) of the construction on the public, a Transportation Operations Plan (TOP) and a Public Information Plan (PIP) may be encouraged or required.

The *Indiana Design Manual 2013*, Chapter 503, *2017 Interstate Highway Congestion Policy* and *Indiana Manual on Uniform Traffic Control Devices* (IMUTCD) provide guidelines that must be followed during the planning phase of a construction project to select the best alternative for an MOT strategy.

In selecting an MOT strategy, several KPIs are considered, including the availability of detour routes, user delays, safety of workers and travelers, and others. Road user cost, which can be a direct and indirect cost to the road users, is typically less often considered. Instead, the user delays associated with increased travel time and detour lengths are considered to a greater extent.

The following four case studies were investigated.

1. I-95 in Wilmington, Delaware
2. I-84 Banfield Freeway, Oregon
3. I-65 (Emergency Closure) in Crawfordsville, Indiana
4. I-70 in Indianapolis, Indiana

The data were obtained through interviews with INDOT engineers and literature review of some published journals/reports. The I-65 in Crawfordsville, Indiana construction project was an emergency project, and therefore received relatively little planning for MOT strategy selection. In that project, the essential KPI considered was the availability of a detour route and how traffic can be managed to reduce delays, as the detour was a transition from a two-lane road to a one-lane road.

7.2 Recommendations for Practice

The identified top five KPIs for MOT strategy development are (1) safety, (2) mobility, (3) budget constraint, (4) project duration, and (5) complexity of project sites. These KPIs were identified through the survey questionnaire. The survey questions are attached in Appendix A. Based on these KPIs and other findings presented in Section 4.3.3, this study has proposed a comparison tool for predetermined MOT strategies in the form of a flowchart. This tool is followed by the scores or weights associated with each KPI. These scores are normalized, i.e., the most important KPI, which is safety, has the maximum weight of 1, and the rest of the KPIs are weighed relatively. INDOT has a set of editable documents which are referred to for making MOT decisions. This proposed flow-chart tool will "walk" the INDOT team by using these spreadsheets corresponding to the identified KPIs through this study. It will be at the discretion of the INDOT team to which KPIs are relevant to the situation. Therefore, it is flexible to incorporate the dynamic nature of MOT strategy selection.

One of the survey respondents indicated that his/her DOT had a performance assessment plan in place, i.e., the DOT evaluates the performance of their MOT strategies based on a pre-defined set of KPIs. These KPIs mainly focus on user feedback and can be measured statistically by monitoring the types of road user complaints received corresponding to the MOT strategy. This way, INDOT can not only monitor but also improve their performance. Overall, this report recommends the use of the proposed flow-chart approach and the KPI scores to make a balanced decision regarding the selection of an MOT strategy for a given problem setting.

7.3 Limitations and Recommendation Directions for Future Research

Although this study developed a decision-making tool through quantitative surveys, quantitative measures were not established, and the developed decision-making tool is subjective depending on input from engineers. Additional quantitative analysis is desired to inform decision-makers further. Furthermore, the potential detour route tables are based on the traffic data during the research period. The AADT and potential alternate routes of interstates in rural areas are highly dependent on existing traffic volumes. The tables can be used for quick initial analysis, but additional capacity and site-specific analysis are necessary for further decision-making.

Future work could also investigate the efficacy of a hybrid strategy where trucks use the highway and cars are made to detour onto parallel roads. It is recognized that letting cars (and not trucks) detour may be the best way to use the detour route facilities to ensure minimal user and travel delay. This is because trucks have special needs in terms of lower speeds, lower geometric standards (and therefore, higher costs of requisite upgrades of detour routes), and load restrictions of bridges at detour roads.

REFERENCES LIST

Adams, M. R. (2005, June 23). *Development of a user cost estimation procedure for work zones* [Master's thesis, Brigham Young University]. Scholars Archive. http://hdl.lib.byu.edu/1877/etd860

Antonucci, N. D., Bryden, J. E., Neuman, T. R., Pfefer, R., & Slack, K. (2005). *Guidance for implementation of the AASHTO strategic highway safety plan: A guide for reducing work zone collisions* (NCHRP Report 500: Volume 17). Transportation Research Board.

Bai, Q., Labi, S., Sinha, K. C., & Thompson, P. D. (2013). Bridge user cost estimation–a synthesis of existing methods and addressing the issues of multiple counting, workzones and traffic capacity limitation. *Structure and Infrastructure Engineering*, *9*(9), 849–859.

Batson, R. G., Turner, D. S., Ray, P. S., Wang, M., Wang, P., Fincher R., Lanctot, J., & Cui, Q. (2009). *Work zone lane closure analysis model* (Report No. ALDOT 930-721). University Transportation Center for Alabama. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.947.3283&rep=rep1&type=pdf

Benekohal, R. F., Ramezani, H., & Avrenli, K. (2010). *Queue and user's costs in highway work zones* (Report No. FHWA-ICT-10-075). Illinois Center for Transportation. http://hdl.handle.net/2142/45846

Bham, G. H., & Hicks, J. E. (1999, March). *Work zones and their impact on user costs* (Report No. FHWA-IL-UI-266). Illinois Department of Transportation.

Borchardt, D. W., Pesti, G., Sun, D., & Ding, L. (2009, September). *Capacity and road user cost analysis of selected freeway work zones in Texas* (Report No. FHWA/TX-09/0-5619-1). Texas Department of Transportation. https://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/0-5619-1.pdf

Carrick, G., Heaslip, K., Srinivasan, S., & Zhu, X. (2008). A case study in spatial misclassification of work zone crashes. *Proceedings of the 88th Transportation Research Board Annual Meeting*. https://digitalcommons.usu.edu/cee_facpub/250/

Gallo, A. A., Dougald, L. E., & Demetsky, M. J. (2012). Effectiveness of a control strategy for forced-detour traffic in continuous lane closure within a rural work zone. *Transportation Research Record: Journal of the Transportation Research Board*, *2272*(1), 19–26.

INDOT. (2013). *Indiana design manual 2013* [Webpage]. Indiana Department of Transportation. Retrieved September 9, 2021, from https://www.in.gov/dot/div/contracts/design/IDM.htm

IN.gov. (n.d.). *Interstate highways congestion policy* [Webpage]. Indiana Department of Transportation. https://secure.in.gov/indot/safety/work-zone-safety/interstate-highways-congestion-policy/

IN.gov. (n.d.). *I-65 Southeast Indiana Project* [Webpage]. Indiana Department of Transportation. https://www.in.gov/indot/about-indot/central-office/welcome-to-the-seymour-district/i-65-southeast-indiana-project/

Jiang, X., & Adeli, H. (2003). Freeway work zone traffic delay and cost optimization model. *Journal of Transportation Engineering*, *129*(3), 230–241.

Mallela, J., & Sadasivam, S. (2011, December). *Work Zone road user costs–Concepts and applications* (Report No. FHWA-HOP-12-005). Federal Highway Administration. https://rgpc.com/wp-content/uploads/2018/10/FR-CRS-18-004-10.pdf

McNamara, M., Li, H., Remias, S., Richardson, L., Cox, E., Horton, D., & Bullock, D. M. (2015). Using real-time probe vehicle data to manage unplanned detour routes. *ITE Journal*, *85*, 32–37.

Nemeth, Z. A., & Rouphail, N. M. (1983). Traffic control at freeway work sites. *Journal of Transportation and Pipeline Engineering*, *109*(1), 1–15. American Society of Civil Engineers.

Ozbay, K., & Bartin, B. (2008, September). *Development of uniform standards for allowable lane closure* (Report No. FHWA-NJ-2008-014). New Jersey Department of Transportation. https://cait.rutgers.edu/wp-content/uploads/2018/05/fhwa-nj-2008-014.pdf

Qiao, Y., Fricker, J. D., & Labi, S. (2019). Influence of project bundling on maintenance of traffic (MOT) costs across highway project types. *Journal of Construction Engineering and Management*, *145*(8), 05019010.

Schneider, H., Hutchinson, C., & Pfetzer, E. (2019, August). *Highway construction work zone safety performance and improvement in Louisiana* (Report No. FHWA/LA.18/606). Louisiana Transportation Research Center. https://www.ltrc.lsu.edu/pdf/2019/FR_606.pdf

Sinha, K. C., McCullouch, B. G., Bullock, D. M., Konduri, S., Fricker, J. D., & Labi, S. (2004). *Evaluation of INDOT hyperfix project* (Joint Transportation Research Program Publication No. FHWA/IN/JTRP-2004/02). West Lafayette, IN: Purdue University. https://doi.org/10.5703/1288284313209

Yang, H., Ozbay, K., Ozturk, O., & Xie, K. (2015). Work zone safety analysis and modeling: A state-of-the-art review. *Traffic Injury Prevention*, *16*(4), 387–396. https://doi.org/10.1080/15389588.2014.948615

Yang, N., Schonfeld, P., & Kang, M. W. (2009). A hybrid methodology for freeway work-zone optimization with time constraints. *Public Works Management & Policy*, *13*(3), 253–264.

APPENDICES

Appendix A. Survey Questions

Appendix B. Telephone Interview

Appendix C. Capacity Analysis and Site-Specific Notes of Potential Detour Routes of Interstates in Rural Areas

Appendix D. INDOT Editable Documents: Detour Worksheet (Interstate)

APPENDIX A. SURVEY QUESTIONS

Please enter the relevant information.

○ Name of your State DOT (3)

____

○ Your Role / Designation (2)

____

Q1 Has your agency performed a project which closed **ONE OR BOTH DIRECTIONS** of **INTERSTATE** highway in **RURAL AREA**? Please use the textbox to fill in any available details of the project.

○ YES, performed interstate highway project(s) in RURAL area (1)

____

○ NO, but performed interstate highway project(s) in URBAN area (2)

____

○ NO, never had any projects that required closure of interstate highways (3)

○ NO, full lane closure was not feasible for our Interstate projects (5)

Q2 Why was not a full closure (either one or two directions) feasible to your State agency? Select all that apply.

☐ It is not feasible to manage the business impacts (e.g., trucking industries), accessibility issues involved in a full closure approach (1)

☐ It is expensive to prepare a detour route to accommodate diverted traffic

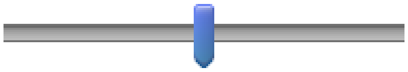
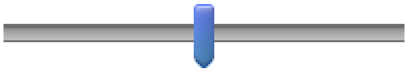
☐ We did not have any appropriate detour alternatives for our projects (3)

☐ Our idea of full closure was opposed by the local communities and organizations (4)

☐ We do not have a framework to assess the benefits or shortcomings of a full road closure MOT strategy (6)

☐ Other comments (5)

Q3 If you are deciding MOT strategies for an Interstate highway maintenance project, what would you prefer among the below scenarios, given that you can readily implement Crossover as well as Full/One direction closure for all the scenarios. You can mention the reason behind you selection in the textbox.

	Crossover preferred 1	2	Equal preference 3	4	Full/One direction closure with detour preferred 5
Interstate project in Urban area ()					
Interstate project in Rural area ()					

Q4 Following are the typically observed problems/hazards associated with implementation of crossover design as a MOT Strategy for Interstate highway projects.

If your DOT decides to implement full/one lane closure instead of crossover, which of the following problems, you believe, can be minimized? Select all that apply.

☐ Costs associated with the MOT plans (e.g., construction of temporary lanes, traffic control devices—signs, markings, signals) (1)

☐ Potential accident risk to road users (e.g., accidents due to shifting lanes, change in speeds) (3)

☐ Safety concerns raised by contractor (e.g., vehicles passing close-by) (4)

☐ Longer durations of project (e.g., full lane closure may allow lesser duration) (5)

☐ Impact to the local business in the vicinity of the project (6)

☐ Compromised quality of the project due to hindrances caused by crossovers (7)

☐ Any technical constraints associated with crossovers (8)

Additional comments (9)

Q5 If your DOT decides to implement full/one lane closure with detour route, what is the agency prescribed acceptable tolerance level for induced detour time?

Tolerance level: The range up to which the increase in the detour time can be deemed as tolerable by your agency, considering the corresponding increase in road user cost, etc.

○ Less than 10% (1)

○ 10%–20% (2)

○ 20%–30% (3)

○ 30% + (4)

○ The agency does not have a prescribed tolerance level (5)

Q6 What work zone software applications or spreadsheet tools does your State DOT use to analyze/simulate the traffic condition for a MOT strategy? Select all that apply.

☐ QuickZone or QuickZone 2.1 software (1)

☐ TransEval (by Eastern Washington Council of Governments') (2)

☐ CORSIM (9)

☐ VisSim (7)

☐ Synchro (8)

☐ Customized software/spreadsheet to suit the agency's needs (4)

☐ Agency does not use any such tool (5)

☐ Other (6) ____

Q7 When your DOT decides MOT strategies for Interstate highway projects (e.g., full/one lane closure or crossovers), what level of importance do you assign to the predetermined KPIs below? Use the textbox to mention any additional comments, if any.

	Not considered at all	Least important	Less important	Moderate	More important	Most important
☐						
	0	1	2	3	4	5
☐						

Safety ()	
Complexity of work zone layout and net available area ()	
Budget constraint (e.g., project cost including MOT costs) ()	
Additional travel time/delay caused by MOT strategy ()	
Potential increase/decrease in project duration with respect to MOT strategy ()	
Daily road user cost (e.g., extra fuel cost, miles traveled and delay) ()	
Mobility (e.g., free-flow corridor to detour route) ()	
Community opinions with selected MOT strategy ()	
Contractor's opinions (e.g., worker safety concerns, equipment logistics, site layout) ()	
Reliability on contractor's work performance, ability and/or quality ()	
Whether or not local roads are a part of the MOT strategy (e.g., roads under same jurisdiction) ()	

Q8 When your DOT decides MOT strategies for Interstate highway projects in **particularly RURAL area (e.g., less available Interstate detour options and/or parallel corridors)**, what level of importance would you differently assign to the KPIs which were viewed in the previous question? Use the textbox to mention any additional comments, if any.

Not considered at all	Least important	Less important	Moderate	More important	Most important
0	1	2	3	4	5

Safety ()	
Complexity of work zone layout and net available area ()	
Budget constraint (e.g., project cost including MOT costs) ()	
Additional travel time/delay caused by MOT strategy ()	
Potential increase/decrease in project duration with respect to MOT strategy ()	
Daily road user cost (e.g., extra fuel cost, miles traveled and delay) ()	
Mobility (e.g., free-flow corridor to detour route) ()	
Community opinions with selected MOT strategy ()	
Contractor's opinions (e.g., worker safety concerns, equipment logistics, site layout) ()	
Reliability on contractor's work performance, ability and/or quality ()	
Whether or not local roads are a part of the MOT strategy (e.g., roads under same jurisdiction) ()	

Q9 When your DOT develops a detour route in **RURAL** areas for full/one lane closure project of interstate, how important is it to collaborate/cooperate with the following **stakeholders/entities** if they are in the vicinity of the potential detour route? Use the textbox to mention additional comments, if any.

Not considered at all	Least important	Less important	Moderate	More important	Most important
0	1	2	3	4	5

Law enforcement agency (e.g., police, sheriff and state troopers) ()	
Emergency service providers (e.g., hospitals, fire department) ()	
Schools ()	
Local communities/residents ()	
Local businesses (e.g., manufacturers, agriculture and farm industries) ()	
Airport authority ()	
Trucking firms/ logistics companies ()	
Tourism bureau and travel agents ()	
Contractors working on ongoing projects nearby ()	
Additional stakeholder you feel should be considered ()	

APPENDIX B. TELEPHONE INTERVIEW

Part I: General Questions

1. What are the main Key Performance Indicators (KPIs) considered for MOT strategies of interstate closing projects? Can you rank them based on importance?

   [Identified KPIs]

   1. Safety of road users and construction workers
   2. Net available area and complexity of work zone
   3. Overall project cost (including expense in maintaining selected detour option)
   4. Additional travel time/delay caused by the detour strategy
   5. Duration of the project with respect to alternate strategies
   6. Road user cost (in terms of excess fuel burnt, miles travelled and lost time)
   7. Mobility
   8. Accessibility to essential services
   9. Public sentiment with type of detour (e.g., crossover design vs. full lane closure)
   10. Number of local businesses affected by the MOT strategy
   11. Number of concerns raised by the contractor to enhance workers safety
   12. Others
2. What other documents apart from the *Indiana Design Manual* Chapter 503 and the *2017 Interstate Highway Congestion Policy* are used in selecting a MOT strategy?
3. What amount (threshold) of AADT is considered as critical for performing a “full road closure” in the construction zone?
4. What factors do you consider in selecting a detour route?
5. How do you predict the maximum tolerable detour time for road users prior to the “full road closure” in your agency?
6. What factors do you consider in selecting a MOT strategy?
7. If you compare the importance of construction and user costs, from 0−10, how will you rate each of them?

Part II: Questions on I-70 Projects

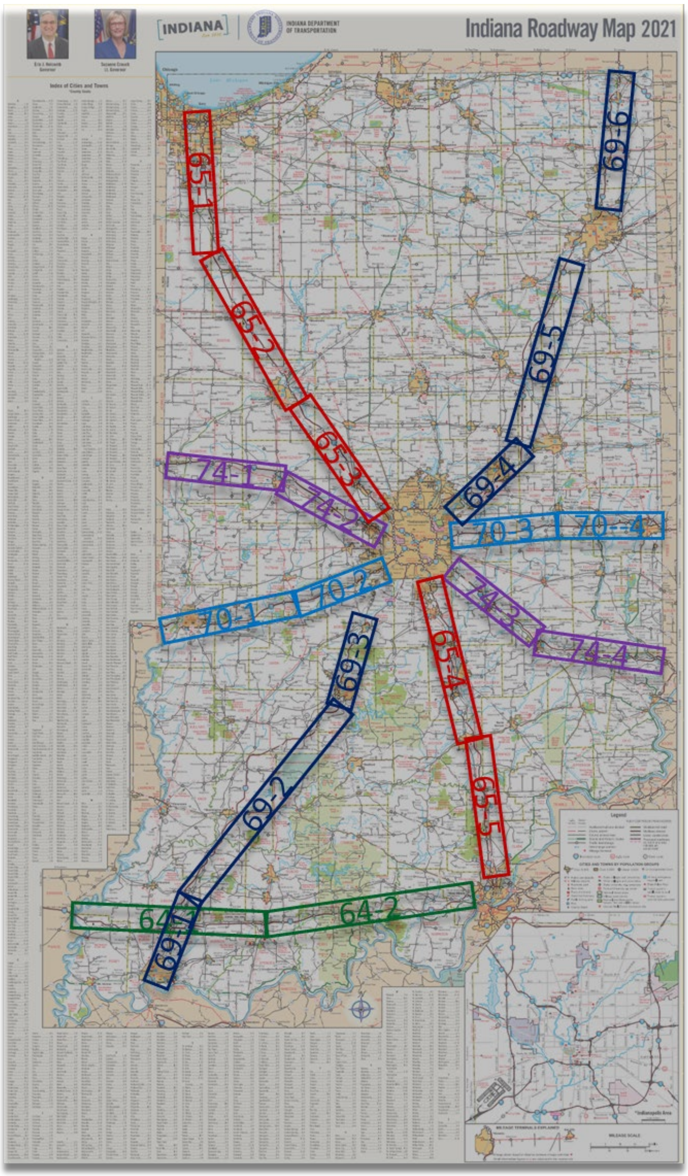
1. Comparison rural vs urban setting
    1. Considering projects (1, 2), which MOT strategies were implemented for each of the road closures? Why?
    2. Considering projects (3, 4), which MOT strategies were implemented for each of the road closures? Why?
    3. What criteria is effective in defining a detour route in an urban and a rural road closure, and why?
    4. What MOT strategies is effective in a rural road closure, and why?
2. Comparison full closure vs partial
    1. Considering projects (1, 2), what are the main factors that affect INDOT decision about the implementation of full closure?
    2. Considering projects (3, 4), what are the main factors that affect INDOT decision about the implementation of partial closure?

3. Based on the traffic data (if available), do drivers follow the suggested detour options provided by INDOT or prefer to find their own travel path?
4. What were the benefits gained from the use of full road closure in 2019? (if any) / What about partial closure?
5. What are the challenges faced during the use of full/partial road closure in 2019? / What about partial closure?
6. Overall, would you say the full road closure in 2019 was successful?

Part III: Comparison closure vs crossover

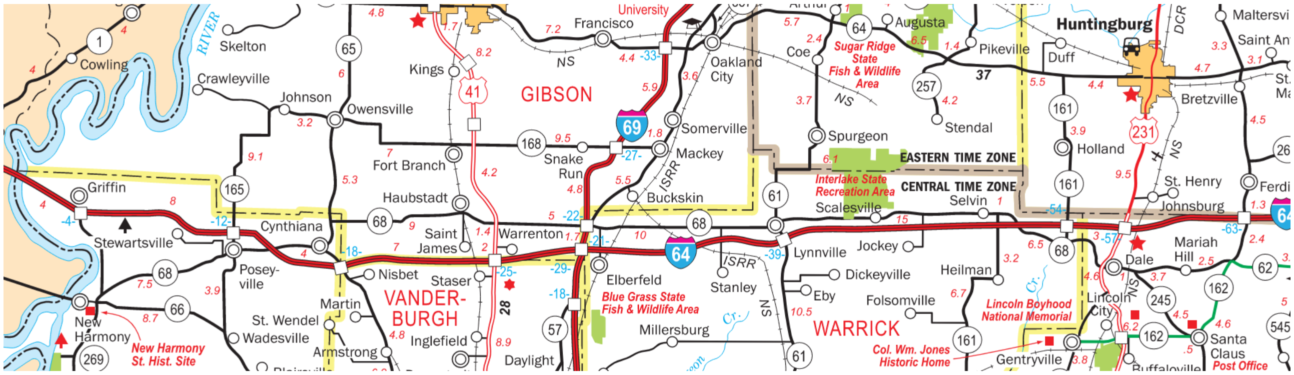
1. Is crossover's effectiveness the same in rural and urban areas?
2. Based on your experience, what is the most practical traffic management strategy in road construction among (full closure/partial closure/crossover) projects? What other options are available?
3. Based on your experience, what is people's preference among closure and crossover?

APPENDIX C. CAPACITY ANALYSIS AND SITE-SPECIFIC NOTES OF POTENTIAL DETOUR ROUTES OF INTERSTATES IN RURAL AREAS



		Direction	From	To	# of Ramps in the section including on/off ramps
I-64	Section 1	West to East	IL State Border	Dubois County (SR162 on/off ramp)	9
I-64	Section 2	West to East	Dubois County (SR162 on/off ramp)	New Albany County (I-265 junction)	9
I-65	Section 1	North to South	Lake County (I-90 junction)	Jasper County (SR14 on/off ramp)	9
I-65	Section 2	North to South	Jasper County (SR14 on/off ramp)	Tippicanoe County (SR38 on/off ramp)	10
I-65	Section 3	North to South	Tippicanoe County (SR38 on/off ramp)	Indianapolis (I-465 junction)	9
I-65	Section 4	North to South	Marion County Border	Jackson County (US50 on/off ramp)	10
I-65	Section 5	North to South	Jackson County (US50 on/off ramp)	New Albany County (I-265 junction)	9
I-69	Section 1	South to North	KY State Border	Gibson County (SR68 on/off ramp)	10
I-69	Section 2	South to North	Gibson County (I-64 on/off ramp)	Monroe County (SR37 on/off ramp)	10
I-69	Section 3	South to North	Monroe County (SR37 on/off ramp)	Morgan County (SR39 on/off ramp)	10
I-69	Section 4	South to North	Marion County Border	Delaware County (SR32 on/off ramp)	9
I-69	Section 5	South to North	Delaware County (SR32 on/off ramp)	Allen County (I469 junction)	9
I-69	Section 6	South to North	Allen County (I469 junction)	MI State Border	11
I-70	Section 1	West to East	IL State Border	Putnam County (US231 on/off ramp)	7
I-70	Section 2	West to East	Putnam County (US231 on/off ramp)	Marion County Border	5
I-70	Section 3	West to East	Marion County Border	Wayne County (SR1 on/off ramp)	6
I-70	Section 4	West to East	Wayne County (SR1 on/off ramp)	Putnam County (US231 on/off ramp)	6
I-74	Section 1	West to East	IL State Border	Montgomery County (SR32 on/off ramp)	6
I-74	Section 2	West to East	Montgomery County (SR32 on/off ramp)	Marion County Border	6
I-74	Section 3	West to East	Marion County Border	Decatur County (US421 on/off ramp)	8
I-74	Section 4	West to East	Decatur County (US421 on/off ramp)	OH State Border	7

I-64-Section 1



Detour Route Table

West Bound		Re-enter to Interstate from								
		SR162	US231	SR161	SR61	I69	US41	SR 65	SR165	SR69
Exit to	SR162		(1) SR 162 - SR 68 - US 231	(2) SR 162 - SR 68 - SR 161	(3) SR 162 - SR 68 - SR 61	(4) SR 162 - SR 68 - I 69	(5) SR 162 - SR 68 - US 41	(6) SR 162 - SR 68 - SR 65	(7) SR 162 - SR 68 - SR 165	(8) SR 162 - SR 68 - SR 69
	US231			(9) US 231 - SR 68 - SR 161	(10) US 231 - SR 68 - SR 61	(11) US 231 - SR 68 - I 69	(12) US 231 - SR 68 - US 41	(13) US 231 - SR 68 - SR 65	(14) US 231 - SR 68 - SR 165	(15) US 231 - SR 68 - SR 69
	SR161				(16) SR 161 - SR 68 - SR 61	(17) SR 161 - SR 68 - I 69	(18) SR 161 - SR 68 - US 41	(19) SR 161 - SR 68 - SR 65	(20) SR 161 - SR 68 - SR 165	(21) SR 161 - SR 68 - SR 69
	SR61					(22) SR 61 - SR 68 - I 69	(23) SR 61 - SR 68 - US 41	(24) SR 61 - SR 68 - SR 65	(25) SR 61 - SR 68 - SR 165	(26) SR 61 - SR 68 - SR 69
	I69						(27) I 69 - SR 68 US 41	(28) I 69 - SR 68 SR 65	(29) I 69 - SR 68 SR 165	(30) I 69 - SR 68 SR 69
	US41							(31) SR 65 - SR 68 - SR 65	(32) US 41 - SR 68 - SR 165	(33) US 41 - SR 68 - SR 69
	SR65								(34) SR 65 - SR 68 - SR 165	(35) SR 65 - SR 68 - SR 69
	SR165									(36) SR 165 - SR 68 - SR 69
	SR69									

Detour Route Table

East Bound		Re-enter to Interstate from								
		SR69	SR165	SR65	US41	I69	SR61	SR161	US231	SR162
Exit to	SR69		(1) SR 69 - SR - 68 - SR 165	(2) SR 69 - SR 68 - SR 65	(3) SR 69 - SR 68 - US 41	(4) SR 69 - SR 68 - I 69	(5) SR 69 - SR 68 - SR 61	(6) SR 69 - SR 68 - SR 161	(7) SR 69 - SR 68 - US 231	(8) SR 69 - SR 68 - SR 162
	SR165			(9) SR 165 - SR 68 - SR 65	(10) SR 165 - SR 68 - US 41	(11) SR 165 - SR 68 - I 69	(12) SR 165 - SR 68 - SR 61	(13) SR 165 - SR 68 - SR 161	(14) SR 165 - SR 68 - US 231	(15) SR 165 - SR 68 - SR 162
	SR65				(16) SR 65 - SR 68 - US 41	(17) SR 65 - SR 68 - I 69	(18) SR 65 - SR 68 - SR 61	(19) SR 65 - SR 68 - SR 161	(20) SR 65 - SR 68 - US 231	(21) SR 65 - SR 68 - SR 162
	US41					(22) US 41 - SR 68 - I 69	(23) US 41 - SR 68 - SR 61	(24) US 41 - SR 68 - SR 161	(25) US 41 - SR 68 - US 231	(26) US 41 - SR 68 - SR 162
	I69						(27) I 69 - SR 68 SR 61	(28) I 69 - SR 68 SR 161	(29) I 69 - SR 68 US 231	(30) I 69 - SR 68 SR 162
	SR61							(31) SR 61 - SR 68 - SR 161	(32) SR 61 - SR 68 - US 231	(33) SR 61 - SR 68 - SR 162
	SR161								(34) SR 161 - SR 68 - US 231	(35) SR 161 - SR 68 - SR 162
	US231									(36) US 231 - SR 68 - SR 162
	SR162									

AADT	8275

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Adding Miles and Time	Site-specific Notes
(1) SR 162 - SR 68 - US 231	2743	1	459	800	1275	1750	0.57	0.36	0.26		#DIV/0!		
(2) SR 162 - SR 68 - SR 161	665	1	373	800	1275	1750	0.47	0.29	0.21		#DIV/0!		
(3) SR 162 - SR 68 - SR 61	1162	1	393	800	1275	1750	0.49	0.31	0.22		#DIV/0!		
(4) SR 162 - SR 68 - I 69	1022	1	387	800	1275	1750	0.48	0.30	0.22		#DIV/0!		
(5) SR 162 - SR 68 - US 41	2471	1	448	800	1275	1750	0.56	0.35	0.26		#DIV/0!		
(6) SR 162 - SR 68 - SR 65	942	1	384	800	1275	1750	0.48	0.30	0.22		#DIV/0!		residential area Sharp turns
(7) SR 162 - SR 68 - SR 165	1571	1	410	800	1275	1750	0.51	0.32	0.23		#DIV/0!		Poseyville - School
(8) SR 162 - SR 68 - SR 69	1689	1	415	800	1275	1750	0.52	0.33	0.24		#DIV/0!		
(9) US 231 - SR 68 - SR 161	665	1	373	800	1275	1750	0.47	0.29	0.21		#DIV/0!		Sharp turns
(10) US 231 - SR 68 - SR 61	1162	1	393	800	1275	1750	0.49	0.31	0.22		#DIV/0!		
(11) US 231 - SR 68 - I 69	1022	1	387	800	1275	1750	0.48	0.30	0.22		#DIV/0!		
(12) US 231 - SR 68 - US 41	2471	1	448	800	1275	1750	0.56	0.35	0.26		#DIV/0!		
(13) US 231 - SR 68 - SR 65	942	1	384	800	1275	1750	0.48	0.30	0.22		#DIV/0!		residential area Sharp turns
(14) US 231 - SR 68 - SR 165	1571	1	410	800	1275	1750	0.51	0.32	0.23		#DIV/0!		Poseyville - School
(15) US 231 - SR 68 - SR 69	1689	1	415	800	1275	1750	0.52	0.33	0.24		#DIV/0!		
(16) SR 161 - SR 68 - SR 61	1162	1	393	800	1275	1750	0.49	0.31	0.22		#DIV/0!		Sharp turns
(17) SR 161 - SR 68 - I 69	1022	1	387	800	1275	1750	0.48	0.30	0.22		#DIV/0!		Sharp turns
(18) SR 161 - SR 68 - US 41	2471	1	448	800	1275	1750	0.56	0.35	0.26		#DIV/0!		Sharp turns
(19) SR 161 - SR 68 - SR 65	942	1	384	800	1275	1750	0.48	0.30	0.22		#DIV/0!		residential area Sharp turns
(20) SR 161 - SR 68 - SR 165	1571	1	410	800	1275	1750	0.51	0.32	0.23		#DIV/0!		Poseyville - School
(21) SR 161 - SR 68 - SR 69	1689	1	415	800	1275	1750	0.52	0.33	0.24		#DIV/0!		Sharp turns
(22) SR 61 - SR 68 - I 69	1022	1	387	800	1275	1750	0.48	0.30	0.22		#DIV/0!		
(23) SR 61 - SR 68 - US 41	2471	1	448	800	1275	1750	0.56	0.35	0.26		#DIV/0!		
(24) SR 61 - SR 68 - SR 65	942	1	384	800	1275	1750	0.48	0.30	0.22		#DIV/0!		residential area Sharp turns
(25) SR 61 - SR 68 - SR 165	1571	1	410	800	1275	1750	0.51	0.32	0.23		#DIV/0!		Poseyville - School
(26) SR 61 - SR 68 - SR 69	1689	1	415	800	1275	1750	0.52	0.33	0.24		#DIV/0!		
(27) I 69 - SR 68 - US 41	2471	1	448	800	1275	1750	0.56	0.35	0.26		#DIV/0!		
(28) I 69 - SR 68 - SR 65	942	1	384	800	1275	1750	0.48	0.30	0.22		#DIV/0!		residential area Sharp turns
(29) I 69 - SR 68 - SR 165	1571	1	410	800	1275	1750	0.51	0.32	0.23		#DIV/0!		Poseyville - School
(30) I 69 - SR 68 - SR 69	1689	1	415	800	1275	1750	0.52	0.33	0.24		#DIV/0!		
(31) US 41 - SR 68 - SR 65	942	1	384	800	1275	1750	0.48	0.30	0.22		#DIV/0!		residential area Sharp turns
(32) US 41 - SR 68 - SR 165	1571	1	410	800	1275	1750	0.51	0.32	0.23		#DIV/0!		Poseyville - School
(33) US 41 - SR 68 - SR 69	1689	1	415	800	1275	1750	0.52	0.33	0.24		#DIV/0!		
(34) SR 65 - SR 68 - SR 165	1571	1	410	800	1275	1750	0.51	0.32	0.23		#DIV/0!		Poseyville - School
(35) SR 65 - SR 68 - SR 69	1689	1	415	800	1275	1750	0.52	0.33	0.24		#DIV/0!		
(36) SR 165 - SR 68 - SR 69	1689	1	415	800	1275	1750	0.52	0.33	0.24		#DIV/0!		

🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

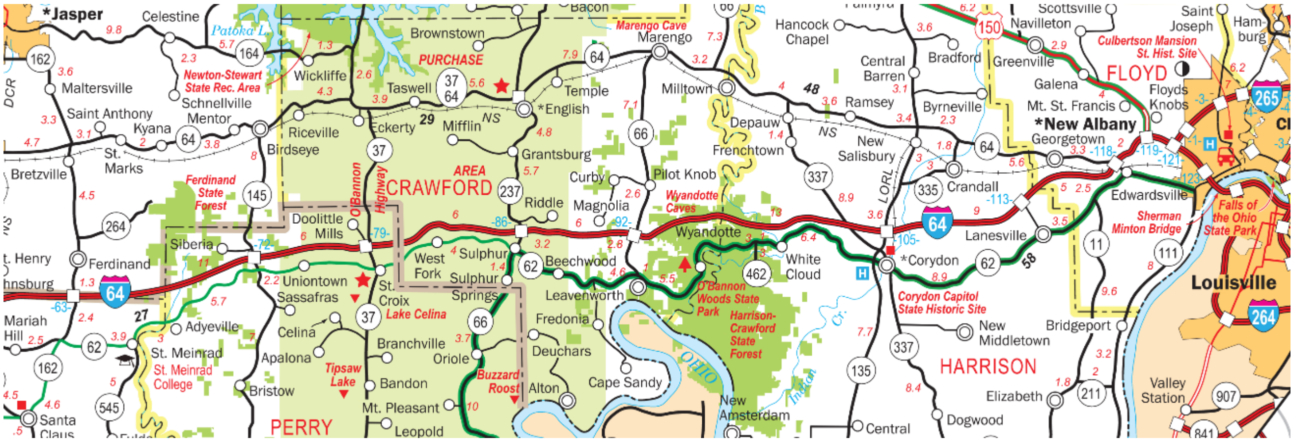
AADT	

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Adding Miles and Time	Site-specific Notes
(1) SR 69 - SR - 68 - SR 165	1689	1	415	800	1275	1750	0.52	0.33	0.24		#DIV/0!		residential community
(2) SR 69 - SR 68 - SR 65	1689	1	415	800	1275	1750	0.52	0.33	0.24		#DIV/0!		residential community
(3) SR 69 - SR 68 - US 41	1689	1	415	800	1275	1750	0.52	0.33	0.24		#DIV/0!		
(4) SR 69 - SR 68 - I 69	1689	1	415	800	1275	1750	0.52	0.33	0.24		#DIV/0!		
(5) SR 69 - SR 68 - SR 61	1689	1	415	800	1275	1750	0.52	0.33	0.24		#DIV/0!		
(6) SR 69 - SR 68 - SR 161	1689	1	415	800	1275	1750	0.52	0.33	0.24		#DIV/0!		
(7) SR 69 - SR 68 - US 231	1689	1	415	800	1275	1750	0.52	0.33	0.24		#DIV/0!		
(8) SR 69 - SR 68 - SR 162	1689	1	415	800	1275	1750	0.52	0.33	0.24		#DIV/0!		
(9) SR 165 - SR 68 - SR 65	1571	1	410	800	1275	1750	0.51	0.32	0.23		#DIV/0!		residential community
(10) SR 165 - SR 68 - US 41	942	1	384	800	1275	1750	0.48	0.30	0.22		#DIV/0!		residential community
(11) SR 165 - SR 68 - I 69	2471	1	448	800	1275	1750	0.56	0.35	0.26		#DIV/0!		residential community
(12) SR 165 - SR 68 - SR 61	942	1	384	800	1275	1750	0.48	0.30	0.22		#DIV/0!		residential community
(13) SR 165 - SR 68 - SR 161	1571	1	410	800	1275	1750	0.51	0.32	0.23		#DIV/0!		residential community
(14) SR 165 - SR 68 - US 231	1571	1	410	800	1275	1750	0.51	0.32	0.23		#DIV/0!		residential community
(15) SR 165 - SR 68 - SR 162	1571	1	410	800	1275	1750	0.51	0.32	0.23		#DIV/0!		residential community
(16) SR 65 - SR 68 - US 41	1571	1	410	800	1275	1750	0.51	0.32	0.23		#DIV/0!		residential community
(17) SR 65 - SR 68 - I 69	2471	1	448	800	1275	1750	0.56	0.35	0.26		#DIV/0!		residential community
(18) SR 65 - SR 68 - SR 61	942	1	384	800	1275	1750	0.48	0.30	0.22		#DIV/0!		residential community
(19) SR 65 - SR 68 - SR 161	1689	1	415	800	1275	1750	0.52	0.33	0.24		#DIV/0!		residential community
(20) SR 65 - SR 68 - US 231	942	1	384	800	1275	1750	0.48	0.30	0.22		#DIV/0!		residential community
(21) SR 65 - SR 68 - SR 162	942	1	384	800	1275	1750	0.48	0.30	0.22		#DIV/0!		
(22) US 41 - SR 68 - I 69	2471	1	448	800	1275	1750	0.56	0.35	0.26		#DIV/0!		
(23) US 41 - SR 68 - SR 61	2471	1	448	800	1275	1750	0.56	0.35	0.26		#DIV/0!		
(24) US 41 - SR 68 - SR 161	2471	1	448	800	1275	1750	0.56	0.35	0.26		#DIV/0!		
(25) US 41 - SR 68 - US 231	2471	1	448	800	1275	1750	0.56	0.35	0.26		#DIV/0!		
(26) US 41 - SR 68 - SR 162	2471	1	448	800	1275	1750	0.56	0.35	0.26		#DIV/0!		
(27) I 69 - SR 68 - SR 61	1689	1	415	800	1275	1750	0.52	0.33	0.24		#DIV/0!		
(28) I 69 - SR 68 - SR 161	1022	1	387	800	1275	1750	0.48	0.30	0.22		#DIV/0!		
(29) I 69 - SR 68 - US 231	1022	1	387	800	1275	1750	0.48	0.30	0.22		#DIV/0!		
(30) I 69 - SR 68 - SR 162	1022	1	387	800	1275	1750	0.48	0.30	0.22		#DIV/0!		
(31) SR 61 - SR 68 - SR 161	1571	1	410	800	1275	1750	0.51	0.32	0.23		#DIV/0!		
(32) SR 61 - SR 68 - US 231	2471	1	448	800	1275	1750	0.56	0.35	0.26		#DIV/0!		
(33) SR 61 - SR 68 - SR 162	942	1	384	800	1275	1750	0.48	0.30	0.22		#DIV/0!		
(34) SR 161 - SR 68 - US 231	1022	1	387	800	1275	1750	0.48	0.30	0.22		#DIV/0!		
(35) SR 161 - SR 68 - SR 162	942	1	384	800	1275	1750	0.48	0.30	0.22		#DIV/0!		
(36) US 231 - SR 68 - SR 162	942	1	384	800	1275	1750	0.48	0.30	0.22		#DIV/0!		

🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

I-64-Section 2



Detour Route Table										
West Bound		Re-enter to Interstate from								
		US150	SR62	Lanesville Rd	SR135	SR66	SR237	SR37	SR145	SR162
Exit to	US150			County Road	(1) US 150 - SR 135	(2) US 150 - SR 66	(3) US 150 - SR 135 - SR 64 - SR 237	(4) US 150 - SR 135 - SR 64 - SR 37	(5) US 150 - SR 135 - SR 64 - SR 145	(6) US 150 - SR 135 - SR 64 - SR 162
	SR62			County Road	(7) SR 62 - SR 135	(8) SR 62 - SR 66	(9) SR 62 - SR 237	(10) SR 62 - SR 37	(11) SR 62 - SR 145	(12) SR 62 - SR 162
	Lanesville Rd				County Road	County Road	County Road	County Road	County Road	County Road
	SR135					(13) SR 135 - SR 62 - SR 66	(14) SR 135 - SR 62 - SR 237	(15) SR 135 - SR 62 - SR 37	(16) SR 135 - SR 62 - SR 145	(17) SR 135 - SR 62 - SR 162
	SR66						(18) SR 66 - SR 62 - SR 237	(19) SR 66 - SR 62 - SR 37	(20) SR 66 - SR 62 - SR 145	(21) SR 66 - SR 62 - SR 162
	SR237							(22) SR 237 - SR 62 - SR 37	(23) SR 237 - SR 62 - SR 145	(24) SR 237 - SR 62 - SR 162
	SR37								(25) SR 37 - SR 62 - SR 145	(26) SR 37 - SR 62 - SR 162
	SR145									(27) SR 145 - SR 62 - SR 162
	SR162									

Detour Route Table

East Bound		Re-enter to Interstate from								
		SR162	SR145	SR37	SR237	SR66	SR135	Lanesville Rd	SR62	US150
Exit to	SR162	☒	(1) SR 162 - SR 6 - SR 145	(2) SR 162 - SR 62 - SR 37	(3) SR 162 - SR 62 - SR 237	(4) SR 162 - SR 62 - SR 66	(5) SR 162 - SR 62 - SR 135	County Road	(6) SR 162 - SR 62	☒
	SR145	☒	☒	(7) SR 145 - SR 62 - SR 37	(8) SR 145 - SR 62 - SR 237	(9) SR 145 - SR 62 - SR 66	(10) SR 145 - SR 62 - SR 135	County Road	(11) SR 145 - SR 62	☒
	SR37	☒	☒	☒	(12) SR 37 - SR 62 - SR 237	(13) SR 37 - SR 62 - SR 66	(14) SR 37 - SR 62 - SR 135	County Road	(15) SR 37 - SR 62	☒
	SR237	☒	☒	☒	☒	(16) SR 237 - SR 62 - SR 66	(17) SR 237 - SR 62 - SR 135	County Road	(18) SR 237 - SR 62	☒
	SR66	☒	☒	☒	☒	☒	(19) SR 66 - SR 62 - SR 135	County Road	(20) SR 66 - SR 62	☒
	SR135	☒	☒	☒	☒	☒	☒	County Road	(21) SR 135 - SR 62	(22) SR 135 - US 150
	Lanesville Rd	☒	☒	☒	☒	☒	☒	☒	County Road	County Road
	SR62	☒	☒	☒	☒	☒	☒	☒	☒	☒
	US150	☒	☒	☒	☒	☒	☒	☒	☒	☒

AADT	**17083**

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Adding Miles and Time	Site-specific Notes
(1) US 150 - SR 135	3200	1	845	800	1275	1750	1.06	0.66	0.48		#DIV/0!		Palmyra residential area
(2) US 150 - SR 66	361	1	727	800	1275	1750	0.91	0.57	0.42		#DIV/0!		Sharp turn
(3) US 150 - SR 135 - SR 64 - SR	1467	1	773	800	1275	1750	0.97	0.61	0.44		#DIV/0!		Marengo resdential area
(4) US 150 - SR 135 - SR 64 - SR 37	2136	1	801	800	1275	1750	1.00	0.63	0.46		#DIV/0!		Marengo resdential area
(5) US 150 - SR 135 - SR 64 - SR	1555	1	777	800	1275	1750	0.97	0.61	0.44		#DIV/0!		Marengo resdential area
(6) US 150 - SR 135 - SR 64 - SR	4328	1	892	800	1275	1750	1.12	0.70	0.51		#DIV/0!		area Sharp turns
(7) SR 62 - SR 135	5917	1	958	800	1275	1750	1.20	0.75	0.55		#DIV/0!		area Sharp turns
(8) SR 62 - SR 66	1137	1	759	800	1275	1750	0.95	0.60	0.43		#DIV/0!		area Sharp turns
(9) SR 62 - SR 237	427	1	730	800	1275	1750	0.91	0.57	0.42		#DIV/0!		area Sharp turns
(10) SR 62 - SR 37	1958	1	793	800	1275	1750	0.99	0.62	0.45		#DIV/0!		Sharp turns
(11) SR 62 - SR 145	382	1	728	800	1275	1750	0.91	0.57	0.42		#DIV/0!		
(12) SR 62 - SR 162	2734	1	826	800	1275	1750	1.03	0.65	0.47		#DIV/0!		
(13) SR 135 - SR 62 - SR 66	1137	1	759	800	1275	1750	0.95	0.60	0.43		#DIV/0!		
(14) SR 135 - SR 62 - SR 237	427	1	730	800	1275	1750	0.91	0.57	0.42		#DIV/0!		
(15) SR 135 - SR 62 - SR 37	1958	1	793	800	1275	1750	0.99	0.62	0.45		#DIV/0!		
(16) SR 135 - SR 62 - SR 145	382	1	728	800	1275	1750	0.91	0.57	0.42		#DIV/0!		
(17) SR 135 - SR 62 - SR 162	2734	1	826	800	1275	1750	1.03	0.65	0.47		#DIV/0!		
(18) SR 66 - SR 62 - SR 237	427	1	730	800	1275	1750	0.91	0.57	0.42		#DIV/0!		
(19) SR 66 - SR 62 - SR 37	1958	1	793	800	1275	1750	0.99	0.62	0.45		#DIV/0!		
(20) SR 66 - SR 62 - SR 145	382	1	728	800	1275	1750	0.91	0.57	0.42		#DIV/0!		
(21) SR 66 - SR 62 - SR 162	2734	1	826	800	1275	1750	1.03	0.65	0.47		#DIV/0!		
(22) SR 237 - SR 62 - SR 37	1958	1	793	800	1275	1750	0.99	0.62	0.45		#DIV/0!		
(23) SR 237 - SR 62 - SR 145	382	1	728	800	1275	1750	0.91	0.57	0.42		#DIV/0!		
(24) SR 237 - SR 62 - SR 162	2734	1	826	800	1275	1750	1.03	0.65	0.47		#DIV/0!		
(25) SR 37 - SR 62 - SR 145	382	1	728	800	1275	1750	0.91	0.57	0.42		#DIV/0!		
(26) SR 37 - SR 62 - SR 162	2734	1	826	800	1275	1750	1.03	0.65	0.47		#DIV/0!		
(27) SR 145 - SR 62 - SR 162	2734	1	826	800	1275	1750	1.03	0.65	0.47		#DIV/0!		

🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

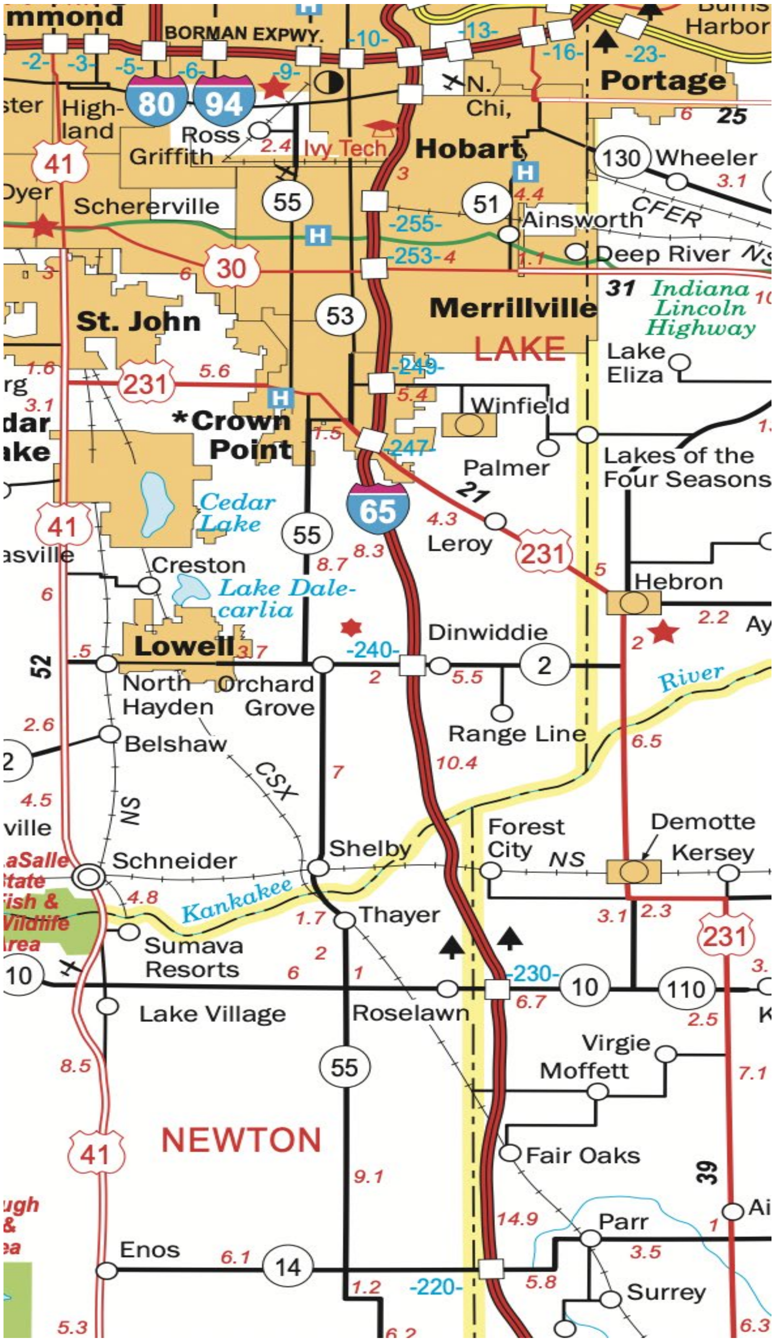
AADT	**16837**

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Adding Miles and Time	Site-specific Notes
(1) SR 162 - SR 62 - SR 145	2734	1	815	800	1275	1750	1.02	0.64	0.47		#DIV/0!		St Meinrad residential area
(2) SR 162 - SR 62 - SR 37	2734	1	815	800	1275	1750	1.02	0.64	0.47		#DIV/0!		
(3) SR 162 - SR 62 - SR 237	382	1	717	800	1275	1750	0.90	0.56	0.41		#DIV/0!		
(4) SR 162 - SR 62 - SR 66	2734	1	815	800	1275	1750	1.02	0.64	0.47		#DIV/0!		
(5) SR 162 - SR 62 - SR 135	2734	1	815	800	1275	1750	1.02	0.64	0.47		#DIV/0!		
(6) SR 162 - SR 62	2734	1	815	800	1275	1750	1.02	0.64	0.47		#DIV/0!		
(7) SR 145 - SR 62 - SR 37	382	1	717	800	1275	1750	0.90	0.56	0.41		#DIV/0!		
(8) SR 145 - SR 62 - SR 237	382	1	717	800	1275	1750	0.90	0.56	0.41		#DIV/0!		
(9) SR 145 - SR 62 - SR 66	382	1	717	800	1275	1750	0.90	0.56	0.41		#DIV/0!		Sharp turn
(10) SR 145 - SR 62 - SR 135	382	1	717	800	1275	1750	0.90	0.56	0.41		#DIV/0!		
(11) SR 145 - SR 62	382	1	717	800	1275	1750	0.90	0.56	0.41		#DIV/0!		
(12) SR 37 - SR 62 - SR 237	1958	1	783	800	1275	1750	0.98	0.61	0.45		#DIV/0!		
(13) SR 37 - SR 62 - SR 66	1958	1	783	800	1275	1750	0.98	0.61	0.45		#DIV/0!		Sharp turn
(14) SR 37 - SR 62 - SR 135	1958	1	783	800	1275	1750	0.98	0.61	0.45		#DIV/0!		
(15) SR 37 - SR 62	1958	1	783	800	1275	1750	0.98	0.61	0.45		#DIV/0!		
(16) SR 237 - SR 62 - SR 66	1137	1	749	800	1275	1750	0.94	0.59	0.43		#DIV/0!		
(17) SR 237 - SR 62 - SR 135	427	1	719	800	1275	1750	0.90	0.56	0.41		#DIV/0!		
(18) SR 237 - SR 62	427	1	719	800	1275	1750	0.90	0.56	0.41		#DIV/0!		
(19) SR 66 - SR 62 - SR 135	1137	1	749	800	1275	1750	0.94	0.59	0.43		#DIV/0!		
(20) SR 66 - SR 62	1137	1	749	800	1275	1750	0.94	0.59	0.43		#DIV/0!		
(21) SR 135 - SR 62	5917	1	948	800	1275	1750	1.19	0.74	0.54		#DIV/0!		Sharp turn
(22) SR 135 - US 150	4328	1	882	800	1275	1750	1.10	0.69	0.50		#DIV/0!		Palmyra residential area
			#DIV/0!	800	1275	1750	#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!		
			#DIV/0!	800	1275	1750	#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!		
			#DIV/0!	800	1275	1750	#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!		
			#DIV/0!	800	1275	1750	#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!		
			#DIV/0!	800	1275	1750	#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!		

🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

I-65-Section 1



Detour Route Table

South Bound		Re-enter to Interstate from								
		I94	E Ridge Rd	W61st Ave	US30	E 109th Ave	US231	SR2	SR10	SR14
Exit to	I94		County Road	County Road	(1) I94 - SR53 - US30	County Road	(2) I94 - SR53 - US231	(3) I94 - US41 - SR2	(4) I94 - US41 - SR10	(5) I94 - US41 - SR14
	E Ridge Rd			County Road	County Road	County Road	County Road	County Road	County Road	County Road
	W 61st Ave				County Road	County Road	County Road	County Road	County Road	County Road
	US30					County Road	(6) US30 - SR53 - US231	(7) US30 - SR55 - SR2	(8) US30 - SR55 - SR10	(9) US30 - SR55 - SR14
	E 109th Ave						County Road	County Road	County Road	County Road
	US231							(10) US231 - SR55 - SR2	(11) US231 - SR55 - SR10	(12) US231 - SR55 - SR14
	SR2								(13) SR2 - SR55 - SR10	(14) SR2 - SR55 - SR14
	SR10									(15) SR10 - SR55 - SR14
	SR14									

Detour Route Table

North Bound		Re-enter to Interstate from								
		SR14	SR10	SR237	US231	E 109th Ave	US30	W 61th Ave	E Ridge Rd	I94
Exit to	SR14		(1) SR14 - US231 - SR10	(2) SR14 - US231 - SR2	(3) SR14 - US231	County Road	(4) SR14 - US421 - US30	County Road	County Road	(5) SR14 - US421 - I94
	SR10			(6) SR10 - US231 - SR2	(7) SR10 - US231	County Road	No feasible route	County Road	County Road	(8) SR10 - US421 - I94
	SR237				(9) SR2 - US231	County Road	(10) SR2 - US30	County Road	County Road	(11) SR2 - SR8 - US421 - I94
	US231					County Road	(12) US231 - SR2 - US30	County Road	County Road	(13) US231 - SR8 - US421 - I94
	E 109th Ave						County Road	County Road	County Road	County Road
	US30							County Road	County Road	No feasible route
	W 61th Ave								County Road	County Road
	E Ridge Rd									County Road
	I94									

AADT	

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes

🟨 Input by Research Team
🟩 Auto Calculation
🟧 Input by Decision Makers

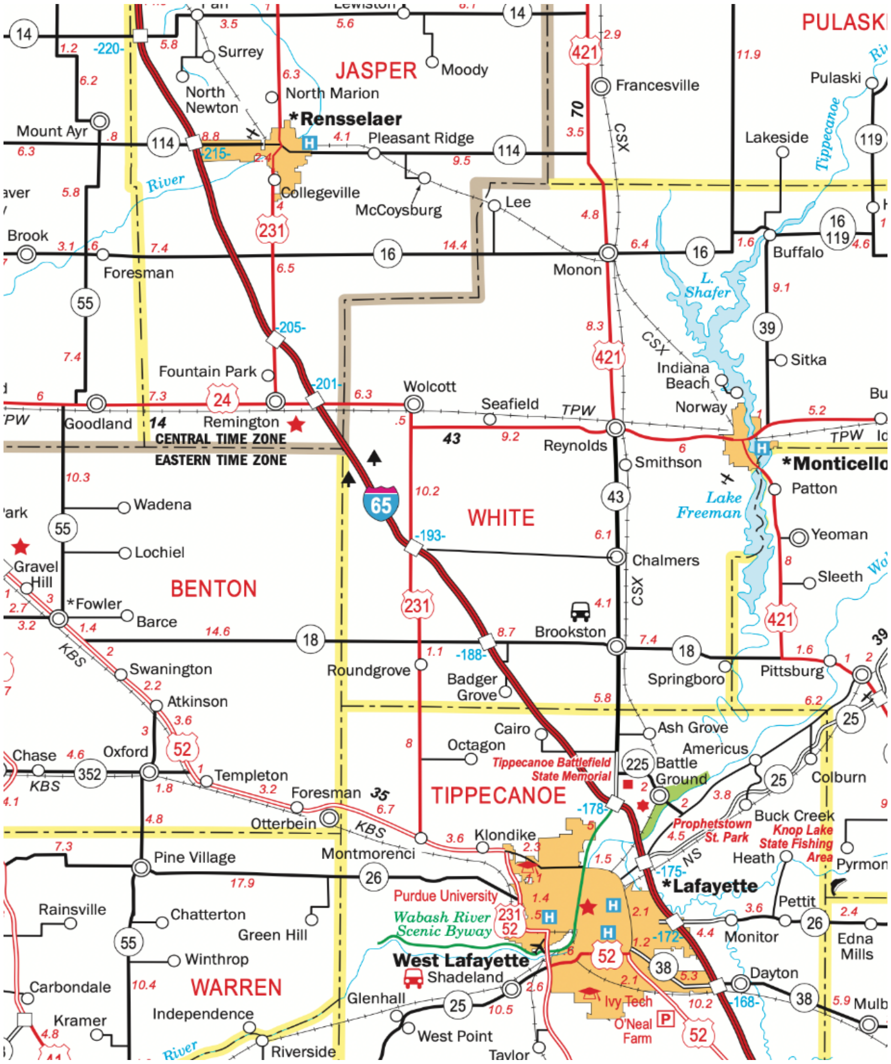
AADT	**25000**

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes
(1) SR14 - US231 - SR10	9000	1	1417	800	1275	1750	1.77	1.11	0.81		#DIV/0!	Multiple sharp turns throughout the detour route
(2) SR14 - US231 - SR2	9000	1	1417	800	1275	1750	1.77	1.11	0.81		#DIV/0!	
(3) SR14 - US231	9000	1	1417	800	1275	1750	1.77	1.11	0.81		#DIV/0!	
(4) SR14 - US421 - US30	9000	1	1417	800	1275	1750	1.77	1.11	0.81		#DIV/0!	
(5) SR14 - US421 - I94	9000	1	1417	800	1275	1750	1.77	1.11	0.81		#DIV/0!	Bypasses the entire neighbourhood of
(6) SR10 - US231 - SR2	5000	1	1250	800	1275	1750	1.56	0.98	0.71		#DIV/0!	Complicated due to multiple turns and signals
(7) SR10 - US231	5000	1	1250	800	1275	1750	1.56	0.98	0.71		#DIV/0!	
(8) SR10 - US421 - I94	5000	1	1250	800	1275	1750	1.56	0.98	0.71		#DIV/0!	Bypasses the entire neighbourhood of
(9) SR2 - US231	5000	1	1250	800	1275	1750	1.56	0.98	0.71		#DIV/0!	
(10) SR2 - US30	5000	1	1250	800	1275	1750	1.56	0.98	0.71		#DIV/0!	
(11) SR2 - SR8 - US421 - I94	18000	1	1792	800	1275	1750	2.24	1.41	1.02		#DIV/0!	Irregular number of lanes, Bypasses the entire
(12) US231 - SR2 - US30	5000	1	1250	800	1275	1750	1.56	0.98	0.71		#DIV/0!	
(13) US231 - SR8 - US421 - I94	18000	1	1792	800	1275	1750	2.24	1.41	1.02		#DIV/0!	Bypasses the entire neighbourhood of
			#DIV/0!				#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!	
			#DIV/0!				#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!	

🟨 Input by Research Team
🟩 Auto Calculation
🟧 Input by Decision Makers

I-65-Section 2



Detour Route Table

South Bound		Re-enter to Interstate from									
		SR14	SR114	US231	US24	US231	SR18	SR43	SR25	SR26	SR38
Exit to	SR14		(1) SR14 - SR55 - SR114	Adds more than 50% of travel time and miles	(2) SR14 - SR55 - US24	Adds more than 50% of travel time and miles	(3) SR14 - SR55 - US52 - SR18	Adds more than 50% of travel time and miles	Adds more than 50% of travel time and miles	Adds more than 50% of travel time and miles	Adds more than 50% of travel time and miles
	SR114			Adds more than 50% of travel time and miles	(4) SR114 - SR55 - US24	Adds more than 50% of travel time and miles	(5) SR114 - SR55 - US52 - SR18	Adds more than 50% of travel time and miles	Adds more than 50% of travel time and miles	Adds more than 50% of travel time and miles	Adds more than 50% of travel time and miles
	US231				(6) US231 - US24	(7) US231 - US24 - US231	(8) US231 - US24 - SR43 - SR18	(9) US231 - US24 - SR43	Adds more than 50% of travel time and miles	Adds more than 50% of travel time and miles	Adds more than 50% of travel time and miles
	US24					(10) US24 - US231	(11) US24 - SR43 - SR18	(12) US24 - SR43	Adds more than 50% of travel time and miles	Adds more than 50% of travel time and miles	Adds more than 50% of travel time and miles
	US231						(13) US231 - SR18	(14) US231 - SR18 - SR43	Adds more than 50% of travel time and miles	Adds more than 50% of travel time and miles	Adds more than 50% of travel time and miles
	SR18							(15) SR18 - SR43	(16) SR18 - SR25	(17) SR18 - SR39 - SR26	(18) SR18 - SR39 - SR38
	SR43								Adds more than 50% of travel time and miles	Adds more than 50% of travel time and miles	Adds more than 50% of travel time and miles
	SR25									(19) SR25 - SR39 - SR26	(20) SR25 - SR39 - SR38
	SR26										(21) SR26 - SR38
	SR38										

Detour Route Table

North Bound		Re-enter to Interstate from									
		SR26	SR25	SR43	SR18	US231	US24	US231	SR114	SR14	SR38
Exit to	SR26		(1) SR26 - SR39 - SR25	No feasible route, added time is more than 50% of the	(2) SR26 - SR39 - SR18	No feasible route, added time is more than 50% of the	No feasible route, added time is more than 50% of the	No feasible route, added time is more than 50% of the	No feasible route, added time is more than 50% of the	No feasible route, added time is more than 50% of the	(3) SR26 - SR39 - SR38
	SR25			No feasible route, added time is more than 50% of the	(4) SR25 - SR18	No feasible route, added time is more than 50% of the	(5) SR25 - SR18 - SR43 - US24	(6) SR25 - SR18 - SR43 - US24 - US231	(7) SR25 - SR18 - SR43 - US421 - SR114	(8) SR25 - SR18 - SR43 - US421 - SR14	No feasible route, added time is more than 50% of the
	SR43				(9) SR43 - SR18	No feasible route, added time is more than 50% of the	(10) SR43 - US24	No feasible route, added time is more than 50% of the	(11) SR43 - SR114	(12) SR43 - SR14	No feasible route, added time is more than 50% of the
	SR18					No feasible route, added time is more than 50% of the	(13) SR18 - SR43 - US24	No feasible route, added time is more than 50% of the	(14) SR18 - SR43 - SR114	(15) SR18 - SR43 - SR14	No feasible route, added time is more than 50% of the
	US231						(16) US231 - US24	(17) US231 - US24 - US231	(18) US231 - US24 - SR43 - SR114	(19) US231 - US24 - SR43 - SR14	No feasible route, added time is more than 50% of the
	US24							No feasible route, added time is more than 50% of the	(20) US24 - US421 - SR114	(21) US24 - SR421 - SR14	No feasible route, added time is more than 50% of the
	US231								(22) US231 - SR114	(23) US231 - SR14	No feasible route, added time is more than 50% of the
	SR114									(24) SR114 - US421 - SR14	No feasible route, added time is more than 50% of the
	SR26										No feasible route, added time is more than 50% of the
	SR38										

AADT

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes

🟨 Input by Research Team
🟩 Auto Calculation
🟧 Input by Decision Makers

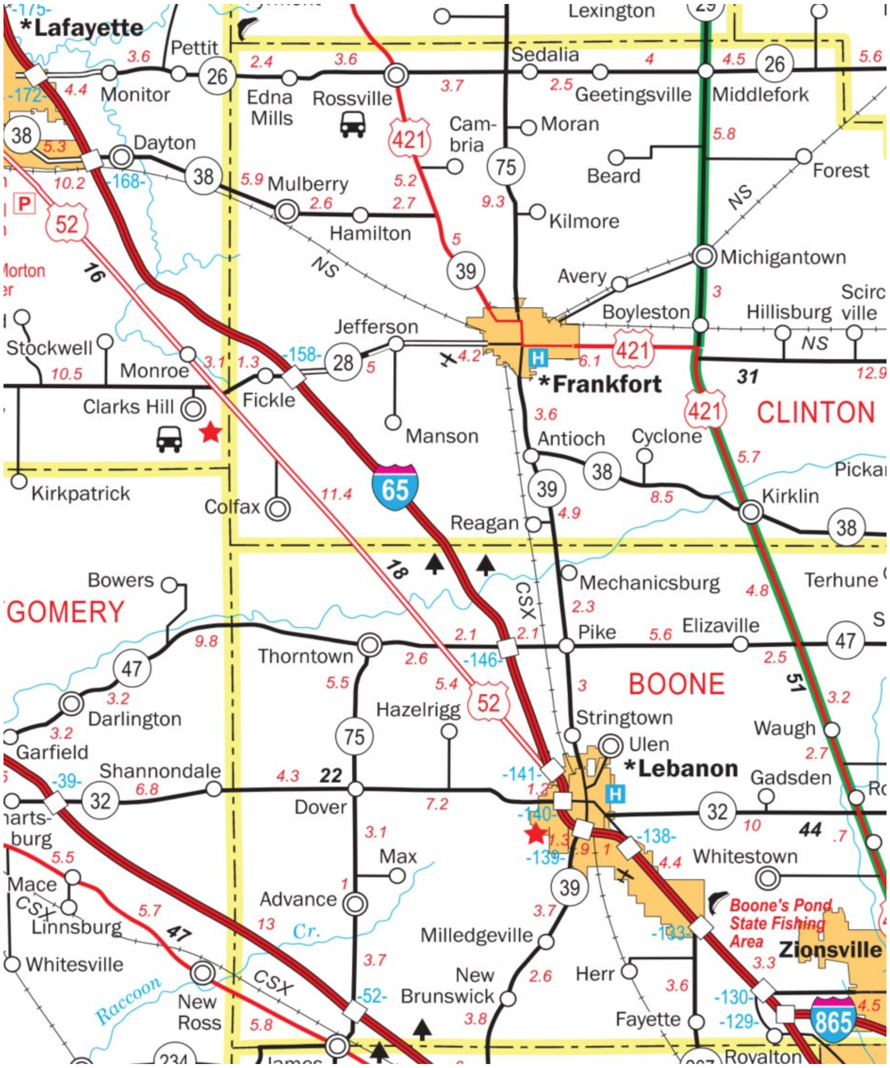
AADT

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes

🟨 Input by Research Team
🟩 Auto Calculation
🟧 Input by Decision Makers

I-65-Section 3



Detour Route Table

South Bound		Re-enter to Interstate from								
		SR38	SR28	SR47	US52	SR32	SR39	S100E	SR267	Whitestown Pkwy
Exit to	SR38		(1) SR38 - US52 - SR28	No feasible route	(2) SR38 - US52	No feasible route	No feasible route	County Road	No feasible route	County Road
	SR28			(3) SR28 - US52 - SR47	(4) SR28 - US52	SR28 - US52 intersects with I65 directly and does not	SR28 - US52 intersects with I65 directly and does not	County Road	SR28 - US52 intersects with I65 directly and does not	County Road
	SR47				No feasible route	(5) SR47 - SR75 - SR32	More than 50% of original travel time	County Road	More than 50% of original travel time	County Road
	US52					Travels northbound, no feasible detour option	Travels northbound, no feasible detour option	County Road	Travels northbound, no feasible detour option	County Road
	SR32						Does not intersect	County Road	Does not intersect	County Road
	SR39							County Road	(6) SR39 - I74 - SR267	County Road
	S100E								County Road	County Road
	SR267									County Road
	Whitestown Pkwy									

Detour Route Table

North Bound		Re-enter to Interstate from								
		Whitestown Pkwy	SR267	S100E	SR39	SR32	US52	SR47	SR28	SR38
Exit to	Whitestown Pkwy		County Road	County Road	County Road	County Road	County Road	County Road	County Road	County Road
	SR267			County Road	No feasible route	No feasible route	No feasible route	No feasible route	No feasible route	No feasible route
	S100E				County Road	County Road	County Road	County Road	County Road	County Road
	SR39					(1) SR39 - SR32	(2) SR39 - US52	(3) SR39 - SR47	(4) SR39 - SR28	(5) SR39 - SR38
	SR32						(6) SR32 - SR39 - US52	(7) SR32 - SR39 - SR47	(8) SR32 - SR39 - SR28	(9) SR32 - SR39 - SR38
	US52							Does not intersect	(10) US52 - SR28	Does not intersect
	SR47								(11) SR47 - SR28	(12) SR47 - SR38
	SR28									More than 50% of original travel time
	SR38									

AADT	**25000**

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes
(1) SR38 - US52 - SR28	5000	1	1250	800	1250	1700	1.56	1.00	0.74		#DIV/0!	turn is inconvenient for
(2) SR38 - US52	5000	1	1250	800	1250	1700	1.56	1.00	0.74		#DIV/0!	turn is inconvenient for
(3) SR28 - US52 - SR47	9000	1	1417	800	1250	1700	1.77	1.13	0.83		#DIV/0!	
(4) SR28 - US52	5000	1	1250	800	1250	1700	1.56	1.00	0.74		#DIV/0!	
(5) SR47 - SR75 - SR32	5000	1	1250	800	1250	1700	1.56	1.00	0.74		#DIV/0!	
(6) SR39 - I74 - SR267	8000	1	1375	800	1250	1700	1.72	1.10	0.81		#DIV/0!	heavy traffic on I74 and sharp
			#DIV/0!		#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!	
			#DIV/0!		#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!	
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🟨 Input by Research Team
🟩 Auto Calculation
🟧 Input by Decision Makers

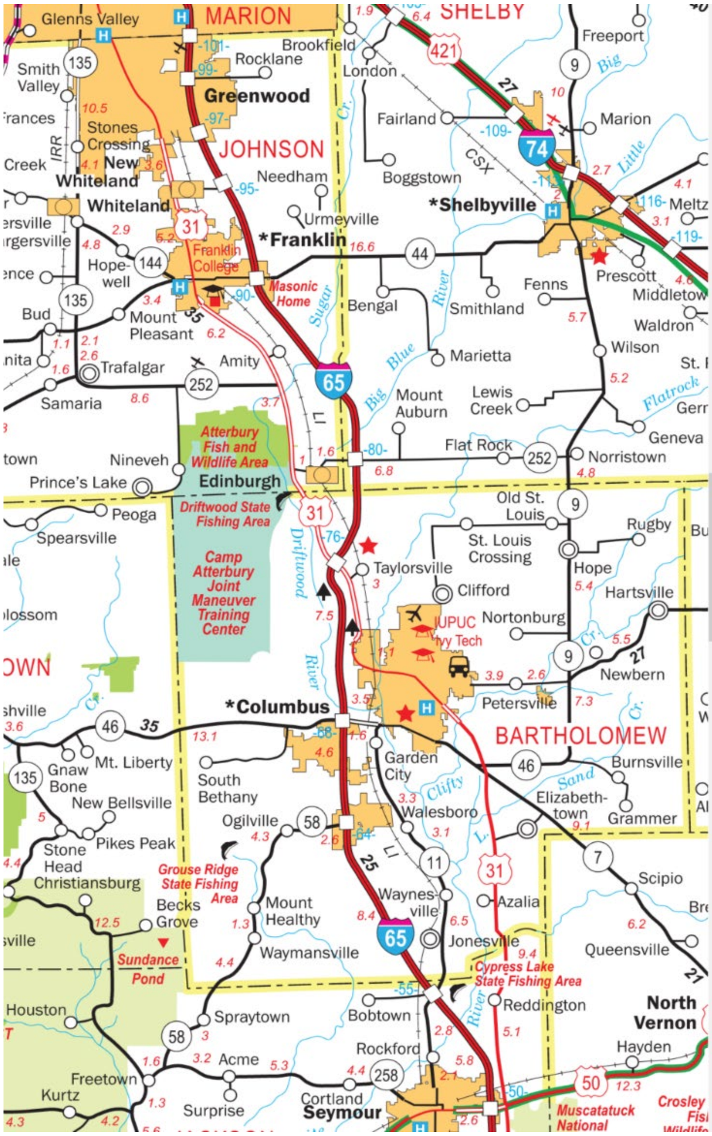
AADT	

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes

🟨 Input by Research Team
🟩 Auto Calculation
🟧 Input by Decision Makers

I-65-Section 4

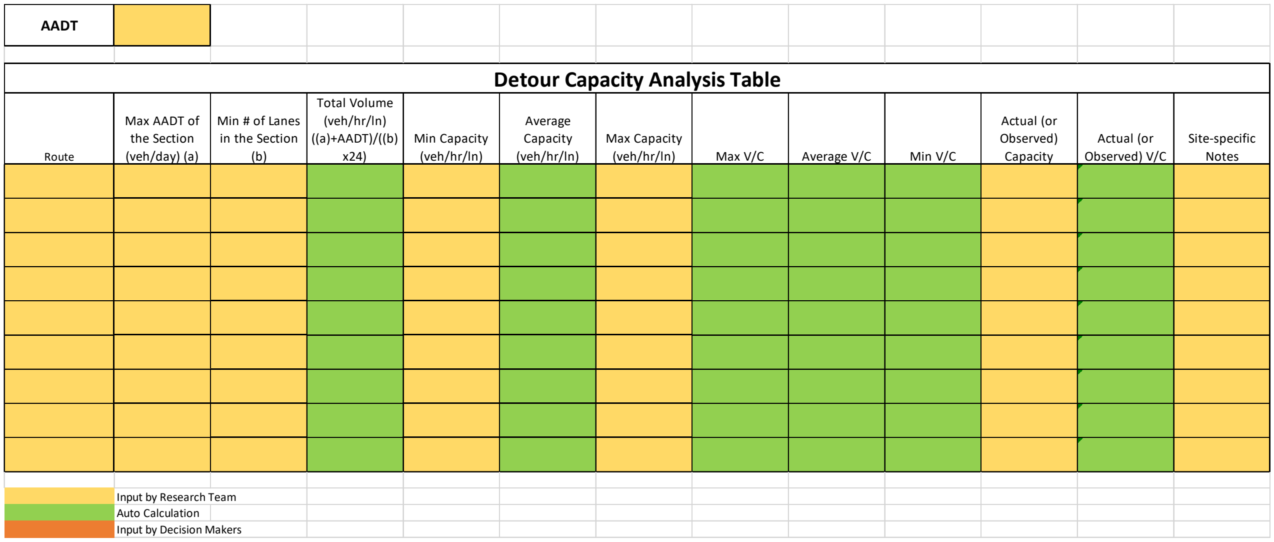


Detour Route Table

South Bound		Re-enter to Interstate from									
		E Main St	Worthsville Rd	E500N	SR44	SR252	US31	SR46	SR58	SR11	US50
Exit to	E Main St		County Road	County Road	County Road	County Road	County Road	County Road	County Road	County Road	County Road
	Worthsville Rd			County Road	County Road	County Road	County Road	County Road	County Road	County Road	County Road
	E500N				County Road	County Road	County Road	County Road	County Road	County Road	County Road
	SR44					(1) SR44 - US31 - SR252	(2) SR44 - US31	(3) SR44 - SR46	No feasible route	No feasible route	No feasible route
	SR252						(4) SR252 - US31	(5) SR252 - SR9 - SR46	No feasible route	No feasible route	No feasible route
	US31							No feasible route, odd curve on turn	No feasible route	No feasible route	(6) US31 - US50
	SR46								No feasible route	(7) SR46 - SR11	(8) SR46 - US31 - US50
	SR58									No feasible route	No feasible route
	SR11										(9) SR11 - US50
	US50										

Detour Route Table

North Bound		Re-enter to Interstate from									
		US50	SR11	SR58	SR46	US31	SR252	SR44	E500N	Worthsville Rd	E Main St.
Exit to	US50		(1) US50 - SR11	More than 50% of original travel time	(2) US50 - US31 - SR46	(3) US50 - US31	More than 50% of original travel time	More than 50% of original travel time	County Road	County Road	County Road
	SR11			(4) SR11 - SR58	More than 50% of original travel time	More than 50% of original travel time	More than 50% of original travel time	More than 50% of original travel time	County Road	County Road	County Road
	SR58				No feasible route	No feasible route	No feasible route	No feasible route	County Road	County Road	County Road
	SR46					More than 50% of original travel time	More than 50% of original travel time	More than 50% of original travel time	County Road	County Road	County Road
	US31						(5) US31 - SR252	(6) US31 - SR44	County Road	County Road	County Road
	SR252							(7) SR252 - US31 - SR44	County Road	County Road	County Road
	SR44								County Road	County Road	County Road
	E500N									County Road	County Road
	Worthsville Rd										County Road
	E Main St.										



AADT	🟨

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes
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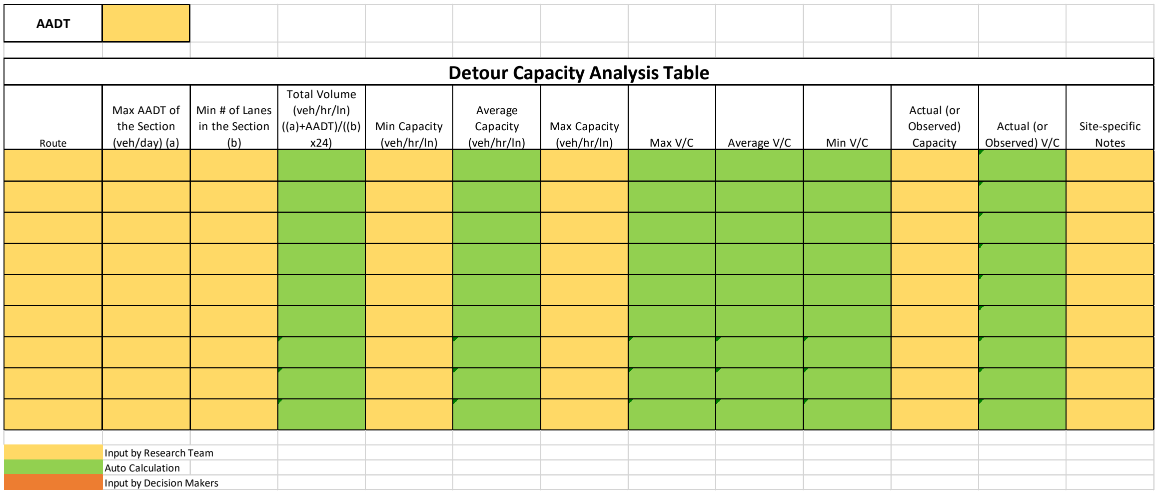
🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers



AADT	🟨

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes
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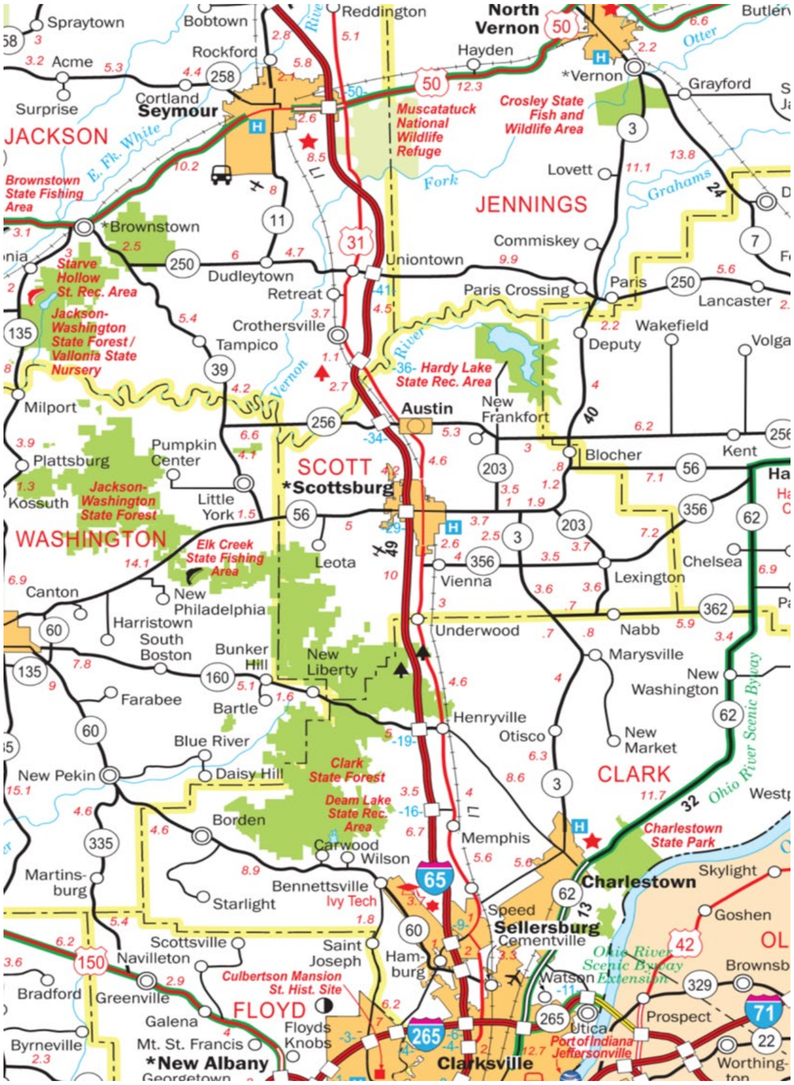
🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

I-65-Section 5



Detour Route Table

South Bound		Re-enter to Interstate from								
		US50	SR250	US31	SR256	SR56	SR160	Blue Lick Rd	US31	SR60
Exit to	US50		(1) SR50 - US31 - SR250	(2) SR50 - US31	(3) US50 - US31 - SR256	(4) US50 - US31 - SR56	(5) US50 - US31 - SR160	County Road	(6) SR50 - US31	No feasible route
	SR250			(7) SR250 - US31	(8) SR250 - US31 - SR256	(9) SR250 - US31 - SR56	(10) SR250 - US31 - SR160	County Road	(11) SR250 - US31	No feasible route
	US31				(12) US31 - SR256	(13) US31 - SR56	(14) US31 - SR160	County Road	(15) US31 - US31	No feasible route
	SR256					(16) SR256 - US31 - SR56	(17) SR256 - US31 - SR160	County Road	(18) SR256 - US31	No feasible route
	SR56						(19) SR56 - US31 - SR160	County Road	(20) SR56 -US31	(21) SR56 - SR60
	SR160							County Road	(22) SR160 - US31	(23) SR160 - SR60
	Blue Lick Rd								County Road	County Road
	US31									No feasible route
	SR60									

Detour Route Table

North Bound		Re-enter to Interstate from								
		SR60	US31	Blue Lick Rd	SR160	SR56	SR256	US31	SR250	US50
Exit to	SR60		(1) SR60 - US31	County Road	(2) SR60 - SR160	(3) SR60 - SR56	No feasible route	No feasible route	No feasible route	No feasible route
	US31			County Road	(4) US31 - SR160	(5) US31 - SR56	(6) US31 - SR256	(7) US31 - US31	(8) US31 - SR250	(9) US231 - US50
	Blue Lick Rd				County Road	County Road	County Road	County Road	County Road	County Road
	SR160					(10) SR160 - US31 - SR56	(11) SR160 - US31 - SR256	(12) SR160 - US31	(13) SR160 - US31 - SR250	(14) SR160 - US31 - US50
	SR56						(15) SR56 - US31 - SR256	(16) SR56 - US31	(17) SR56 - US31 - SR250	(18) SR56 - US31 - US50
	SR256							(19) SR256 - US31	(20) SR56 - US31 - SR250	(21) SR56 - US31 - US50
	US31								(22) US31 - SR250	(23) US31 - US50
	SR250									(24) SR250 - US31 - US50
	US50									

AADT	

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes
			#DIV/0!		#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!	

🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

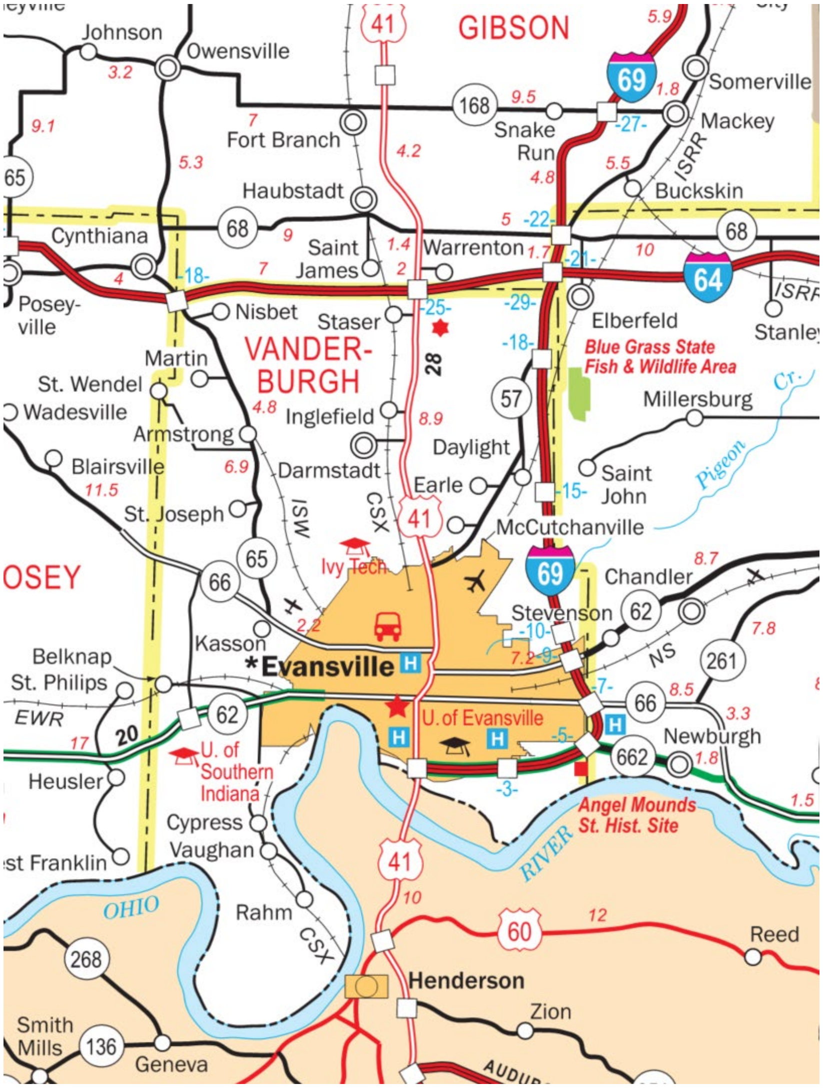
AADT	**25000**

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes
(1) SR60 - US31	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(2) SR60 - SR160	3500	1	1188	800	1250	1700	1.48	0.95	0.70		#DIV/0!	downtown traffic zone
(3) SR60 - SR56	3500	1	1188	800	1250	1700	1.48	0.95	0.70		#DIV/0!	
(4) US31 - SR160	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(5) US31 - SR56	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(6) US31 - SR256	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(7) US31 - US31	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(8) US31 - SR250	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(9) US231 - US50	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(10) SR160 - US31 - SR56	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(11) SR160 - US31 - SR256	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(12) SR160 - US31	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(13) SR160 - US31 - SR250	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(14) SR160 - US31 - US50	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(15) SR56 - US31 - SR256	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(16) SR56 - US31	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(17) SR56 - US31 - SR250	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(18) SR56 - US31 - US50	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(19) SR256 - US31	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(20) SR56 - US31 - SR250	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(21) SR56 - US31 - US50	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(22) US31 - SR250	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(23) US31 - US50	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	
(24) SR250 - US31 - US50	6000	1	1292	800	1250	1700	1.61	1.03	0.76		#DIV/0!	

🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

I-69-Section 1



Detour Route Table

South Bound		Re-enter to Interstate from									
		SR68	I64	SR57	Bnvl-New HarmonyRd	Rynch Rd	SR62	SR66	SR662	Green River Rd	US41
Exit to	SR68	☒	(1) SR 68 - US 41 - I 64	(2) SR 68 - US 41 - SR 57	County Road	County Road	(3) SR 69 - US 41 - SR 62	(4) SR 68 - US 41 - SR 66	☒	County Road	(5) SR 68 - US 41
	I64	☒	☒	(6) I 64 - US 41 - SR 57	County Road	County Road	(7) I 64 - US 41 - SR 62	(8) I 64 - US 41 - SR 66	(9) I 64 - SR 61 - SR 662	County Road	(10) I 64 - US 41
	SR57	☒	☒	☒	County Road	County Road	(11) SR 57 - US 41 - SR 62	(12) SR 57 - US 41 - SR 66	☒	County Road	(13) SR 57 - US 41
	Bnvl-New Harmony Rd	☒	☒	☒	☒	County Road	County Road	County Road	County Road	County Road	County Road
	Lynch Rd	☒	☒	☒	☒	☒	County Road	County Road	County Road	County Road	County Road
	SR62	☒	☒	☒	☒	☒	☒	(14) SR 62 - US 41 - SR 66	(15) SR 62 - SR 61 - SR 662	County Road	(16) SR 62 - US 41
	SR66	☒	☒	☒	☒	☒	☒	☒	(17) SR 66 - SR 662	County Road	(18) SR 66 - US 41
	SR662	☒	☒	☒	☒	☒	☒	☒	☒	County Road	☒
	Green River Rd	☒	☒	☒	☒	☒	☒	☒	☒	☒	County Road
	US41	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒

Detour Route Table

North Bound		Re-enter to Interstate from									
		US41	Green River Rd	SR662	SR66	SR62	Lynch Rd	Bnvl New Harmony Rd	SR57	I64	SR68
Exit to	US41	☒	County Road	☒	(1) US 41 - SR 66	(2) US 41 - SR 62	County Road	County Road	(3) US 41 - SR 57	(4) US 41 - I 64	(5) US 41 - SR 68
	Green River Rd	☒	☒	County Road	County Road	County Road	County Road	County Road	County Road	County Road	County Road
	SR662	☒	☒	☒	(6) SR 662 - SR 66	☒	County Road	County Road	☒	(7) SR 662 - SR 61 - I 64	(8) SR 662 - SR 61 - SR 68
	SR66	☒	☒	☒	☒	(9) SR 66 - SR 62	County Road	County Road	(10) SR 66 - US 41 - SR 57	(11) SR 66 - US 41 - I 64	(12) SR 66 - US 41 - SR 68
	SR62	☒	☒	☒	☒	☒	County Road	County Road	(13) SR 62 - US 41 - SR 57	(14) SR 62 - US 41 - I 64	(15) SR 62 - US 41 - SR 68
	Lynch Rd	☒	☒	☒	☒	☒	☒	County Road	County Road	County Road	County Road
	Bnvl New Harmony Rd	☒	☒	☒	☒	☒	☒	☒	County Road	County Road	County Road
	SR57	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒
	I64	☒	☒	☒	☒	☒	☒	☒	☒	☒	(16) I 64 - SR 68
	SR68	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒

AADT	**13502**

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Adding Miles and Time	Site-specific Notes
(1) SR 68 - US 41 - I 64	10271	1	991	800	1275	1750	1.24	0.78	0.57		#DIV/0!		
(2) SR 68 - US 41 - SR 57	4565	1	753	800	1275	1750	0.94	0.59	0.43		#DIV/0!		
(3) SR 68 - US 41 - SR 62	10271	1	991	800	1275	1750	1.24	0.78	0.57		#DIV/0!		
(4) SR 68 - US 41 - SR 66	2251	1	656	800	1275	1750	0.82	0.51	0.38		#DIV/0!		
(5) SR 68 - US 41	2471	1	666	800	1275	1750	0.83	0.52	0.38		#DIV/0!		
(6) I 64 - US 41 - SR 57	4565	1	753	800	1275	1750	0.94	0.59	0.43		#DIV/0!		
(7) I 64 - US 41 - SR 62	4565	1	753	800	1275	1750	0.94	0.59	0.43		#DIV/0!		
(8) I 64 - US 41 - SR 66	32689	2	962	2100	2200	2300	0.46	0.44	0.42		#DIV/0!		
(9) I 64 - SR 61 - SR 662	2025	1	647	800	1275	1750	0.81	0.51	0.37		#DIV/0!		center Sharp turns
(10) I 64 - US 41	29028	2	886	2100	2200	2300	0.42	0.40	0.39		#DIV/0!		
(11) SR 57 - US 41 - SR 62	4565	1	753	800	1275	1750	0.94	0.59	0.43		#DIV/0!		
(12) SR 57 - US 41 - SR 66	4565	1	753	800	1275	1750	0.94	0.59	0.43		#DIV/0!		Regional airport
(13) SR 57 - US 41	17366	2	643	2100	2200	2300	0.31	0.29	0.28		#DIV/0!		
(14) SR 62 - US 41 - SR 66	2251	1	656	800	1275	1750	0.82	0.51	0.38		#DIV/0!		
(15) SR 62 - SR 61 - SR 662	6387	1	829	800	1275	1750	1.04	0.65	0.47		#DIV/0!		center Sharp turns
(16) SR 62 - US 41	10690	2	504	800	1275	1750	0.63	0.40	0.29		#DIV/0!		
(17) SR 66 - SR 662	6387	1	829	800	1275	1750	1.04	0.65	0.47		#DIV/0!		
(18) SR 66 - US 41	29028	2	886	2100	2200	2300	0.42	0.40	0.39		#DIV/0!		

🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

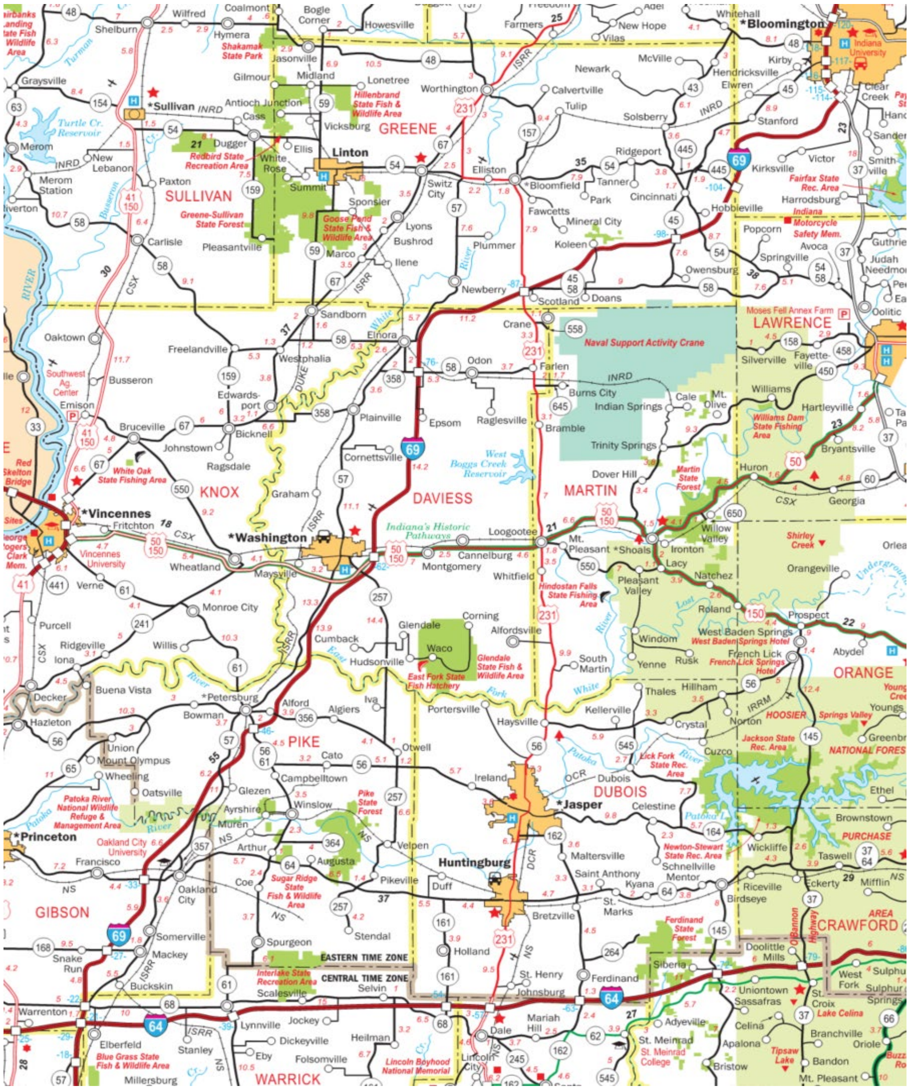
AADT	

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Adding Miles and Time	Site-specific Notes

🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

I-69-Section 2



Detour Route Table

South Bound		Re-enter to Interstate from									
		SR37	SR445	SR45	US231	SR58	US50	SR56	SR64	SR168	SR68
Exit to	SR37					(1) SR 37 - SR 58	(2) SR 37 - US 50				
	SR445			(3) SR 445 - SR 45	(4) SR 445 - SR 54 - US 231	(5) SR 445 - SR 45 - SR 58	(6) SR 445 - SR 54 - US 231 - US 50				
	SR45					(7) SR 45 - SR 58					
	US231					(8) US 231 - SR 58	(9) US 231 - US 50	(10) US 231 - SR 56			
	SR58						(11) SR 58 - SR 57 - US 50	(12) SR 58 - SR 57 - SR 56	(13) SR 58 - SR 57 - SR 64	(14) SR 58 - SR 57 - SR 168	(15) SR 58 - SR 57 - SR 68
	US50							(16) US 50 - SR 57 - SR 56	(17) US 50 - SR 57 - SR 64	(18) US 50 - SR 57 - SR 168	(19) US 50 - SR 57 - SR 68
	SR56								(20) SR 56 - SR 64	(21) SR 56 - SR 57 - SR 168	(22) SR 56 - SR 61 - SR 68
	SR64									(23) SR 64 - SR 57 - SR 168	(24) SR 64 - SR 57 - SR 68
	SR168										(25) SR 168 - SR 57 - SR 68
	SR68										

Detour Route Table

North Bound		Re-enter to Interstate from									
		SR68	SR168	SR64	SR56	US50	SR58	US231	SR45	SR445	SR37
Exit to	SR68		(1) SR 68 - SR 57 - SR 168	(2) SR 68 - SR 57 - SR 64	(3) SR 68 - SR 57 - SR 56	(4) SR 68 - SR 57 - US 50	(5) SR 68 - SR 57 - SR 58	(6) SR 68 - SR 57 - US 50 - US 231			
	SR168			(7) SR 168 - SR 57 - SR 64	(8) SR 168 - SR 57 - SR 56	(9) SR 168 - SR 57 - US 50	(10) SR 168 - SR 57 - SR 58	(11) SR 168 - SR 57 - US 50 - US 231			
	SR64				(12) SR 64 - SR 57 - SR 56	(13) SR 64 - SR 57 - US 50	(14) SR 64 - SR 57 - SR 58	(15) SR 64 - SR 57 - US 50 - US 231			
	SR56					(16) SR 56 - SR 57 - US 50	(17) SR 56 - SR 57 - SR 58	(18) SR 56 - SR 57 - US 50 - US 231			
	US50						(19) US 50 - US 231 - SR 58	(20) US 50 - US 231			
	SR58							(21) SR 58 - US 231	(22) SR 58 - SR 45	(23) SR 58 - SR 45 - SR 445	(24) SR 58 - SR 37
	US231								(25) US 231 - SR 54 - SR 45	(26) US 231 - SR 54 - SR 445	
	SR45									(28) SR 45 - SR 445	
	SR445										
	SR37										

AADT	🟨

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Adding Miles and Time	Site-specific Notes
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🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

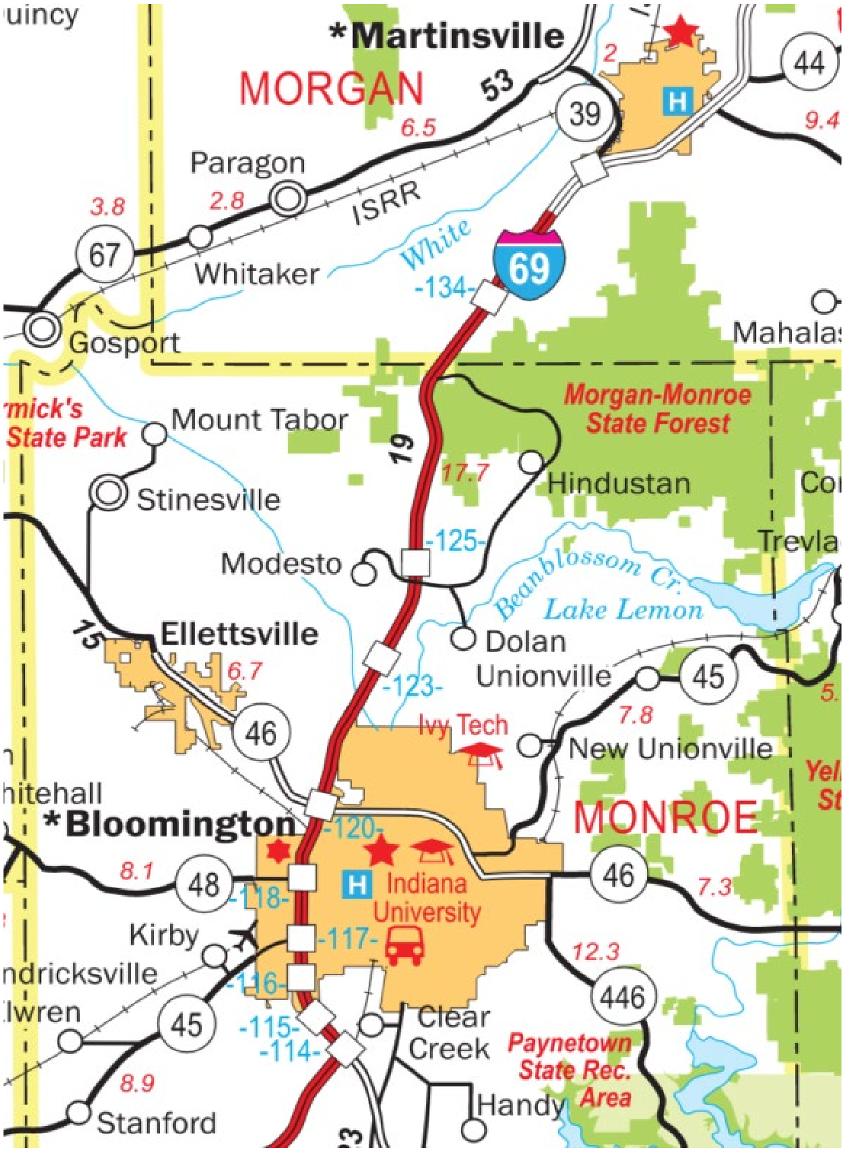
AADT	

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Adding Miles and Time	Site-specific Notes
(1) SR 68 - SR 57 - SR 168	580	1	269	800	1275	1750	0.34	0.21	0.15		#DIV/0!		
(2) SR 68 - SR 57 - SR 64	1042	1	288	800	1275	1750	0.36	0.23	0.16		#DIV/0!		
(3) SR 68 - SR 57 - SR 56	1841	1	321	800	1275	1750	0.40	0.25	0.18		#DIV/0!		
(4) SR 68 - SR 57 - US 50	4745	1	442	800	1275	1750	0.55	0.35	0.25		#DIV/0!		
(5) SR 68 - SR 57 - SR 58	4745	1	442	800	1275	1750	0.55	0.35	0.25		#DIV/0!		Narrow lanes on SR 58
(6) SR 68 - SR 57 - US 50 - US 231	3266	1	381	800	1275	1750	0.48	0.30	0.22		#DIV/0!		Narrow lanes on SR 58
(7) SR 168 - SR 57 - SR 64	1042	1	288	800	1275	1750	0.36	0.23	0.16		#DIV/0!		
(8) SR 168 - SR 57 - SR 56	824	1	279	800	1275	1750	0.35	0.22	0.16		#DIV/0!		Passes through town center
(9) SR 168 - SR 57 - US 50	4745	1	442	800	1275	1750	0.55	0.35	0.25		#DIV/0!		
(10) SR 168 - SR 57 - SR 58	4745	1	442	800	1275	1750	0.55	0.35	0.25		#DIV/0!		Narrow lanes on SR 58
(11) SR 168 - SR 57 - US 50 - US	3266	1	381	800	1275	1750	0.48	0.30	0.22		#DIV/0!		Passes through town center
(12) SR 64 - SR 57 - SR 56	1693	1	315	800	1275	1750	0.39	0.25	0.18		#DIV/0!		Passes through town center
(13) SR 64 - SR 57 - US 50	4745	1	442	800	1275	1750	0.55	0.35	0.25		#DIV/0!		
(14) SR 64 - SR 57 - SR 58	4745	1	442	800	1275	1750	0.55	0.35	0.25		#DIV/0!		Narrow lanes on SR 58
(15) SR 64 - SR 57 - US 50 - US 231	3266	1	381	800	1275	1750	0.48	0.30	0.22		#DIV/0!		
(16) SR 56 - SR 57 - US 50	4745	1	442	800	1275	1750	0.55	0.35	0.25		#DIV/0!		
(17) SR 56 - SR 57 - SR 58	4745	1	442	800	1275	1750	0.55	0.35	0.25		#DIV/0!		Narrow lanes on SR 58
(18) SR 56 - SR 57 - US 50 - US 231	3266	1	381	800	1275	1750	0.48	0.30	0.22		#DIV/0!		Narrow lanes on SR 58
(19) US 50 - US 231 - SR 58	3266	1	381	800	1275	1750	0.48	0.30	0.22		#DIV/0!		Narrow lanes on SR 58
(20) US 50 - US 231	3266	1	381	800	1275	1750	0.48	0.30	0.22		#DIV/0!		
(21) SR 58 - US 231	3266	1	381	800	1275	1750	0.48	0.30	0.22		#DIV/0!		Narrow lanes on SR 58
(22) SR 58 - SR 45	4745	1	442	800	1275	1750	0.55	0.35	0.25		#DIV/0!		Narrow lanes on SR 58
(23) SR 58 - SR 45 - SR 445	2060	1	330	800	1275	1750	0.41	0.26	0.19		#DIV/0!		Narrow lanes on SR 58
(24) SR 58 - SR 37	2546	1	351	800	1275	1750	0.44	0.28	0.20		#DIV/0!		Narrow lanes on SR 58
(25) US 231 - SR 54 - SR 45	3266	1	381	800	1275	1750	0.48	0.30	0.22		#DIV/0!		
(26) US 231 - SR 54 - SR 445	3266	1	381	800	1275	1750	0.48	0.30	0.22		#DIV/0!		
(28) SR 45 - SR 445	2060	1	330	800	1275	1750	0.41	0.26	0.19		#DIV/0!		

🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

I-69-Section 3



Detour Route Table											
South Bound		Re-enter to Interstate from									
		SR39	Godsey Rd	Sample Rd	Walnut St	SR46	SR48	SR45	Tapp Rd	Fullerton Pike	SR37
Exit to	SR39	☒	County Road	County Road	County Road	(1) SR 39 - SR 67 - US 231 - SR 46	(2) SR 39 - SR 67 - US 231 - SR 43 - SR 48	(3) SR 39 - SR 67 - US 231 - SR 43 - SR 45	County Road	County Road	No suitable route
	Godsey Rd	☒	☒	County Road	County Road	County Road	County Road	County Road	County Road	County Road	County Road
	Sample Rd	☒	☒	☒	County Road	County Road	County Road	County Road	County Road	County Road	County Road
	Walnut St	☒	☒	☒	☒	County Road	County Road	County Road	County Road	County Road	County Road
	SR46	☒	☒	☒	☒	☒	(4) SR 46 - SR 43 - SR 48	(5) SR 46 - SR 43 - SR 45	County Road	County Road	No suitable route
	SR48	☒	☒	☒	☒	☒	☒	(6) SR 48 - SR 43 - SR 45	County Road	County Road	No suitable route
	SR45	☒	☒	☒	☒	☒	☒	☒	County Road	County Road	No suitable route
	Tapp Rd	☒	☒	☒	☒	☒	☒	☒	☒	County Road	County Road
	Fullerton Pike	☒	☒	☒	☒	☒	☒	☒	☒	☒	County Road
	SR37	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒

Detour Route Table											
North Bound		Re-enter to Interstate from									
		SR37	Fullerton Pike	Tapp Rd	SR45	SR48	SR46	Walnut St	Sample Rd	Godsey Rd	SR39
Exit to	SR37	☒	County Road	County Road	No suitabel route	No suitable route	No suitable soute	County Road	County Road	County Road	No suitable soute
	Fullerton Pike	☒	☒	County Road	County Road	County Road	County Road	County Road	County Road	County Road	County Road
	Tapp Rd	☒	☒	☒	County Road	County Road	County Road	County Road	County Road	County Road	County Road
	SR45	☒	☒	☒	(1) SR 45	(2) SR 45 - SR 43 - SR 48	(3) SR 45 - SR 43 - SR 46	County Road	County Road	County Road	(4) SR 45 - SR 43 - US 231 - SR 67 - SR 39
	SR48	☒	☒	☒	☒	☒	(5) SR 48 - SR 43 - SR 46	County Road	County Road	County Road	(6) SR 48 - SR 43 - US 231 - SR 67 - SR 39
	SR46	☒	☒	☒	☒	☒	☒	County Road	County Road	County Road	(7) SR 46 - US 231 - SR 67 - SR 39
	Walnut St	☒	☒	☒	☒	☒	☒	☒	County Road	County Road	County Road
	Sample Rd	☒	☒	☒	☒	☒	☒	☒	☒	County Road	County Road
	Godsey Rd	☒	☒	☒	☒	☒	☒	☒	☒	☒	County Road
	SR39	☒	☒	☒	☒	☒	☒	☒	☒	☒	☒

AADT	

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Adding Miles and Time	Site-specific Notes

🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

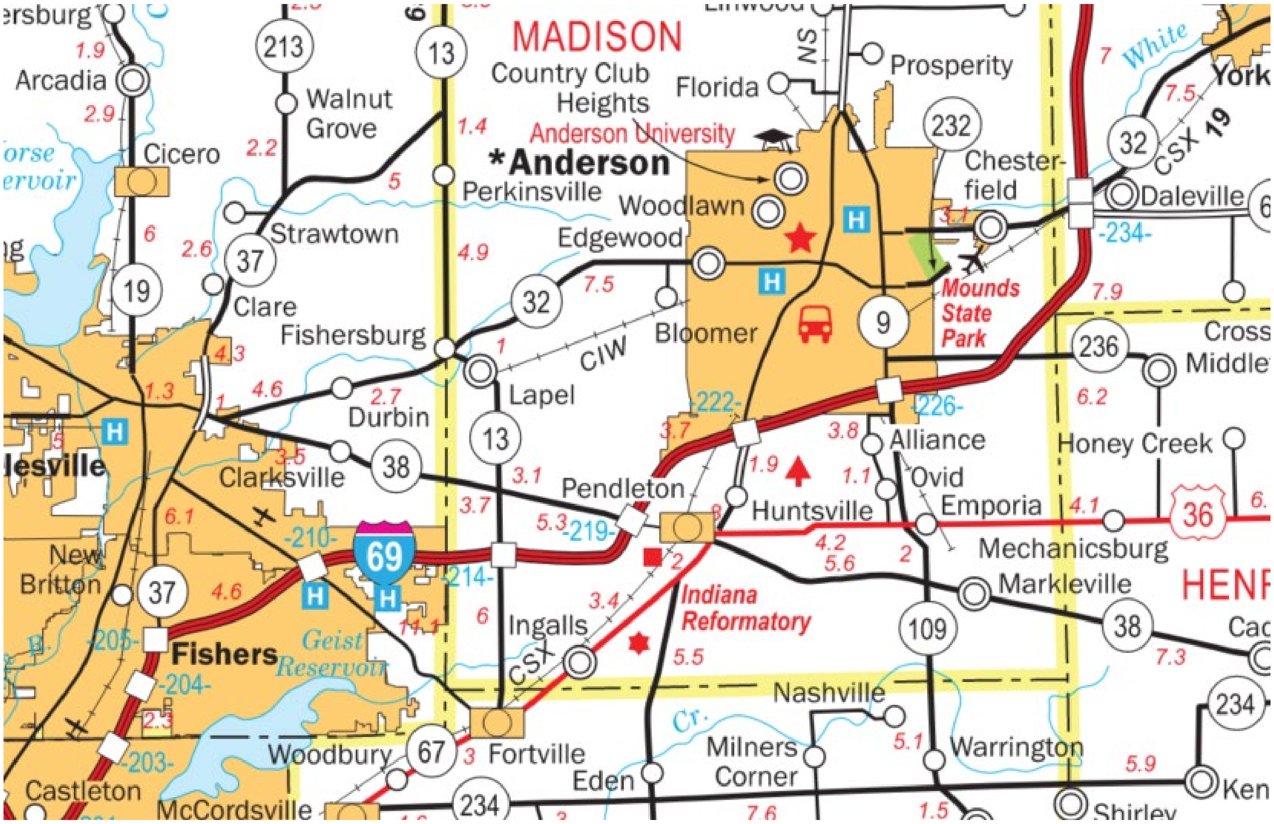
AADT	

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Adding Miles and Time	Site-specific Notes
(1) SR 45	5222	1				1750	0.61	0.38	0.28		#DIV/0!		
(2) SR 45 - SR 43 - SR 48	2854	1				1750	0.49	0.31	0.22		#DIV/0!		Narrow lanes
(3) SR 45 - SR 43 - SR 46	7217	1				1750	0.71	0.45	0.33		#DIV/0!		Narrow lanes Sharp turns
(4) SR 45 - SR 43 - US 231 - SR 67 -	2877	1				1750	0.49	0.31	0.22		#DIV/0!		Narrow lanes Sharp turns
(5) SR 48 - SR 43 - SR 46	2854	1				1750	0.49	0.31	0.22		#DIV/0!		Narrow lanes on SR 43
(6) SR 48 - SR 43 - US 231 - SR 67 -	2877	1				1750	0.49	0.31	0.22		#DIV/0!		Narrow lanes on SR 43
(7) SR 46 - US 231 - SR 67 - SR 39	2877	1				1750	0.49	0.31	0.22		#DIV/0!		Passes through town centers

🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

I-69-Section 4



Detour Route Table

South Bound		Re-enter to Interstate from								
		SR32	SR67	SR9	SR38	SR38	SR13	Campus Pkwy	SR37	E116th St
Exit to	SR32		No suitable route	(1) SR 32 - SR 9	(2) SR 32 - SR 38	(2) SR 32 - SR 38	(3) SR 32 - SR 13	County Road	(4) SR 32 - SR 37	County Road
	SR67			(5) SR 67 - SR 3 - US 36 - SR 9 (SR 109)	(6) SR 67 - SR 3 - SR 38	(6) SR 67 - SR 3 - SR 38	No suitable route	County Road	No suitable route	County Road
	SR9				(7) SR 9 (SR 109) - SR 38	(7) SR 9 (SR 109) - SR 38	(8) SR 9 - SR 32 - SR 13	County Road	(10) SR 9 - SR 32 - SR 37	County Road
	SR38						(11) SR 38 - SR 13	County Road	(12) SR 38 - SR 37	County Road
	SR38						(11) SR 38 - SR 13	County Road	(12) SR 38 - SR 37	County Road
	SR13							County Road	(13) SR 13 - SR 37	County Road
	Campus Pkwy								County Road	County Road
	SR37									County Road
	E116th St									

Detour Route Table

North Bound		Re-enter to Interstate from								
		E116th St	SR37	Campus Pkwy	SR13	SR38	SR38	SR9	SR67	SR32
Exit to	E116th St		County Road	County Road	County Road	County Road	County Road	County Road	County Road	County Road
	SR37			County Road	(1) SR 37 - SR 32 - SR 13	(2) SR 37 - SR 38	(2) SR 37 - SR 38	(3) SR 37 - SR 32 - SR 9	No suitable route	(4) SR 37 - SR 32
	Campus Pkwy				County Road	County Road	County Road	County Road	County Road	County Road
	SR13					(5) SR 13 - SR 38	(5) SR 13 - SR 38	(6) SR 13 - SR 32 - SR 9	No suitable route	(7) SR 13 - SR 32
	SR38							(8) SR 38 - SR 9 (SR 109)	No suitable route	(9) SR 38 - SR 32
	SR38							(8) SR 38 - SR 9 (SR 109)	No suitable route	(9) SR 38 - SR 32
	SR9								No suitable route	(10) SR 9 - SR 32
	SR67									No suitable route
	SR32									

AADT	

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Adding Miles and Time	Site-specific Notes

🟨 Input by Research Team
🟩 Auto Calculation
🟧 Input by Decision Makers

AADT	**22372**

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Adding Miles and Time	Site-specific Notes
(1) SR 37 - SR 32 - SR 13	2474	1	1035		#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!		Passes through residential area
(2) SR 37 - SR 38	2310	1	1028		#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!		
(2) SR 37 - SR 38	2310	1	1028		#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!		
(3) SR 37 - SR 32 - SR 9	4497	1	1120		#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!		Passes through residential area
(4) SR 37 - SR 32	3526	1	1079		#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!		Passes through residential area
(5) SR 13 - SR 38	2310	1	1028		#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!		Passes through town center
(5) SR 13 - SR 38	2310	1	1028		#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!		Passes through town center
(6) SR 13 - SR 32 - SR 9	4497	1	1120		#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!		Passes through town center
(7) SR 13 - SR 32	2602	1	1041		#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!		
(8) SR 38 - SR 9 (SR 109)	2096	1	1020		#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!		
(9) SR 38 - SR 32	2172	1	1023		#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!		Passes through town center
(10) SR 9 - SR 32	4497	1	1120		#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!		Passes through town center
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🟨 Input by Research Team
🟩 Auto Calculation
🟧 Input by Decision Makers

I-69-Section 5

Detour Route Table

South Bound		Re-enter to Interstate from								
		US224	SR5	SR218	SR18	SR22	SR26	US35	SR332	SR32
Exit to	US224		(1) US 224 - SR 5	(2) US 224 - SR 3 - SR 218	(3) US 224 - SR 3 - SR 18	(4) US 224 - SR 3 - SR 22	(5) US 224 - SR 3 - SR 26	(6) US 224 - SR 3 - US 35	(7) US 224 - SR 3 - US 35 - SR 332	(8) US 224 - SR 3 - US 35 - SR 32
	SR5			(9) SR 5 - SR 3 - SR 218	(10) SR 5 - SR 3 - SR 18	(11) SR 5 - SR 3 - SR 22	(12) SR 5 - SR 3 - SR 26	(13) SR 5 - SR 3 - US 35	(14) SR 5 - SR 3 - US 35 - SR 332	(15) SR 5 - SR 3 - US 35 - SR 32
	SR218				(16) SR 218 - SR 5 - SR 18	(17) SR 218 - SR 5 - SR 22	(18) SR 218 - SR 5 - SR 26	(19) SR 218 - SR 3 - US 35	(20) SR 218 - SR 3 - US 35 - SR 332	(21) SR 218 - SR 3 - US 35 - SR 32
	SR18					(22) SR 18 - SR 5 - SR 22	(23) SR 18 - SR 5 - SR 26	(24) SR 18 - SR 3 - US 35	(25) SR 18 - SR 3 - US 35 - SR 332	(26) SR 18 - SR 3 - US 35 - SR 32
	SR22						(27) SR 22 - SR 3 - SR 26	(28) SR 22 - SR 3 - US 35	(29) SR 22 - SR 3 - US 35 - SR 332	(30) SR 22 - SR 3 - US 35 - SR 32
	SR26							(31) SR 26 - SR 3 - US 35	(32) SR 26 - SR 3 - US 35 - SR 332	(33) SR 26 - SR 3 - US 35 - SR 32
	US35								(34) US 35 - SR 332	(35) US 35 - SR 32
	SR332									(36) SR 332 - SR 32
	SR32									

Detour Route Table

North Bound		Re-enter to Interstate from								
		SR32	SR332	US35	SR26	SR22	SR18	SR218	SR5	US224
Exit to	SR32		(1) SR 32 - US 35 - SR 332	(2) SR 32 - US 35	(3) SR 32 - SR 9 - SR 26	(4) SR 32 - SR 9 - SR 22	(5) SR 32 - SR 9 - SR 18	(6) SR 32 - SR - SR 218	(7) SR 32 - SR 9 - SR 124 - SR 5	(8) SR 32 - SR 9 - US 224
	SR332			(9) SR 332 - US 35	(10) SR 332 - US 35 - SR 26	(11) SR 332 - US 35 - SR 3 - SR 22	(13) SR 332 - US 35 - SR 3 - SR 18	(14) SR 332 - US 35 - SR 3 - SR 218	(15) SR 332 - US 35 - SR 3 - SR 218 - SR 5	(16) SR 332 - US 35 - SR 3 - US 224
	US35				(17) US 35 - SR 3 - SR 26	(18) US 35 - SR 3 - SR 26 -SR 22	(19) US 35 - SR 3 - SR 18	(20) US 35 - SR 3 - SR 218	(21) US 35 - SR 3 - SR 5	(22) US 35 - SR 3 - US 224
	SR26					(23) SR 26 - SR 5 - SR 22	(24) SR 26 - SR 5 - SR 28	(25) SR 26 - SR 5 - SR 218	(26) SR 26 - SR 5	(27) SR 26 - SR 3 - US 224
	SR22						(28) SR 22- SR 5 - SR 28	(29) SR 22- SR 5 - SR 218	(30) SR 22- SR 5	(31) SR 22- SR 3 - US 224
	SR18							(32) SR 18 - SR 5 - SR 218	(33) SR 18 - SR - 3 - SR 218	(34) SR 18 - SR 3 - US 224
	SR218								(35) SR 218 - SR 5	(36) SR 218 - SR 3 - US 224
	SR5									(37) SR 5 - US 224
	US224									

AADT	🟨

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Adding Miles and Time	Site-specific Notes
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🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

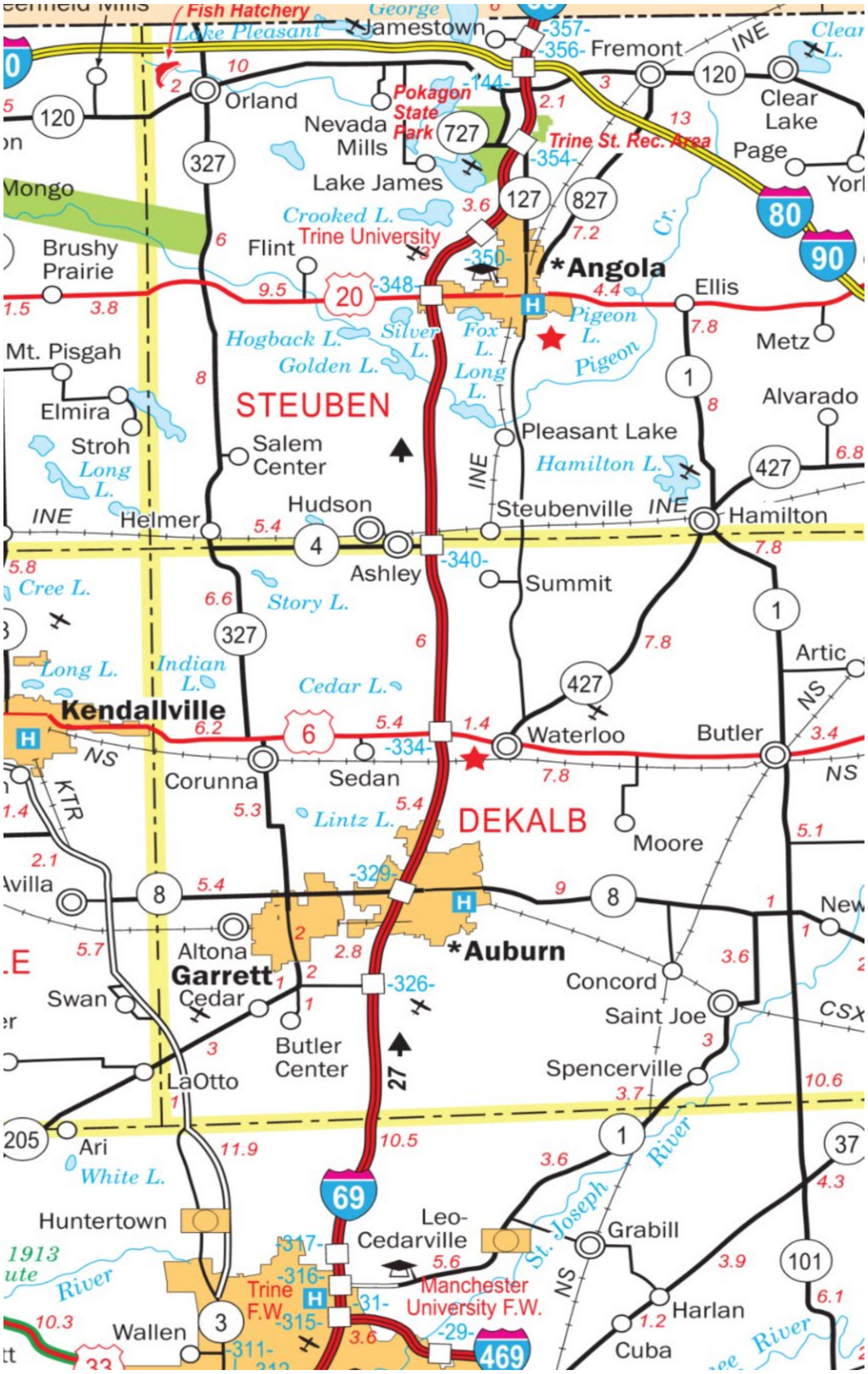
AADT	

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Adding Miles and Time	Site-specific Notes
(1) SR 32 - US 35 - SR 332	3347	1	776	800	1275	1750	0.97	0.61	0.44		#DIV/0!		Passes through town center
(2) SR 32 - US 35	3347	1	776	800	1275	1750	0.97	0.61	0.44		#DIV/0!		
(3) SR 32 - SR 9 - SR 26	2465	1	739	800	1275	1750	0.92	0.58	0.42		#DIV/0!		
(4) SR 32 - SR 9 - SR 22	2465	1	739	800	1275	1750	0.92	0.58	0.42		#DIV/0!		Narrow lanes on SR 22
(5) SR 32 - SR 9 - SR 18	4794	1	836	800	1275	1750	1.05	0.66	0.48		#DIV/0!		
(6) SR 32 - SR - SR 218	4794	1	836	800	1275	1750	1.05	0.66	0.48		#DIV/0!		
(7) SR 32 - SR 9 - SR 124 - SR 5	2717	1	749	800	1275	1750	0.94	0.59	0.43		#DIV/0!		
(8) SR 32 - SR 9 - US 224	3375	1	777	800	1275	1750	0.97	0.61	0.44		#DIV/0!		
(9) SR 332 - US 35	4794	1	836	800	1275	1750	1.05	0.66	0.48		#DIV/0!		Passes through town center
(10) SR 332 - US 35 - SR 26	4794	1	836	800	1275	1750	1.05	0.66	0.48		#DIV/0!		Passes through town center
(11) SR 332 - US 35 - SR 3 - SR 22	4794	1	836	800	1275	1750	1.05	0.66	0.48		#DIV/0!		Passes through town center
(13) SR 332 - US 35 - SR 3 - SR 18	4794	1	836	800	1275	1750	1.05	0.66	0.48		#DIV/0!		Passes through town center
(14) SR 332 - US 35 - SR 3 - SR 218	4794	1	836	800	1275	1750	1.05	0.66	0.48		#DIV/0!		Passes through town center
(15) SR 332 - US 35 - SR 3 - SR 218 -	2717	1	749	800	1275	1750	0.94	0.59	0.43		#DIV/0!		Passes through town center
(16) SR 332 - US 35 - SR 3 - US 224	2717	1	749	800	1275	1750	0.94	0.59	0.43		#DIV/0!		Passes through town center
(17) US 35 - SR 3 - SR 26	3375	1	777	800	1275	1750	0.97	0.61	0.44		#DIV/0!		
(18) US 35 - SR 3 - SR 26 -SR 22	3375	1	777	800	1275	1750	0.97	0.61	0.44		#DIV/0!		Narrow lanes on SR 22
(19) US 35 - SR 3 - SR 18	3375	1	777	800	1275	1750	0.97	0.61	0.44		#DIV/0!		
(20) US 35 - SR 3 - SR 218	4794	1	836	800	1275	1750	1.05	0.66	0.48		#DIV/0!		
(21) US 35 - SR 3 - SR 5	2717	1	749	800	1275	1750	0.94	0.59	0.43		#DIV/0!		
(22) US 35 - SR 3 - US 224	3347	1	776	800	1275	1750	0.97	0.61	0.44		#DIV/0!		
(23) SR 26 - SR 5 - SR 22	2753	1	751	800	1275	1750	0.94	0.59	0.43		#DIV/0!		
(24) SR 26 - SR 5 - SR 28	2753	1	751	800	1275	1750	0.94	0.59	0.43		#DIV/0!		
(25) SR 26 - SR 5 - SR 218	2753	1	751	800	1275	1750	0.94	0.59	0.43		#DIV/0!		
(26) SR 26 - SR 5	3347	1	776	800	1275	1750	0.97	0.61	0.44		#DIV/0!		
(27) SR 26 - SR 3 - US 224	3347	1	776	800	1275	1750	0.97	0.61	0.44		#DIV/0!		
(28) SR 22- SR 5 - SR 28	2753	1	751	800	1275	1750	0.94	0.59	0.43		#DIV/0!		Narrow lanes on SR 22
(29) SR 22- SR 5 - SR 218	2753	1	751	800	1275	1750	0.94	0.59	0.43		#DIV/0!		Narrow lanes on SR 22
(30) SR 22- SR 5	2753	1	751	800	1275	1750	0.94	0.59	0.43		#DIV/0!		Narrow lanes on SR 22
(31) SR 22- SR 3 - US 224	4679	1	831	800	1275	1750	1.04	0.65	0.47		#DIV/0!		Narrow lanes on SR 22
(32) SR 18 - SR 5 - SR 218	4679	1	831	800	1275	1750	1.04	0.65	0.47		#DIV/0!		
(33) SR 18 - SR -3 - SR 218	4679	1	831	800	1275	1750	1.04	0.65	0.47		#DIV/0!		
(34) SR 18 - SR 3 - US 224	4679	1	831	800	1275	1750	1.04	0.65	0.47		#DIV/0!		
(35) SR 218 - SR 5	4794	1	836	800	1275	1750	1.05	0.66	0.48		#DIV/0!		
(36) SR 218 - SR 3 - US 224	4794	1	836	800	1275	1750	1.05	0.66	0.48		#DIV/0!		
(37) SR 5 - US 224	2717	1	749	800	1275	1750	0.94	0.59	0.43		#DIV/0!		

🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

I-69-Section 6



Detour Route Table

South Bound		Re-enter to Interstate from					
		SR 127	US 20	SR 4	US 6	SR 8	SR 1
Exit to	SR 127	☒	(1) SR 127 - US 20	No suitable route	No suitable route	No suitable route	No suitable route
	US 20	☒	☒	(2) US 20 - SR 327 - SR 4	(3) US 20 - SR 327 - US 6	(4) US 20 - SR 327 - SR 8	(5) US 20 - SR 1
	SR 4	☒	☒	☒	(6) SR 4 - SR 327 - US 6	(7) SR 4 - SR 327 - SR 8	No suitable route
	US 6	☒	☒	☒	☒	(8) US 6 - SR 327 - SR 8	(9) US 6 - SR 1
	SR 8	☒	☒	☒	☒	☒	(10) SR 8 - SR 1
	SR 1	☒	☒	☒	☒	☒	☒

Detour Route Table

North Bound		Re-enter to Interstate from					
		SR 1	SR 8	US 6	SR 4	US 20	SR 127
Exit to	SR 1	☒	(1) SR 1 - SR 8	(2) SR 1 - US 6	No suitable route	(3) SR 1 - US 20	(4) SR 1 - US 20 - SR 127
	SR 8	☒	☒	(5) SR 8 - SR 327 - US 6	(6) SR 8 - SR 327 - SR 4	(7) SR 8 - SR 327 - US 20	No suitable route
	US 6	☒	☒	☒	(8) US 6 - SR - 327 - SR 4	(9) US 6 - SR 327 - US 20	No suitable route
	SR 4	☒	☒	☒	☒	(10) SR 4 - SR 327 - US 20	No suitable route
	US 20	☒	☒	☒	☒	☒	No suitable route
	SR 127	☒	☒	☒	☒	☒	☒

AADT	🟨

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes
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🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

AADT	🟨

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes
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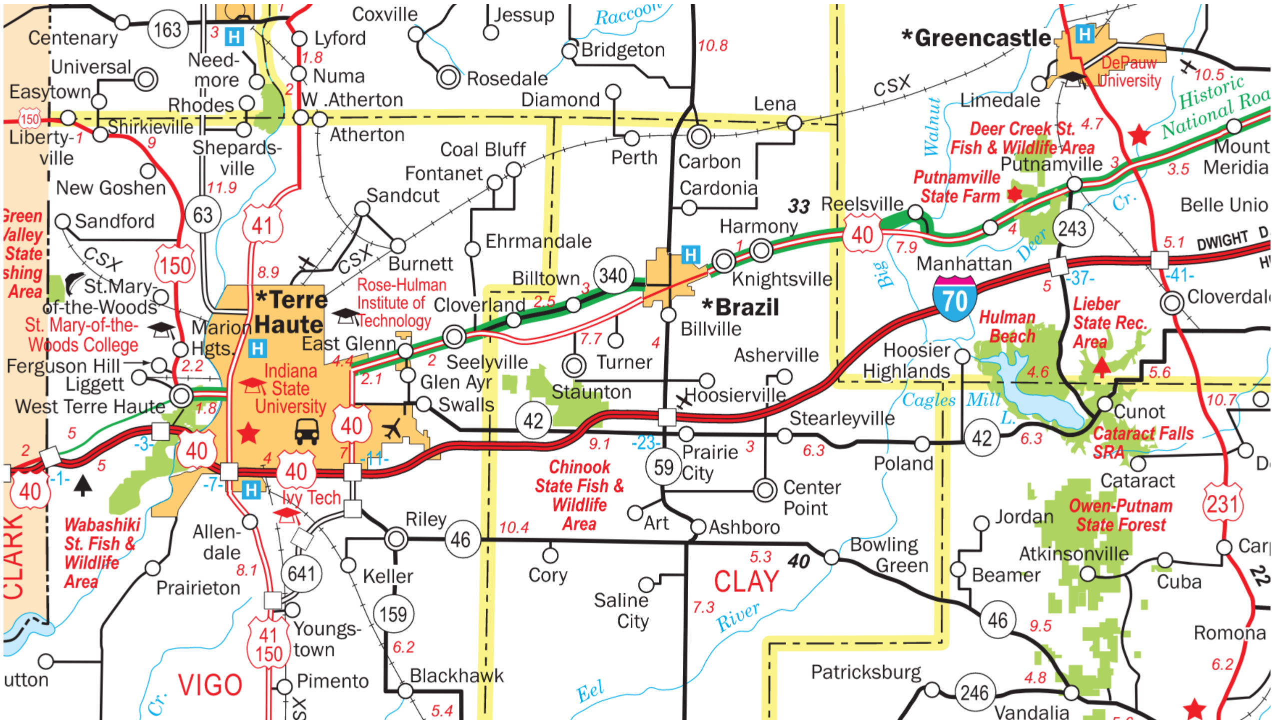
🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

I-70-Section 1



Detour Route Table

East Bound		Re-enter to Interstate from						
		National Ave	Darwin Rd	US150	US40	SR59	SR243	US231
Exit to	National Ave		County Road	County Road	County Road	County Road	County Road	County Road
	Darwin Rd			County Road	County Road	County Road	County Road	County Road
	US150				US150 travels in opposite direction of the eastbound	US150 travels in opposite direction of the eastbound	US150 travels in opposite direction of the eastbound	US150 travels in opposite direction of the eastbound
	US40					(1) US40 - SR59	(2) US40 - SR243	No intersection and feasible route
	SR59						(3) SR59 - SR243	No intersection and feasible route
	SR243							No intersection and feasible route
	US231							

Detour Route Table

West Bound		Re-enter to Interstate from						
		US231	SR243	SR59	US40	US150	Darwin Rd	National Ave
Exit to	US231		Does not intersect	Does not intersect	Does not intersect	Does not intersect	County Road	County Road
	SR243			(1) SR243 - US40 - SR59	(2) SR243 - US40	No feasible route	County Road	County Road
	SR59				(3) SR59 - SR42 - US40	No feasible route	County Road	County Road
	US40					No feasible route	County Road	County Road
	US150						County Road	County Road
	Darwin Rd							County Road
	National Ave							

AADT	🟨

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes
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🟨	Input by Research Team
🟩	Auto Calculation
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AADT	🟨

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes
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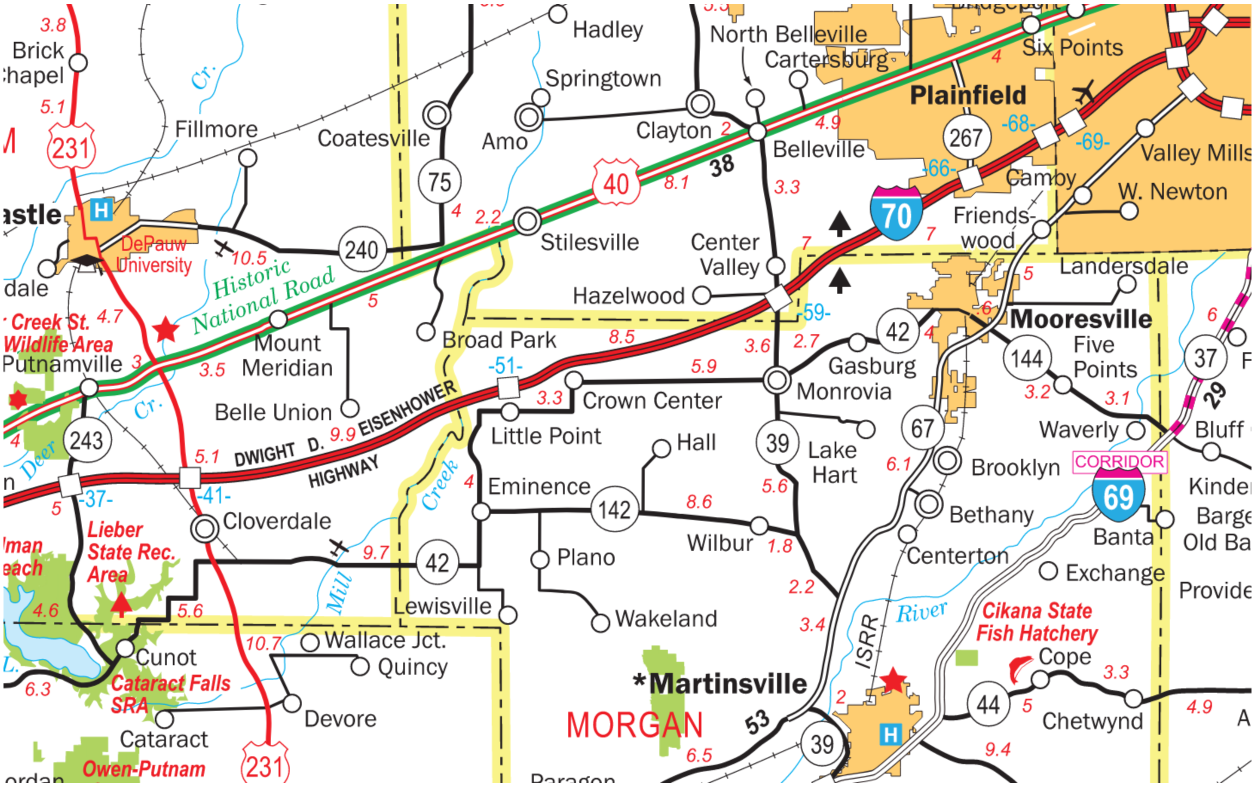
🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

I-70-Section 2



Detour Route Table

East Bound		Re-enter to Interstate from				
		US231	Little Point Rd	SR39	SR267	Ronald Reagan Pkwy
Exit to	US231	☒	County Road	(1) US231 - SR67 - SR39	Does not intersect with US40 to reach SR267	County Road
	Little Point Rd	☒	☒	County Road	County Road	County Road
	SR39	☒	☒	☒	(2) SR39 - US40 - SR267	County Road
	SR267	☒	☒	☒	☒	County Road
	Ronald Reagan Pkwy	☒	☒	☒	☒	☒

Detour Route Table

West Bound		Re-enter to Interstate from				
		Ronald reagan Pkwy	SR267	SR39	Little Point Rd	US231
Exit to	Ronald Reagan Pkwy	☒	County Road	County Road	County Road	County Road
	SR267	☒	☒	(1) SR267 - US40 - SR39	County Road	No intersection with US231
	SR39	☒	☒	☒	County Road	(2) SR39 - SR67 - US231
	Little Point Rd	☒	☒	☒	☒	County Road
	US231	☒	☒	☒	☒	☒

AADT	🟨

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes
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🟨	Input by Research Team
🟩	Auto Calculation
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AADT	🟨

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes
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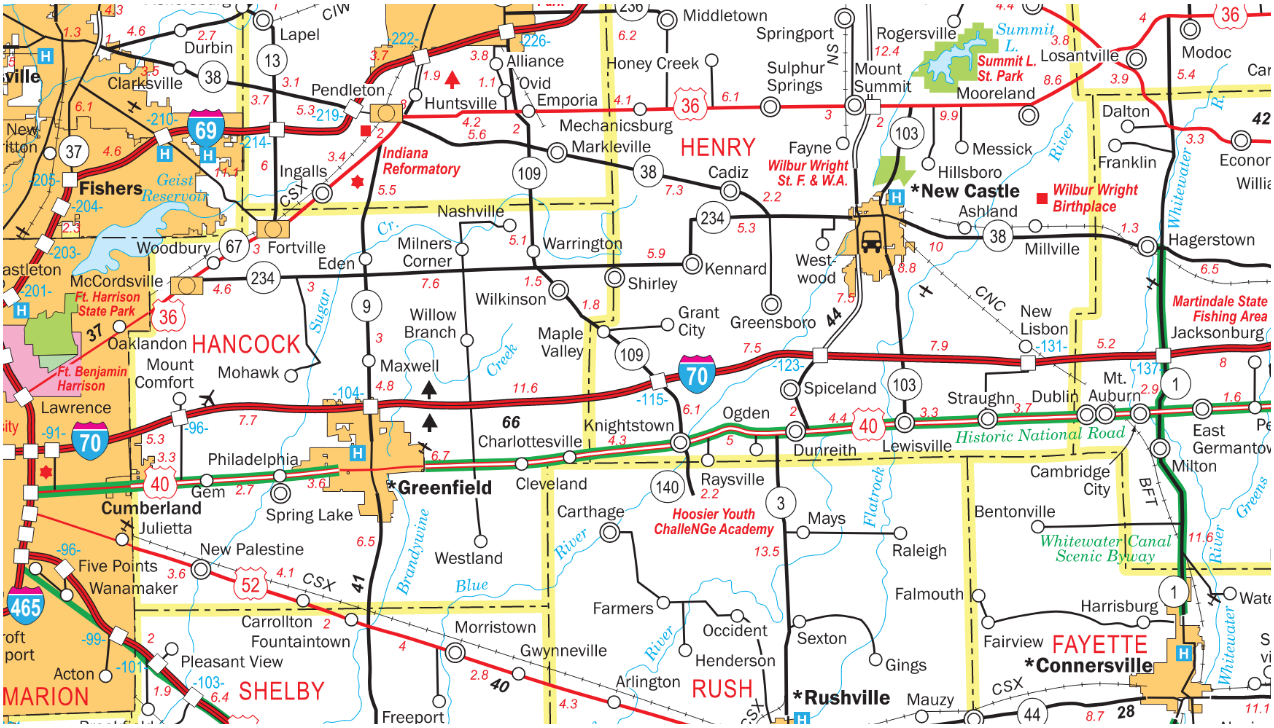
🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

I-70-Section 3



Detour Route Table

East Bound		Re-enter to Interstate from				
		Mt Comfort Rd	SR9	SR109	SR3	Willbur Wright Rd
Exit to	Mt Comfort Rd	╳	County Road	County Road	County Road	County Road
	SR9	╳	╳	(1) SR9 - US40 - SR109	(2) SR9 - US40 - SR3	County Road
	SR109	╳	╳	╳	(3) SR109 - US40 - SR3	County Road
	SR3	╳	╳	╳	╳	County Road
	Willbur Wright rd	╳	╳	╳	╳	╳

Detour Route Table

West Bound		Re-enter to Interstate from				
		Willbur Wright rd	SR3	SR109	SR9	Mt Comfort Rd
Exit to	Willbur Wright Rd	╳	County Road	County Road	County Road	County Road
	SR3	╳	╳	(1) SR3 - SR234 - SR109	(2) SR3 - SR234 - SR9	County Road
	SR109	╳	╳	╳	(3) SR109 - SR234 - SR9	County Road
	SR9	╳	╳	╳	╳	County Road
	Mt Comfort Rd	╳	╳	╳	╳	╳

AADT	🟨

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes
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🟨	Input by Research Team
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AADT	🟨

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes
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🟨	Input by Research Team
🟩	Auto Calculation
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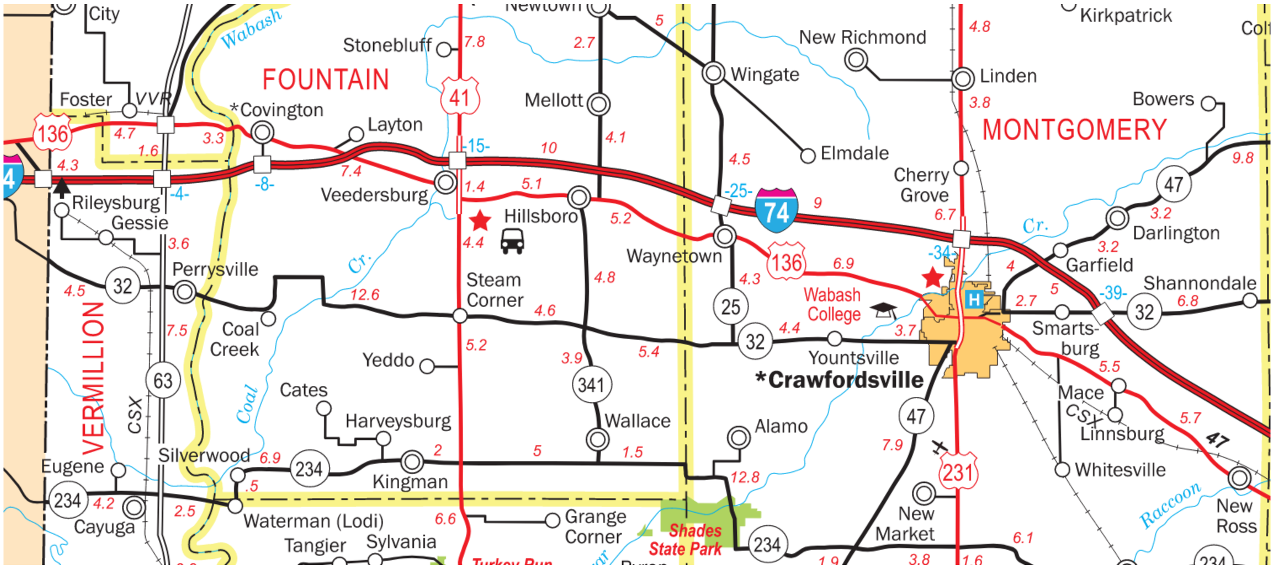
I-74-Section 1



Detour Route Table

East Bound		Re-enter to Interstate from					
		SR63	Stringtown Rd	US41	SR25	US231	SR32
Exit to	SR63		County Road	(1) SR 63 - US 136 - US 41	(2) SR 63 - US 136 - SR 25	(3) SR 63 - US 136 - US 231	(4) SR 63 - US 136 - SR 32
	Stringtown Rd			County Road	County Road	County Road	County Road
	US41				(5) US 41 - US 136 - SR 25	(6) US 41 - US 136 - US 231	(7) US 41 - US 136 - SR 32
	SR25					(8) SR 25 - US 136 - US 231	(9) SR 25 - US 136 - SR 32
	US231						(10) US 231 - US 136 - SR 32
	SR32						

Detour Route Table

West Bound		Re-enter to Interstate from					
		SR32	US231	SR25	US41	Stringtown Rd	SR63
Exit to	SR32		(1) SR 32 - US 136 - US 231	(2) SR 32 - US 136 - SR 25	(3) SR 32 - US 136 - US 41	County Road	(4) SR 32 - US 136 - SR 53
	US231			(5) US 231 - US 136 - SR 25	(6) US 231 - US 136 - US 42	County Road	(7) US 231 - US 136 - SR 63
	SR25				(8) SR 25 - US 136 - US 42	County Road	(9) SR 25 - US 136 - SR 63
	US41					County Road	(10) US 41 - US 136 - SR 63
	Stringtown Rd						County Road
	SR63						

AADT	

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes

🟨	Input by Research Team
🟩	Auto Calculation
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AADT	

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Adding Miles and Time	Site-specific Notes
(1) SR 32 - US 136 - US 231	5602	1				1750	0.71	0.45	0.33			Passes through town center
(2) SR 32 - US 136 - SR 25	1233	1				1750	0.49	0.31	0.22			Passes through town center
(3) SR 32 - US 136 - US 41	2526	1				1750	0.55	0.35	0.25			Passes through town center
(4) SR 32 - US 136 - SR 63	2303	1				1750	0.54	0.34	0.25			Passes through town center
(5) US 231 - US 136 - SR 25	1233	1				1750	0.49	0.31	0.22			Passes through town center
(6) US 231 - US 136 - US 41	2526	1				1750	0.55	0.35	0.25			Passes through town center
(7) US 231 - US 136 - SR 63	2303	1				1750	0.54	0.34	0.25			Passes through town center
(8) SR 25 - US 136 - US 41	1233	1				1750	0.49	0.31	0.22			Sharp turn to US 136
(9) SR 25 - US 136 - SR 63	2526	1				1750	0.55	0.35	0.25			Sharp turn to US 136
(10) US 41 - US 136 - SR 63	2303	1				1750	0.54	0.34	0.25			

🟨	Input by Research Team
🟩	Auto Calculation
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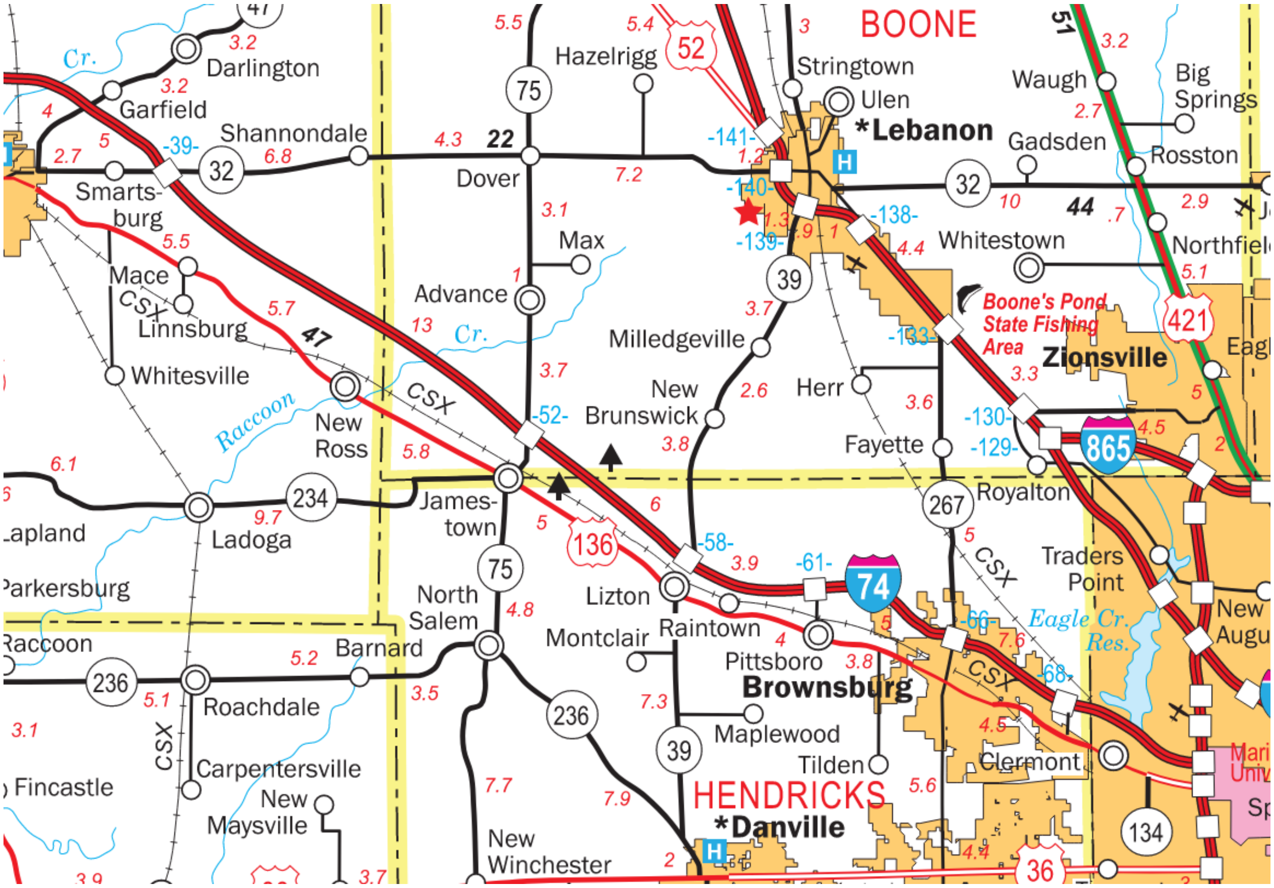
I-74-Section 2



Detour Route Table

East Bound		Re-enter to Interstate from					
		SR32	SR75	SR39	Jeff Gordon Blvd	SR267	Ronald Reagan Pkwy
Exit to	SR32		(1) SR 32 - US 136 - SR 75	(2) SR 32 - US 136 - SR 39	County Road	(3) SR 32 - US 136 - SR 267	County Road
	SR75			(4) SR 75 - US 136 - SR 39	County Road	(5) SR 75 - US 136 - SR 267	County Road
	SR39				County Road	(6) SR 39 - US 136 - SR 267	County Road
	Jeff Gordon Blvd					County Road	County Road
	SR267						County Road
	Ronald Reagan Pkwy						

Detour Route Table

West Bound		Re-enter to Interstate from					
		Ronald Reagan Pkwy	SR267	Jeff Gordon Blvd	SR39	SR75	SR32
Exit to	Ronald Reagan Pkwy		County Road	County Road	County Road	County Road	County Road
	SR267			County Road	(1) SR 267 - US 136 - SR 39	(2) SR 267 - US 136 - SR 75	(3) SR 267 - US 136 - SR 32
	Jeff gordon Blvd				County Road	County Road	County Road
	SR39					(4) SR 39 - US 136 - SR 75	(5) SR 39 - US 136 - SR 32
	SR75						(6) SR 75 - US 136 - SR 32
	SR32						

AADT	🟨

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes
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🟨 Input by Research Team
🟩 Auto Calculation
🟧 Input by Decision Makers

AADT	🟨

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes
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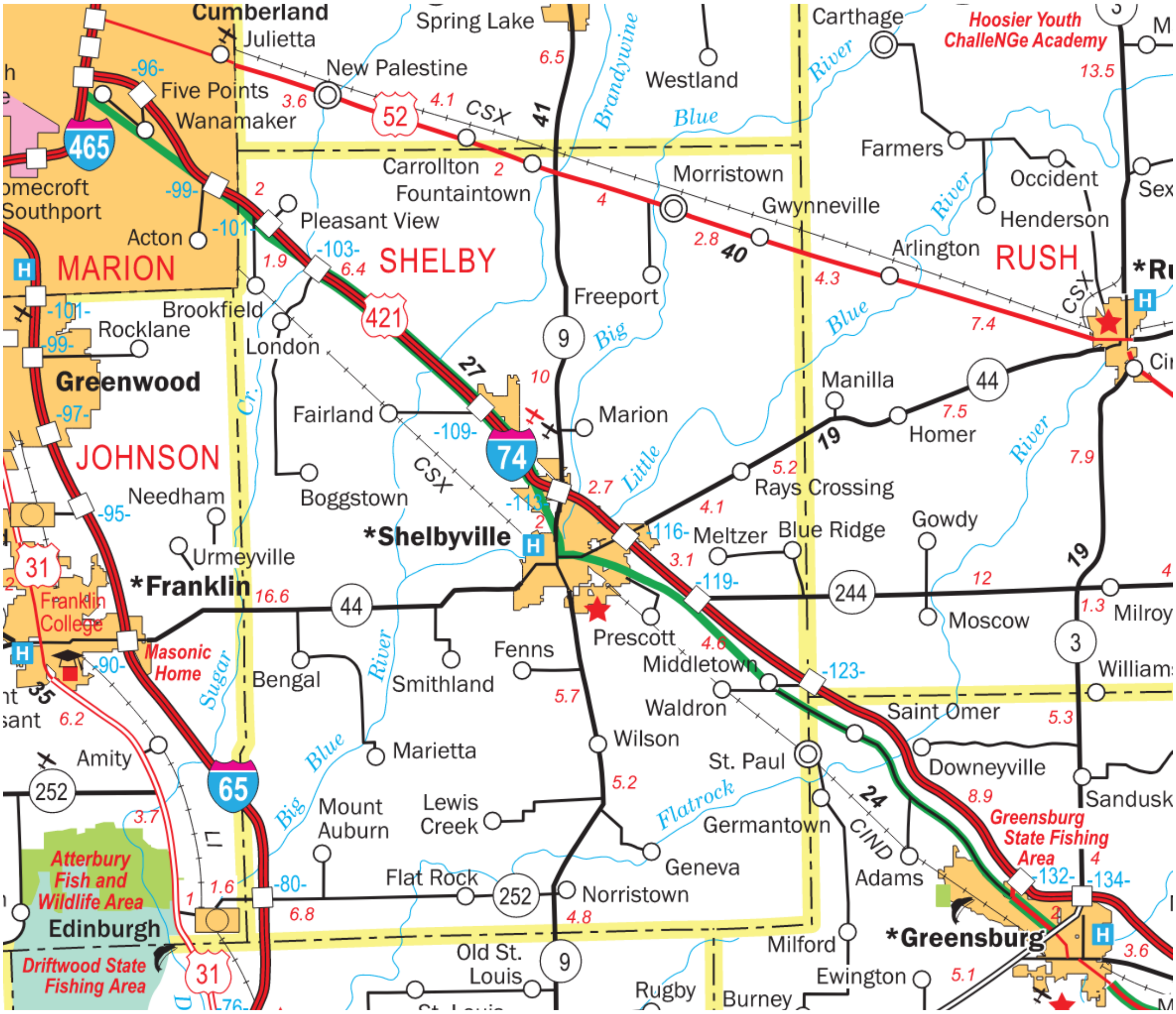
I-74-Section 3



Detour Route Table

East Bound		Re-enter to Interstate from							
		Walnut St	London Rd	US 52	SR9	SR44	SR244	Michian Rd	US421
Exit to	Walnut St		County Road	County Road	County Road	County Road	County Road	County Road	County Road
	London Rd			County Road	County Road	County Road	County Road	County Road	County Road
	US 52				(1) US 52 - SR 9	(2) US 52 - SR 44	(3) US 52 - SR 3 - SR 244	County Road	No suitable route
	SR9					(4) SR 9 - SR 44	(5) SR 9 - US 52 - SR 3 - SR 244	County Road	No suitable route
	SR44						(6) SR 44 - US 52 - SR 3 - SR 244	County Road	No suitable route
	SR244							County Road	No suitable route
	Michian Rd								County Road
	US421								

Detour Route Table

West Bound		Re-enter to Interstate from							
		US421	Michian Rd	SR244	SR44	SR9	US 52	London Rd	Walnut St
Exit to	US421		County Road	No suitable route	No suitable route	No suitable route	No suitable route	County Road	County Road
	Michian Rd			County Road	County Road	County Road	County Road	County Road	County Road
	SR244				(1) SR 244 - SR 3 - US 52 - SR 44	(2) SR 244 - SR 3 - US 52 - SR 9	(3) SR 244 - SR 3 - US 53	County Road	County Road
	SR44					(4) SR 44 - US 52 - SR 9	(5) SR 44 - US 52	County Road	County Road
	SR9						(6) SR 9 - US 52	County Road	County Road
	US 52							County Road	County Road
	London Rd								County Road
	Walnut St								

AADT	

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes

🟨 Input by Research Team
🟩 Auto Calculation
🟧 Input by Decision Makers

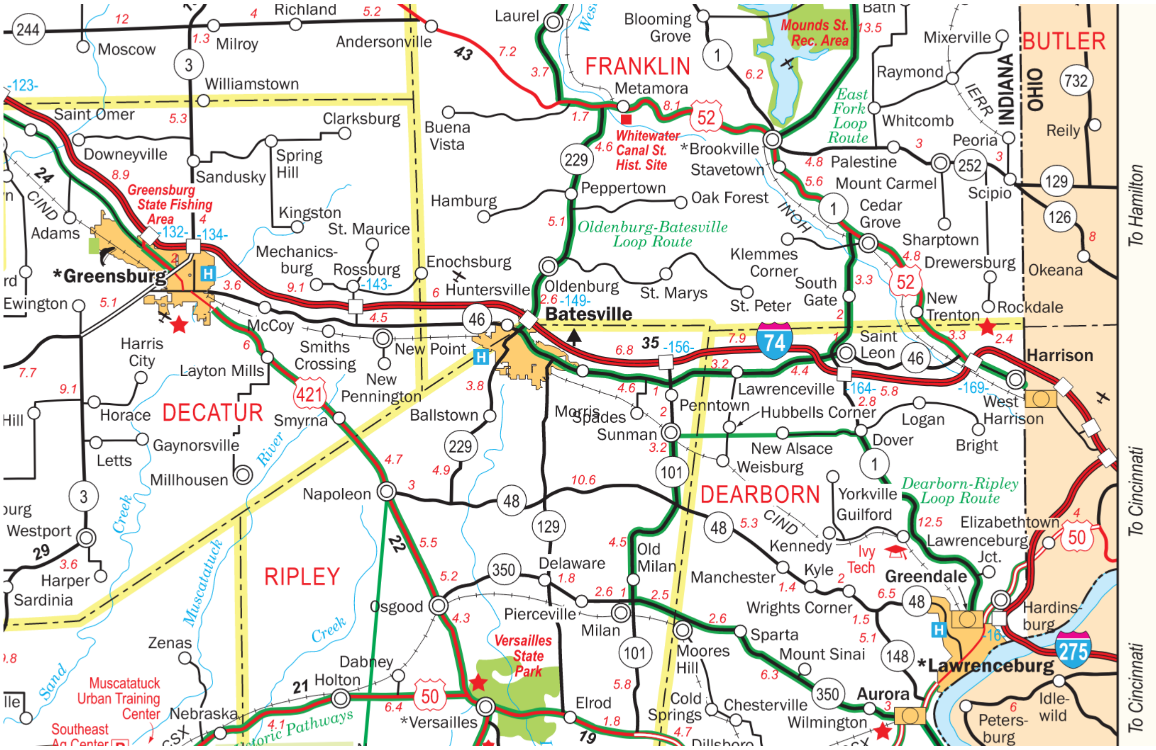
AADT	

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Site-specific Notes
						1750	1.47	0.92	0.67		
						1750	1.46	0.91	0.67		
						1750	1.81	1.14	0.83		
						1750	1.32	0.83	0.60		
						1750	1.46	0.92	0.67		
						1750	1.46	0.91	0.67		

🟨 Input by Research Team
🟩 Auto Calculation
🟧 Input by Decision Makers

I-74-Section 4



Detour Route Table

East Bound		Re-enter to Interstate from						
		US421	SR3	S Co Rd 850E	SR229	SR101	SR1	US52
Exit to	US421	☒	No suitable route	County Road	No suitable route	No suitable route	No suitable route	No suitable route
	SR3	☒	☒	County Road	(1) SR 3 - SR 46 - SR 229	(2) SR 3 - SR 46 - SR 101	(3) SR 3 - SR 46 - SR 1	(4) SR 3 - SR 46 - US 52
	S Co Rd 850E	☒	☒	☒	County Road	County Road	County Road	County Road
	SR229	☒	☒	☒	☒	(5) SR 229 - SR 46 - SR 101	(6) SR 229 - SR 46 - SR 1	(7) SR 229 - SR 46 - US 52
	SR101	☒	☒	☒	☒	☒	(8) SR 101 - SR 46 - SR 1	(9) SR 101 - SR 46 - US 52
	SR1	☒	☒	☒	☒	☒	☒	(10) SR 1 - SR 46 - US 52
	US52	☒	☒	☒	☒	☒	☒	☒

Detour Route Table

West Bound		Re-enter to Interstate from						
		US52	SR1	SR101	SR229	S Co Rd 850E	SR3	US421
Exit to	US52	☒	(1) US 52 - SR 46 - SR 1	(2) US 52 - SR 46 - SR 101	(3) US 52 - SR 46 - SR 229	County Road	(4) US 52 - SR 46 - SR 3	No suitable route
	SR1	☒	☒	(5) SR 1 - SR 46 - SR 101	(6) SR 1 - SR 46 - SR 229	County Road	(7) SR 1 - SR 46 - SR 3	No suitable route
	SR101	☒	☒	☒	(8) SR 101 - SR 46 - SR 229	County Road	(9) SR 101 - SR 46 - SR 3	No suitable route
	SR229	☒	☒	☒	☒	County Road	(10) SR 229 - SR 46 - SR 3	No suitable route
	S Co Rd 850E	☒	☒	☒	☒	☒	County Road	County Road
	SR3	☒	☒	☒	☒	☒	☒	No suitable route
	US421	☒	☒	☒	☒	☒	☒	☒

AADT	🟨

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes
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🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

AADT	🟨

Detour Capacity Analysis Table

Route	Max AADT of the Section (veh/day) (a)	Min # of Lanes in the Section (b)	Total Volume (veh/hr/ln) ((a)+AADT)/((b) x24)	Min Capacity (veh/hr/ln)	Average Capacity (veh/hr/ln)	Max Capacity (veh/hr/ln)	Max V/C	Average V/C	Min V/C	Actual (or Observed) Capacity	Actual (or Observed) V/C	Site-specific Notes
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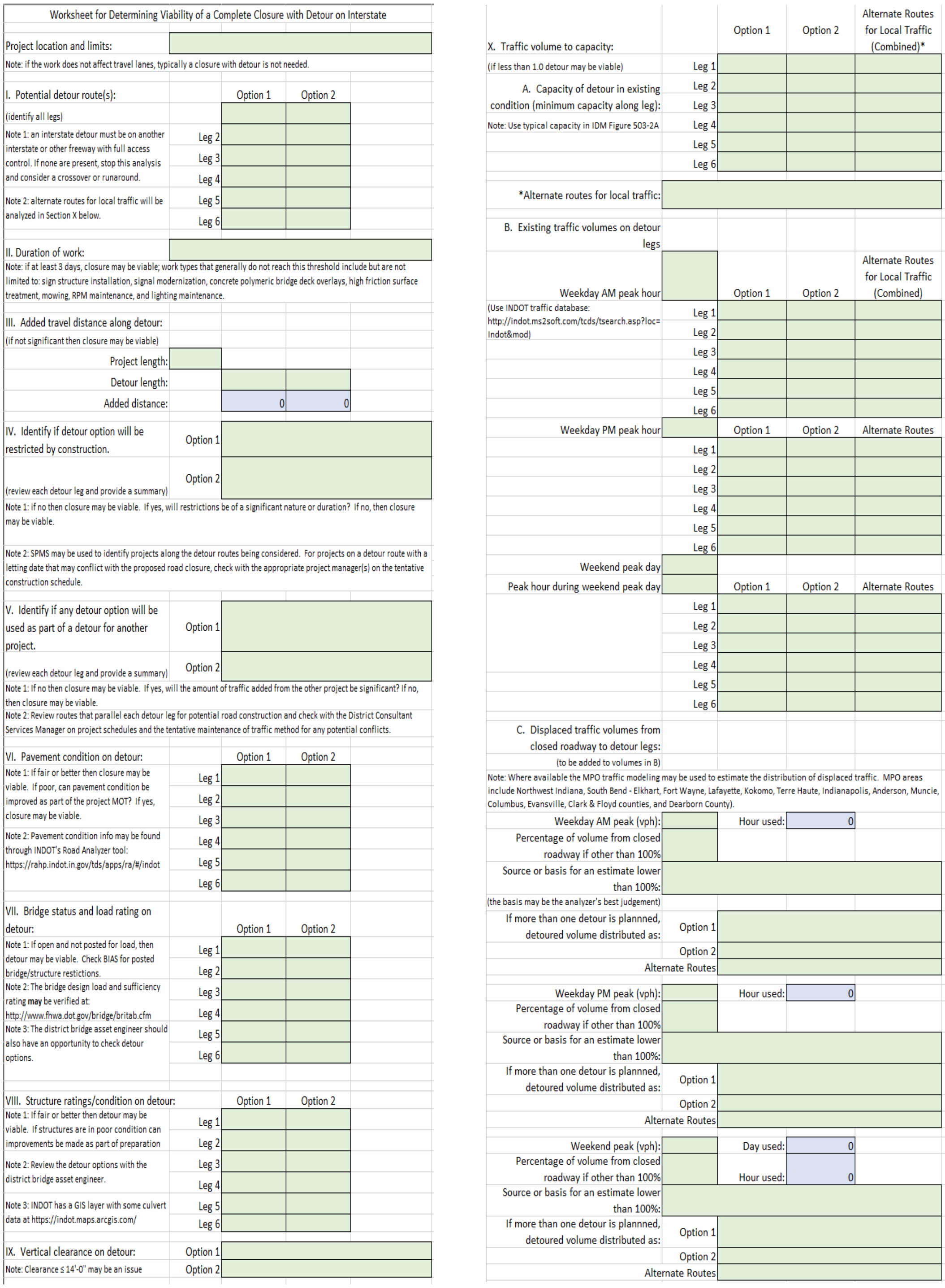
🟨	Input by Research Team
🟩	Auto Calculation
🟧	Input by Decision Makers

APPENDIX D. INDOT EDITABLE DOCUMENT: DETOUR WORKSHEET (INTERSTATE)



Worksheet for Determining Viability of a Complete Closure with Detour on Interstate

Project location and limits:

Note: if the work does not affect travel lanes, typically a closure with detour is not needed.

I. Potential detour route(s):		Option 1	Option 2
(identify all legs)			
Note 1: an interstate detour must be on another interstate or other freeway with full access control. If none are present, stop this analysis and consider a crossover or runaround.	Leg 2		
	Leg 3		
	Leg 4		
Note 2: alternate routes for local traffic will be analyzed in Section X below.	Leg 5		
	Leg 6		

II. Duration of work:

Note: if at least 3 days, closure may be viable; work types that generally do not reach this threshold include but are not limited to: sign structure installation, signal modernization, concrete polymeric bridge deck overlays, high friction surface treatment, mowing, RPM maintenance, and lighting maintenance.

III. Added travel distance along detour:

(if not significant then closure may be viable)

		Option 1	Option 2
Project length:			
Detour length:			
Added distance:		0	0

IV. Identify if detour option will be restricted by construction.

Option 1

Option 2

(review each detour leg and provide a summary)

Note 1: if no then closure may be viable. If yes, will restrictions be of a significant nature or duration? If no, then closure may be viable.

Note 2: SPMS may be used to identify projects along the detour routes being considered. For projects on a detour route with a letting date that may conflict with the proposed road closure, check with the appropriate project manager(s) on the tentative construction schedule.

V. Identify if any detour option will be used as part of a detour for another project.

Option 1

Option 2

(review each detour leg and provide a summary)

Note 1: If no then closure may be viable. If yes, will the amount of traffic added from the other project be significant? If no, then closure may be viable.

Note 2: Review routes that parallel each detour leg for potential road construction and check with the District Consultant Services Manager on project schedules and the tentative maintenance of traffic method for any potential conflicts.

VI. Pavement condition on detour:		Option 1	Option 2
Note 1: If fair or better then closure may be viable. If poor, can pavement condition be improved as part of the project MOT? If yes, closure may be viable.	Leg 1		
	Leg 2		
	Leg 3		
Note 2: Pavement condition info may be found through INDOT's Road Analyzer tool: https://rahp.indot.in.gov/tds/apps/ra/#/indot	Leg 4		
	Leg 5		
	Leg 6		

VII. Bridge status and load rating on detour:		Option 1	Option 2
Note 1: If open and not posted for load, then detour may be viable. Check BIAS for posted bridge/structure restictions.	Leg 1		
	Leg 2		
Note 2: The bridge design load and sufficiency rating **may** be verified at: http://www.fhwa.dot.gov/bridge/britab.cfm	Leg 3		
	Leg 4		
Note 3: The district bridge asset engineer should also have an opportunity to check detour options.	Leg 5		
	Leg 6		

VIII. Structure ratings/condition on detour:		Option 1	Option 2
Note 1: If fair or better then detour may be viable. If structures are in poor condition can improvements be made as part of preparation	Leg 1		
	Leg 2		
Note 2: Review the detour options with the district bridge asset engineer.	Leg 3		
	Leg 4		
Note 3: INDOT has a GIS layer with some culvert data at https://indot.maps.arcgis.com/	Leg 5		
	Leg 6		

IX. Vertical clearance on detour:	Option 1	
Note: Clearance ≤ 14'-0" may be an issue	Option 2	

X. Traffic volume to capacity:		Option 1	Option 2	Alternate Routes for Local Traffic (Combined)*
(if less than 1.0 detour may be viable)	Leg 1			
A. Capacity of detour in existing condition (minimum capacity along leg):	Leg 2			
	Leg 3			
Note: Use typical capacity in IDM Figure 503-2A	Leg 4			
	Leg 5			
	Leg 6			

*Alternate routes for local traffic:

B. Existing traffic volumes on detour legs

Weekday AM peak hour		Option 1	Option 2	Alternate Routes for Local Traffic (Combined)
(Use INDOT traffic database: http://indot.ms2soft.com/tcds/tsearch.asp?loc=Indot&mod)	Leg 1			
	Leg 2			
	Leg 3			
	Leg 4			
	Leg 5			
	Leg 6			

Weekday PM peak hour		Option 1	Option 2	Alternate Routes
	Leg 1			
	Leg 2			
	Leg 3			
	Leg 4			
	Leg 5			
	Leg 6			

Weekend peak day				
Peak hour during weekend peak day		Option 1	Option 2	Alternate Routes
	Leg 1			
	Leg 2			
	Leg 3			
	Leg 4			
	Leg 5			
	Leg 6			

C. Displaced traffic volumes from closed roadway to detour legs:

(to be added to volumes in B)

Note: Where available the MPO traffic modeling may be used to estimate the distribution of displaced traffic. MPO areas include Northwest Indiana, South Bend - Elkhart, Fort Wayne, Lafayette, Kokomo, Terre Haute, Indianapolis, Anderson, Muncie, Columbus, Evansville, Clark & Floyd counties, and Dearborn County).

Weekday AM peak (vph):		Hour used:	0
Percentage of volume from closed roadway if other than 100%			
Source or basis for an estimate lower than 100%:			
(the basis may be the analyzer's best judgement)			
If more than one detour is plannned, detoured volume distributed as:	Option 1		
	Option 2		
	Alternate Routes		

Weekday PM peak (vph):		Hour used:	0
Percentage of volume from closed roadway if other than 100%			
Source or basis for an estimate lower than 100%:			
If more than one detour is plannned, detoured volume distributed as:	Option 1		
	Option 2		
	Alternate Routes		

Weekend peak (vph):		Day used:	0
Percentage of volume from closed roadway if other than 100%		Hour used:	0
Source or basis for an estimate lower than 100%:			
If more than one detour is plannned, detoured volume distributed as:	Option 1		
	Option 2		
	Alternate Routes		

D. Total traffic volumes on detour legs during construction:

(items B plus C)

		Option 1	Option 2	Alternate Routes
Weekday AM peak:	Leg 1	0	0	0
	Leg 2	0	0	0
	Leg 3	0	0	0
	Leg 4	0	0	0
	Leg 5	0	0	0
	Leg 6	0	0	0
Weekday PM peak:		Option 1	Option 2	Alternate Routes
	Leg 1	0	0	0
	Leg 2	0	0	0
	Leg 3	0	0	0
	Leg 4	0	0	0
	Leg 5	0	0	0
	Leg 6	0	0	0
Weekend peak:		Option 1	Option 2	Alternate Routes
	Leg 1	0	0	0
	Leg 2	0	0	0
	Leg 3	0	0	0
	Leg 4	0	0	0
	Leg 5	0	0	0
	Leg 6	0	0	0

E. Volume to Capacity during construction with detour legs as is:

(divide values in D by the values in A)

		Option 1	Option 2	Alternate Routes
Note: If less than 1.0 then closure may be viable, go to item XVI. If modestly over 1.0 detour may be considered if reasonable to estimate that after first few days of detour motorists adjust time of trip or route.	Leg 1	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 2	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 3	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 4	#DIV/0!	#DIV/0!	#DIV/0!
Weekday AM peak:	Leg 5	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 6	#DIV/0!	#DIV/0!	#DIV/0!
Weekday PM peak:		Option 1	Option 2	Alternate Routes
	Leg 1	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 2	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 3	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 4	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 5	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 6	#DIV/0!	#DIV/0!	#DIV/0!
Weekend peak:		Option 1	Option 2	Alternate Routes
	Leg 1	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 2	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 3	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 4	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 5	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 6	#DIV/0!	#DIV/0!	#DIV/0!

F. Can improvements to the detour be made to improve V/C ratio?

		Option 1	Option 2	Alternate Routes
Describe viable improvements:	Leg 1			
	Added capacity:			
Describe viable improvements:	Leg 2			
	Added capacity:			
Describe viable improvements:	Leg 3			
	Added capacity:			
Describe viable improvements:	Leg 4			
	Added capacity:			
Describe viable improvements:	Leg 5			
	Added capacity:			
Describe viable improvements:	Leg 6			
	Added capacity:			

G. Volume to capacity during construction with improvements to detours

(divide values in F by the values in A)

		Option 1	Option 2	Alternate Routes
Weekday AM peak	Leg 1	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 2	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 3	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 4	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 5	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 6	#DIV/0!	#DIV/0!	#DIV/0!
		Option 1	Option 2	Alternate Routes
Weekday PM peak	Leg 1	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 2	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 3	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 4	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 5	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 6	#DIV/0!	#DIV/0!	#DIV/0!
		Option 1	Option 2	Option 3
Weekend peak	Leg 1	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 2	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 3	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 4	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 5	#DIV/0!	#DIV/0!	#DIV/0!
	Leg 6	#DIV/0!	#DIV/0!	#DIV/0!

XI. Other concerns:

(is any road work recommended if a detour option is selected such as to the bridge deck joints, adding capacity to ramps, etc.)	Option 1	
	Option 2	

Summary of Findings

	Option 1	Option 2
I. Duration of work		
III. Travel distance along detour		
IV. Detour legs restricted by construction or special events		
V. Detour legs engaged as part of a detour for another project		
VI. Pavement condition on detour		
VII. Bridge ratings on detour		
VIII. Structure ratings/condition on detour		
IX. Vertical clearance on detour		
X. Traffic volume to capacity		
XI. Other concerns		
Is interstate detour route viable?		

Detour route(s) selected:

Implementing the Results:

If there is no viable detour then a crossover, or maintaining traffic through the project limits should be considered.

If there are multiple viable detour routes, typically the detour route with the shortest travel time and fewest number of improvements needed should be selected. Judgment should be used in balancing added travel time and detour route improvements.

When a viable detour route is identified then the next steps are as follows:

- If a project has a formal TMP team the results should be shared with the team members for their concurrence. With TMP concurrence, closure with detour should be selected as the traffic control strategy.
- If a project does not have a formal TMP team, inform the district technical services, construction, and communications offices of the planned closure and detour.

About the Joint Transportation Research Program (JTRP)

On March 11, 1937, the Indiana Legislature passed an act which authorized the Indiana State Highway Commission to cooperate with and assist Purdue University in developing the best methods of improving and maintaining the highways of the state and the respective counties thereof. That collaborative effort was called the Joint Highway Research Project (JHRP). In 1997 the collaborative venture was renamed as the Joint Transportation Research Program (JTRP) to reflect the state and national efforts to integrate the management and operation of various transportation modes.

The first studies of JHRP were concerned with Test Road No. 1—evaluation of the weathering characteristics of stabilized materials. After World War II, the JHRP program grew substantially and was regularly producing technical reports. Over 1,600 technical reports are now available, published as part of the JHRP and subsequently JTRP collaborative venture between Purdue University and what is now the Indiana Department of Transportation.

Free online access to all reports is provided through a unique collaboration between JTRP and Purdue Libraries. These are available at http://docs.lib.purdue.edu/jtrp.

Further information about JTRP and its current research program is available at http://www.purdue.edu/jtrp.

About This Report

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