U.S. Department of Transportation
Federal Highway Administration

An Agency Guide on Overcoming Unique Challenges to Localized Congestion Reduction Projects

FHWA's Bottleneck Reduction Initiative Program
Office of Operations

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16. Abstract
FHWA's Localized Bottleneck Reduction Initiative (LBR) program focuses attention on mitigating the operational causes of recurring congestion "hot spots" (i.e., traffic bottlenecks) at ramps, merges, lane drops, intersections, weaves, etc. One of the efforts of the LBR program is to encourage agencies to adopt a defined, "named" annualized spot-congestion program in the same manner that they might have an annualized spot-safety program for high crash locations.

This document was developed to provide guidance to state and local transportation personnel on how to overcome barriers and challenges to implementation of localized congestion relief projects. It presents and describes examples of institutional, design, funding and safety challenges that agencies face when trying to develop unique solutions to localized congestion problems. The main questions that this guidance helps an agency address are:

1. What are the most common barriers and challenges with addressing localized congestion problems?
2. What are some case study examples that highlight how barriers and challenges were overcome?
3. What are some of the key factors in successful implementation of localized bottleneck projects?

The document also presents nine detailed case studies of projects and programs that illustrate how to overcome common barriers and challenges. The case studies were chosen to highlight agencies that have implemented effective projects in a unique and praiseworthy fashion. The final section provides some high-level guidance and practical ideas on how to implement successful solutions to localized congestion problems based on experience and information gathered during this project.

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Executive Summary

The Federal Highway Administration's (FHWA) Localized Bottleneck Reduction Initiative (LBR) program focuses attention on mitigating the operational causes of recurring congestion "hot spots" (i.e., traffic bottlenecks) at ramps, merges, lane drops, intersections, weaves, etc. One of the efforts of the LBR program is to encourage agencies to adopt a defined, "named" annualized spot-congestion program in the same manner that they might have an annualized spot-safety program for high crash locations. In the course of conducting state visits to "spread the gospel" of the tremendous benefits of clearing up one or more congested bottlenecks, the LBR staff has occasionally heard "push back" from some agencies that cite institutional or other barriers to enacting either individual projects or agency-wide programs. Examples of some of these barriers would be "we can't enact (these types of solutions) because (we feel) they violate firm safety design tenets or regulations;" or, "we can't undertake a spot-solution on a freeway absent having a vetted, adopted, twenty-year plan (or similar) already in place;" or, "how would such projects affect (our) Metropolitan Planning Organization's (MPOs) air quality, nonattainment status?" Conversely, the LBR staff has conducted state visits wherein these questions never came up; either signifying no such concerns, or success in overcoming them.

The main questions that this guidance helps an agency frame are:

1. **What are the most common barriers and challenges with addressing localized congestion problems?**
2. **What are some case study examples that highlight how barriers and challenges were overcome?**
3. **What are some of the key factors in successful implementation of localized bottleneck projects?**

This document was developed to provide guidance to state and local transportation personnel on how to overcome barriers and challenges to implementation of localized congestion relief projects. It presents and describes examples of institutional, design, funding and safety challenges that agencies face when trying to develop unique solutions to localized congestion problems.

The document also presents ten detailed case studies of projects and programs that illustrate how to overcome common barriers and challenges. The case studies were chosen to highlight agencies that have implemented effective projects in a unique and praiseworthy fashion. The final section provides some high-level guidance and practical ideas on how to implement successful solutions to localized congestion problems based on experience and information gathered during this project.

1.0 Introduction

1.1 Purpose of the Guidance Document

This guidance document provides guidelines that can be used by state departments of transportation (DOTs) and local transportation agencies. The guidance document was developed based on best practices used by state and local agencies during the planning, design and implementation of localized congestion (a.k.a. bottleneck) relief programs and projects.

1.2 How to Use this Document

Target Audience

This document is designed for state, regional, and local transportation agencies and private consultants that are focused on mitigating operational causes of bottlenecks. These bottleneck locations include a wide variety of causes from poorly functioning merges/diverges to poor ramp spacing throughout an entire freeway corridor. This document targets planners as well as traffic, safety, and design engineers, because bottlenecks need to be addressed in all phases of the project development process. Operations and maintenance staff will also find this document useful because it highlights innovative thinking and action by agencies on implementing projects to relieve localized congestion caused by bottlenecks. The document includes a series of case studies and some high-level guidance on developing and implementing successful projects.

Target Audience:

- Transportation
  - State
  - Regional
  - Local
- Consultants
- Planners
- Designers
- Operations and maintenance

Document Structure and Content

This guidance document includes the following sections:

- **Section 1.0 – Introduction.** This section contains background information on traffic bottlenecks and describes how the FHWA is addressing bottlenecks through their LBR Program.
- **Section 2.0 – Common Barriers and Challenges to Localized Congestion Projects.** This section provides information on common barriers and challenges associated with implementing localized congestion relief projects. The barriers and challenges are divided into four primary categories, including: institutional, design, funding and safety.
- **Section 3.0 – Case Studies of Successful Programs and Projects.** This section summarizes case study examples of successful bottleneck programs and projects across the United States, focusing on ten that provide valuable lessons on overcoming common barriers and challenges.
- **Section 4.0 – High-Level Guidance on Implementing Successful Projects.** This section includes some high-level guidance on developing and implementing successful bottleneck and localized congestion relief projects.

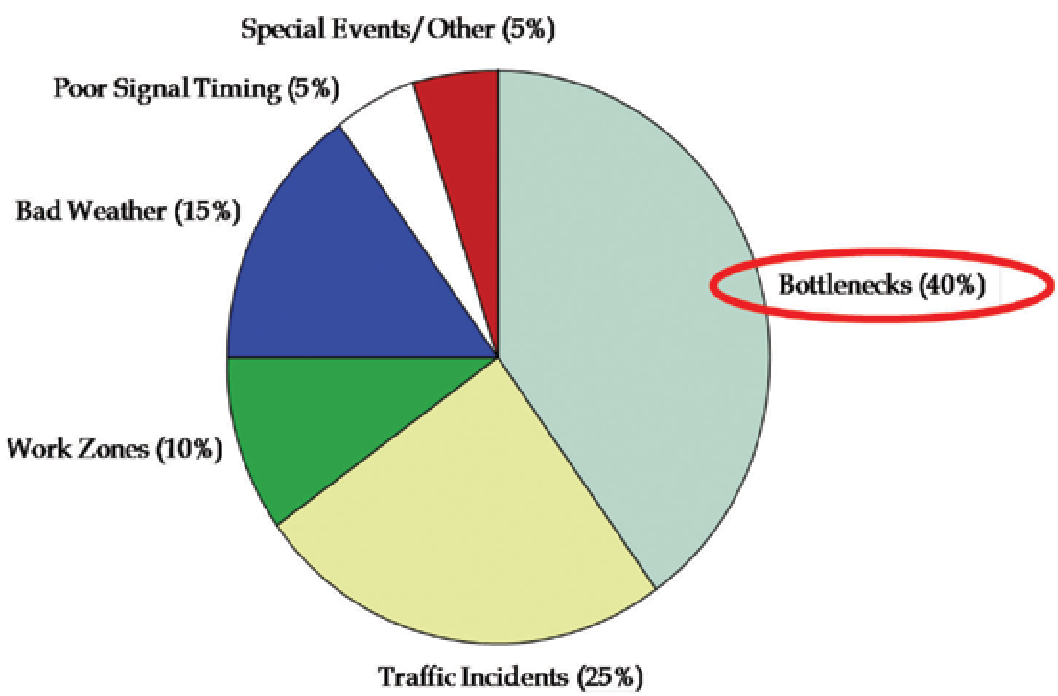
1.3 Background

Bottlenecks: A Definition

> **Traffic Bottlenecks:**
> Localized sections of highway where traffic experiences reduced speeds and delays due to recurring operational conditions or nonrecurring traffic-influencing events.

The FHWA estimates that 40 percent of all congestion nationwide can be attributed to recurring congestion (see **Figure 1**); some of it "mega" where entire regions or large facilities (e.g., interchanges or corridors) are overwhelmed by seemingly unceasing traffic demand and some of it "subordinate" – locations on the highway system where periodic volume surges temporarily overwhelm the physical capacity of the roadway. Of this 40 percent, there has never been research to determine how much is attributable to subordinate locations. During off-peak hours, the subordinate locations operate sufficiently and safely for the conditions. These recurring "localized" bottlenecks are those encountered in our everyday commutes, and are characterized as being relatively predictable in cause, location, time of day, and approximate duration. Nonrecurring congestion, on the other hand, is caused by random events such as crashes, inclement weather, and even "planned" events such as work zones and special events.

Figure 1. Pie Chart. Sources of Traffic Congestion.



Source: FHWA – http://ops.fhwa.dot.gov/congestion_report/congestion_report_05.pdf

Localized Bottlenecks

This guidance document focuses on "localized" recurring bottlenecks (i.e., point-specific or short corridors of congestion). **Mega-bottlenecks or those occurring due to systemic congestion are not meant to be covered by this guidance.** It is understood that transportation agencies have different thresholds (financial and otherwise) of what it means to be a localized versus mega bottleneck project.

For a bottleneck to be "localized," the factors causing the bottleneck *ideally* should not exert influence upon, or be influenced by, any other part of the transportation system. As a practical measure, the LBR program recommends considering the closest upstream and downstream decision points as either impacting "to" or impacting "from" the subject location, respectively. Anything much beyond that reach might be considered more than "localized." One exception might be collector-distributor lanes that would almost certainly run through two or more on- or off-ramps. Such a "system" can be considered as a larger, localized condition. Otherwise, recurring, localized bottlenecks generally occur at the areas described in **Table 1**.

Localized Bottlenecks:
- Usually exist in one direction (e.g., underserved movement)
- Predictable:
  - ✓ Cause
  - ✓ Location
  - ✓ Time of day
  - ✓ Duration
- Point-specific or short corridor
- Solutions to fix are:
  - ✓ Small geometric changes
  - ✓ Relatively low-cost
  - ✓ Delivery is reasonably quick

(1 construction season or less)

Table 1. Common Locations for Localized Bottlenecks.

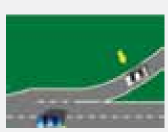
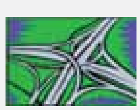
Location	Symbol	Description
Lane drops		Bottlenecks can occur at **lane drops**, particularly mid-segment where one or more traffic lanes ends or at a low-volume exit ramp. They might occur at jurisdictional boundaries, just outside the metropolitan area, or at the project limits of the last mega project. Ideally, lane drops should be located at exit ramps where there is a sufficient volume of exiting traffic.
Weaving areas		Bottlenecks can occur at **weaving areas**, where traffic must merge across one or more lanes to access entry or exit ramps or enter the freeway main lanes. Bottleneck conditions are exacerbated by complex or insufficient weaving design and distance.
Freeway on-ramps		Bottlenecks can occur at **freeway on-ramps**, where traffic from local streets or frontage roads merges onto a freeway. Bottleneck conditions are worsened on freeway on-ramps without auxiliary lanes, short acceleration ramps, where there are multiple on-ramps in close proximity and when peak volumes are high or large platoons of vehicles enter at the same time.
Freeway exit ramps		**Freeway exit ramps**, which are diverging areas where traffic leaves a freeway, can cause localized congestion. Bottlenecks are exacerbated on freeway exit ramps that have a short ramp length, traffic signal deficiencies at the ramp terminal intersection, or other conditions (e.g., insufficient storage length) that may cause ramp queues to back up onto freeway main lanes. Bottlenecks could also occur when a freeway exit ramp shares an auxiliary lane with an upstream on-ramp, particularly when there are large volumes of entering and exiting traffic.
Freeway-to-freeway interchanges		**Freeway-to-freeway interchanges**, which are special cases on on-ramps where flow from one freeway is directed to another. These are typically the most severe form of physical bottlenecks because of the high traffic volumes involved.

Table 1. Common Locations for Localized Bottlenecks (continued)

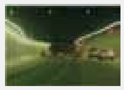
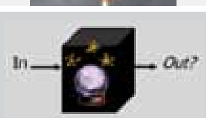
Changes in highway alignment		**Changes in highway alignment**, which occur at sharp curves and hills and cause drivers to slow down either because of safety concerns or because their vehicles cannot maintain speed on upgrades. Another example of this type of bottleneck is in work zones where lanes may be shifted or narrowed during construction.
Tunnels/ underpasses		Bottlenecks can occur at low clearance structures, such as **tunnels and underpasses.** Drivers slow to use extra caution, or to use overload bypass routes. Even sufficiently tall clearances could cause bottlenecks if an optical illusion causes a structure to appear lower than it really is, causing drivers to slow down.
Narrow lanes/ lack of shoulders		Bottlenecks can be caused by either **narrow lanes** or narrow or a lack of roadway shoulders. This is particularly true in locations with high volumes of oversize vehicles and large trucks.
Traffic control devices		Bottlenecks can be caused by **traffic control devices** that are necessary to manage overall system operations. Traffic signals, freeway ramp meters, and tollbooths can all contribute to disruptions in traffic flow.

Table 2 describes five of the most common causes or reasons why localized bottlenecks exist.

Table 2. Common Causes for Localized Bottlenecks.

Causal Factor	Symbol	Description
Traffic patterns change		Bottlenecks exist in freeway and arterial street systems because **traffic patterns change**, due to new development, changes in roadway characteristics (especially new roadways), employment, or other factors.
Traffic forecasting is inexact		Bottlenecks can exist because of the difficultly with forecasting growth in traffic volumes. **Traffic forecasting is inexact**, particularly when trying to look at peak hour and peak period travel characteristics.
Disconnect between disciplines		Bottlenecks can result from a **disconnect between disciplines** within the project development process, where communication among planners, design and operations personnel does not adequately address localized congestion concerns.
Lack of knowledge		Sometimes agencies simply do not know where bottlenecks are located on their system. This **lack of knowledge** of localized congestion is often the result of a lack of available data to support good congestion mapping.
Misinterpretation: localized vs. systemic		Sometimes agencies **misinterpret that the situation is not localized but systemic** – characterizing the entire interchange or corridor as over capacity.

A detailed discussion on bottleneck characteristics is provided in FHWA Publication FHWA-HOP-09-037, *Recurring Traffic Bottlenecks: A Primer – Focus on Low-Cost Operational Improvements*, available on FHWA's web site at http://www.ops.fhwa.dot.gov/publications/fhwahop09037/fhwahop09037.pdf

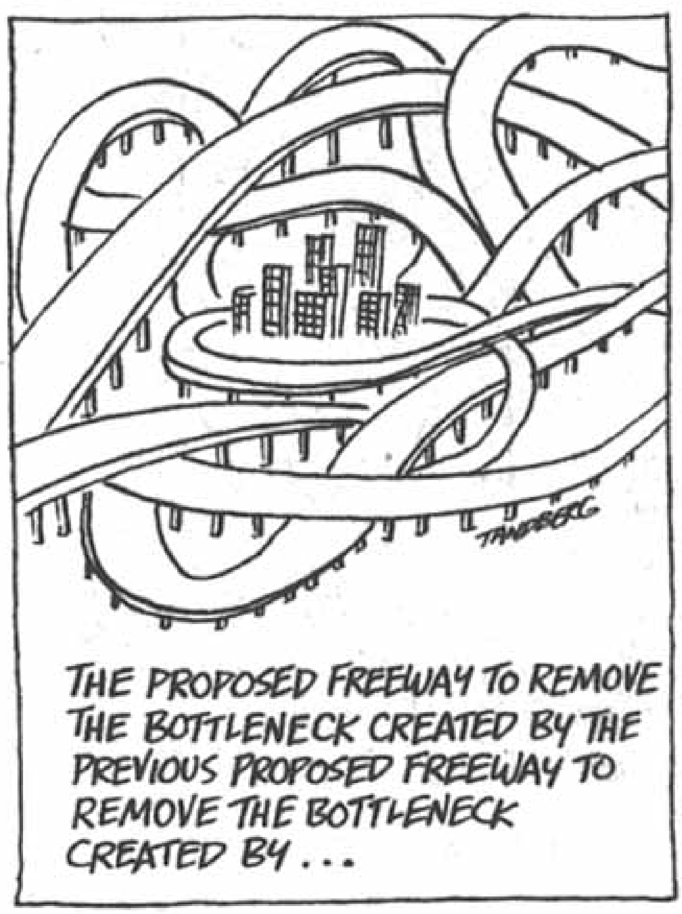
Bottlenecks: A History

Timeline of National Bottleneck Activities

Over the past decade, transportation professionals have come to realize that highway bottlenecks demand special attention. Several national studies have highlighted bottlenecks as a major congestion problem in urban areas. These studies have raised the level of awareness about bottlenecks as a problem, warranting that they be treated as a significant part of the congestion problem.

One of the LBR tenets is "a bottleneck is congestion, but congestion is not always just a bottleneck." This means that a bottleneck (or chokepoint) is merely a subset of the larger congestion pie. However, that "subset" is now realized to be a uniquely impacting (and increasingly growing) genre of congestion; namely, that it is *subordinate* locations along a highway that need to be fixed, and not necessarily the knee-jerk expectation to rebuild the entire facility. Granted, in some cases, an aging or clearly capacity-deficient facility may need to be replaced. But in this age of budget constraints and economizing, one or two corrections to inefficient subordinate locations on a facility may be all that is needed to improve the condition. **Figure 2** takes a satirical approach to the argument that we can build our way out of congestion by continued major expansion of freeway facilities.

Figure 2. Graphic. The Endless Pursuit of Congestion Relief.



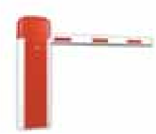
1.4 Localized Bottleneck Reduction Program

FHWA's Localized Bottleneck Reduction Program promotes operational and low-cost bottleneck mitigation strategies to improve mobility. Managed by the Office of Operations, the program serves to bring attention to the root causes, impacts, and potential solutions to recurring traffic chokepoints; ones that are wholly the result of operational influences. This is "good and bad" news in the sense that design influences can always be corrected, but some corrections may be cost-prohibitive in terms of direct construction costs or indirect right-of-way impacts. Regardless, many locations have the potential to be corrected for relatively low-cost and with relatively low physical impact. In any case, the goal of the program is to raise awareness of bottlenecks at the state level and promote low-cost, quick-to-implement geometric and operational improvements. The LBR Program has several activities either completed or underway, including:

- This guidance document, which provides guiding principles and concepts common to knowing and overcoming the barriers and challenges to implementing low-cost operational improvement programs and projects.
- A companion guidance document, *An Agency Guide on How to Establish Localized Congestion Mitigation Programs*, developed to provide guidance to state and local personnel who wish to develop a formal program for mitigating congestion using localized and low-cost treatments. It presents templates for developing a localized congestion mitigation program, including documenting alternative templates in use by state DOTs and Metropolitan Planning Organizations (MPO).
- *Traffic Analysis Toolbox Volume X: Localized Bottleneck Congestion Analysis – Focusing on What Analysis Tools are Available, Necessary, and Productive for Localized Congestion Remediation*. This document provides guidance on tools required to analyze the specific genre of localized congestion problems.
- *Recurring Traffic Bottlenecks: A Primer – Focus on Low-Cost Operational Improvements*. This Primer is the "face" of the program. It provides an overview of the wide range of operational and low-cost strategies available to reduce congestion at bottlenecks.
- Localized Bottleneck Reduction Regional Workshops. Regional workshops for state and local agencies to learn and share information on localized bottleneck reduction strategies and how they can be incorporated into state and local planning processes.
- Many of the items listed above can be found at the FHWA bottleneck web site (http://ops.fhwa.dot.gov/bn/index.htm), which can be found at the FHWA Office of Operations web site.

Additional guidance documents are forthcoming that are aimed at agencies and personnel who have first responsibility to address bottleneck congestion locations.

2.0 Common Barriers and Challenges to Localized Congestion Projects



2.1 Background

There really are no set, widely utilized guidelines for roles and responsibilities of an LBR program or project development process. State DOTs, MPOs, or local transportation agencies could all lead an effective LBR effort or individual project. State DOTs and MPOs are traditionally the organizations who lead LBR efforts simply because they usually have larger missions, which include congestion management and mitigation, as well as access to a variety of funding mechanisms. Many successful LBR programs actually depend on a high level of coordination between state DOTs and MPO. Many times, the state may identify bottlenecks and work closely with MPOs to integrate these projects into their Transportation Improvement Program (TIP) and other targeted funding sources such as Congestion Mitigation and Air Quality (CMAQ) and safety. However the split or leadership role is defined, any agency can lead an effective program.

This current document is aimed at determining and understanding the common barriers/challenges to localized congestion mitigation programs and projects and why some agencies have had success overcoming them while others have not. The research team used a variety of methods to gather information on common barriers/challenges, including an agency survey, attendance at LBR workshops, and a state-of-the-practice review of published studies and internet pages dealing with the subject of localized congestion and bottleneck removal projects.

LBR Workshop Feedback

FHWA has sponsored a number of workshops to help partner agencies become engaged in starting or improving efforts aimed at reducing localized bottlenecks. LBR staff has occasionally heard "push back" from some agencies that cite institutional or other barriers to enacting either individual projects or agency-wide programs. Examples of some of these barriers would be:

1. "we can't enact (these types of solutions) because (we feel) they violate firm safety design tenets or regulations"
2. "we can't undertake a spot-solution on a freeway absent having a vetted, adopted, twenty-year plan (or similar) already in place"
3. "how would such projects affect (our) MPOs air quality, nonattainment status?"

Conversely, the LBR staff has conducted state visits and workshops wherein these barriers never came up; either signifying no such concerns, or success in overcoming them. Those agencies that have been effective at dealing with bottlenecks have developed either special or ongoing programs specifically targeted at dealing with current bottleneck projects. The options for structuring an LBR program vary widely, as described in *An Agency Guide on How to Establish Localized Congestion Mitigation Programs*. There is no cookie-cutter approach to implementing low-cost bottleneck projects.

2.2 Barrier/Challenge Categories

This section describes the four categories for common barriers and challenges to localized congestion and bottleneck reduction projects. The research team developed the categories based on synthesizing available information from the LBR workshops, agency surveys, and state-of-the-practice review. **Table 3** outlines the four categories for most of the common barriers and challenges to localized congestion and bottleneck reduction projects.

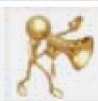
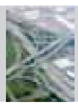
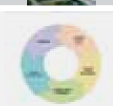
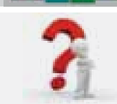
Table 3. Bottleneck Barrier and Challenge Categories.

Category	Symbol	Description
Institutional		Barriers and challenges that are bureaucratic in nature – caused by the way transportation agencies have traditionally operated and functioned.
Design		Barriers and challenges that are related to the way the transportation facilities are physically designed – particularly in relation to accepted standards and practices.
Funding		Barriers and challenges that are related to how transportation facilities are paid for and implemented.
Safety		Barriers and challenges that are related to the potential traffic safety impacts resulting from localized congestion relief treatments.

2.3 Institutional Barriers and Challenges

This section outlines the common barriers and challenges to localized congestion projects that are bureaucratic in nature – that is they are caused by the way agencies have traditionally operated. The research team identified ten common institutional barriers shown in **Table 4**.

Table 4. Common Institutional Barrier and Challenges.

Barrier	Symbol	Description
Project champion		Localized congestion relief projects often need a project champion to be successful. Someone with a high-level of authority and ability to gain consensus make implementation easier.
Disposition towards mega projects		Many transportation agencies are organized to plan, design and construct large projects and do not have a well defined process for smaller, localized congestion reduction projects.
Project planning and programming requirements		Transportation agencies that receive federal funds use a defined planning process that is sometimes at odds with implementing localized congestion reduction projects (see air quality conformity later in this section).
Lack of training		There is a lack of available training for DOTs and MPOs on how to properly identify, analyze, and successfully implement localized congestion reduction projects.
Knowledge of problem locations		The barrier for some agencies is a lack of knowledge of localized congestion locations in their jurisdiction that might be mitigated with a low-cost/spot operational or geometric improvement.
Deficiency with internal and/ or external communication		Communication – both internally within a transportation provider – and externally with partner agencies or key stakeholders can often be a barrier to project initiation and ultimately field implementation.
Culture of historical practices/resistance to change		Many DOTs struggle with organizational change and rely heavily on historical practices and approaches to project development.
Lack of incentives or recognition		Formal incentives and/or recognition for successful implementation of localized congestion reduction projects are not widespread.
Project is not in or consistent with approved regional and state transportation plans		Some agencies will not implement localized congestion reduction projects unless they have been through a formal process and been added to approved regional and state transportation funding plans.
Lack of confidence in proposed solution		Some engineers struggle with confidence in the ability of low-cost/localized improvements to be effective at reducing the congestion and not just moving it or making the situation worse.

Example of Institutional Barrier: Project Planning and Programming Requirements – Air Quality Conformity

An example barrier to localized congestion reduction projects in large urban areas relates to **air quality conformity**. Because they are short-term in nature, localized bottleneck improvements may emerge as formal projects that have not been previously identified in Statewide Transportation Improvement Programs (STIP) or TIP. Thus, they may not be part of those projects that have been approved to deal with air quality issues in the region or state. Such occurrences must be dealt with on a case-by-case basis by agencies wishing to undertake bottleneck projects. One point worth noting: if air quality conformity in a location precludes or discourages major capital expansion (e.g., additional lane-miles), the type of improvements in a localized bottleneck program clearly do not fall in this category.

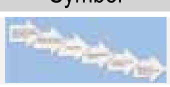
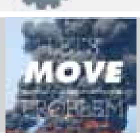
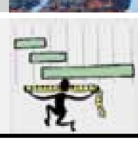
Example of Institutional Barrier: Consistency with Long-Range Transportation Plans

Another example of a potential institutional barrier is that **bottlenecks may not be seen as consistent with long-range transportation plans**. Most bottleneck mitigation strategies such as roadway widening, left-turn lengthening, auxiliary lanes on freeways, or improvement of weave/merge areas may all be seen as distracting resources or blurring the need for larger design solutions, which will be made anyway in a larger longer-term project already in a 20-year plan. Agencies must decide and weigh the benefits themselves whether the cost of doing smaller bottleneck solutions in the short term is against the cost of waiting for a more complete solution. This decision can be difficult, especially for agencies without a good appreciation for the typical benefits and costs of smaller bottleneck solutions and how long those benefits might last.

2.4 Design-Based Barriers and Challenges

This section outlines the common barriers and challenges to localized congestion projects that are related to the way the transportation facilities are physically designed – particularly in relation to accepted standards and practices. The research team identified five common design-based barriers shown in **Table 5**.

Table 5. Common Design-Based Barriers and Challenges.

Barrier	Symbol	Description
Design exception process is difficult		Many bottleneck solutions require design exceptions for narrow lanes, shoulder width, etc. and the process of getting approval can sometimes be difficult.
Non-standard design is considered a deal-breaker		Many transportation agencies adhere strictly to design standards such as the AASHTO *Policy on Geometric Design of Highways and Streets* and do not move non-standard designs forward to implementation.
Problem is too big and nothing short of a total rebuild will fix it		A common thought process by DOTs, MPOs and elected officials is that most congestion problems require a large investment and multi-year construction to fix.
Spot treatment will move the problem and not fix it		Quite a few planners and engineers often believe that smaller, spot treatments will move the bottleneck and not fix it; therefore, the project is not pursued.
Standard practices contribute to bottleneck formation		Some agencies cite that existing design standards and practices (e.g., maintaining basic number of lanes through major freeway-to-freeway interchanges) actually contribute to the formation of bottlenecks.

Example Design-Based Barrier: Design Exception Process is Difficult

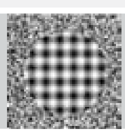
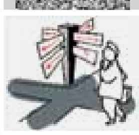
An example design-based barrier to localized congestion reduction relates to the FHWA **design exception** process. Because some bottleneck treatments use innovative solutions that maximize effectiveness with a minimum of new construction, they are occasionally at odds with highway design standards and might require a design exception (e.g., the addition of slip ramp to a collector/distributor road or the use of a shoulder as a through lane at selected locations may not strictly follow design standards). Such deviations have the potential to degrade safety if not properly implemented (e.g., shoulder elimination may lead to more collisions with roadside features or may impede incident management activities).

As it is FHWA's intent to foster creative approaches for low-cost bottleneck projects, agencies should not see the design standard issue as insurmountable. Rather, they should fully assess the potential safety impacts of strategies and devise ways of addressing them, if necessary. For example, in the case of a shoulder-to-lane conversion, review of crash data, and the specific roadway location (perhaps through a Roadway Safety Audit), it may be determined that a barrier is required to keep vehicles off of the roadside. It may also require a change in incident management policy that would allow emergency vehicles to access incidents from the opposite direction. Finally, agencies should be in contact with the FHWA Division offices throughout the process as design review may be required, depending on circumstances.

2.5 Funding Barriers and Challenges

This section outlines the common barriers and challenges to localized congestion projects that are related to how transportation facilities are paid for and implemented. The research team identified four common funding barriers shown in **Table 6**.

Table 6. Common Funding Barriers and Challenges.

Barrier	Symbol	Description
There is no dedicated funding category or named program		Bottleneck projects typically do not have a dedicated funding category like what exists for safety. Unless there is a formal program identity, bottleneck remediation is usually relegated to a few project completed as part of an annualized safety program, or as a subordinate part of larger, other purposed projects.
Low-cost solution may blur or preclude the need for a bigger project		Some agencies do not implement localized solutions because they might distract resources from or blur the need for a bigger capital investment project.
Do not understand if alternative funding categories can be used		Transportation funding can be a complex process and some agencies do not understand what types of categories can be used to support implementation of localized bottleneck reduction-type projects.
Lack of available resources for implementation		Perhaps the most universal barrier is a lack of available resources for building, maintaining and operating transportation infrastructure. Some agencies cite lack of roadway striping crews as a challenge.

Example Funding Barrier: Lack of Available Resources for Implementation
An example funding barrier to localized congestion reduction relates to the lack of available resources for implementation. Many transportation agencies are dealing with increased congestion and transportation needs while receiving less funding into the future. On a high level, most of the funding for roadway improvements comes from motor vehicle fuel taxes. This revenue source is fixed (most state and federal fuel taxes have remained at the same level since the early 90s) and the buying power has been diminished by increasing construction costs and the increasing overall fuel efficiency of the vehicle fleet. All of this makes agencies careful about where money is spent. Some DOTs have taken steps to reduce expenditures by outsourcing operations and maintenance activities. One example of a reduced in-house function that has affected their ability to implement localized congestion reduction projects is not having dedicated crews and equipment for roadway restriping. Simple restriping – such as adding marking to create option lanes at diverge points – is sometimes all that is needed in order to mitigate an existing bottleneck. Not having a dedicated striping crew or equipment has made it difficult to implement small, low-cost restriping projects because they are not cost efficient for their private contractors.

2.6 Safety-Related Barriers and Challenges

This section outlines the common barriers and challenges to localized congestion projects that are related to the safety performance of transportation facilities. The research team identified four common safety-related barriers shown in **Table 7**.

Table 7. Common Safety-Related Barriers and Challenges.

Barrier	Symbol	Description
Hesitancy to implement a solution that does not follow standards		Agencies typically follow design standards and accepted practices very strictly in order to promote consistency and meet driver expectation. There is often a hesitancy to implement solutions that do not follow standards due to fear of unwanted outcomes.
Perception that safety is compromised with low-cost solutions		Some agencies have an organizational culture with a strong commitment to putting safety first and perceive that safety might be compromised by low-cost solutions, particularly when non-standard designs are involved.
Lack of shoulders takes away refuge areas		Utilization of shoulders as travel lanes, either permanently, during peak periods, or by special vehicles such as buses, can be an effective bottleneck improvement. Some agencies are reluctant to take away shoulders because the cross section is reduced and the refuge areas for disabled vehicles are eliminated.
Lanes that are not full width create safety issues for large trucks		Transportation agencies reduce lane widths in order to create an additional travel lane for bottleneck relief. Some agencies are adverse to this practice because of the potential safety implications – particularly when it is on freeways with high truck volumes.

Example Safety-Related Barrier: Lack of Shoulders Takes Away Refuge Areas

An example safety-related barrier to localized congestion reduction relates to when an agency rejects moving a project forward because of concerns about the lack of roadway shoulders. The concerns about safety being compromised and incident management being more difficult, whether real or perceived, have to be adequately addressed before there is a comfort level to implement a project. Transportation agencies can struggle with the paradox and balancing act of putting safety first with the implementing mobility solutions such as shoulder removal – even if it is for short sections like would be the case for localized congestion reduction projects.

3.0 Case Studies of Successful Programs and Projects

3.1 Overview of Case Study Process

Much of the emphasis in this document to this point has been on identifying and describing barriers and challenges to implementing localized congestion (bottleneck) programs and projects. It is evident that while there is a wide range of barriers and challenges, many agencies have found ways to overcome them and implement programs and projects that are significantly successful and improving safety and mobility at relatively low cost. This section focuses on highlighting a variety of case studies that illustrate key principles and lessons on how the barriers and challenges were overcome.

The research team used an assortment of methods to gather information on the case study programs and projects, including an agency survey, attendance at LBR workshops, and a state-of-the-practice review of published studies and internet pages dealing with the subject of localized congestion and bottleneck removal projects.

Agency Survey

The research team conducted the research necessary to gather information for telling the story of the individual case-study examples that illustrate successful approaches and concepts for overcoming common barriers and challenges. The research was accomplished using a variety of means, including:

1. Internet searches,
2. Phone interviews, and
3. Electronic surveys.

The research team designed a short survey instrument to gather details regarding approximately forty potential case study projects where agencies implemented localized congestion relief projects. The survey collected information on:

- **Project background:** roadway description, type of improvement, cost and implementation date.
- **Implementation barriers**: checklist of common barriers with opportunity to provide original ideas.
- **Strategies/methods for overcoming barriers**: how were individual barriers overcome and what was the most difficult.
- **Catalyst for project**: was there an event or circumstance that caused the agency to address the localized congestion with a low-cost reduction project?
- **Outcome assessment**: what was the result (performance measurement, community reaction, awards/recognitions, etc.) of the reduction project?

State-of-the-Practice Review

The research team also performed a state-of-the-practice review to gather information on potential case study projects and programs. Internet searches and review of published literature and sources generated during workshops and state visits were the key information sources.

3.2 Case Study Matrix

The information gathered online was synthesized into the *Overcoming Challenges Matrix* shown in **Table 8**, which lists a number of case study examples where the most common challenges were overcome. The *Overcoming Challenges Matrix* provides one or more case study examples; however, detailed information was not available for all of these examples but a web link is provided in the outcome column in order to give readers a way to get additional information if it is desired. This document also contains a number of detailed case studies that are provided in the following subsections of Section 3 and also in Appendix A.

3.3 Detailed Case Studies

Table 9 lists the case study sites selected to illustrate key principles and lessons on how the barriers and challenges were successfully overcome. Each of the selected projects and programs demonstrates a somewhat unique approach and has practical value for agencies that want to start or expand an effort aimed at mitigating localized congestion resulting from bottlenecks. These sites also had sufficient information available—including their background, barriers, improvement strategies, circumstances, and outcome assessment—that made a detailed case study possible. The following subsections in Section 3 give a brief overview of the sites selected for detailed study. One-page summary fact sheets of the case studies are also provided in Appendix A.

Table 8. Overcoming Challenges Matrix[1].

	Challenge Description	Case Studies	Outcome
Institutional	Having a project champion	Dallas, TX Kansas City, KS	+: 20+ projects due to DOT/MPO champions +: Governor passes bill allowing buses on shoulders
Institutional	Disposition towards mega projects	Minneapolis, MN Manchester, NH	+: Similar benefit for $7 vs. $138 million projects +: Expedited work at Exit 5 as part of mega project
Institutional	Project planning and programming requirements	Danbury, CT Austin, TX	+: Restriping at Exit 7 improved flow significantly +: Multi-disciplinary group mitigating congestion
Institutional	Lack of training/understanding on how to develop a successful project	Dallas, TX LBR workshops	+: *Freeway Bottleneck Workshop* +: Federal outreach workshops building consensus
Institutional	Knowledge of problem locations that can be fixed with low-cost solutions	Phoenix, AZ Dallas, TX Little Rock, AR	+: Regional bottleneck study +: Aerial freeway congestion mapping +: *Operation Bottleneck* program by MPO
Institutional	A culture of historical practices	Saginaw, MI	+: Successful roundabout at I-75/M-81 interchange
Institutional	Deficiency with internal and external coordination (design/operations)	New York, NY	+: PFI functional groups
Institutional	Can't implement projects without being in approved regional/state plans	Rhode Island DOT	+: Creation of the Strategically Targeted Affordable Roadway Solutions (STARS) program
Institutional	No incentive or recognition for successful low-cost bottleneck reductions	Dallas, TX	+: Engineers performance evaluation includes bottlenecks
Institutional	Will the proposed solution work – lack of confidence	Florida DOT	+: Trial fix with cones made permanent with striping
Design	Design exception (DE) process is difficult	Pittsburgh, PA	+: New shoulder to avoid DE, Academy at I-279
Design	"Non-standard" design is considered a deal-breaker	Minnesota DOT	+: Creation of "flexible design" concept
Design	Problem is too big and nothing short of a rebuild will fix it	Plano, TX	+: Implement auxiliary lane on US 75 at SH 190
Design	Spot treatment will move problem downstream and not improve mobility	Renton, WA	+: SR 167 spot fix near Boeing reduces congestion
Design	Standard design practices contribute to bottleneck formation	Fort Worth, TX	+: I-20/SH 360 fix defies AASHTO basic lanes policy
Funding	There is no dedicated funding category for this type of project	Mississippi DOT Nebraska DOT	+: I-10 shoulder use after Katrina improves flow +: ITS funds for ramp gates to fix US 75 bottleneck
Funding	Low-cost solution may blur or preclude need for bigger project	Dallas, TX	+: I-635 early action doesn't stop $3B mega project
Funding	Don't understand if alternate funding categories can be used	Virginia DOT Ohio DOT	+: STARS program uses safety $ to target congestion +: Safety funds include congestion index
Funding	Lack of available resources (e.g., DOT striping crews) for implementation	Dallas, TX	+: District striping contract implements small fixes
Safety	Hesitancy to implement solution that does not follow standard design	Minnesota DOT	+: Mobility crisis from I-35 bridge collapse
Safety	Perception that safety is compromised with low-cost, non-standard fixes	Texas DOT	+: Average 35% crash reduction for 13 projects in TX
Safety	Lack of shoulders takes away necessary refuge areas	Arlington, TX	+: Crash reduction at SH 360/Division
Safety	Lanes that are not full width create safety issues for large trucks	Dallas, TX	+: I-30 Canyon truck rollovers basically eliminated

[1]For more details on these case studies, visit the informational links found in Appendix B.

Table 9. Overview of Detailed Case Studies.

Case Study	Key Lesson Learned
Arkansas: Operation Bottleneck Program	"Ask and they will tell" → Active public involvement
California: I-580/US-101 Connector Ramp Restriping	"It is amazing what some white paint can do" → Low-cost restriping can really improve mobility
Louisiana: US-90 near Louisiana Superdome in New Orleans	"Sometimes less is more: creating exit-only lanes" → Eliminating a through lane can improve traffic flow
Maryland: Gateway Signal Optimization in Baltimore City	"Removing stops means more go's" → Optimizing traffic signals can yield significant results
Michigan: I-75/M-81 Interchange Reconfiguration	"Michigan roundabout proves golden" → Innovative design saves $6 million and wins award
Minnesota: I-94 Lane Modification near Lowry Tunnel	"Providing options can smooth flow" → Providing drivers an option lane reduces congestion
Minnesota: TH-100 at St. Louis Park	"Smaller can sometimes equal bigger" → Small bottleneck fix has similar result to mega project
Missouri: I-44/Route 13 Diverging Diamond Interchange (DDI)	"The early bird gets the worm" → First DDI project tough to sell but worth the effort
Texas: Low-Cost Freeway Bottleneck Removal Projects	"Championing low-cost projects" → Many successful projects where champions were key

3.4 Arkansas Case Study

Metroplan MPO

Metroplan, the MPO for the Little Rock region, has implemented a program dubbed "Operation Bottleneck" aimed at identifying current congested locations that are amenable to relatively quick and inexpensive treatments. Major congestion problems – arterial corridors and freeway sections/interchanges with major capacity deficiencies – are well known throughout the area. Further, future (major) problems have been identified with the modeling done for the long-range transportation plan. However, funding for the major improvements necessary at these locations must come from either:

- State DOT, Arkansas State Highway and Transportation Department (they would be managed as state projects; and
- Local governments saving up several years of state and Federal allocations for a single project.

Metroplan wanted a way to serve their constituents better than constructing a scarce few megaprojects. Further, the region is almost in nonattainment for the eight-hour ozone standard. The text from their press release on the program sums up their intent very well:

"We're aware of the major congestion issues in our area and have identified those in our long-range plans, but we know there are dozens, maybe hundreds of neighborhood problems throughout the region that could be fixed with something as simple as a roundabout or coordinating traffic signals to improve flow," McKenzie says. "Localized problems like these can be harder to identify and are sometimes overlooked, even though they can be just as frustrating to drivers. Often they can be addressed much more quickly than larger projects. Those are the types of areas we are hoping to identify through Operation Bottleneck."

Operation Bottleneck Program

Operation Bottleneck is largely based on the establishment of a Regional Mobility Authority (RMA). In Arkansas, an RMA is a coordinating body with no taxing powers – member counties would have to raise the taxes necessary to fund projects; multiple counties would be involved. Most likely, the RMA will be based on a temporary increase in local sales taxes county-by-county; they feel it is important to sunset the tax so it is more palatable to the public and elected officials. Metroplan hopes to leverage state and Federal funds against their self-generated revenue to fund the projects. Also key to the strategy is a specific list of projects to be funded by the tax increase, and most of the Operation Bottleneck effort has gone into project identification, as discussed below.

Project identification is being driven almost exclusively by public input via local meetings and an Internet survey. Metroplan also hired a marketing firm to promote the program through local media. Both congestion and safety problem areas are being solicited, along with other modal deficiencies (transit, special transportation). A huge range of responses has been received, from megaprojects to minor problems on local roads. For congestion problems, signals and interchanges are dominating the responses. Safety problems identified by the public tend to be more general than site-specific. (This is understandable since congestion is experienced routinely but crashes are rare events for individuals.)

Metroplan staff will assemble the projects and will develop a list of projects to iterate with the public. Staff will also make revenue projections under different sales tax rates. No formal benefits assessment is planned – as with project identification Metroplan emphasized that public input is the driver for Operation Bottleneck, not technical processes (which they use for all other transportation planning activities). The staff will compare public-identified projects with those in the TIP and LRTP as well as against congested sections identified in their Congestion Management System in developing a prioritized list. Metroplan staff offered two types of improvements that are likely to dominate the project list:

- Low-cost arterial improvements – improved timing, intersection approach geometric improvements, and access management; and
- Roundabouts at uncontrolled, stop sign-controlled, or low volume signal locations.

Initial results were presented to public officials in October 2008. Metroplan would like to make this an ongoing process, especially since the public support for the program has been very high. How to structure the funding for an ongoing program will be tricky, however. Metroplan staff highlighted a $1.5 million dollar improvement project implemented in 2010 that alleviated intersection congestion at Dave Ward Drive and Donaghey Road in Conway, Arkansas as an effective outcome of the Operation Bottleneck program. **Table 10** outlines the key barriers and challenges and how they were overcome.

Table 10. Synopsis of Operation Bottleneck – Dave Ward Drive/Donaghey Road Case Study.

Barriers and Challenges	How They Were Overcome
Other – congestion at intersection located near college, major intersection improvements proposed required additional right-of-way	Project in part associated with proposed development
Other – federal funds were first proposed for project, funds were shifted and all local money was used on the project	City identified local funding to be used on the project, with the limited federal funding being placed on another project that included federal funds

For More Information

See the fact sheet in Appendix A for a synopsis of the Operation Bottleneck case study.

3.5 California Case Study

Caltrans

The California Department of Transportation (Caltrans) does not have a formal bottleneck planning process; rather, bottleneck issues are addressed at the district level as part of their Corridor System Management Plans (CSMP), which are developed for some of California's most congested transportation corridors. System monitoring and evaluation is seen as the foundation for the entire process because it cannot only identify congestion problems, but also be used to evaluate and prioritize competing investments. The CSMP includes the identification of bottlenecks and potential short-term fixes as part of an overall and long-term strategy for making corridor improvements. This may take the form of an "LBR audit," which is a review of traditional large-scale corridor studies to identify opportunities for using LBR improvements as part of the package of improvements. The LBR audit concept is similar to that of Road Safety Audits. Caltrans does not have a direct funding for bottlenecks, although bottleneck projects are routinely programmed through the CSMP process.

I-580/US-101 Connector Ramp Restriping

The second detailed case study is a project in California that involved restriping a ramp to improve traffic flow. **Table 11** outlines the key barriers and challenges and how they were overcome.

Table 11. Synopsis of I-580/US-101 Connector Ramp Restriping Case Study.

Barriers and Challenges	How They Were Overcome
Project champion	Public became champion due to organized outcry
Lack of confidence in proposed solution	Confidence from knowledge that this was a temporary solution.
Low-cost spot solution may blur the need for larger project	Still went forward with $10 million project for permanent widening of the ramp to two lanes
Lack of shoulders takes away necessary refuge areas	Loss of shoulders only a temporary condition

For More Information

See the fact sheet in Appendix A for further details of the I-580/US-101 Connector Ramp Restriping case study.

3.6 Louisiana Case Study

Louisiana Department of Transportation and Development

The Louisiana Department of Transportation and Development (DOTD) does not current have a formal localized bottleneck reduction program for project implementation. Low-cost projects that address localized congestion are done on an ad hoc basis within the various district offices.

US-90 near Louisiana Superdome in New Orleans

The fourth case study is a project implemented by the Louisiana DOTD in the New Orleans area on US-90, also commonly referred to as the Ponchartrain Expressway (PE). This project is unique because it is a case where DOT officials decided to eliminate through lanes on the PE to create exit-only lanes designed to reduce last-second merging and ease the chronic bottleneck. **Table 12** outlines the key barriers and challenges and how they were overcome.

Table 12. Synopsis of the US-90 near the Louisiana Superdome in New Orleans Case Study.

Barriers and Challenges	How They Were Overcome
Lack of confidence in the proposed solution	DOTD staff performed a before study to get traffic volumes and determine that the reduction from 3 to 2 through lanes was not going to create another bottleneck in order to ease fears of management staff
Spot treatment will move the problem and not fix it	DOTD staff agreed to perform an after study to assess the operational outcome and make sure the bottleneck did not just move downstream

For More Information

See the fact sheet in Appendix A for a synopsis of the US-90 near Louisiana Superdome in New Orleans case study.

3.7 Maryland Case Study

Maryland State Highway Administration

The Maryland State Highway Administration (SHA) has a dedicated program of about $5M per year for the identification and implementation of low-cost traffic congestion improvements at intersections. The program's genesis tracks to when SHA asked, "What can be done if and when a megaproject's 'no-build' alternative is chosen?" The program has been well received by the public and local governments. Projects typically include low-cost projects that can be implemented quickly, such as signal timing upgrades and adding turn lanes and through lanes at intersections. The Maryland SHA also has had considerable success with projects to improve freeway ramps and merge areas that have reduced congestion bottlenecks at a low cost.

Baltimore City Gateway Signal Optimization

The fifth case study is a project implemented in Baltimore City, Maryland involving optimization of traffic signals in nine regionally significant arterial corridors. The signal retiming was implemented for less than half a million dollars and produced an overall benefit-to-cost ratio of 51:1 based on benefits accrued from reductions in vehicle delay, number of stops, fuel consumption, and particulate emissions. **Table 13** outlines the key barriers and challenges and how they were overcome.

Table 13. Synopsis of the Baltimore City Gateway Signal Optimization Case Study.

Barriers and Challenges	How They Were Overcome
Lack of training	City staff hired a consultant with experience in corridor signal timing projects
Culture of historical practices	Prior to the project the City signal shop had a lot of control over signal timings; however, majority control was switched to engineering
No dedicated funding category	City obtained funding using the CMAQ program in additional to local funds
Lack of available resources	Hiring a consultant supplemented available City staff

For More Information

See the fact sheet in Appendix A for a synopsis of the Baltimore City Gateway Signal Optimization case study.

3.8 Michigan Case Study

Michigan DOT

Michigan DOT currently is in the process of developing a structured Localized Bottleneck Reduction (LBR) Program. The effort began several years ago with structured changes at MDOT, during which MDOT officially reorganized their Maintenance and Traffic and Safety Divisions to create a Division of Operations. The next step was the formation of a new section titled Systems Operations and Management (SOM). One of their early charges was to develop an approach to identify and eliminate bottlenecks throughout the State. Several years previous to this reorganization, MDOT developed and utilized a "Choke Point" Program, and their current efforts are patterned after that effort.

One of the first official action steps that the SOM Section pursued was to solicit potential bottleneck locations and problem descriptions from each of their seven region offices. More than 200 locations were identified, with about one-third being freeway interchanges. Based on further review by the SOM Section, the total number of potential locations was reduced to approximately 125 locations, which they believed: 1) met their definition of a "bottleneck" location; and 2) had a potential cost-effective solution that could address the problem. One of the primary goals of this highly focused initial effort is to develop a documented and sustainable approach that can demonstrate excellent benefit-to-cost ratios, as well as justification for allocation and expenditure of funds on the statewide LBR Program. The underlying goal was to obtain leadership support and a dedicated funding template specifically for bottleneck reduction projects, which has now been achieved.

Many challenges exist as the Program and structure move forward. One primary challenge is the need to complete a detailed analysis necessary for a large number of potentially competing projects, as well as a freeway analysis of these projects. MDOT staff resources are limited and MDOT is reviewing the potential use of consultants and/or universities for project analysis. Another issue is how to justify and evaluate the impacts of the suggested changes as well as the existing problem. The intent is to create a level playing field for application of LBR funding by each of the seven regions. The third major challenge is the availability of funding. Michigan is going through an extremely dynamic period with the overhaul of the automobile industry, and their funding has been reduced. These issues are all being discussed and debated as MDOT moves forward to establish and document a formal, fully funded LBR Program.

I-75/M-81 Interchange Reconfiguration

The sixth case study is a project implemented in Saginaw, Michigan involving a reconfiguration of the I-75/M-81 interchange from a diamond to a modern roundabout. Given limited resources, the Michigan DOT chose to use an innovative design approach with roundabouts replacing the tight diamond. **Table 14** outlines the key barriers and challenges and how they were overcome.

Table 14. Synopsis of I-75/M-81 Interchange Reconfiguration Case Study.

Barriers and Challenges	How They Were Overcome
Culture of historical practices	Local DOT staff had a focused discussion with management on the design concept – and the approximately $6 million dollar cost savings
Lack of confidence in proposed solution	Used a microscopic simulation model to analyze the roundabout solution and show a level-of-service (LOS) improvement from D to A
Other: getting stakeholder buy-in	Performed presentations to stakeholders and used an aggressive public involvement and education campaign including the use of special brochures, videos and newspaper editorials.

For More Information

See the fact sheet in Appendix A for a synopsis of the I-75/M-81 Interchange Reconfiguration case study.

3.9 Minnesota Case Studies

Minnesota DOT

Minnesota DOT was originally driven to explore low-cost congestion relief projects because of budgetary restrictions, but soon realized that these projects could be implemented very quickly and, as a bonus, were highly visible and popular with the public. In less than one year, the Minnesota DOT developed a highly accelerated process for bottleneck identification and prioritization, which led to many effective projects in the following two years. The Minnesota DOT also found that because of lower costs, it could identify multiple locations throughout the region and "spread around" bottleneck projects in an equitable way. This process consisted of a study that used a five-step process to narrow potential projects into a recommendation list to the state legislature. Evaluation of completed projects produced high benefit/cost ratios, usually greater than 8:1.

Note: Circa 2009, this one-time activity was replaced by an ongoing CMS process known as the Congestion Management Planning Process, which has been formally adopted as part of the 3C planning process.

Minnesota's Process to Identify and Prioritize Bottleneck Improvements

Step 1: Project Identification

Potential congestion management projects were identified from existing sources:

- Low-cost capacity improvements (e.g., auxiliary lanes);
- Restriping lane configuration; and
- Traffic control device improvements (e.g., ramp meters and signal timing).

Step 2: Quantitative Screening

- Project cost < $15 million
- Not in three-year TIP
- Annual hours of delay > 25,000
- Minimum of two hours of congestion

Step 3: Qualitative Screening

- Design readiness
- Cost range
- Congestion benefit
- Construction traffic management
- Future demand changes
- No adverse downstream effects

Step 4: Expert Workshop

Projects were prioritized by an expert group during a half-day workshop.

Step 5: Project Planning

The following were prepared for each project:

- Geometric sketches;
- Project scope;
- Congestion impacts;
- Safety impacts; and
- Benefit-to-cost ratio.

I-94 Lane Modification near Lowry Tunnel

The seventh case study is a project implemented in Minneapolis, Minnesota involving a lane modification near the Lowry Tunnel. The Minnesota DOT implemented a relatively low-cost ($300,000) project to provide an option lane on westbound I-94 approaching the I-394 interchange in proximity to the Lowry tunnel. This is a relatively recent project (September 2010) that is still being assessed by DOT staff. **Table 15** outlines the key barriers and challenges and how they were overcome.

Table 15. Synopsis of I-94 Lane Modification near Lowry Tunnel Case Study.

Barriers and Challenges	How They Were Overcome
Culture of historical practices	Education on benefits in short-term goals.
Lack of confidence in solution	Review of traffic analysis and other data supports the solution.
Spot treatment won't fix the problem	Commitment to monitor for one year and make necessary changes with future programmed project one year out.
Hesitancy to implement non-standard solution	Review of standards and how project does not violate driver expectation and, where design exception needed, determine likely outcomes.

TH-100 at St. Louis Park Project

The eighth case study is a second project implemented in Minneapolis, Minnesota involving improvements to a section of Trunk Highway 100 (TH-100) between 36th Street and I-394. The Minnesota DOT implemented a $7.1 million dollar project to add a third travel lane in one of the metro areas worst bottlenecks by converting roadway shoulders. This project was completed in 2006 and then won an award for Public Project of the Year in Minnesota because of the significant mobility improvement. **Table 16** outlines the key barriers and challenges and how they were overcome.

Table 16. Synopsis of TH-100 at St. Louis Park Project Case Study.

Barriers and Challenges	How They Were Overcome
Culture of historical practices	Education on benefits in short-term goals.
Lack of confidence in solution	Review of traffic analysis and other data supports the solution.
Spot treatment won't fix the problem	Commitment to monitor for one year and make necessary changes with future projects.
Hesitancy to implement non-standard solution	Review of standards and how project does not violate driver expectation and, where design exception needed, determine likely outcomes.

For More Information

See the fact sheets in Appendix A for a synopsis of the I-94 Lane Modification near Lowry Tunnel and TH-100 at St. Louis Park Project case studies.

3.10 Missouri Case Study

Missouri DOT

1. The Missouri DOT does not currently have a formal localized bottleneck reduction program. Low-cost projects that address localized congestion are done on an ad hoc basis within the various district offices – most notably in the Springfield and St. Louis metropolitan areas. The Missouri DOT utilized a "practical design" concept in the fall of 2005 that challenged internal staff, the FHWA and consulting community to help cut the budget of the 5-year STIP by 10 percent. Engineers were told that they could put their design manuals on the shelf for a year and be guided by the following three rules:

1. **Safety** – every project must get safer. There is no room for compromise where safety is concerned.
2. **Communication** – there is collaboration in developing practical solutions.
3. **Quality** – the practical solution must function properly and cannot leave a legacy of maintenance challenges.

The District challenge resulted in an initial savings of over $400 million across the 5-year STIP. District representatives were assembled to discuss their experiences with practical design – both good and bad. About 400 ideas and comments were discussed and documented and then boiled down to 25 broad policies in 5 general areas. These five areas accounted for 80 percent of the Missouri DOTs program delivery expenditures:

- Paving and based – 35 percent;
- Bridges – 17 percent;
- Grading – 11 percent;
- Right-of-way – 10 percent; and
- Traffic control – 7 percent.

The switch to the practical design concept in Missouri has produced a significant organizational change and also positive results in the safety, communication and quality as shown in **Table 17**.

Table 17. Outcome of Missouri DOT Organizational Change to Practical Design Concept.

Category	Outcomes
Safety	• Largest drop in traffic-related fatalities of any state in the nation in 2006 • Fatal crashes dropped below 1,000 in 2007 and still further in 2008. • 11% decrease in run-off-road crashes since 2004
Communications	• 90% of newspaper editorials in 2008 were positive • Customer satisfaction with Missouri DOT rose to 78% in 2008 • 95% of customers believe projects are the right transportation solution
Quality	• Since 2002, Missouri DOT has delivered a $7 billion dollar program 0.4% under budget

I-44/Route 13 Diverging Diamond Interchange

The ninth case study is a first of its kind implemented in Springfield, Missouri. The Missouri DOT implemented a $3.2 million dollar project to convert an existing congested interchange (I-44/Route 13) into the first Diverging Diamond Interchange (DDI) in the United States. The first DDI was somewhat of a battle to get in place but its success is leading to more implementations in Missouri. **Table 18** outlines the key barriers and challenges and how they were overcome.

Table 18. Synopsis of I-44/Route 13 Diverging Diamond Interchange Case Study.

Barriers and Challenges	How They Were Overcome
Project champion	The project engineer became champion and garnered by internal (upper DOT management) and external (business) support.
Project planning and programming requirements	The FHWA required that a modified Interstate Access Justification (IAJ) be done 2 weeks before the project was let; however, project staff was able to finish the new analysis prior to the deadline.
Lack of confidence in the proposed solution	Project staff utilized an enhanced level of traffic analysis and public outreach (particularly with Wal-Mart) including a simulation model and project video designed to showcase how a DDI operates.
Hesitancy to implement solution that does not follow standards	The project engineer had to convince DOT Central Design staff that the pedestrian access would work well through the middle of the DDI instead of on the outside like traditional diamonds.

For More Information

See the fact sheet in Appendix A for a synopsis of the I-44/Route 13 Diverging Diamond Interchange case study.

3.11 Texas Case Study

Texas DOT

The Texas DOT does not currently have a formal localized bottleneck reduction program. Low-cost projects that address localized congestion are done on an ad hoc basis within the various district offices – most notably in Austin (see **Table 19**) and Dallas/Fort Worth (see **Table 20**).

Texas Low-Cost Freeway Bottleneck Removal Projects

The tenth case study is of a low-cost freeway bottleneck removal program primarily in the DFW metropolitan area. The Texas DOT implemented a number of low-cost projects to address localized congestion. Most projects utilized improvements such as restriping, shoulder conversion, and installation of auxiliary lanes to improve mobility in short sections of freeway. Most improvements were implemented with local DOT discretionary funds, and projects champions at both the DOT and MPO were a key to success. **Table 21** outlines the key barriers and challenges and how they were overcome.

Table 19. Summary of Seven Bottleneck Removal Projects in Austin, Texas.

Project Location	Implemented Improvements
I-35 NB at Parmer Lane	Supplemental lane was added from the Parmer Lane entrance to the Dessau exit and then extended to Wells Branch Parkway.
I-35 SB at Wells Branch Parkway	Closed Dessau Road entrance to southbound (SB) I-35 and added an auxiliary lane from the Wells Branch entrance to the Parmer Lane exit.
I-35 NB at US 183	Added an auxiliary lane from US 183 to the Braker Lane exit ramp.
I-35 SB at US 183	Began a 4th lane for SB I-35 at the Rundberg entrance (instead of the US 183 direct connector) and extended the auxiliary lane from the US 183 frontage entrance to the US 290 exit upstream so that it begins at the direct connector. The US 183 entrance from the SB I-35 frontage road was closed in order to facilitate flow along the auxiliary lane.
I-35 SB at Riverside Drive	Added an auxiliary lane from the Riverside Drive entrance to the Oltorf Road exit.
Loop 1 SB at Far West Boulevard	Added an auxiliary lane from the Far West Boulevard entrance to the Ranch-to-Market 2222/ Northland exit ramp.
Loop 1 at Loop 360	Realigned the SB Loop 1 main lanes so that the lane drop occurs at Loop 360 East rather than at the Loop 360 West exit ramp. Upstream of this lane drop are the high-volume Bee Caves Road entrance and the low-volume Barton Skyway entrance ramp to SB Loop 1.

Table 20. Evaluation of Thirteen Texas Bottleneck Projects – Mostly in Dallas-Fort Worth.

District	Freeway(s) and Limits	Improvement Type	Annual Benefit	Cost	B-C Ratio*
FTW	NB SH360 @Division (SH180)	Shoulder conversion (outside) + auxiliary lane addition	$200,000	$150,000	10:1
ELP	EB I-10 @ US54	Restriping + ramp modification + auxiliary lane addition	$1.3M	$530,000	20:1
DAL	EB I-30 I-35E to I-45	Ramp reversal (exit converted to entrance) + auxiliary lane addition	$700,000	$660,000	9:1
DAL	NB I-35E I-30 to Dallas North Tollway	Shoulder conversion (inside) + auxiliary lane additions	$600,000	$130,000	37:1
DAL	EB SH190 to SB US75	Restriping + ramp modification	$500,000	$11,000	374:1
DAL	NB I-35E ramp to Dallas North Tollway	Re-striping + ramp modification	$300,000	$20,000	132:1
DAL	NB-SB I-35E Loop 12 to I-635	Shoulder conversion (inside) + removal of two inside merges	$11.0M	$1.9M	47:1
DAL	WB I-30 ramp to SB I-35E	Restriping + ramp modification	$200,000	$5,000	324:1
FTW	EB I-20 to NB SH360	Restriping + ramp modification + removal of thru lane inside interchange	$500,000	$10,000	400:1
FTW	SB SH360 to WB I-20	Restriping + ramp modification + removal of thru lane inside interchange	$30,000	$8,000	32:1
FTW	SB SH360 @ Division (SH180)	Ramp closure + auxiliary lane addition	$1.0M	$440,000	18:1
DAL	EB I-635 to NB US75	Restripe and widen left-side ramp from one to two lanes	$3.6M	$2.45M	24:1
DAL	SB US75 to WB I-635	Shoulder conversion (inside) on I-635 to allow ramp from US75 its own lane	$3.8M		

* B-C ratio based on ten-year project life with a 4 percent discount rate

Table 21. Synopsis of Texas Low-Cost Freeway Bottleneck Removal Projects Case Study.

Barriers and Challenges	How They Were Overcome
Project Champion	Support for low-cost bottleneck projects was at a high level, including the District Engineer and MPO Director.
Project planning and programming requirements	Most solutions were over a short distance where air quality and environmental requirements were not necessary.
Lack of training	The Texas Transportation Institute developed a *Freeway Bottleneck* workshop that taught the DOT about successful bottleneck removal.
Lack of incentives/recognition	DOT leadership formalized recognition for successful projects, rewarding Area Engineers during annual performance evaluations.
Design exception process is difficult	Over time, DOT gained the trust of FHWA staff by evaluating projects and showing the positive operational and safety benefits.

For More Information

See the fact sheet in Appendix A for a synopsis of the Low-Cost Freeway Bottleneck Removal Projects case study.

4.0 Guidelines for Successful Localized Bottleneck Reduction Projects

4.1 Overview of Guidance

This document, *An Agency Guide on Overcoming Unique Challenges to Localized Congestion Reduction Projects*, provides guidance developed from successful localized bottleneck reduction programs and projects. As has been demonstrated throughout this document, there is a wide variety of barriers and challenges to successful project implementation, and many agencies have taken unique approaches to overcome them. There is no one size fits all or cookie-cutter way of attacking localized congestion with low-cost bottleneck improvements. However, the following guidance is synthesized from practical experience from over 50 successful bottleneck removal projects and feedback from transportation professionals throughout the country.

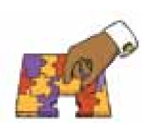
4.2 Guidance For Successful Localized Bottleneck Reduction Projects

This section presents ten high-level guidelines to assist agencies in the development and execution of successful localized bottleneck reduction projects. Each of the ten guidelines is presented in a text box and then followed by a short explanation of how this guidance can be applied.

Guideline 1: Get a high-level project champion to promote the project and/or program.

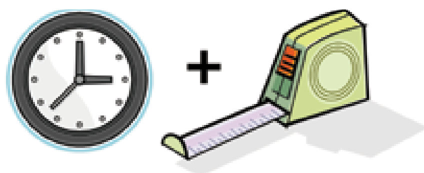
Having a project champion, ideally a high-level person with decision-making authority and respect from peers is desirable for getting low-cost localized congestion projects implemented. The tenth case study in Texas highlights the importance of this principle with champions from both the Texas DOT Dallas District Engineer (highest level DOT local authority) and the Director of Transportation for the North Central Texas Council of Governments, the Dallas/Fort Worth MPO.

Guideline 2: Find the exact problem and place the improvement to help this movement.



It is critical to successful bottleneck removal to find the exact problem causing the congestion and place the right improvement *to help serve that underserved movement*. Resurrecting Transportation System Management (TSM) thinking is the key to use of this strategy of obtaining short-term congestion relief without unnecessarily impacting other movements or just moving the bottleneck to a nearby downstream location.

Guideline 3: Collect enough of the right data in order to perform the proper analysis.



Another important component is to collect enough of the right data to capture the extent of queuing, both in time and space, so that a proper analysis of improvement alternatives can be performed. Having the right data before and after will be necessary for an appropriate performance evaluation to capture the real-world benefits after the project has been implemented. At times, the collection of speed data on parallel routes is important, since traffic diversion may occur after the improvement.

Guideline 4: Establish low-cost bottleneck removal in a formal project development process.

It is important to realize that there is significant value in making low-cost bottleneck removal part of an established project development and/or planning process and involving multiple agencies in implementation. Examples of this type of approach and coordination were evident in the case studies presented in Section 3 and a companion guidance document, *An Agency Guide on How to Establish Localized Congestion Mitigation Programs*, which provides three templates that can be used to start new programs. Having a named program can also help gain visibility and support and lead to more frequent opportunities for successful project implementation.

Guideline 5: Use a team-based approach.

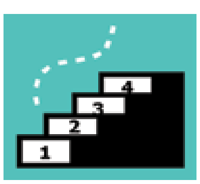
Like many types of projects, implementation of localized congestion removal projects benefits from the use of a team-based, collaborative approach. Case studies of successful programs and projects have shown that many agencies emphasize interagency coordination (sometimes through formal processes such as traffic management teams, design charrettes, major investment studies, etc.) because of the positive synergy and opportunities for collective brainstorming. One project champion that was interviewed during this project indicated that "bottlenecks are a team sport".

Guideline 6: When possible test trial a bottleneck improvement prior to the permanent fix.

Several case studies have demonstrated that it is a great advantage to be able to test a bottleneck improvement prior to the permanent fix. This allows an agency, and possibly even the public, to overcome fears about potential negative outcomes. The best case is being able to physically test the bottleneck improvement at the real-world site. Examples of real-world trials include the Florida DOT using the cones for a temporary merge pattern prior to restriping (see **Figure 3**) and the Texas DOT using barrels to temporarily close ramps prior to their permanent closure. When a real-world trial is not feasible, the use of microsimulation models can serve the same purpose and also provide reassurance to both internal and external audiences about the likelihood of success of the proposed improvement.

Figure 3. Graphic. Florida DOT Tests New Merge Pattern Prior to Permanent Implementation.

Guideline 7: Utilize a consistent approach to project analysis and development.



Another key component to successful project delivery is to utilize a consistent approach to project analysis and development. The Texas Transportation Institute (TTI) has developed the four-step process, IDEA, based on analysis of dozens of freeway bottleneck projects. The IDEA process consists of the following four steps:

1. *Identification* – screening of potential bottleneck locations.
2. *Detection* – finding the causes of the localized congestion at the bottleneck locations.
3. *Evaluation* – developing and analyzing alternatives for mitigating the congestion at the bottleneck location.
4. *Assessment* – assessing the outcome of the bottleneck removal project after it is implemented in the field.

There is no standard approach to project analysis and development, and other agencies have developed similar frameworks to TTI that are useful for this purpose.

Guideline 8: Utilize lessons from other successful projects to overcome common barriers.

This document is intended to provide individual transportation professionals and the agencies they serve the information needed to overcome common barriers and challenges to implementing low-cost localized congestion relief projects. The lessons learned and unique approaches highlighted in Section 3 should give individuals and agencies confidence that relieving congestion with low-cost improvements is possible and often results in significant operational and safety benefits being realized for relatively little cost.

Guideline 9: Agencies should not delay implementation of improvements because most projects pay for themselves in one year.

Several case studies, particularly for the 20 projects in Texas, reveal that the benefits of low-cost bottleneck projects typically have benefit-to-cost ratios ranging from 3:1 to 400:1, based on service lives estimated from 5 to 20 years. Further economic analysis reveals that many of these projects actually pay for themselves (i.e., have B/C ratios greater than 1.0) after only one year. This reality supports the guidance that agencies should not delay implementation of improvements because they are extremely cost-effective in an era of constrained funding.

Guideline 10: Skipping the final step (assessment of outcome) takes away the opportunity for lessons learned and potential praise.

Several agencies, notably the Minnesota and Texas DOTs, have done an excellent job of making sure to evaluate many of the low-cost localized congestion removal projects they have implemented. Skipping the assessment of outcome of the project leaves the benefits undocumented, removes the opportunity for lessons learned, and also takes away the prospect of potential praise from stakeholders and the media. Taking the time and dedicating the resources up front to make sure assessment of outcome is performed are likely to lead to more successful projects in the future.

APPENDIX A
CASE STUDY FACT SHEETS

ARKANSAS: OPERATION BOTTLENECK PROGRAM
"ASK & THEY WILL TELL"

Location: Little Rock, Arkansas
Primary Agency: Metroplan
Contact: Jim McKenzie, Executive Director
mckenzie@metroplan.org
(501) 372-3300

CASE STUDY OVERVIEW

What was the problem? The federal government requires that metropolitan planning organizations (MPOs) report every 5 years on long-term traffic solutions. The Metroplan MPO determined that federal dollars available for transportation were not meeting local needs and they needed to look into cost-efficient solutions to improving traffic. They also wanted to get a better idea of how bad the regional mobility problems were based on community input.

How was it solved? A comprehensive public outreach effort – *Operation Bottleneck* – was launched in October 2008 to identify traffic bottlenecks as well as auto, bike, and pedestrian safety issues throughout the region. Public input was solicited via newspapers, public meetings, and the internet.

What was the outcome? The *Operation Bottleneck* program received 3,000 responses in 1 ½ months, with on-line submissions constituting the highest return. Metroplan is currently reviewing, classifying, and analyzing the feedback, and the next step will be to coordinate with local jurisdictions. This effort might also help make the case to adopt a Regional Mobility Authority to local agencies that can raise local taxes for public improvements. Other foreseeable activities include: a half-dozen corridor upgrades, an *Operation Roundabout* program to investigate potential intersections, two to three dozen minor spot location projects, hiring a signal timing expert to assist regional agencies with needed adjustments, and consideration of a new traffic management center. One project that has already been implemented is a $1.5 million project for intersection improvements at the Dave Ward Drive/Donaghey Avenue intersection in Conway, Arkansas.

OVERCOMING KEY CHALLENGES & BARRIERS

What were the barriers & challenges?

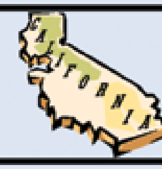
1. Disposition towards major projects
2. Lack of confidence in proposed solutions
3. Low-cost solution may blur the need for larger project
4. Lack of understanding of funding possibilities
5. Lack of available resources for implementation

How were they overcome? The mindset of the MPO is now more focused on operations and management and trying to implement solutions that reduce congestion and improve air quality. The region is also pursuing a local tax dedicated to transportation improvements and believes the intense public involvement engendered during the *Operation Bottleneck* program will help to outline specific projects that would be received well by the community.

For more information – http://www.metroplan.org/

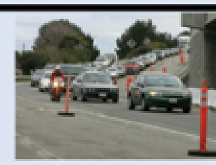
I-580/US-101 CONNECTOR RAMP RESTRIPING
"IT'S AMAZING WHAT SOME WHITE PAINT CAN DO"

Location: Marin County, California: I-580 WB to US-101 SB
Primary Agency: Caltrans
Contact: Bob Haus, Public Information Officer
robert_haus@dot.ca.gov
(510) 286-5576



CASE STUDY OVERVIEW

What was the problem?



For years, the one-lane exit ramp between I-580 westbound and US-101 northbound was a daily headache for commuters. First opened in 1956, the connector operated with only one lane for more than half a century, causing one of the most infamous bottlenecks in the Bay Area. It was so notorious that the traffic monitoring company Inrix ranked it as the fourth worst bottleneck in the United States in its 2008 National Traffic Scorecard Report. The company determined that the backed-up exit ramp caused traffic to be congested for 69 hours a week. Cars passed through during peak commute hours at a puttering average of 7.6 miles per hour (mph) due to the abrupt contraction of two lanes to one lane.

How was it solved?

In the Spring of 2009, Caltrans – urged by the community – restriped the ramp, temporarily changing the shoulder into a second lane to ease the flow of traffic.

What was the outcome?

Positive results from the restriping were almost instantaneous. For 2009, the 580-101 connector ramp plummeted to the inconspicuous position of 491st on Inrix's national bottleneck rankings as drivers experienced only 19 hours of congestion a week and averaged a speed of 14 mph during peak hours.

OVERCOMING KEY CHALLENGES & BARRIERS

What were the barriers & challenges?

1. Project champion
2. Lack of confidence in proposed solution
3. Low-cost spot solution may blur the need for larger project
4. Lack of shoulders takes away necessary refuge areas

How were they overcome?

Caltrans had a significant capital project ($10 million) to improve the ramp to a permanent dual-lane configuration as part of a bigger US-101 project. There was reluctance to implement the project; however, the public basically became the project champion for the interim restriping with their persistent outcry. The lack of shoulders was only going to be a temporary condition because of the already funded project to widen the ramp to two lanes with full shoulders.

For more information – http://bayarea.blogs.nytimes.com/2010/05/21/unclogging-a-traffic-bottleneck-in-marin/

US-90 Near Louisiana Superdome in New Orleans
"Sometimes Less Is More: Creating Exit-Only Lanes"

Location: US-90 Ponchartrain Expressway at I-10/Claiborne
Primary Agency: Louisiana Department of Transportation
Contact: Chris Morvant, Transportation Engineer
chris.morvant@la.gov
(504) 437-3109

Case Study Overview

What was the problem? A section of the US-90 elevated expressway in New Orleans near the Louisiana Superdome was a chronic bottleneck, primarily due to several ramps in close proximity and one ramp (South Claiborne Avenue) that had an abrupt merge known to commonly cause driver anxiety.

How was it solved? In a less-is-more strategy to improve traffic flow near the Superdome, state officials eliminated some through-lanes on US-90 to create exit-only lanes designed to reduce last-second merging and improve flow. The striping changes implemented in December 2010 converted sections of two lanes into shoulders, creating exit-only lanes for I-10 East and Claiborne Avenue.

What was the outcome? Anecdotal reports based on relatively light holiday traffic suggest that the striping changes are working. A formal study is being conducted to supplement the preliminary findings.

Overcoming Key Challenges & Barriers

What were the barriers & challenges?

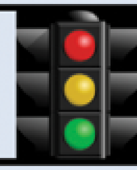
1. Lack of confidence in proposed solution
2. Spot treatment will move the problem and not fix it

How were they overcome? The proposed solution of reducing the number of travel lanes in certain areas seemed counterintuitive. The idea was to separate traffic according to where people want to go and try and eliminate the need to try and merge over, which slows things down, especially in heavier traffic. A before study showed that reducing the traffic bound for I-10 West from three lanes to two should not create a new bottleneck because more than a third of motorists exit at I-10 East.

For more information – http://www.nola.com/traffic/index.ssf/2011/01/pontchartrain_expressway_restr.html

GATEWAY SIGNAL OPTIMIZATION IN BALTIMORE CITY
"REMOVING STOPS MEANS MORE GOS"

Location: Baltimore City, Maryland
Primary Agencies: Baltimore City and Sabra, Wang & Associates
Contact: Ziad Sabra
zsabra@sabra-wang.com
(410) 737-6564



CASE STUDY OVERVIEW

What was the problem? Motorists commuting to and from downtown Baltimore City, Maryland along key arterials faced significant delays at closely-spaced signals. A need was identified to develop optimized signal timing plans to serve both the directional commuter peak as well as local traffic patterns and to reduce travel times, delays, stops and environmental impacts for all users.

How was it solved? A project known as *Baltimore City Gateways Signal Optimization* developed optimized signal timing plans for approximately 175-signals along nine corridors. The City hired a consultant to perform all major components, including data collection, existing conditions evaluation, modeling, timing plan development, field implementation and fine tuning, and travel time studies and recommendations.

What was the outcome? The project had a total cost of $402,500, approximately $2,300 per intersection. The net benefits from retiming the 175 gateway signals alone resulted in significant savings in reduced stops and delays, and fuel consumption; equivalent to a monetary benefit of approximately $20.4 million in the first year (see table below for performance measures).

Benefits of Optimized Gateway Timing Plans

	Vehicle Delay (hr)	Number of Stops	Fuel Consumption (gal)	CO Emissions (kg)	NO Emissions (kg)
"Before"	6,963	499,066	15,827	1,106	215
"After"	4,938	455,807	14,042	982	191
Improvement	2,025	53,259	1,785	125	24
% Improvement	29%	11%	11%	11%	11%
Annual Benefit	$16,221,490	$372,813	$3,213,000	$436,785	$171,936
Total Benefit	$20,416,524				
Approximate Cost	$402,500				
Benefit-Cost Ratio	51:1				

Baltimore City Signal Timing Optimization – Gateway Corridors, May 2008.

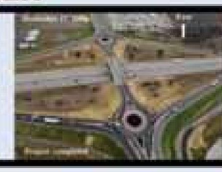
OVERCOMING KEY CHALLENGES & BARRIERS

Barriers/Challenges	How They Were Overcome
Lack of training	Hired a consultant with experience in corridor signal timing projects.
Culture of historical practices	Prior to the project the signal shop had a lot of control over signal timings; however majority control was switched to engineering.
No dedicated funding category	City obtained funding using the Congestion, Mitigation and Air Quality (CMAQ) program in addition to local funds.
Lack of available resources	Hiring a consultant supplemented available City staff.

For more information – http://sabra-wang.com/media/BaltimoreSignalTimingOptimizationITEJournalJune08RinikerSilbermanSabra.pdf

I-75/M-81 Interchange Reconfiguration
"Michigan Roundabout Proves Golden"

Location: Saginaw County, Michigan: I-75/M-81 interchange
Primary Agency: Michigan Department of Transportation
Contact: Louie Taylor, Delivery Engineer
TaylorLo@michigan.gov
(517) 322-6092



Case Study Overview

What was the problem? Multiple problems existed at this tight diamond interchange. It suffered from heavy truck traffic on M-81, inefficient signal control at the ramp terminals, and safety problems as a result of sharp left turns to and from the ramps that contributed to frequent truck overturns. Backups routinely occurred and the bridge for M-81 over I-75 was in "critical condition."

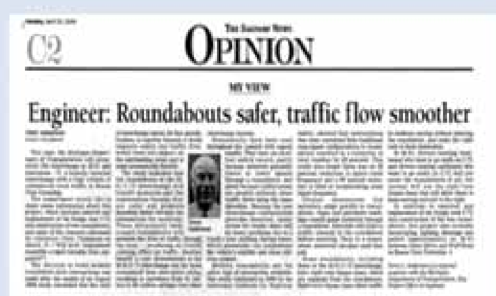
How was it solved? Given limited resources, the state chose an innovative design approach with roundabouts replacing the tight diamond. The project included reconstruction of the bridge, roundabouts (which include bypass lanes) at the ramp terminals, and removal of the traffic signals. At $5.1 million, this solution represented a cost savings of $6 to $7 million over typical reconstruction, primarily because right-of-way needs were considerably smaller compared to other proposed alternatives.

What was the outcome? The installation of modern roundabouts significantly reduced delay and fuel consumption, with no visible traffic backups. Ultimately, the initially lukewarm reception of the design concept was replaced by public acceptance and accolades for the completed project – including being selected as a Gold Level Winner of the 2007 National Achievement Awards sponsored by the National Partnership for Highway Quality.

Overcoming Key Challenges & Barriers

Barriers/Challenges	How They Were Overcome
Culture of historical practices	Focused discussion with management on design concept – cost savings
Lack of confidence in solution	Simulation models showing level-of-service improvement from D to A.
Getting stakeholder buy-in	Presentations to stakeholders and aggressive public involvement and education campaign including the use of special brochures, videos and newspaper editorials.

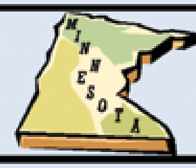
Roundabout Brochure



For more information – http://www.nphq.org/doc/awardnominations/2007/Michigan.doc

I-94 Lane Modification Near Lowry Tunnel
"Providing Options Can Smooth Flow"

Location:	Minneapolis, Minnesota: I-94 approaching I-394
Primary Agency:	Minnesota Department of Transportation
Contact:	John Griffith John.Griffith@state.mn.us (651) 234-7728



Case Study Overview

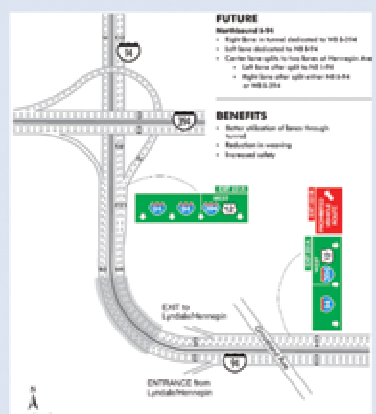
What was the problem? Congestion regularly occurred in the right lane of westbound I-94 prior to the westbound I-394 exit. This was caused by the high amount of weaving from vehicles that tended to occur from motorists trying to avoid the right lane congestion and merge just north of the Lowry tunnel where there was a lane added.

How was it solved? The $300,000 project reconfigured the westbound lanes so that the right lane through the tunnel became an exit-only lane to I-394, the left lane became exclusively for westbound I-94 and the middle lane was split into two lanes at the tunnel exit with the left lane designated for westbound I-94 and the right lane an "option" lane between either I-94 or I-394. The lane modification was designed to provide better access to I-394, reduce congestion in the right lane, and improve safety in the area by eliminating the last-minute weaving into the right lane.

What was the outcome? Minnesota DOT is gathering data from traffic detectors to regularly assess the performance of this project which was completed in September 2010. Preliminary results show positive increases in throughput during the AM peak and no significant effect in the PM. The safety effects will be evaluated at a later date.

Overcoming Key Challenges & Barriers

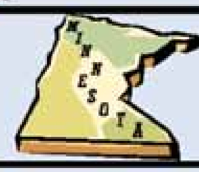
Barriers/Challenges	How They Were Overcome
Culture of historical practices	Education on benefits in short-term goals.
Lack of confidence in solution	Review of traffic analysis and other data supports the solution.
Spot treatment won't fix the problem	Commitment to monitor for one year and make necessary changes with future programmed project one year out.
Hesitancy to implement non-standard solution	Review of standards and how project does not violate driver expectation and, where design exception needed, determine likely outcomes.



For more information –
http://www.dot.state.mn.us/metro/projects/cmsp/pastprojects.html

TH-100 AT ST. LOUIS PARK PROJECT
"SMALLER CAN SOMETIMES EQUAL BIGGER"

Location: Minneapolis, Minnesota: TH-100 from 36th St. to I-394
Primary Agency: Minnesota Department of Transportation
Contact: Lars Impola, Metro District Traffic Engineer
Lars.Impola@state.mn.us
(651) 234-7820



CASE STUDY OVERVIEW

What was the problem?

The section of TH-100 from 36th Street to I-394 was the last remaining segment of original 1937 construction. A bottleneck existed with a four-lane section of freeway sandwiched between two six-lane segments. This bottleneck caused congestion during both the AM and PM peak periods in both directions. MnDOT found that this part of TH-100 was exposed to congestion for the longest amount of time per day of the Minneapolis/St. Paul metro area. Additionally, recent crash studies indicated that several of the substandard ramps were causing an unacceptable number of correctable crashes. Urgency was added to this project because it could act as a reliever to the upcoming I-35W/MN-62 reconstruction.

How was it solved?

MnDOT converted the shoulders of TH-100 to a general purpose through lane northbound and a collector-distributor lane southbound. These lanes were designed to increase the existing capacity and throughput. The existing interchanges were also reconfigured to correct substandard ramp entrances. Construction was completed in 2006 at a cost of $7.1 million.

What was the outcome?

The table below shows that significant mobility benefits were realized; however, due to downstream bottlenecks and a substandard ramp, crashes have increased within the area of influence of this project. This project won an award in Minnesota for public project of the year and provided a greater level of mobility benefit than a parallel design-build project on I-494 that cost $138 million to construct.

Project Cost (millions)	Reduction (Annual Hrs of Delay)	Increase in Traffic Flow (vehicles)	Decrease in Peak Period Congestion	Peak Period Travel Speed[1]	Crash Reduction	Benefit-Cost Ratio[2]
$7.1	1,063,500	AM peak: 8,770 PM peak: 11,918	AM: 5 miles PM: 6 miles	AM: 45-50 mph PM: 45-50 mph	49% increase-SB 17% increase-NB	13:1

[1] The daily peak period is 10 hours, AM peak from 6:00 to 10:00AM and the PM peak from 2:00 to 7:00PM
[2] Based on 7 year congestion savings

OVERCOMING KEY CHALLENGES & BARRIERS

Barriers/Challenges	How They Were Overcome
Culture of historical practices	Education on benefits in short-term goals.
Lack of confidence in solution	Review of traffic analysis and other data supports the solution.
Spot treatment won't fix the problem	Commitment to monitor for one year and make necessary changes with future projects.
Hesitancy to implement non-standard solution	Review of standards and how project does not violate driver expectation and, where design exception needed, determine likely outcomes.

More information–http://www.dot.state.mn.us/metro/programmanagement/pdf/beforeafter.pdf

I-44/Route 13 Diverging Diamond Interchange
"The Early Bird Gets the Worm"

Location: Springfield, Missouri: I-44 at Route 13
Primary Agency: Missouri Department of Transportation
Contact: Don Saiko, Project Manager
Donald.Saiko@modot.mo.gov
(417) 895-7692

Case Study Overview

What was the problem? The I-44/Route 13 interchange had a number of issues including: traffic congestion, left-turns backing up and blocking thru traffic, and 73% of crashes are rear-end and left-turn right angle. MoDOT had limited funds to improve this location and considered three options: (1) widen the bridge with dual lefts; (2) replace bridge with a Single-Point Urban Interchange (SPUI); or (3) convert the existing interchange to a Diverging Diamond Interchange (DDI), which would be the first in the United States.

How was it solved? MoDOT chose to build the first DDI because it was cheaper to build ($3.2 million vs. $9 million for a SPUI) and maintain. The DDI option also was quicker to build (6 months vs. 1½-2 years) primarily because it utilized the existing bridge and required no additional ROW.

What was the outcome? MoDOT evaluated the DDI on traffic operations, safety & public perception

Traffic Operations	Safety	Public Perception
– Left-turn movements within the DDI had a noticeable decrease in delay & queuing – Through movements within the DDI had a slight increase in travel time – Over-dimension loads up to 18 ft wide and 200 ft long have successful moved – Overall traffic flow is better and typical 1 mile backups during the AM and PM and 2-3 mile backups during weekends and holidays have been eliminated	– Total crashes down by 46% in the first year of operation – Left turn type crashes were eliminated and left turn right angle crashes were down 72% – Rear-end type crashes were down slightly – The DDI's post-construction crash types are similar to any other signalized intersection	– A very high percentage (80+) expressed that traffic flow had improved and delay had decreased – A very high percentage (87%) said that crash were more likely to occur at the previous diamond than the new DDI – A very high percentage (80%) expressed that larger vehicles and pedestrian/bike movements through the DDI were better or similar to a standard diamond

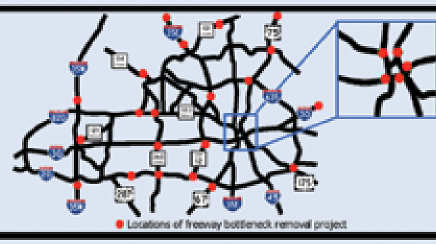
Overcoming Key Challenges & Barriers

Barriers/Challenges	How They Were Overcome
Project champion	The project engineer became champion and garnered by internal (upper MoDOT management) and external (business) support.
Project planning and programming requirements	The FHWA required that a modified Interstate Access Justification (IAJ) be done 2 weeks before the project was let; however, project staff was able to finish the new analysis prior to the deadline.
Lack of confidence in the proposed solution	Project staff utilized an enhanced level of traffic analysis and public outreach (particularly with Wal-Mart) including a simulation model and project video designed to showcase how a DDI operates.
Hesitancy to implement solution that does not follow standards	The project engineer had to convince MoDOT Central Design staff that the pedestrian access would work well through the middle of the DDI instead of on the outside like traditional diamonds.

For more information – http://library.modot.mo.gov/RDT/reports/TRyy1013/or11012.pdf

Freeway Bottleneck Removal in Texas
"Championing Low-Cost Projects"

Location: Dallas-Fort Worth, Texas: 17 projects
Primary Agency: Texas Department of Transportation
Contact: Stan Hall, Advance Planning Engineer
Stan.hall@txdot.gov
(214) 320-6155



Case Study Overview

What was the problem?

The DFW area has the most extensive freeway system on a per-capita basis when considering lane-miles and interchanges. Over the last 20 years, recurrent congestion appeared at many locations and in areas with no major capital improvements in the long-range plan. TxDOT developed a number of low-cost projects to address these localized congestion areas, also commonly called bottlenecks. Most improvements were implemented with discretionary funds and project champions were a key to success.

How was it solved?

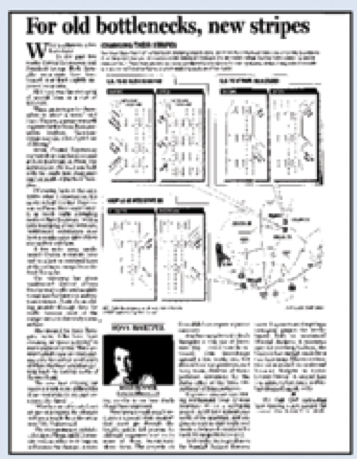
Some of the typical low-cost solutions implemented in the DFW region included: restriping, reducing lane widths and converting shoulders in order to provide additional travel lane(s) for a short section, auxiliary lanes, and ramp modifications (e.g., closure, reversal and/or metering).

What was the outcome?
See *Transportation Research Record No. 1925*, 2005, pp. 66-75.

Evaluations of the 17 case study projects revealed benefit-cost ratios from 3 to 400:1, based on measured travel time savings. Typical project costs ranged from $5,000 to $2.7 million dollars with most under $1 million. The project also improved safety with an average 35% reduction in injury crash rates after congestion mitigation from the bottleneck improvement. Since TxDOT took the time to evaluate the project outcomes, positive media attention and public feedback from commuters often followed.

Overcoming Key Challenges & Barriers

Barriers/Challenges	How They Were Overcome
Project Champion	Support for low-cost bottleneck projects was at a high level, including the District Engineer and MPO Director.
Project planning and programming requirements	Most solutions were over a short distance where air quality and environmental requirements were not necessary.
Lack of training	The Texas Transportation Institute developed a *Freeway Bottleneck* workshop that taught TxDOT about successful bottleneck removal.
Lack of incentives/recognition	TxDOT leadership formalized recognition for successful projects, rewarding Area Engineers during annual performance evaluations.
Design exception process is difficult	Over time, TxDOT gained the trust of FHWA staff by evaluating projects and showing the positive operational and safety benefits.


For old bottlenecks, new stripes

APPENDIX B
TABLE 8
INFORMATIONAL LINKS

Listing of Informational Links for Table 8. Overcoming Challenges Matrix (pg 3-3)

Case Studies	Information Link
Little Rock, AR	http://metroplan.org/files/53/3_Metroplan_Unveils_plan_to_battle_traffic.pdf
Phoenix, AZ	http://www.azmag.gov/%5Carchivetotape%5Cpub%5Cbottleneck%5Cweb site attached file%5Cranking process working paper.pdf
Danbury, CT	http://ops.fhwa.dot.gov/publications/fhwahop09037/examples.htm
Florida DOT Pittsburgh, PA Plano, TX Renton, WA	http://ops.fhwa.dot.gov/publications/fhwahop09037/examples.htm
Kansas City, KS	http://twincitiestransit.blogspot.com/2010/05/kansas-city-next-city-to-use-shoulder.html
LBR workshops	http://ops.fhwa.dot.gov/bn/workshop_series_08/index.htm
Saginaw, MI	http://www.nphq.org/doc/awardnominations/2007/Michigan.doc
Minnesota DOT	http://www.cts.umn.edu/contextsensitive/workshops/flexible/documents/whitepaper.pdf
Manchester, NH	http://www.rebuildingi93.com/
New York, NY Ohio DOT	http://ops.fhwa.dot.gov/publications/fhwahop11009/fhwahop11009.pdf
Rhode Island DOT	http://www.dot.state.ri.us/documents/Safety2010/MONDAY/RISTARS_Rocchio.pdf
Austin, TX	http://www.dot.state.tx.us/aus/cngstmgt/bottlehm.htm
Dallas, TX	http://utcm.tamu.edu/publications/final_reports/Walters-Cooner_08-37-16.pdf http://www.lbjexpress.com/ http://www.nctcog.org/trans/cmp/aerial/
Texas DOT Arlington, TX Dallas, TX Fort Worth, TX	http://trb.metapress.com/content/8433746471376934/
Virginia DOT	http://www.dot.state.ri.us/documents/Safety2010/TUESDAY/RSA Forum/HRTPO_Nichols.pdf

U.S. Department of Transportation

Federal Highway Administration

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Federal Highway Administration

Office of Transportation Management (HOTM)
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Washington, DC 20590
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