APPENDIX G

CONGESTION MANAGEMENT PROCESS (CMP)

(RTC Adoption anticipated December 2016)

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Congestion Management Process Report 2016

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ABSTRACT:

Pursuant to Title 23, U.S. Code § 134, a Congestion Management Process (CMP) is required in metropolitan regions with populations greater than 200,000. These regions are referred to as Transportation Management Areas (TMA). Congestion management is the application of strategies to improve transportation system performance and reliability by reducing the adverse impacts of congestion on the movement of people and goods.

The Federal Highway Administration (FHWA) further defines a CMP as "a systematic approach collaboratively developed and implemented throughout a metropolitan region, that provides for the safe and effective management and operation of new and existing transportation facilities through the use of demand reduction and operational management strategies."

As the Metropolitan Planning Organization for the Southern Nevada region, the Regional Transportation Commission of Southern Nevada (RTCSNV) is tasked with the responsibility of preparing the Congestion Management Process. The CMP shall be developed and implemented as an integrated element of metropolitan planning. The findings of the Congestion Management Process can be addressed through the introduction and completion of relevant projects within both the Transportation Improvement Program and the Regional Transportation Plan.

The CMP is intended to be an ongoing, collaborative process with our member jurisdictions, fully integrated into the metropolitan transportation planning process. The CMP is also a living document, continually evolving to address the results of performance measures, concerns of the community, new objectives and goals of the MPO, and up-to-date information on congestion issues.

EXECUTIVE SUMMARY

The Regional Transportation Commission of Southern Nevada serves as the home to the Metropolitan Planning Organization (MPO), the policy body responsible for cooperative, comprehensive and coordinated regional transportation planning and decision making for the Las Vegas Metropolitan Planning Area as designated by the Governor of the State of Nevada under federal law and regulations.

As the regional population is greater than 200,000 people, the region is categorized as a Transportation Management Area (TMA) by the Federal Highway Administration.

Regions categorized as TMAs are required to maintain a congestion management process (CMP) as part of their ongoing transportation planning process.[1] The CMP is intended to address congestion based on a cooperatively developed and implemented region wide strategy that provides for the safe and effective management and operation of its multimodal transportation system.

A Congestion Management Process can play a role in addressing the region's multimodal transportation needs and cost effective solution. The development of a Congestion Management Process is required for regions with populations of greater than 200,000 persons.

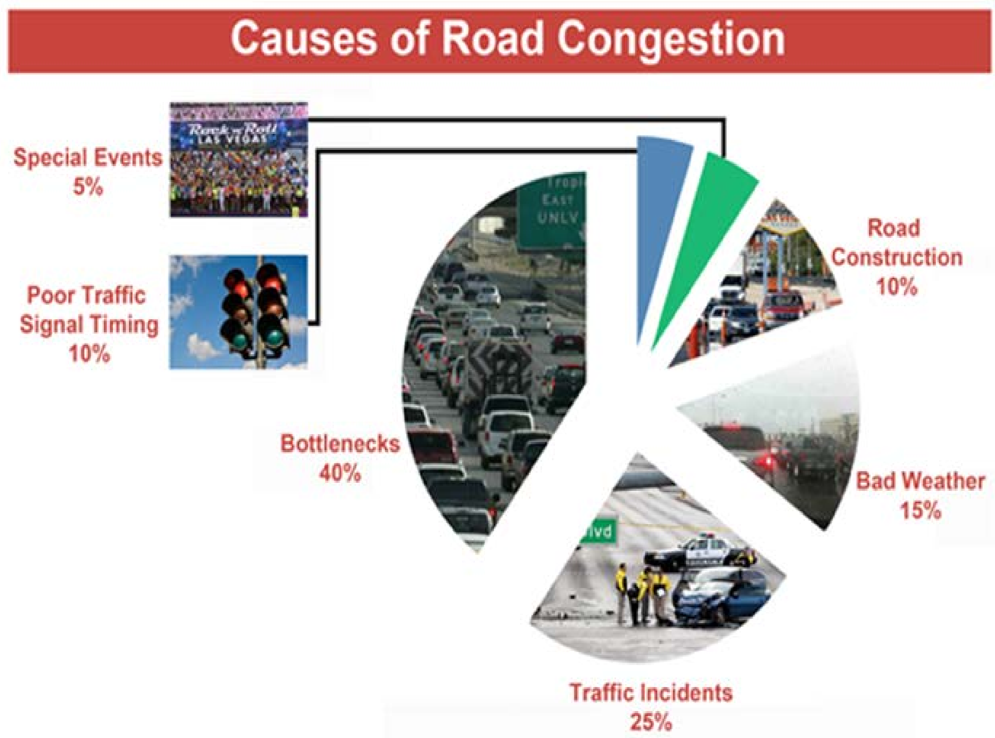
The Congestion Management Process document describes a process which defines the area of application for study, proposes performance measures and methods of data collection for evaluation seeks to go beyond simply focusing on projecting traffic volumes twenty years into the future and identifying road capacity expansion needs. The CMP should serve as a blueprint for an ongoing coordinated, systematic inter-agency process for examining not just capacity expansion, but the feasibility of lower cost strategies such as Travel Demand Management [TDM] and Transportation System Management [TSM] for corridors. The CMP will also provide a framework for the assessment of the effectiveness of strategies and projects once implemented or constructed.

The Congestion Management Process begins with an examination of the causes of traffic congestion. The requirements for the development of the process and a framework for methodology of the study are presented. In Chapter 2, existing operational efforts to manage traffic congestion are described. These include the Southern Nevada FAST program, the incident management program and partners. In Chapter 3, performance measures, congestion mitigation strategies and safety screening are detailed. Congestion management strategies are grouped under four thematic tiers, starting with reducing person trips or vehicle miles traveled, shifting auto trips to other modes, improving roadway operations and finally adding new capacity. In Chapter 4, the findings of various measurement sources are discussed, with further detail provided in the appendices. The conclusions of the Congestion Management Process are listed in Chapter 5.

1.0- Introduction

What is traffic congestion? It is defined as the level at which transportation system performance is no longer considered acceptable due to the extent of traffic interference. There are a variety of circumstances which cause congestion to form. Figure 1-1 below shows the results of a national study presented by Federal Highway Administration (FHWA) on the sources of traffic congestion. Six major causes of congestion were identified:

Figure 1- Causes of Road Congestion by Type of Incident (Nationwide)



- **Bottlenecks** are points where the roadway narrows or regular traffic demands (typically at traffic signals) cause traffic to back up. These are the largest source of congestion and typically cause roadways to operate below their adopted level of service standards**.**
- **Traffic incidents** include crashes, stalled vehicles, and debris on the road. These incidents instigate about one quarter of all congestion conditions. The CMP will discuss incident response to clear incidents due to rapid detection with the existing ITS systems in place.

- **Work zones** are where new road building and maintenance activities such as filling pot holes and maintenance work take place. The amount of congestion from these actions can be reduced by various strategies.

- **Bad weather** can cause traffic chaos with conditions of floods, dust storms and ice. Travelers can be notified of the adverse conditions and conditions monitored for safety.
- **Traffic signals –** where timing of traffic signals and length of phasing does not match the volume on the intersecting roads.
- **Special events** can cause "spikes" in traffic volumes for popular events and lead to temporary changes in traffic patterns.

1.01 – Reason for the Congestion Management Process

Congestion management systems were first established as a required task for MPO's in the 1991 transportation authorization bill known as the Intermodal Surface Transportation Efficiency Act (ISTEA). Their original role was to be a systematic, transparent way for transportation planning agencies to identify and manage congestion. The guidelines for congestion management were further developed in the following federal transportation act, the Safe Accountable Flexible Efficient Transportation Equity Act– A Legacy for Users (SAFETEA-LU).

With the passage of Public Law 112-141, the Moving Ahead for Progress in the 21st Century Act (MAP-21), became law on July 6, 2012, providing federal transportation funding for fiscal years 2013 and 2014. MAP-21 has provided updated policy and programmatic framework for investments to guide the growth and development of the country's transportation infrastructure. It seeks to guide the development of streamlined, performance-based, multimodal programs to address the needs of the national transportation system. These needs are expressed through the following goals:

1.1 National Goals Established for Transportation in MAP-21

- Safety — to achieve a significant reduction in traffic fatalities and serious injuries.
- Infrastructure condition — to keep the highway infrastructure in good repair.
- Congestion reduction — to achieve a significant reduction in congestion on the National Highway System (NHS).
- System reliability — to improve the efficiency of the surface transportation system.
- Freight movement and economic vitality — to improve the national freight network, strengthen the ability of rural communities to access trade markets, and support regional economic development.
- Environmental sustainability — to enhance the performance of the transportation system while protecting the natural environment.
- Reduced project delivery delays — to reduce project costs, promote the economy, and expedite the movement of people and goods by eliminating delays in project development and delivery, including reducing regulatory burdens and improving agencies' work practices.

1.2 Federal and State Requirements

The following section summarizes the federal requirements for a CMP in TMAs. This guidance is codified in the Code of Federal Regulations (CFR) 450.320) — Statewide Transportation Planning; Metropolitan Transportation Planning; Final Rule).

a. The congestion management process provides for safe and effective integrated management and operation of the multimodal transportation system.

b. The congestion management process should result in multimodal system performance measures and strategies reflected in the Regional Transportation Plan and Transportation Improvement Program (TIP).

Acceptable levels of service may vary from area to area, strategies should:

I. Manage demand

II. Reduce single occupant vehicle travel

III. Improve transportation system management and operations

When general purpose lanes are determined to be appropriate, consideration should be given to features that facilitate future demand management strategies.

c. The CMP shall be developed, established, and implemented in coordination with maintenance and operations activities. The CMP shall include:

(1) Methods to monitor and evaluate the performance of the multimodal transportation system and its congestion;

(2) Definition of congestion management objectives and appropriate performance measures that are tailored to the specific needs of the area with other stakeholders in the covered area;

(3) Establishment of a coordinated program for data collection and system performance monitoring to define the extent and duration of congestion, to contribute in determining the causes of congestion, and evaluate the efficiency and effectiveness of implemented actions;

(4) Identification and evaluation of the anticipated performance and expected benefits of appropriate congestion management strategies, such as demand management measures, traffic operational improvements, public transportation improvements, ITS technologies, and where necessary, additional system capacity;

(5) Identification of an implementation schedule, implementation responsibilities, and possible funding sources for each strategy proposed for implementation; and

(6) Implementation of a process for periodic assessment of the effectiveness of implemented strategies.

There are not any state specific requirements or guidelines released by the state of Nevada for the Congestion Mitigation Process.

1.3 Framework for the Format of the Congestion Management Process -

In April 2011, the FHWA released Congestion Management Process: A Guidebook, which provides additional detail and guidance to MPOs in the development and implementation of a congestion management process. This guidebook includes an eight-step process summarizing the key parts of an ongoing congestion management process.

1.3.1 – Eight Steps for an Effective Congestion Management Process -

There are eight steps to an effective CMP. These steps are as follows:

1. Developing Regional Objectives for Congestion Management
2. Defining the CMP Network
3. Developing Performance Measures
4. Collecting Data and Monitoring System Performance
5. Instituting System Performance Monitoring Plan
6. Identifying and Evaluating Strategies
7. Programming and Implementing Strategies
8. Evaluating Strategy Effectiveness

1.3.2 – Step 1- Developing Regional Objectives for Congestion Management-

Objectives are specific steps that help to accomplish a goal, and include outcome or output-oriented measures. These should be stated in such a way that performance measures can be derived from the objectives. Congestion management objectives may be related to other, operations-oriented objectives, such as making transit more attractive to commuters or to objectives aligned with regional land use goals.

These objectives are described in detail in Section 3 of the Congestion Management Process report, starting on page 12

1.3.3 – Step 2- Defining the CMP Network –

Defining the CMP network involves examining two aspects of the system as part of the planning process:

- the geographic boundaries or area of application; and
- the system components/network of surface transportation facilities.

The travel demand model represents a primary analysis tool in regional planning, and therefore the model roadway network typically provides the baseline for establishing a CMP roadway network.

If the model contains a transit network as well as a highway network, the CMP network may consider how these two modes interact. In areas where multimodal analysis is done off-model, the highway network may provide the basis for selecting a CMP network, although transit services, and bicycle and pedestrian infrastructure may also be incorporated into the CMP network analysis. It is difficult to determine the impacts of including pedestrian and bicycle facilities when there is scarcity of data. We can assume that a mode shift will occur for some trips when appropriate pedestrian, bicycle or transit facilities are provided.

1.3.4 – Step 3- Developing Performance Measures

Performance measures provide metrics that can be used regionally to track system performance, whether it is along a corridor, a road segment or intersection. These have been identified and are integrated within the CMP

1.3.5 – Step 4: Collecting Data and Monitoring System Performance

After performance measures are defined, data should be collected and analyzed to determine, ―How does the transportation system perform? Data collection may be on-going and involve a wide range of data sources and partners.

1.3.6 – Step 5: Analyzing Congestion Problems and Needs

Using data and analysis techniques, the CMP should address the questions, "What congestion problems are present in the region, or are anticipated?" and "What are the sources of unacceptable congestion?"

1.3.7 – Step 6: Identifying and Assessing Strategies

Working together with partners, the CMP should address the question, ―What strategies are appropriate to mitigate congestion? This action involves both identifying and assessing potential strategies, and may include efforts conducted as part of the MTP, corridor studies, or project studies.

1.3.8 – Step 7: Programming and Implementing Strategies

This action involves answering the question, "How and when will solutions be implemented?" It typically involves including strategies in the RTP, determining funding sources, prioritizing strategies, allocating funding in the TIP, and ultimately, implementing these strategies.

1.3.9 – Step 8: Evaluating Strategy Effectiveness

Finally, efforts should be undertaken to assess, "What have we learned about implemented strategies?" This action may be tied closely to monitoring system performance under Action 4, and is designed to inform future decision making about the effectiveness of transportation strategies.

Selected projects and strategies are implemented to achieve objectives and to mitigate congestion. Various types of strategies to be considered in the CMP are identified in the congestion toolbox. The Congestion Management Process requires that priority be given to strategies that reduce congestion and improve the mobility of people, goods and services without requiring the construction of additional roadway capacity.

There are two other categories of congestion mitigation strategies: transportation system management (TSM) and travel demand management (TDM). The TDM approach to congestion management focuses on user behavior modification strategies to reduce drive alone and shift travel away from peak periods. The TSM approach involves the more effective management of existing infrastructure through intersection improvements, signalization changes and freeway optimization. In the Las Vegas region, many of these efforts have been successfully implemented by the Freeway and Arterial Surface Transportation group (a.k.a. Southern Nevada FAST).

2.0 – EXISTING OPERATIONS MANAGEMENT EFFORTS –

There are several different existing operations in place for managing congestion in the region.

2.0.1- Transportation Operations - FAST

The Regional Transportation Commission of Southern Nevada is proud to have the component known as the Freeway and Arterial System of Transportation (FAST), which is one of the first truly integrated Intelligent Transportation System (ITS) organizations in the country. RTC staff working at FAST oversees management of both arterial streets and freeway operations. FAST is able to monitor traffic conditions in real time remotely through access to streaming data feeds from over 200 traffic cameras deployed across the region. These are complimented with traffic flow detectors embedded in the roadways which measure travel speed.

Data for these devices flows via fiber optic and microwave networks to the FAST control center on a continuous basis. FAST technicians can view this information and make decisions to alert motorists to traffic conditions through posted updates to dynamic message signs in the region as well as automatically generated alerts through email and subscription text messaging.

The FAST has responsibility for programming and coordination for over 1,000 of the 1,200 signalized intersections in the Las Vegas Valley.

This service is offered to the local entities for application to their traffic signal infrastructure. The goal is to optimize traffic flow by minimizing unnecessary delays and stops along a corridor. The efforts put in place have resulted in the following benefits in mobility.

- Reductions of travel time
- Reductions of unnecessary stops
- Reductions of fuel consumption
- Reductions of vehicular emissions
- Reductions of incidence of traffic crashes

These types of improvements and policies closely reflect the goals and strategies outlined in the national goals in Section 1.1 on page 4.

To monitor the effects of signal timing efforts, travel time before-and-after studies are completed for the re-timed corridors. These have typically utilized visually tracking the progression of a distinctive vehicle through the roadway segment via overhead traffic camera.

2.0.2- Operations Management Committee

The Operations Management Committee (OMC) advises the FAST director on policy direction. The OMC also establishes operational procedures and principles and monitors the day-to-day operations of FAST.

Operations Management Committee membership consists of one representative from each of the member jurisdictions which are Clark County, the City of Henderson, the City of Las Vegas, the NDOT, the City of North Las Vegas and the RTC. The representatives are agency directors, assistant deputy director(s) of public works, the deputy director(s), or assistant director for operations. The NDOT is represented by the District I Engineer and the RTC has an Assistant General Manager present.

The Operations Management Committee has the authority to approve or disapprove the recommendation from FAST for installation or the removal of any infrastructure for transportation management or field devices for intelligent transportation systems.

The Operations Management Committee has steered congestion management activities, plans and processes conducted by FAST. The evolving concepts of congestion management continue to move toward a more data driven, performance based approach, and the Operations Management Committee continues to consider the implementation of new technologies and systems to improve regional efficiencies.

2.0.3– Incident Management-

FAST works closely with the NDOT Freeway Service Patrol by alerting them to incidences of disabled vehicles observed through the monitoring system. The Freeway Service Patrol provides free assistance during incidents to improve safety and reduce delay. When the Patrol responds to non-emergency incidents, these incidents are cleared more quickly as a result of their assistance. The deployment of the Freeway Service Patrol to non-emergency situations allows for emergency responders to be available for actual emergencies, rather than disabled vehicles.

There also is a Memorandum of Understanding (MOU) between the regional traffic, public safety, and emergency first responder agencies in the Las Vegas region to handle traffic incidents. This agreement describes the need for the Traffic Incident Management coalition in the area, establishes the coalition, and details the roles and responsibilities of the partners in the agreement.

Partners in incident management include NDOT, the Department of Highway Safety - Nevada Highway Patrol; the RTC; the Clark County Departments of Public Works, Fire, Environment and Safety; and the Clark County Coroner's Office.

3.0 THE FEDERAL EIGHT STEP CONGESTION MANAGEMENT PROCESS

3.0.1 - Federal Congestion Management Process Guidebook

In April 2011 the FHWA released *Congestion Management Process: A Guidebook*, which provides additional detail and guidance to MPOs in the development and implementation of a congestion management process. This guidebook included an eight-step process which summarized the key parts of an ongoing congestion management process. ***Figure 3-1*** illustrates the process that will be used by the RTC.

The first three steps will typically be updated concurrent with each update of the Regional Transportation Plan which takes place every four years. Steps 4 through 8 will potentially be updated on an annual basis. The remainder of this section details the steps and how they will be implemented.

3.1 - Regional Congestion Management Objectives (Step 1)

Consistent with federal rules and guidance, the first step in the CMP is the definition of objectives to guide the overall process. Coordination with the Operational Management Committee and the Executive Advisory Committee will help ensure that the CMP is consistent with the Regional Transportation Plan.

To maintain consistency with regional goals and plans, the CMP objectives were developed along guidelines set forth by the *Congestion Management Process: A Guidebook.* An acronym which was used to describe CMP objectives there was "SMART" – which stands for **S**pecific, **M**easureable, **A**greed, **R**ealistic and **T**ime **B**ound [1]

Operations objectives and their associated performance measures are the focal point for integrating operations into the planning process. They guide the discussion about operations in the region. While goals relate to the overall vision or desired end-result, operations objectives are specific and measurable. Unlike goals, progress toward an operations objective and its achievement can be evaluated with performance measures.

1) Performance Based Planning Guidebook. Retrieved January 27, 2016, from http://www.fhwa.dot.gov/planning/performance_based_planning/pbpp_guidebook/page03.cfm

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Table 3.1- Objectives Related to Congestion Management

	Objective	Measurement Area and Data Availability
1	**Reduce hours of delay per capita by 15% and improve travel times during peak hour periods.**	• Freeways with hours of travel per day at volume/capacity ratio of 1.5 or greater. • Intersection Capacity Utilization • Percentage of arterial roadways experiencing travel time index of 1.20 or greater. • Average regional commute time by mode.
2	**Reduce non-recurring delay by 15% during peak hour periods caused by traffic incidents.**	• Response and/or incident clearance time. (source: FAST).
3	**Improve average on time performance for transit routes**	• Percentage of buses arriving on time regionally (source: RTC Transit).
4	**Reduce the number of pedestrian – vehicular and bicycle - crash injuries and fatalities.**	Reduction in the number of crashes resulting in death or serious injury for bicyclists and pedestrians. Identifying and implementing safety enhancements to improve safety for users. These are addressed in the Southern Nevada Transportation Safety Plan. http://tinyurl.com/j9ma5yj
5	**Reduce the number vehicular crashes resulting in serious injury and fatality**	Reduction in the number of crashes resulting in death or serious injury for vehicles regionally. Reduction in crash rate along major routes and at intersections. These are addressed in the Southern Nevada Transportation Safety Plan.
6	**Enhancement of traveler information systems.**	Increase the coverage of traveler information systems on regional roadway system. (source: FAST) Increase the share of bus stops with "next bus" information. (source: RTC Transit)
7	**Address mobility needs of all members of the community**	Miles of bicycle lanes or paths or share of roads designated as bicycle routes regionally (source: RTC Bicycle Lane Inventory)
8	**Air Quality and Environment**	Develop strategies to protect air quality.

3.2- Identifying the Areas of Application (Step 2)

This section of the CMP report presents an overview of the geographic area of application and the transportation network for the Regional Transportation Commission of Southern Nevada (RTC).

Area of Application

The CMP geographic area of application includes the arterials and freeways in the Las Vegas Valley of Clark County, Nevada.

Transportation Network

Consistent with federal guidelines, the CMP addresses the multimodal transportation network. In addition to evaluating congestion on the roadways, the CMP evaluates transit availability as well as the development of bicycle lane facilities within its area of application. The CMP roadway network is those roads classified as principal arterials and higher. The traffic performance on these is monitored through the data collection process of Southern Nevada Freeways and Arterial System of Transportation (FAST) and also INRIX Insights.

Roadway Modeled V/C Network

The volume to capacity network includes all functionally classified roadways of arterials and above classifications. For example, ***Figure 3-2*** depicts the regional roadways at the classification of arterial and above. This represents the study area and network for the Southern Nevada Regional CMP.

Figure 3.2- Functional Classification Map

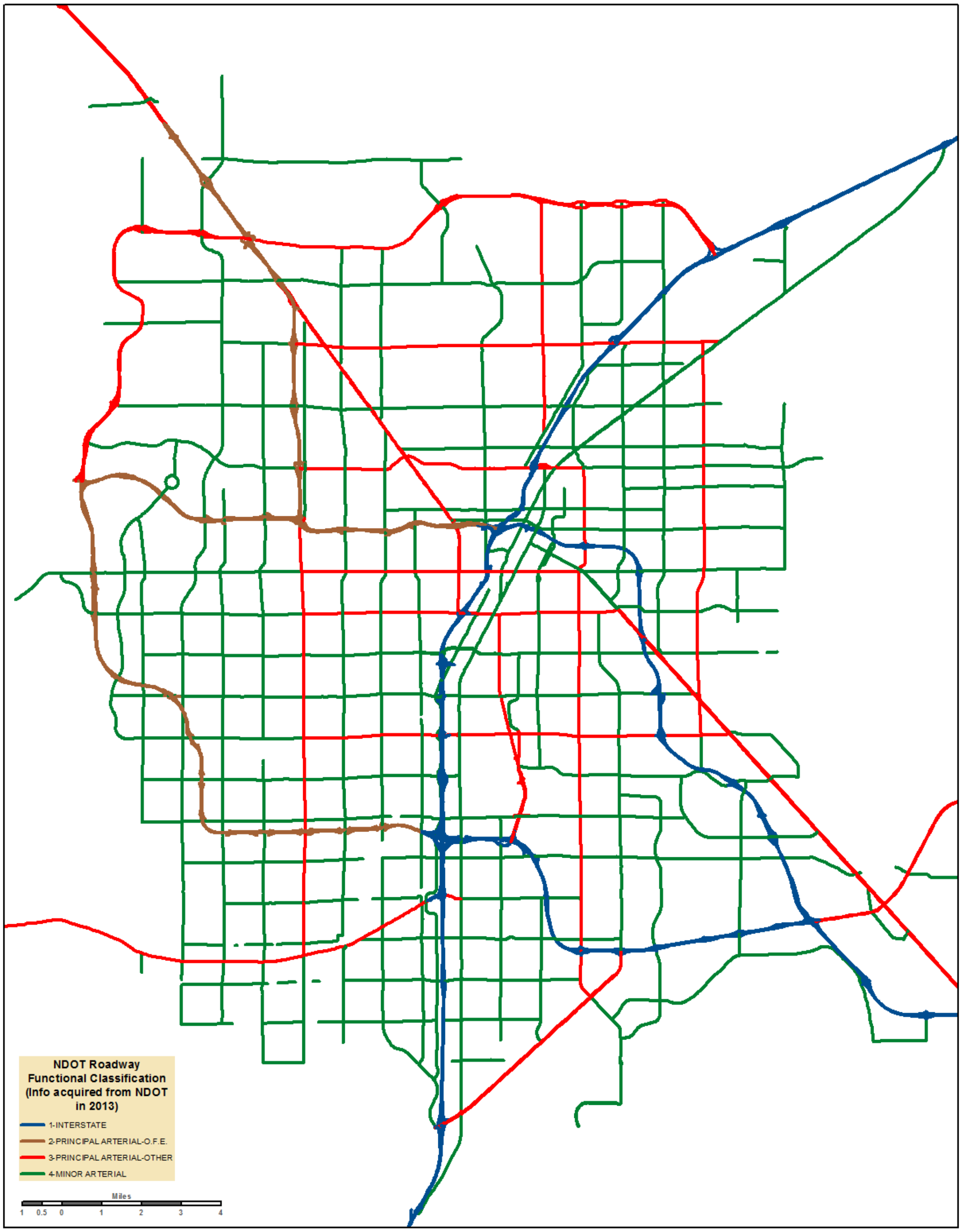

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Table 3.2- 2015 -Modeled Network Miles By Roadway Type

	Link Miles	Lane Miles
External links	44.1	93.0
System-System Ramp	24.0	35.8
Minor Arterial	446.1	1863.8
Major Arterial	475.1	2325.0
Ramp	151.6	197.9
Interstate	205.5	625.3
Freeway	94.4	277.6
Expressway/Beltway	26.1	62.5
Collector	702.7	1936.2
Centroid Collector	1439.3	2882.6
Local	32.5	72.2
HOV Lanes	24.9	24.9
Transit Link	33.0	49.4
Transit Access Link	6.3	12.6
Totals	3,705	10,459

3.3 - Development of Multimodal Performance Measures (Step 3)

Performance measures are tools to measure and monitor the transportation system in the CMP. They assist in identifying, tracking and monitoring congestion, but they are dependent upon the transportation network and the availability of data. They typically are used to measure the extent and severity of congestion and to evaluate the effectiveness of the implemented strategies.

As identified by FHWA, the roles of performance measures are:

- To characterize existing and anticipated conditions on the regional transportation systems.
- To track progress toward meeting regional objectives.
- To identify specific locations with congestion to address.
- To assess congestion mitigation strategies, programs and projects.
- To communicate system performance to decision makers, the public and MPO member agencies.

3.4- Performance Measures

Congestion deals with the *quality* of the use of the system as well as the *quantity* of the use. Conceptually, congestion occurs when there are too many people or vehicles at the same location simultaneously. This causes the quality of the user trip declines due to the quantity of volume present.

Congestion also has two dimensions, *spatial* and *temporal*. Spatial refers to the location of congestion (such as a location, an intersection, roadway segment) where congestion occurs. Temporal concerns the when (time of day or year) that congestion occurs. There is also a *systemic* aspect in that transportation facilities do not operate in isolation, if traffic backs up on one route, it may result in diversion by arriving vehicles to adjacent routes. There also is a relative aspect in that observations of congestion may be qualitatively perceived as being more or less severe than observations at the same time.

According to the "Freeway Management and Operations Handbook" [1] published by the Federal Highway Administration, good performance measures have several attributes:

- Goals and objectives – Performance measures should be identified to reflect goals and objectives, rather than the other way around.
- Decision-making process – Performance measures must be integrated into the decision-making process; otherwise, performance measurement will be simply an add-on activity that does not affect the agency's operation.
- Limited number of measures – Fewer rather than more measures is better. Too much data and analysis could overwhelm agency resources as well as decision makers. Performance measures can be thought of as being similar to gauges on a dashboard, several gauges are vital, but too many would be a distraction.
- Easy to measure – The data required for performance measures should be easy to collect and analyze.
- Simple and understandable – Within the constraints of required precision, accuracy, and facilitating improvement, performance measures should prove simple in application with consistent definitions and interpretations. Any presentation of performance measures data must be carefully designed such that it is easy for the audience to understand the information, and that the data analysis provides the information necessary to improve decision making.
- Sensitivity – Performance measurement must be designed in such a way that change is measured at the same order-of-magnitude as will likely result from the implemented actions.

1 Performance Monitoring and Evaluation. Retrieved from http://ops.fhwa.dot.gov/freewaymgmt/publications/frwy_mgmt_handbook/chapter4_01.htm

The performance measures for the Southern Nevada CMP were selected to address the existing conditions for the regional multimodal transportation network. The measures include elements that address safety, roadway improvements, public transit, bicycle/pedestrian/multi-use trail facilities, travel demand management (TDM), and goods movement.

These performance measures were developed in conjunction with other Nevada metropolitan planning organizations through a working group process during the past year. A committee was formed of representatives of the agencies to determine how to measure for and meet MAP-21 performance measure requirements.

Below**,** Table 3.2 summarizes the recommended performance measures for use with the Congestion Management Process. Figure 3.3 relates the objectives identified in Table 3.1 with the Congestion Management Process performance measures.

Table 3.3 Congestion Management Process Objectives and Performance Measures

Performance Measure	System wide	Corridor	Reason
Annual Average Serious Injuries and Fatalities from Vehicular Crashes	YES	YES	NDOT MAP-21 Reporting
Vehicle Miles Traveled	YES	YES	Local Measurement
Percent of Travel in Generally Acceptable Operating Conditions (Peak Hour)	YES	YES	NDOT MAP-21 Reporting
Congestion Duration	YES	YES	MPO Use of INRIX and FAST Data
Congestion Intensity	YES	YES	MPO Use of INRIX and FAST Data
Delay	YES	YES	NDOT MAP-21 Reporting
Travel Time Reliability	YES	YES	NDOT MAP-21 Reporting
Incident Duration on Freeways	YES	YES	Local Measurement
Transit On-Time Performance	YES	YES	Transit Measure (From RTC)
Annual Route Ridership	YES	YES	Transit Measure (From RTC)
Number of Participants in Commuter Program	YES	NO	TDM Measure
Signal retiming cost/benefit	NO	YES	Existing Measure
Freight Miles Traveled	NO	YES	NDOT Data
Percent of Miles Severely Congested	YES	YES	Existing Measurement
Delay to Freight	NO	YES	NPMRDS Data for Freight Speed
Number of crashes involving trucks	YES	YES	Safety Measure

Figure 3-3 Relationship of CMP Objectives to Performance Measures

Performance Measures	Freight and Goods Movement	Balanced System	Bicycle System	Pedestrian System	Safety	System Preservation	Cost Effectiveness	Mobility Enhancements	Intelligent Transportation Systems	System Functionality & Performance	Air Quality
Serious Injuries & Fatalities from Vehicular Crashes					all	all				all	
Vehicle Miles Traveled		auto						auto			auto
Percent of Travel in Generally Acceptable Operating Conditions		auto						auto	auto	auto	auto
Congestion Duration									auto	auto	auto
Travel Time Reliability		auto						auto	auto	auto	
Percent of Miles Severely Congested (based on V/C ratio)									auto	auto	auto
Freight Miles Traveled	truck										truck
Delay to Freight	truck										truck
Fixed Route Transit Accidents		bus			bus	bus		bus		bus	bus
Infrastructure - Transit State of Good Repair		bus				bus	bus		bus	bus	bus
Passenger Trips on Transit Per Revenue Hour		bus						bus			
Average Peak Service Frequency		bus						bus			
Transit On Time Performance		bus						bus	bus	bus	bus
Annual Ridership Volume		bus						bus			bus
Number of Participants in Commuter Program		hov						hov			hov
Number of Crashes Involving Heavy Vehicles	truck				truck	truck				truck	
Incident duration on freeways	time								time	time	time

auto	truck	hov	bus	ped	bike	time	all

The icons are displayed to indicate the dominant mode of travel involved in the relationship.

3.4- (Step 4) Data Collection and System Performance

The FHWA identifies congestion monitoring as just one transportation system performance aspect that leads to more effective investment decisions for transportation improvements. Safety, physical condition, environmental quality, economic development, quality of life, and customer satisfaction are among others that require monitoring.

The *Final Rule on Metropolitan Transportation Planning* [1] calls for a coordinated data program "to assess the extent of congestion, to contribute in determining the causes of congestion, and evaluate the efficiency and effectiveness of implemented actions." It also indicates that "to the extent possible, this data collection program should be coordinated with existing data sources and coordinated with operations managers in the metropolitan area."

The goal of the RTC of Southern Nevada Congestion Management Process is to develop a system for ongoing accumulation of performance data for roadways, public transit, goods movement as well as pedestrian and bicycle facility development and usage.

A. Roadways can be monitored through the use of several different data sets. These are:
   - INRIX Insights
   - Freeway performance monitoring data from FAST.
   - National Performance Measures Research Data Set (NPMRDS) from the FHWA
   - Floating car method using a gps equipped vehicle traveling in peak hour traffic.
   - Model estimates from the Regional Travel Demand Model

B. Freeway crashes and incident clearance times are tracked and monitored on a daily basis by FAST to help measure non-recurring congestion. Crash data for arterials is aggregated by the Nevada Department of Transportation and statistics are released to the RTC on an annual basis.
C. Transit performance is monitored continuously by the RTC and is related through monthly summary reports on trends in ridership and performance for each route.
D. Bicycle route development is tracked and usage counts have been periodically performed.
E. Significant goods movement corridors are evaluated to address mobility needs of the goods movement providers.
F. Volume data (AADT) is provided by NDOT to the RTC which will help with some measurement reporting requirements of MAP-21.

1. U.S. Department of Transportation, (2007, February 14). Statewide Transportation Planning; Metropolitan Transportation. Retrieved from https://www.gpo.gov/fdsys/pkg/FR-2007-02-14/html/07-493.htm

The RTC, as part of the system monitoring plan, will typically update the Congestion Management System Report in conjunction with the TIP. The RTC will develop a map of congested roadways. The existing road network will be depicted using the most recent traffic counts from NDOT. Data from INRIX and the NPMRDS will be analyzed to depict the travel times and speed on routes within the National Highway System.

3.5- Analysis of Congestion Problems and Needs (Step 5)

Congested Corridor Selection

This section summarizes the evaluation of the CMP strategies, including the process for selecting corridors and projects for implementation. Also included are an implementation schedule, implementation responsibilities, costs, and possible funding sources for each strategy proposed.

3.5.1- Congested Corridor Identification

The purpose of the CMP is to identify congested corridors. These corridors can be evaluated as part of potential TIP projects/programs. The process has two phases, with an overview illustration provided in ***Figure 3-4:***

3.5.2- Congested Corridor Network Identification (Phase 1)

Annual monitoring of roadway performance data can identify areas experiencing recurring congestion. Roadways that are congested today or forecasted to be congested in the long term are considered for review through the CMP. Corridors are identified as "not congested," "approaching congestion or minimally congested," or "extremely congested," as summarized below.

- *Not Congested* — Corridors that are not anticipated to generate volumes resulting in congestion, either as they are or after improvements in the TIP program are made.
- *Approaching Congestion or Moderately Congested* —Corridors that are not presently congested but have segments with traffic volumes at more than 90% of the roadway's capacity.
- *Extremely Congested* — Roadways in the Existing + Committed (E+C) network that have forecast volumes greater than their physical capacities. (This typically occurs when using detailed analysis and the volume-to-capacity ratio is 1.00 or greater).

Crash data can also identify corridors or intersections with a high frequency of crashes that cause non-recurring congestion. Safety improvements reduce potential harm to persons in our communities and can also reduce congestion.

Generally, non-congested corridors do not need to be addressed by the CMP, Roadway segments identified as being moderately or extremely congested could be assessed for applicability of strategies to manage traffic demand or improve operations. Corridors with moderate levels of recurring congestion can show the most improvement in performance from application of non-capacity expanding operational strategies from the congestion management matrix. For corridors with extreme levels of recurring congestion, CMP improvements typically will require capacity expansion or strategies with extensive efforts at reducing solo vehicular trips demand, such as introducing new transit service to the corridor.

The identification of congested corridors could coincide with the identification of locations in the road network with a high frequency of vehicle crashes. These could be determined by RTC staff using available crash data statistics. After the congested roadways and high crash locations are identified, these would be sorted and presented be presented to the Executive Advisory Committee, which would then offer guidance on which should be examined for further study.

3.5.3 - Other Considerations

The formalized technical process for evaluating recurring and non-recurring congestion may be augmented by these resources:

- **Goods Movement Stakeholder Input —** these are locations where issues affecting goods movement have been identified.
- **Safety Stakeholder Input —** typically this information is provided by members of the technical committee, first responders (law enforcement, fire, and/or EMS) or local elected officials.
- **CMP Spreadsheet —**these identify specific issues or concerns identified by or presented to the EAC.

3.6- (Step 6) Congestion Management Strategies

This section of the CMP Update identifies and evaluates the strategies intended to mitigate congestion in the Southern Nevada roadway network. A Toolbox of Strategies is presented to help policy makers and planners effectively use these congestion reduction strategies.

For MPOs with more than 200,000 people within their planning areas, federal regulations require that the MPO:

"shall address congestion management … through the use of travel demand reduction and operational management strategies." [1]

In addition, the Final Rule on Statewide and Metropolitan Transportation Planning, states:

"Development of a congestion management process should result in multimodal system performance measures and strategies that can be reflected in the metropolitan transportation plan and the Transportation Improvement Program (TIP)." [1]

Based on these regulations, MPOs must use the CMP to address congestion. Improvement projects must be implemented to help the transportation system run more efficiently.

3.6.1- CMP and Safety Strategy Screening

As indicated in Figure 3.4, once congested corridors are identified for further review, they can be screened to identify mitigation strategies to reduce congestion or improve safety. In locations where significant recurring congestion is present, the congestion matrix (Appendix D-1) could be utilized. In locations where there are a high incidence of vehicular crashes are causing non-recurring congestion, the safety matrix (Appendix D-2) could be utilized.

A range of congestion mitigation strategies have been grouped into categories and are presented on Figure 3.5 on the following page. Selective utilization of these strategies can assist in mitigating congestion.

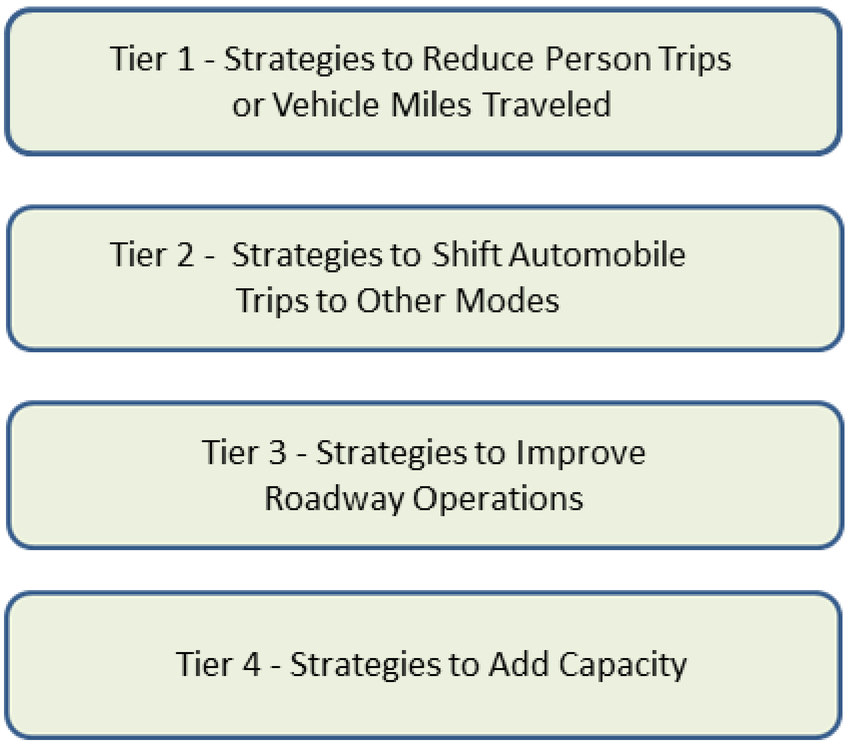
1. Congestion Management Process in Transportation Management Areas. Retrieved from https://www.gpo.gov/fdsys/pkg/CFR-2011-title23-vol1/pdf/CFR-2011-title23-vol1-sec450-320.pdf

Figure 3.5: Types of Congestion Management Strategies

3.6.2- Congestion Mitigation Strategy Tiers-

The CMP uses thematically tiered strategies to guide the incremental process for addressing identified congestion in corridors. Following an approach used by other MPOs and promoted by FHWA, the tiers are arranged so measures at the top take precedence over those at the bottom. The tiers are displayed below.

Figure 3.7: Congestion Mitigation Strategy Tiers



The “top-down” approach promotes the growing sentiment in transportation planning and the FHWA’s direction to consider all solutions before recommending additional roadway capacity. The various elements of the congestion management toolbox are described in the remainder of this section.

3.7.1- Tier 1: Strategies to Reduce Person Trips and Vehicle Miles Traveled

Transportation Demand Management -

The RTC has a vigorous Transportation Demand Management (TDM) program called “Club Ride” Commuter Services. Established thirteen years ago, Club Ride was designed to help reduce traffic congestion, improve air quality and mobility, encourage the use of commute alternatives and ultimately create a more sustainable community.

Club Ride has developed a successful regional trip reduction program by targeting their message to large employers and their employees. The Club Ride program works with both groups to establish customized commute option program which incentivize use of alternative modes of transportation for getting to and from work, such as transit, carpooling, van pooling, bicycling or walking.

Elements of the Club Ride program have included:

- Computerized Rideshare Matching
- E-Z Rider Discounted Transit Passes
- Club Ride Rewards Program
- Guaranteed Emergency Ride Home
- Preferential parking for employees participating in carpool commuting.
- Vanpool subsidies

In 2014, Club Ride had 18,143 active registrants and 271 participating employers. The RTC also offers parking spaces at three of its four transit bus transfer centers (Centennial Hills, Westcliff and South Strip Transfer Terminal) for commuters to use. Centennial Hills has a significant number of commuters parking there and using vanpools to commute daily to Creech Air Force Base located 30 miles to the northwest. South Strip Transfer Terminal sees its heaviest use of its parking facilities on weekends by people traveling out of nearby McCarran International Airport.

Alternative Work Hours- These more evenly distribute employee working hours across the day and contribute to reducing congestion. There are three types of alternatives, flex time, staggered hours and compressed work weeks. Flex time allows an employee to start and end their workday outside of the general commuting periods. Staggered hours have different work schedules for employees in different work groups. Compressed work weeks reduce the number of work days per week, while lengthening the work day.

Telecommuting- This allows employees to work at home or at a regional center instead of going into a central office.

Preferential Parking for Carpools- This provides incentive for employees to carpool with preferred or free parking.

3.7.2- Tier 2: Strategies to Shift Automobile Trips to Other Modes

Improving Transit Accessibility-

The RTC recognizes that there is a need for qualitative improvements in transit service that means going beyond fleet renewal and maintenance of the present operations and system components. The challenge facing RTC is to make transit as an option more attractive to a wider range of people. The two primary needs that must be met to make progress on this objective are to make transit rides considerably faster and also to make the experience of riding transit more enjoyable.

Surveys have shown that, for individuals who have a choice between driving and using transit, the biggest challenge for transit is the length of trip time. An ongoing goal of the RTC is to increase service where feasible and also consider along with more amenities have been taking place.

The RTC has established several “bus rapid transit” routes as overlays to the existing conventional route network grid. The key to these routes working successfully is to route them in corridors where they can operate in a relatively uncongested right of way. Dedicated bus lanes are located on the roadway shoulder in each direction of West Sahara Avenue and also in the median of Grand Central Parkway and Casino Center Boulevard. RTC buses also make use of HOV lanes on US 95 and the flyover to and from Summerlin Parkway.

Previous studies have indicated that approximately 60 percent of all RTC bus commuters utilize less than 10 percent of bus stops in the system. These heavily used bus stops are typically in areas where there are very busy trip destinations or transfer destinations. If transfers are necessary between bus lines, it often requires that pedestrians disembark on foot and cross over street intersections that are busy and congested, such as going from southbound SDX Express to the westbound Sahara Express. Thus attention for improvement needs to be given not only to improving the aesthetic quality of the bus stops but also the convenience and safety of adjacent sidewalks and crosswalk facilities.

Expansion of Transit Services

These strategies add new vehicles or expand transit services. They are guided by service demands and also fiscal constraints.

Increasing bus route coverage or frequencies- This strategy provides better accessibility to transit to a greater share of the population. Increasing frequency makes transit more attractive to use.

Providing real-time information on transit routes- The RTC already provides real time information on bus location and projected arrival times. It plans to expand further in this area with the imminent release of a customized app for smart phones which will provide tracking information, schedules and allow for fare purchases.

Providing exclusive bus right-of-way- Exclusive right-of-way includes bus ways, bus-only lanes, and bus bypass ramps. The RTC already has some dedicated corridors along South Grand Central Parkway, Casino Center Boulevard and dedicated shoulder lanes on west Sahara Avenue. This will continue to be considered as an option for future projects.

Non-Motorized Transportation Strategies-

New sidewalk connections- Sidewalk connectivity encourages people to walk for short trips as opposed to driving.

Bicycle Lane Network- There are 80 miles of designated bicycle routes, 100 miles of designated bicycle paths and 180 miles of bicycle lanes on streets in the Las Vegas Valley. Efforts are underway to increase the availability of facilities in our region as well as initiating a bike sharing program in downtown Las Vegas in the summer of 2016.

Increasing Safety for Pedestrian and Bicycle Facilities- Safety can be increased through implementing modifications deemed appropriate for the circumstances. These can include additional lighting, signage, traffic control devices, improving pavement and sidewalk surface, bulb-out curbs at intersections and raised crosswalks.

Complete Streets- Designing a corridor to enable safer access for pedestrians, bicyclists, transit users and motorists.

The RTC has researched and completed the *Alternative Mode Transportation Plan*, which prioritizes safe bicycle/pedestrian opportunities.

Improving transportation sustainability –

The RTC supports the creation of a more sustainable transportation system through initiatives, such as the continued development of Complete Streets and pursuing Transit Oriented Development that links employment and housing opportunities together with high quality transit.

Protecting air quality is of concern to Southern Nevada. The RTC is pursuing initiatives to reduce vehicular emissions. These include managing traffic flow through traffic signal timing coordination and ramp metering to minimize stop and go traffic flow conditions as well as idling, both of which emit more emissions than a vehicle in motion.

Projects to make operational improvements of intersections to reduce idling, such as adding turn lanes at busy intersections, have been funded through Congestion Mitigation for Air Quality grants. Within the RTC system, the transit fleet makes extensive use of buses which are diesel – electric powered, run on compressed natural gas or alternative fuels. Wherever possible, the RTC has utilized solar panels to provide power to bus shelters and illuminate bus stop signs.

<u>3.7.3- Tier 3: Strategies to Improve Roadway Operations -</u>

Roadway Operations and Intelligent Transportation Systems-

As described earlier, the Freeways and Arterials System of Transportation has an extensive amount of intelligent transportation system equipment and technology deployed in the field along the regional freeway corridors and at many arterial signalized intersections. These systems have many components, including vehicle sensors, electronic variable message board signs, streaming video cameras, controls, and communication technologies. ITS strategies are sets of components working together to provide information and allow greater control and operation. Strategies include:

Traffic Signal Coordination- The Southern Nevada FAST center already has many arterial corridors linked to their control center by fiber optic line to allow for oversight and adjustment of signalized intersections. Signals can be set to run on different pre-timed plans or to run based on actuation from specific events, such as the arrival of a vehicle, a transit bus, a pedestrian or an emergency vehicle. The phasing plans can be optimized for ongoing conditions.

Dynamic Messaging- These electronic message signs are in use on Las Vegas regional freeways. They provide motorists with information concerning travel time estimates to destinations and have the capability of displaying alternate route detour information, information on special events or emergency closures. There are presently 82 of these signs installed and operational around the region.

Advanced Traveler Information Systems (ATIS) — FAST provides information to travelers via its web site nvfast.org as well as via text messages and soon a customized app for smart phone users.

3.7.4 Tier 4: Strategies to Add Capacity

These involve the construction of new lanes for vehicular traffic or Selecting from this tier of options should be preceded by considering the applicability of demand management measures from the three tiers listed earlier. Capacity adding strategies should be considered only after the demand management options have been deemed unfeasible.

Bottleneck Removal —This strategy is aimed correcting at short segments of roadway which have temporary lane reductions or other design limitations that cause physical capacity to be limited. As heavier flows of upstream traffic arrive at the bottleneck point, vehicles can back up due to the sudden constriction.

Channelization — This separates turning traffic from the through lanes at intersections. This can take the form of lane markings or in some instances concrete islands. Consideration for pedestrians needs to be given if considering placing right turn channels.

Intersection Improvements — Intersections can be widened and lanes re-striped to increase capacity as well as safety. Elements of this may include the construction of left (and/or right) turn lane(s), widening the shoulders, applying changes to the traffic control at the intersection.

New travel lanes added along an existing roadway- This will provide increased capacity and reduce congestion and travel delays for existing levels of traffic. It could also result in less traffic on parallel side streets and arterials as vehicles divert to the widened road. However, the cost of construction could be high depending on the amount of right of way needed and impediments.

New or Extended Roadway – This is a new road along a separate right of way to serve newly developed or developing areas or an extension of an existing roadway to complete a network. It is applicable to areas experiencing new development or relieving an existing severely congested corridor. Cost depends on amount of right-of-way needed and the scale of construction impediments.

3.8- (Step 7) Programming and Implementing Strategies

3.8.1- Project Identification and Implementation (Phase 3)

The congestion or safety mitigation strategies identified as having the greatest potential benefit are to be evaluated in detail based on committee or technical recommendations. During this phase, additional analysis of potential projects is undertaken to identify the specific improvement, implementation issues, and costs. Programs such as demand-reducing programs or policy changes are evaluated to identify recommended action items.

Recommendations then are made for the projects or programs to be considered for inclusion of the TIP or RTP. This may result in refocusing resources, programming improvements in local agency capital improvement programs or using boxed funds controlled by the MPO. These finally may be identified as projects for implementation in future RTPs. In summary, the RTP projects can be funded by any of the following means:

Funding for Project Implementation

1. Congestion Mitigation Air Quality (CMAQ) funding
2. Surface Transportation Program (STP)
3. Transportation Alternatives Program (TAP)
4. Other Funding Options

Traffic conditions on the regional roadway network (classified as arterials or above) are monitored regularly to identify locations of recurring and non-recurring congestion. Corridors which are considered non-congested usually don't need to be addressed by the Congestion Management Process. In contrast, the corridors or locations identified as having significant recurring or non-recurring congestion will be candidates for congestion relieving strategies. Corridors where extreme congestion occurs may need consideration of strategies to reduce single occupancy vehicle travel, other operational improvements or finally capacity expansion.

Vehicular crash statistics can be utilized to identify corridors or intersections with a high frequency of crashes that cause non-recurring congestion. Safety improvements at these locations can reduce not only harm to individuals, but also reduce the incidences of congestion. Additionally, it is important to monitor the cumulative time it takes to clear vehicles and debris from a crash scene to allow traffic to flow again. The Southern Nevada FAST has established agreements with emergency services and towing companies regarding time benchmarks for crash clearance on the regional freeway system.

The RTC will use its Operational Management Committee, consisting of technical professionals from each of the member jurisdictions as well as the RTC, to review initial findings concerning both recurring and non-recurring congestion.

Once the congested corridors were sought for review after the end of Phase I, they would be screened to identify applicable mitigation strategies to reduce the occurrence of congestion or improve safety. The RTC congestion reduction strategies would be consulted for options to address areas of congestion while the safety factors would come from the Southern Nevada Transportation Safety Plan.

The congestion or safety mitigation strategies that are identified as having the greatest potential benefit are then evaluated in greater detail based on committee or technical recommendations. The congestion or safety mitigation strategies that are identified as having the greatest potential benefit are then evaluated in greater detail based on committee or technical recommendations.

3.8.2- Congestion Mitigation Air Quality (CMAQ) Funding for Projects

For funding operational and ITS projects, such as intersection improvements and signal system interconnection, the Regional Transportation Commission of Southern Nevada often utilizes local jurisdiction funds combined with CMAQ funds.

The FHWA mandates that projects be prioritized based on the cost effectiveness of emission reductions. This mandate was strengthened with the passage and ultimate implementation of MAP-21. During the project selection process, projects are evaluated based on their cost effectiveness. Priority consideration is given to those projects which result in the most emissions reductions for the least amount of CMAQ funds expended.

There are seven different types of CMAQ projects implemented by local agencies in Clark County:

1. Intersection modifications, including HOV direct connections from freeways
2. Bicycle lane and pedestrian improvements
3. Intelligent Transportation System (ITS) improvements that focus on improved signal coordination resulting in an increase in travel speed and a reduction in idle delay.
4. Installation of bus turnouts in places where transit vehicles use general purpose travel lanes to board and alight passengers;
5. Purchase of electric vehicles (EV) or installation of EV charging stations
6. Transportation Demand Management (TDM);
7. Electric and natural gas vehicle purchases.

The RTC has found that ITS, TDM, bicycle and pedestrian and intersection modifications were the most cost effective projects. The 2015-2018 Transportation Improvement Program (TIP) for the RTC shows the following amounts of expenditure using CMAQ funds. The total amount represents about 5% of all programmed expenditures outlined in the TIP for this period.

Table 3.8– RTC CMAQ funding for 2015-2018 [1]

Fiscal Year	Programmed CMAQ Funds:
2015	$19,831,726
2016	$25,653,110
2017	$18,384,711
2018	$20,725,000
Total Programmed CMAQ Funds for 2015-2019	$89,594,547
All Programmed Funds for 2015-2019	$1,827,838,953

3-8.3 Congestion Mitigation and Air Quality (CMAQ) Project Selection

The Congestion Mitigation and Air Quality Improvement (CMAQ) Program was created under the Intermodal Surface Transportation Efficiency Act of 1991. Subsequently, it has been reauthorized under each of the following federal transportation bills, including MAP-21 most recently

The CMAQ program supports two important goals of the U.S. Department of Transportation (USDOT): improving air quality and relieving congestion. Reducing pollution and other adverse environmental effects of transportation projects and transportation system inefficiency have been longstanding objectives of the USDOT.

The strategic plans for both the USDOT and the Federal Highway Administration (FHWA) include performance measures specifically focused on reducing air pollution from transportation facilities. The CMAQ program provides funding for a broad array of tools to accomplish these goals. By choosing to fund a CMAQ project, a state or local government can improve air quality and make progress towards achieving attainment status and ensuring compliance with the transportation conformity provisions of the Clean Air Act.

3.9 – (Step 8) Monitoring Strategy Effectiveness

The FHWA guidelines call for CMPs to include provisions to monitor the performance of strategies implemented to address congestion. Regulations require "a process for periodic assessment of the efficiency and effectiveness of implemented strategies, in terms of the area's established performance measures." This step helps determine whether operational or policy adjustments are needed to make the current strategies work better and provides information about how various strategies work to implement future approaches within the CMP study area.

Data collection and performance monitoring are ongoing with the various periodic assessments of roadway, transit, bicycle/pedestrian/trail, freight network performance in the planning area served by Regional Transportation Commission of Southern Nevada. However, this CMP also identifies the need for a process that supports an annual tracking of the effectiveness of implemented congestion mitigation strategies and the multimodal system as a whole. This annual process is described below.

3.9.1 Updates to the Congestion Management Process Report

An updated Congestion Management Process Report will be periodically developed by RTC staff. The updated reports will track the effectiveness of the implemented strategies, to the extent possible with the available project level data, and conditions of the multimodal transportation system as a whole. Where appropriate, performance evaluations may be undertaken for specific programs or projects implemented as part of the CMP. The content, commitment and scheduling of the CMP Report will be determined by the Executive Advisory Committee (EAC).

Chapter 4 –FREEWAY PERFORMANCE

4.1- Freeway and Arterial System of Transportation (FAST) -

The Southern Nevada Freeways and Arterials System of Transportation (FAST) system collects and assesses ongoing performance data acquired through the embedded roadway loops and traffic monitoring cameras. The loops can count the number of vehicles traveling across them as well as their average speed. The traffic cameras allow for FAST personnel to identify the occurrence of incidents which disrupt traffic flow, but also to measure how long delays last.

The data which FAST subsequently produces shows the following details:

1) Percent of week days that experience recurring congestion
2) The average maximum and 95th percentile delay in congestion
3) When recurring traffic delays typically start on the route.
4) How long traffic delays last.

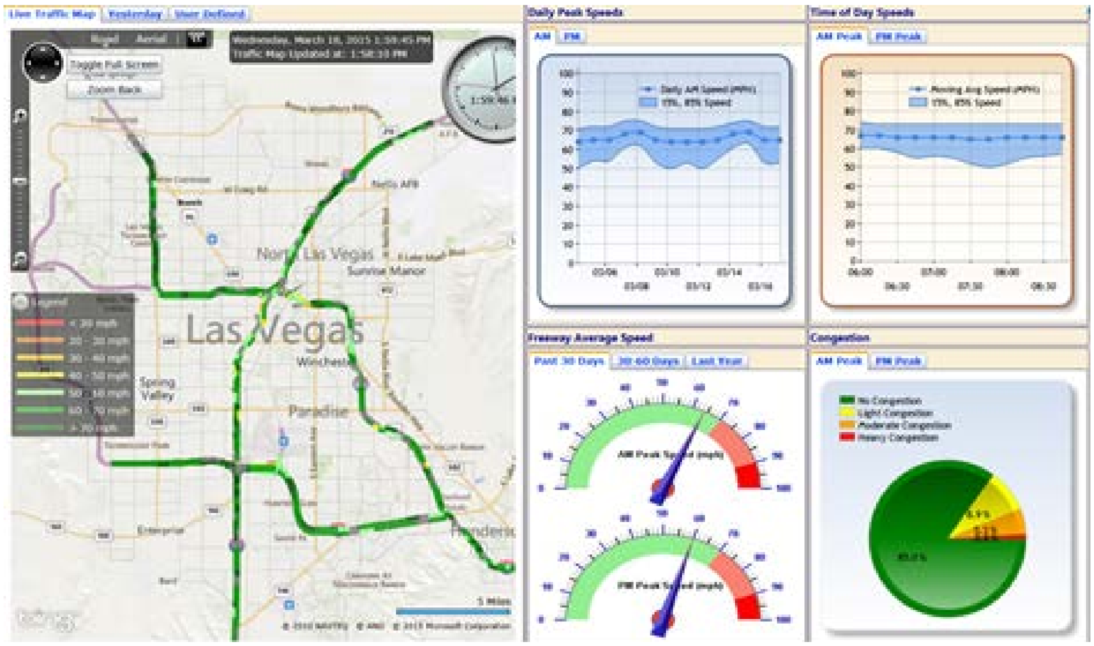
FAST also keeps of the time it takes to clear vehicular crashes from freeway travel lanes. The objectives set for clearance time are less than 30 minutes for vehicular crashes involving property damage only and less than 60 minutes for vehicular crashes where there are physical injuries.

4.1.1- FAST Performance Monitoring-

The FAST Dashboard (Performance Monitoring & Measurement System) is a software program totally designed, developed and written using in-house staff in the Regional Transportation Commission of Southern Nevada's (RTC), Freeway and Arterial System of Transportation (FAST) division.

It provides an easy-to-understand web-based user interface to enable the public to pull and depict real-time and historical freeway network monitoring and performance information in a wide variety of user-selectable and user-customizable displays. The FAST Dashboard is built upon the enormous storehouse of raw data automatically gathered by the Intelligent Transportation Systems (ITS) that Nevada Department of Transportation (NDOT) has implemented on its freeway network in southern Nevada, plus incident-specific data logged by FAST's technicians.

Figure 4-1: FAST Performance Dashboard -



By integrating these data, the FAST Dashboard not only develops maps, charts and graphs showing trends and ‘report cards’ on freeway performance, but also enables the user to quantitatively characterize the discrete traffic flows. For the public, it can provide basic travel time related information and camera snapshots; for FAST and NDOT technical analysts, it is feature rich analytical tool whose primary output is the magnitude of traffic delays experienced for various alternative study scenarios; for other transportation professionals, it is a platform to obtain meaningful transportation information. As a result, the FAST Dashboard satisfies the various demands from the public to transportation professionals and decision makers.

4.1.2- FAST Congestion Report through the 4th quarter of 2014:

Below is a ranking of regional freeway bottlenecks by intensity during the peak hours of either 7 am to 9 am (AM Peak) or 4 pm to 6 pm (PM Peak). Data columns that are included are the percentage of weekdays that experience congestion, the average delay in minutes of time, the average time of day when delays originate and also whether there are projects for the corridor scheduled in the Transportation Improvement Program (TIP) or Regional Transportation Plan (RTP).

Table 4.2 - Top Congested Freeway Segments According to FAST-

Rank	Route	Percent of Weekdays Congested	Average Delay (minutes)	95th Percentile Delay (minutes)	Average Time When Delays Begin	Duration of Delay (minutes)	TIP	RTP
1	I-15 north from Sahara Ave to Charleston Blvd - PM	100	11	16	3:09 PM	143	☒	☒
2	I-215 west - Airport connector to Rainbow Blvd - PM	89	15	24	4:42 PM	90	☐	☒
3	US 95 south to I-15 south – PM	87	10	14	3:02 PM	136	☐	☒
4	I-515 west from Charleston Blvd to I-15 - PM	85	12	20	4:06 PM	100	☐	☒
5	US 95 south to I-15 south - AM	71	10	13	7:15 AM	69	☒	☒
6	I-15 south from US 95 to Charleston Blvd - PM	81	10	17	3:25 PM	107	☐	☒
7	I-15 south from US 95 to Charleston Blvd - AM	76	11	21	6:56 AM	72	☒	☒
8	I-215 south from Eastern Ave to I-515 - PM	85	5	11	4:57 PM	53	☐	☒
9	I-515 west from Eastern Avenue to I-15 - AM	50	4	15	7:40 AM	29	☐	☒
10	I-215 west from Green Valley to I-15 - AM	19	10	27	7:45 AM	41	☐	☒
11	I-215 east from I-15 to Windmill - PM	56	6	12	4:52 PM	70	☐	☒

4.3 - INRIX Data Findings:

INRIX is a private company specializing in the accumulation and refinement of traffic data which can be used to assess roadway performance and traffic conditions. This is gathered from traditional road sensor networks with up-to-the-minute data from consumer and fleet vehicles as well as mobile devices, and incidents. The RTC, in conjunction with the other three Nevada metropolitan planning organizations (Lake Tahoe, Washoe and Carson City) utilizes INRIX data through a subscription provided by the Nevada Department of Transportation.

The full version of Inrix Insights provides real time as well as archival data. Inrix Insights offers web based tools to allow users to download reports, visualize data on maps or graphics and download raw data for off line analysis. The Insights program produces findings in the form of:

- Real Time/Historical Speed Data
- Travel Time Index
- Travel Time Reliability Metrics
- Queue Measurements
- Bottleneck Ranking

4.3.1 - How INRIX Works:

The INRIX system is built upon the framework of traffic message codes which are nine character codes uniquely applied to a directional segment of roadway. TMC codes generally span a direction of road from one exit or entrance ramp to the next.

Inrix uses a harmonic mean, a type of average typically used for speeds taken across a given distance. The arithmetic mean is used when taking the average of speeds over given periods of time. Probe data provides speeds over certain distances, which is averaged with the harmonic mean to get aggregate speed data for each TMC.

Categories of data which Inrix processes include:

Speed — the current estimated harmonic mean speed for the roadway segment in miles per hour.

Travel Time — Time it will take to drive along the roadway segment (Distance Traveled / Speed).

Reference Speed — the calculated "free flow" mean speed for the roadway segment in miles per hour. This attribute is calculated based upon the 85th-percentile point of the observed speeds on that segment for all time periods, which establishes a reliable proxy for the speed of traffic at free-flow for that segment.

Historic Average Speed — the historical average speed for the roadway segment for that hour of the day and day of the week in miles per hour.

Comparative Speed — measured speed as a percentage of the historic average speed for this time of day and day of week.

Congestion — Measured speed as a percentage of the free flow speed.

Historic Average Congestion — Historic average speed as a percentage of the free flow speed for this time of day and day of week.

Confidence Score - This is a simple confidence factor.

- 30 - high confidence, based on real-time data for that specific segment
- 20 - medium confidence, based on real-time data across multiple segments and/or based on a combination of expected and real-time data
- 10 - lower confidence, based primarily on historical data or road reference speeds

C-Value —this indicates the probability that the current probe reading represents the actual roadway conditions based on recent and historic trends. This value is only used when the confidence score is 30. (0= low probability, 100 = high probability)

The following metrics are calculated from vendor-provided data and defined by the Travel Time Reliability publication provided by the Federal Highway Administration and produced by the Texas Transportation Institute with Cambridge Systematics, Inc:

Buffer Time — the extra time (or time cushion) that travelers must add to their average travel time when planning trips to ensure on-time arrival (95% Travel Time - Average Travel Time).

Buffer Index — the Buffer Time's percentage value of the Average Travel Time ((95% Travel Time - Average Travel Time) / Average Travel Time). Its value increases as reliability gets worse. For example, a buffer index of .4 (40 percent) means that, for a 20-minute average travel time, a traveler should budget an additional 8 minutes (20 minutes x 40 percent = 8 minutes) to ensure on-time arrival most of the time.

Planning Time —total time a traveler should plan for to ensure on-time arrival (95% Travel Time).

Planning Time Index -

A travel time reliability measure that represents the total travel time that should be planned for a trip. Computed with the 95th percentile travel time it represents the amount of time that should be planned for a commute trip to be late for only 1 day a month. The planning time index differs from the buffer index because it includes typical delay as well as unexpected delay. Thus, the planning time index compares near-worst case travel time to a travel time in light or free-flow traffic. For example, a planning time index of 1.60 means that, for a 15-minute trip in light traffic, the total time that should be planned for the trip is 24 minutes (15 minutes x 1.60 = 24 minutes).

Travel Time Index — Travel time represented as a percentage of the ideal travel time (Travel Time / Free-flow Travel Time). This is a measure of congestion that focuses on each trip and each mile of travel. It is calculated as the ratio of travel time in the peak period to travel time in free-flow. A value of 1.30 indicates that a 20-minute free-flow trip takes 26 minutes in the peak hour.

The INRIX system also calculates bottlenecks in the roadway network. These are determined by comparing the current reported speed to the reference speed (posted speed limit) for each segment of road. If the reported speed falls below 60% of the reference speed, the road segment is flagged as a potential bottleneck. If the reported speed remains below 60% for five minutes or more, the segment is confirmed as a bottleneck location.

Adjacent road segments meeting this condition are joined together to form the bottleneck queue. When reported speeds on every segment associated with a bottleneck queue have returned to values greater than 60% of their reference values and remained that way for 10 minutes, the bottleneck is considered cleared. The total duration of a bottleneck is the difference between the time when the congestion condition was first noticed (prior to the 5 minute lead in) and the time when the congestion condition recovered (prior to the 10 minute lead out). Bottlenecks whose total queue lengths, determined by adding the length of each road segment associated with the bottleneck, are less than 0.3 miles are ignored.

The bottleneck analysis tool feature on INRIX Insights allows for us to analyze where bottleneck conditions exist on over 3,000 roadway segments in the Las Vegas Valley. We opted to examine conditions for the maximum feasible time range for this tool, 90 days, choosing a date range of March 1st to June 1st, 2016. The analysis tool determined where bottleneck conditions existed and ranked them in severity using the following criteria.

1) **Average duration –** the average length of time that congested conditions persisted on the segment.
2) **Average maximum length –** the distance from the incident where slowed conditions could be experienced.
3) **Occurrences –** the number of separate, distinct incidents of congestion which were measured during the designated time period.
4) **Impact factor** = average duration (in minutes) x average maximum length x number of occurrences,

A fifth measurement category, "**All events and incidents**" is also possible for incorporation into the INRIX module, but would require additional agreements with INRIX to become available for Southern Nevada. This category would link the occurrence of reported traffic incidents or other special events to congestion within the roadway segment during that time frame.

The table below represents the ranking of bottlenecks in the Las Vegas region for March 2016 to June 2016. They are ranked in order of their impact factor.

Table 4-3: Inrix Calculated Bottlenecks in Las Vegas Valley, March to June, 2016-

Rank	Location	Direction	Average duration	Average maximum length (miles)	Number of Occurrences	Impact factor
1	I-515 @ I-15/EXIT 76A	NB	4 h 49 m	3.46	120	120,118
2	I-15 @ SAHARA AVE/EXIT 40	SB	2 h 35 m	3.87	126	75,675
3	I-15 @ CHARLESTON BLVD/EXIT 41	NB	2 h 1 m	2.8	200	67,671
4	TROPICANA AVE @ BOULDER HWY	EB	1 h 7 m	1.33	731	65,299
5	TROPICANA AVE @ SWENSON ST	WB	1 h 3 m	1.23	648	50,039
6	I-15 N AT DESERT INN ROAD	NB	1 h 26 m	3	180	46,428
7	US-95 @ I-15/EXIT 76B	SB	1 h 48 m	1.65	248	44,247
8	TROPICANA AVE @ SWENSON ST	WB	1 h 6 m	1.28	497	41,924
9	I-215 @ DECATUR BLVD/EXIT 11	WB	1 h 50 m	3.14	120	41,512
10	I-15 @ CHARLESTON BLVD/EXIT 41	SB	1 h 5 m	1.82	323	38,316
11	EASTERN AVE @ E WARM SPRINGS RD	SB	1 h 5 m	1.4	412	37,398
12	TROPICANA AVE @ BOULDER HWY	EB	1 h 19 m	1.44	322	36,601
13	CR-215 @ US-95	SB	41 m	2.42	367	36,430
14	TROPICANA AVE @ S NELLIS BLVD	EB	1 h 4 m	1.23	438	34,518
15	I-15 @ LAKE MEAD BLVD/EXIT 45	NB	3 h 50 m	7.59	19	33,169
16	US-93 @ NEVADA HWY/BUCHANAN BLVD	NB	59 m	1.5	365	32,283
17	SAHARA AVE @ I-15	WB	56 m	1.33	415	30,966
18	NELLIS BLVD @ CHARLESTON BLVD	SB	50 m	0.86	704	30,312
19	I-515 @ CASINO CENTER BLVD/EXIT 75	NB	1 h 48 m	2.43	114	29,904
20	TROPICANA AVENUE AT I-15	WB	50 m	1.13	513	28,998
Direction: NB = Northbound, SB = Southbound, WB = Westbound, EB = Eastbound						

Further details on INRIX data findings can be found in Appendix B of this report.

4.5 FHWA measurement of Las Vegas regional traffic congestion -

The Federal Highway Administration (FHWA) prepares a quarterly urban congestion report, which serves as a snapshot of year to year congestion trends in 52 major metropolitan areas nationwide, including Las Vegas. The data utilized includes information from the National Performance Measure Resource Data Set, which includes observed measurements (collected 24 hours per day) and average travel times in five minute increments in three categories – freight truck, passenger vehicles and all vehicles. This data is segmented along paths known as Traffic Message Channels (TMC) which are approximately one mile in length each. The five minute travel times are aggregated into 15 minute monthly average travel times by day of the week

Four primary measures of data result-

- *Congested Hours* are computed as the average number of hours during specified time periods in which road sections are congested. This is defined as speeds less than 90 percent of the free flow speed (example: 54 miles per hour if the free flow speed is 60 miles per hour). The measure is reported for weekdays (between 6:00 am and 10:00 pm). Averages are weighted across road sections and urban areas by vehicle miles traveled using volumes from the FHWA Highway Performance Management System (HPMS).

- *Travel Time Index* is the ratio of the peak period travel time compared to the free flow travel time. This measure is computed for the AM Peak Period (6 am to 9 am) and PM Peak Period (4 pm to 7 pm) on weekdays. The averages across urban areas, road sections and time periods are weighted by vehicle miles traveled (VMT) using volume estimates derived from the FHWA Highway Performance Measurement System (HPMS).

  The Unified Congestion Report (UCR) states that Las Vegas has a travel time index of 1.23. This means that a trip can generally be expected to take 23% longer during the peak time than it would if made at another time with low traffic volume. A commute of 20 minutes would take almost 25 minutes in peak time due to the volume on the road.

- *Planning Time Index* is the ratio of the 95th percentile travel time compared to the free flow travel time. The measure is computed during the AM Peak Period and PM Peak Period as defined in the Travel Time Index and averages across urban areas, road sections and time periods are weighted by VMT using volume estimates derived from FHWA's Highway Performance Measurement System (HPMS).

With the planning time index, just 5 percent of the observations of travel time exceed the 95th percentile. For commuters, this means that for 19 out of 20 workdays in a month, their trips will take no more than the Planning Time.

4.5-1: FHWA Urban Congestion Report (UCR)
A Snapshot of Year to Year Congestion Trends in the U.S. for January through March, 2015

City: Las Vegas, NV
Congested Hours (2015): 3:59
Change from 2014: -0:01
Travel Time Index: 1.23
Change in Travel Time Index from 2014: +5
Planning Time Index (2015): 2.19
Change in Planning Time Index from 2014: +20
Complete Data: 92%

Data prepared by FHWA Office of Operations
http://www.ops.fhwa.dot.gov/perf_measurement/ucr/reports/fy2015_q2.htm

4.5-2: Urban Congestion Report (UCR)
A Snapshot of Year to Year Congestion Trends in the U.S. for January through March, 2015

City: Las Vegas, NV
Congested Hours (2015): 3:59
Change from 2014: -0:01
Travel Time Index: 1.23
Change in Travel Time Index from 2014: +5
Planning Time Index (2015): 2.19
Change in Planning Time Index from 2014: +20
Complete Data: 92%

Data prepared by FHWA Office of Operations
http://www.ops.fhwa.dot.gov/perf_measurement/ucr/reports/fy2015_q2.html

5.0 CONCLUSIONS AND RECOMMENDATIONS

A vibrant CMP can serve a valuable role in addressing the region's transportation needs in light of the following:

• Many corridors in the Las Vegas region have been built out to their maximum number of travel lanes
• Funding limits the number of large scale projects that can be planned and constructed
• Transportation safety issues continue to be a concern, particularly pedestrian fatality incidents.

A CMP can help the Las Vegas Valley identify and improve transportation conditions. Key highlights of the Southern Nevada CMP include:

• Prioritizing corridors on identified congestion to assist with the project selection process for the Regional Transportation Plan (RTP) and Transportation Improvement Program.
• Routine attendance by planning staff at the FAST Operations Maintenance Committee.

The components to be monitored for congestion include roadways, transit, bicycle/pedestrian/trail, TDM, and goods movement where:

- Roadways are monitored through data continually collected throughout the region.
- Crashes are monitored to help measure nonrecurring congestion.
- Transit performance is monitored continuously through various operating and capital plans.
- Bicycle, pedestrian facility and trail data are monitored and updated.
- Significant goods movement corridors are evaluated to address mobility needs of the goods movement providers.
- Data will be provided by NDOT to address metropolitan and statewide performance measurement reporting requirements of MAP-21.

The Southern Nevada CMP will make use of the Congestion Management System Report to document the performance of the transportation system.

Appendix A – FAST Results:

Located in this particular appendix are tables provided by the Southern Nevada Freeways and Arterial System of Transportation which show performance data for the segments of regional freeway identified as being most congested. This data has been collected and analyzed through their deployed system of roadway loops and traffic monitoring cameras. The categories depicted in the data tables are the percentage of weekdays that are experiencing recurring congestion, the average maximum and 95th percentile delay in congestion, when recurring traffic delays typically start on the route, how long traffic delays last. FAST also tracks and reports on the length of time required to clear vehicular crashes.

1) **Table 4.3: Interstate 15 northbound between Sahara Avenue and Charleston Boulevard - PM Peak Hour**

Delay							
Year	Quarter	Percent of Weekdays Congested	Average (minutes)	95th Percentile (minutes)	Delays Begin	Duration (minutes)	Average Speed (mph)
2014	4	100	11	16	3:09 PM	143	
2014	3	94	10	19	2:57 PM	138	
2014	2	95	9	19	3:16 PM	116	
2014	1	100	11	19	3:03 PM	174	

Incident management (2014):
Eighty percent of vehicular crashes occurring in this segment were cleared within the time objective set of thirty to sixty minutes. This segment of the Interstate 15 corridor between the US 95 interchange and Sahara Avenue averages four accidents each day.

Corridor Projects:
Project NEON (listed in both 2015-2019 TIP and 2013-2035 RTP)-

This will extend 3.7 miles along Interstate 15 from Sahara to the US 95 interchange. It will construct:

1. HOV lane connections between US 95 and Interstate 15 with direct HOV egress and exit access ramps constructed at Wall Street.
2. Reconstruct both the Charleston Boulevard interchange with Interstate 15 and Grand Central Parkway intersection with Charleston Blvd. The connection planned between the HOV lanes on US 95 and the Express Lanes on Interstate 15 will create a complete corridor for express travel. With direct access to and from the HOV lanes at Wall Street, carpoolers and rapid transit will have expanded options to the south, northwest, and into downtown.

Results of the Final Environmental Impact Study (FEIS) for Project NEON showed that presently, I-15 northbound tends to operate at LOS D or better during the morning traffic peak, but it drops to LOS E (at capacity) in several areas during the afternoon traffic peak period. In the southbound direction, I-15 experiences morning peak congestion (LOS E) north of the Charleston Boulevard interchange because of heavy southbound US 95 traffic combining (weaving) with I-15 southbound traffic.

2) **Table 4.4: Interstate 215 westbound from Airport Connector through Rainbow Boulevard - PM Peak Hour**

Delay							
Year	Quarter	Percent of Weekdays Congested	Average (minutes)	95th Percentile (minutes)	Delays Begin	Duration (minutes)	Average Speed (mph)
2014	4	89	15	24	4:42 PM	90	
2014	3	96	10	17	4:56 PM	68	
2014	2	100	10	17	5:06 PM	51	
2014	1	98	9	19	5:06 PM	58	

Incident management (2014):
Seventy-nine percent of vehicular crashes occurring in this segment were cleared within the time objective set of thirty to sixty minutes.

Corridor Projects: (listed in 2013-2035 RTP)

1. Clark County 215 from Decatur Boulevard to Russell Road – construct overpasses at selected streets (unfunded).
2. Clark County 215 from Interstate 15 to Russell Road - widen to 10 lanes, including HOV lanes (unfunded).

3) Table 4.5: US 95 southbound - Valley View Drive to Interstate 15 southbound at Charleston Boulevard - PM Peak Hour

Delay							
Year	Quarter	Percent of Weekdays Congested	Average Delay Time (minutes)	95th Percentile Delay Time (minutes)	Delays Begin	Duration of Delay (minutes)	Average Speed (mph)
2014	4	87	10	14	3:02 PM	136	
2014	3	76	9	18	3:02 PM	102	
2014	2	60	10	17	3:01 PM	97	
2014	1	61	6	11	4:06 PM	89	

Incident management (2014):
Eighty two percent of vehicular crashes occurring in this segment were cleared within the time objective set of thirty to sixty minutes.

Corridor Projects: (listed in 2013-2035 RTP)

1. This eastern end of this roadway will be part of the Project NEON corridor project between the Interstate 15 / US 95 interchange and Sahara Avenue interchange (2020).

2. US 95 between Oakey Boulevard and Rancho, widen I-15 and HOV ramps – phase 1 of Project NEON (2020).

4) **Table 4.6: Interstate 515 / US 95 westbound - from Charleston Boulevard to Interstate 15 interchange - PM Peak Hour**

Delay							
Year	Quarter	Percent of Weekdays Congested	Average Delay Time (minutes)	95th Percentile Delay Time (minutes)	Delays Begin	Duration of Delay (minutes)	Average Speed (mph)
2014	4	85	12	20	16:06	100	
2014	3	72	8	18	15:57	78	
2014	2	63	9	17	15:35	92	
2014	1	97	10	20	16:01	105	

Incident management (2014):
Seventy-four percent of vehicular crashes occurring in this segment were cleared within the time objective set of thirty to sixty minutes.

Corridor Projects: (listed in 2013-2035 RTP)

1. This eastern end of this roadway will be part of the Project NEON corridor project between the Interstate 15 / US 95 interchange and Sahara Avenue interchange (2020).
2. US 95 between Oakey Boulevard and Rancho, widen Interstate 15 and HOV ramps – phase 1 of Project NEON (2020).

5) **Table 4.7- US 95 Southbound from Decatur through to Interstate 15 at Charleston Boulevard - AM Peak Hour**

Delay							
Year	Quarter	Percent of Weekdays Congested	Average Delay Time (minutes)	95th Percentile Delay Time (minutes)	Delays Begin	Duration of Delay (minutes)	Average Speed (mph)
2014	4	71	10	13	7:15 AM	69	
2014	3	87	10	16	7:22 AM	69	
2014	2	91	8	11	7:29 AM	62	
2014	1	81	8	12	7:29 AM	62	

Incident management (2014):
Eighty two percent of vehicular crashes occurring in this segment were cleared within the time objective set of thirty to sixty minutes.

Corridor Projects: (listed in 2015-2019 TIP and 2013-2035 RTP)

1. The eastern end of this roadway will be part of the Project NEON corridor project between the Interstate 15 / US 95 interchange and Sahara Avenue interchange.

6) **Table 4.8- Interstate 15 southbound**
US 95 interchange to Tropicana Avenue - PM Peak Hour

Delay							
Year	Quarter	Percent of Weekdays Congested	Average Delay Time (minutes)	95th Percentile Delay Time (minutes)	Delays Begin	Duration of Delays (minutes)	Average Speed (mph)
2014	4	81	10	17	3:25 PM	107	
2014	3	46	20	25	3:22 PM	78	
2014	2	53	10	23	3:21 PM	79	
2014	1	75	12	25	3:46 PM	79	

Incident management (2014):
Eighty four percent of vehicular crashes occurring in this segment were cleared within the time objective set of thirty to sixty minutes.

Corridor Projects: (listed in 2013-2035 RTP)

1. This corridor will be part of the Project NEON corridor project between the Interstate 15 / US 95 interchange and Sahara Avenue interchange (2020).

7) **Table 4.9: Interstate 15 southbound**
US 95 interchange to Tropicana Avenue - AM Peak Hour

Delay							
Year	Quarter	Percent of Weekdays Congested	Average Delay Time (minutes)	95th Percentile Delay Time (minutes)	Delays Begin	Duration of Delays (minutes)	Average Speed (mph)
2014	4	76	11	21	6:56 AM	72	
2014	3	79	10	21	7:27 AM	45	
2014	2	100	9	23	7:25 AM	54	
2014	1	89	11	23	7:25 AM	52	

Incident management (2014):

Eighty four percent of vehicular crashes occurring in this segment were cleared within the time objective set of thirty to sixty minutes.

Corridor Projects: (listed in 2013-2035 RTP)

1. This corridor will be part of the Project NEON corridor project between the Interstate 15 / US 95 interchange and Sahara Avenue interchange (2020).

8) **Table 4.10- Interstate 215 eastbound - Eastern Avenue to Interstate 515 interchange - PM Peak Hour**

Delay							
Year	Quarter	Percent of Weekdays Congested	Average Delay Time (minutes)	95th Percentile Delay Time (minutes)	Delays Begin	Duration of Delays (minutes)	Average Speed (mph)
2014	4	85	5	11	4:57 PM	53	
2014	3	53	6	11	5:06 PM	35	
2014	2	37	6	16	5:16 PM	40	
2014	1	60	4	7	4:56 PM	49	

Incident management (2014):
Ninety one percent of vehicular crashes occurring in this segment were cleared within the time objective set of thirty to sixty minutes.

Corridor Projects: (listed in 2013-2035 RTP)

1. Interstate 215 at Eastern Avenue – construct interchange improvements (unfunded).
2. Interstate 215 at Pecos Road – construct interchange improvements (unfunded)

9) **Table 4.11: Interstate 515/US Hwy 95 northbound from Charleston Boulevard to the Interstate 15 interchange AM Peak Hour**

Delay							
Year	Quarter	Percent of Weekdays Congested	Average Delay Time (minutes)	95th Percentile Delay Time (minutes)	Delays Begin	Duration of Delay (minutes)	Average Speed (mph)
2014	4	50	4	15	7:40 AM	29	
2014	3	49	3	9	7:36 AM	32	
2014	2	40	3	9	7:43 AM	29	
2014	1	82	5	11	7:40 AM	24	

Incident management (2014):
Seventy four percent of vehicular crashes occurring in this segment were cleared within the time objective set of thirty to sixty minutes.

Corridor Projects: (listed in 2015-2019 TIP and 2013-2035 RTP)

1) Interstate 515 at Charleston Boulevard – Interchange improvement to reconfigure interchange as a diverging diamond interchange. (Programmed for 2017)
2) Interstate 515 interchange with Interstate 15 – partial reconstruction of interchange and widening to six eastbound lanes (Programmed for 2020).

10) **Table 4.12- Interstate 215 westbound**
from Airport Connector through to Rainbow Boulevard- AM Peak Hour

Delay							
Year	Quarter	Percent of Weekdays Congested	Average Delay Time (minutes)	95th Percentile Delay Time (minutes)	Delays Begin	Duration of Delay (minutes)	Average Speed (mph)
2014	4	19	10	27	7:45 AM	41	
2014	3	37	8	15	7:37 AM	39	
2014	2	28	15	18	7:46 AM	26	
2014	1	24	6	14	7:48 AM	23	

Incident management (2014):
Seventy nine percent of vehicular crashes occurring in this segment were cleared within the time objective set of thirty to sixty minutes.

Corridor Projects: (listed in 2013-2035 RTP).

1. From Decatur Boulevard to Russell Road – construct overpasses at selected streets (unfunded).
2. From Interstate 15 to Russell Road – widen roadway to 10 lanes including HOV lanes (unfunded)

11) **Table 4.13- Interstate 215 eastbound**
Interstate 15 interchange to Windmill Lane - PM Peak Hour

Delay							
Year	Quarter	Percent of Weekdays Congested	Average Delay Time (minutes)	95th Percentile Delay Time (minutes)	Delays Begin	Duration of Delay (minutes)	Average Speed (mph)
2014	4	56	6	12	4:52 PM	70	
2014	3	n/a	n/a	n/a	n/a	n/a	
2014	2	39	4	9	5:14 PM	37	
2014	1	66	3	6	5:06 PM	47	

Incident management (2014):
Eighty seven percent of vehicular crashes occurring in this segment were cleared within the time objective set of thirty to sixty minutes.

Corridor Projects: (listed in 2015-2019 TIP and 2013-2035 RTP)

1. Interstate 215 at Airport Connector - interchange improvements (programmed for 2015).
2. Interstate 215 from Eastern Avenue to Windmill Lane - widen to eight lanes (programmed for 2020).
3. Interstate 215 from Interstate 15 interchange to Eastern Avenue – build system to system direct HOV ramps and widen to ten lanes (unfunded).

Appendix B – INRIX Data Findings

As described in section 4.4.1 of the congestion management report, we have subscribed to the traffic data service INRIX Insights to help monitor traffic congestion conditions across the Las Vegas Valley. INRIX Insights is a very capable system which can provide live as well as archival data on traffic performance. We used INRIX Insights to provide reports on the performance of major routes during the AM Peak (7 AM - 9 AM) and PM Peak (4 PM – 6 PM) hours and also to identify segments of road where bottleneck conditions existed. The time period of the data used was from March 1, 2016 until June 1, 2016.

Table B-1 - Summary of Travel Time Index Scores -
PM Peak Hour, 4:00 PM to 6:00 PM Weekdays, March 1 - June 1, 2016
(sorted in order of travel time index) - Data determined by INRIX Insights

Route Name (Direction of Travel) - Endpoints	PM Peak Travel Time Index
Flamingo Road (westbound) - Boulder Highway to Durango Drive	1.73
Maryland Parkway (southbound) - Bruce Street to Russell Road	1.69
Tropicana Avenue (westbound) from Boulder Highway to Clark County 215	1.67
Martin L. King Jr Blvd (northbound) - from Craig Road to Oakey	1.66
Nellis Boulevard (northbound) - Hacienda to Craig Road	1.65
Charleston Boulevard (eastbound) Clark County 215 to Hollywood Boulevard	1.64
Maryland Parkway (northbound) - Russell Road to Bruce Street	1.64
Las Vegas Boulevard (southbound) - Bonanza Road to I-215	1.63
Decatur Boulevard (northbound) - Clark County 215 to Rancho Drive	1.63
Flamingo Road (eastbound) - Durango Drive to Boulder Highway	1.62
Nellis Boulevard (southbound) - Craig Road to Hacienda	1.62
Las Vegas Boulevard (northbound) - I-215 to Bonanza Road	1.59
Charleston Boulevard (westbound) - Hollywood Boulevard to Clark County 215	1.59
Decatur Boulevard (southbound) - Rancho Drive to Clark County 215	1.59
Eastern Avenue (southbound) - Bruce Street to Anthem	1.58
Eastern Avenue (northbound) - Anthem to Bruce Street	1.58
Tropicana Avenue (eastbound) from Clark County 215 to Boulder Highway	1.58
Rainbow Boulevard (northbound) - Tropicana Road to Craig Road	1.56
Martin L. King Jr Blvd (southbound) - from Craig Road to Oakey	1.55
Sahara Avenue (eastbound) - Clark County 215 to Nellis Boulevard	1.51
Lamb Boulevard (southbound) - Boulder Highway to I-15	1.5
Sahara Avenue (westbound) - Nellis Boulevard to Clark County 215	1.48

Table B-1 Continued

Route Name (Direction of Travel) - Endpoints	PM Peak Travel Time Index
Rancho Drive (southbound) - US 95 to Sahara Avenue	1.48
Desert Inn Road (eastbound) - Clark County 215 to Boulder Highway	1.48
Lake Mead Boulevard (eastbound) - Buffalo Drive to Nellis Boulevard	1.46
Lamb Boulevard (southbound) - I-15 to Boulder Highway	1.46
Desert Inn Road (westbound) - Boulder Highway to Clark County 215	1.45
Rainbow Boulevard (southbound) - Craig Road to Tropicana Road	1.43
Lake Mead Boulevard (westbound) - Nellis Boulevard to Buffalo Drive	1.41
Rancho Drive (northbound) - Sahara Avenue to US 95	1.41
US 95 from CC 215 to I-215 (southbound)	1.41
St Rose Parkway (westbound) - I-215 to I-15	1.37
St Rose Parkway (eastbound) - I-215 to I-15	1.37
Boulder Highway (southbound) - Fremont Street to US 93	1.36
Boulder Highway (northbound) - US 93 to Fremont Street	1.34
Blue Diamond Road - NV 160 (westbound) from Las Vegas Boulevard to Rainbow Boulevard	1.28
US 95 from CC 215 to I-215 (southbound)	1.21
US 93 - Boulder City (southbound)	1.2
Blue Diamond Road - NV 160 (westbound) from Rainbow Boulevard to Las Vegas Boulevard	1.14
Lake Mead Parkway (eastbound) from I-215 to Lake Las Vegas Parkway	1.13
Lake Mead Parkway (westbound) from I-215 to Lake Las Vegas Parkway	1.13
US 93 - Boulder City (northbound)	1.06

Table B-2 -
Summary of Travel Time Index Scores -
PM Peak Hour, 4:00 PM to 6:00 PM Weekdays, March 1 - June 1, 2016
(sorted in order of travel time index) - Data determined by INRIX Insights

Route Name (Direction of Travel) - Endpoints	**AM Peak Hour Travel Time Index**
Martin L. King Jr Blvd (southbound) - from Craig Road to Oakey	1.57
Nellis Boulevard (northbound) - Hacienda to Craig Road	1.55
Martin L. King Jr Blvd (northbound) - from Craig Road to Oakey	1.51
Nellis Boulevard (southbound) - Craig Road to Hacienda	1.49
Flamingo Road (westbound) - Boulder Highway to Durango Drive	1.48
Maryland Parkway (northbound) - Russell Road to Bruce Street	1.47
Maryland Parkway (southbound) - Bruce Street to Russell Road	1.46
Eastern Avenue (northbound) - Anthem to Bruce Street	1.46
Decatur Boulevard (northbound) - Clark County 215 to Rancho Drive	1.46
Rancho Drive (southbound) - US 95 to Sahara Avenue	1.45
Tropicana Avenue (westbound) from Boulder Highway to Clark County 215	1.44
Lamb Boulevard (southbound) - I-15 to Boulder Highway	1.44
Lamb Boulevard (southbound) - Boulder Highway to I-15	1.44
Eastern Avenue (southbound) - Bruce Street to Anthem	1.43
Flamingo Road (eastbound) - Durango Drive to Boulder Highway	1.42
Charleston Boulevard (westbound) - Hollywood Boulevard to Clark County 215	1.42
Lake Mead Boulevard (eastbound) - Buffalo Drive to Nellis Boulevard	1.4
Rancho Drive (northbound) - Sahara Avenue to US 95	1.4
Charleston Boulevard (eastbound) Clark County 215 to Hollywood Boulevard	1.39
St Rose Parkway (westbound) - I-215 to I-15	1.37
St Rose Parkway (eastbound) - I-215 to I-15	1.37
Lake Mead Boulevard (westbound) - Nellis Boulevard to Buffalo Drive	1.36
Boulder Highway (southbound) - Fremont Street to US 93	1.36
Desert Inn Road (westbound) - Boulder Highway to Clark County 215	1.36
Tropicana Avenue (eastbound) from Clark County 215 to Boulder Highway	1.36
Sahara Avenue (westbound) - Nellis Boulevard to Clark County 215	1.34
Decatur Boulevard (southbound) - Rancho Drive to Clark County 215	1.34
Boulder Highway (northbound) - US 93 to Fremont Street	1.34
Las Vegas Boulevard (northbound) - Bonanza Road to I-215	1.32
Rainbow Boulevard (southbound) - Craig Road to Tropicana Road	1.32

Table B-2 Continued

Route Name (Direction of Travel) - Endpoints	AM Peak Hour Travel Time Index
Rainbow Boulevard (northbound) - Tropicana Road to Craig Road	1.32
Desert Inn Road (eastbound) - Clark County 215 to Boulder Highway	1.31
Las Vegas Boulevard (northbound) - I-215 to Bonanza Road	1.3
Sahara Avenue (eastbound) - Clark County 215 to Nellis Boulevard	1.26
US 95 from CC 215 to I-215 (southbound)	1.21
Lake Mead Parkway (westbound) from I-215 to Lake Las Vegas Parkway	1.17
US 95 from CC 215 to I-215 (southbound)	1.17
Lake Mead Parkway (eastbound) from I-215 to Lake Las Vegas Parkway	1.13
Blue Diamond Road - NV 160 (westbound) from Las Vegas Boulevard to Rainbow Boulevard	1.12
Blue Diamond Road - NV 160 (westbound) from Rainbow Boulevard to Las Vegas Boulevard	1.12
US 93 - Boulder City (northbound)	1.08
US 93 - Boulder City (southbound)	1.06

Table B-3 - Bottleneck Ranking for Las Vegas Valley Road Network
March 1st to June 1, 2016

Rank	Location	Direction	Average duration	Average max length (miles)	Occurrences	Impact factor
1	I-515 N @ I-15/EXIT 76A	NB	4 h 49 m	3.46	120	120,118
2	I-15 S @ SAHARA AVE/EXIT 40	SB	2 h 35 m	3.87	126	75,675
3	I-15 N @ CHARLESTON BLVD/EXIT 41	NB	2 h 1 m	2.8	200	67,671
4	TROPICANA AVE E @ NV-582/BOULDER HWY	EB	1 h 7 m	1.33	731	65,299
5	TROPICANA AVE E @ NV-582/BOULDER HWY	EB	1 h 17 m	1.01	816	63,239
6	TROPICANA AVE W @ SWENSON ST	WB	1 h 3 m	1.23	648	50,039
7	I-15 NORTH AT DESERT INN	NB	1 h 26 m	3	180	46,428
8	US-95 S @ I-15/EXIT 76B	SB	1 h 48 m	1.65	248	44,247
9	TROPICANA AVE W @ SWENSON ST	WB	1 h 6 m	1.28	497	41,924
10	I-215 W @ DECATUR BLVD/EXIT 11	WB	1 h 50 m	3.14	120	41,512
11	I-15 S @ CHARLESTON BLVD/EXIT 41	SB	1 h 5 m	1.82	323	38,316
12	EASTERN AVE S @ E WARM SPRINGS RD	SB	1 h 5 m	1.4	412	37,398
13	TROPICANA AVE E @ NV-582/BOULDER HWY	EB	1 h 19 m	1.44	322	36,601
14	CR-215 S @ US-95	SB	41 m	2.42	367	36,430
15	TROPICANA AVE E @ S NELLIS BLVD	EB	1 h 4 m	1.23	438	34,518
16	I-15 N @ LAKE MEAD BLVD/EXIT 45	NB	3 h 50 m	7.59	19	33,169
17	US-93 N @ NEVADA HWY/BUCHANAN BLVD	NB	59 m	1.5	365	32,283
18	SAHARA AVE W @ I-15	WB	56 m	1.33	415	30,966
19	NELLIS BLVD S @ E CHARLESTON BLVD	SB	50 m	0.86	704	30,312
20	I-515 N @ CASINO CENTER	NB	1 h 48 m	2.43	114	29,904

Table B-4
Performance Summary: Las Vegas Boulevard – Bonanza to I-215
March 1st to June 1st, 2016

4:00 PM to 6:00 PM, Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Southbound	30.3	1.22	55.16	2.64	15.06	32.78	1.59
Northbound	33.48	1.32	58.26	2.92	15.07	32.72	1.63

7:00 AM - 9:00 AM Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Southbound	23.53	1.1	44.92	2.17	18.39	26.84	1.3
Northbound	21.81	1.06	42.42	2.11	18.59	26.52	1.32

Las Vegas Blvd (resort corridor)- Bottleneck Locations - March 1 through June 1, 2016

Location	Overall Regional Rank	Direction	Average Duration	Average Maximum Length (miles)	Number of Occurrences	Impact Factor
1) LAS VEGAS BLVD @ FLAMINGO RD	35	NB	49 min	0.67	622	20,500
2) LAS VEGAS BLVD @ FLAMINGO RD	51	SB	36 min	0.87	560	17,507
3) LAS VEGAS BLVD @ I-215	74	SB	38 min	0.67	597	15,167

Table B-5

Performance Summary: Flamingo Road – Boulder Highway to Durango Drive (12 miles)

March 1st to June 1st, 2016

4:00 PM - 6:00 PM Weekdays	**Buffer Time (minutes)**	**Buffer index**	**Planning time (minutes)**	**Planning time index**	**Speed (mph)**	**Travel time (minutes)**	**Travel time index**
Westbound	30.96	1.23	56.04	2.78	20.44	35.23	1.73
Eastbound	31.94	1.32	56.16	2.83	22.44	32.08	1.62

7:00 AM - 9:00 AM Weekdays	**Buffer Time (minutes)**	**Buffer index**	**Planning time (minutes)**	**Planning time index**	**Speed (mph)**	**Travel time (minutes)**	**Travel time index**
Westbound	26.65	1.22	48.56	2.39	23.96	30.05	1.48
Eastbound	24.2	1.13	45.54	2.3	25.6	28.12	1.42

Flamingo Road – Top Bottleneck Locations - March 1 to June 1, 2016

Location	**Overall Regional Rank**	**Direction**	**Average Duration**	**Average Maximum Length (miles)**	**Number of Occurrences**	**Impact Factor**
1) FLAMINGO RD @ MARYLAND PKWY	24	EB	48 min	1.44	363	25,148
2) FLAMINGO RD @ PARADISE RD	31	WB	39 min	1	593	23,067
3) FLAMINGO RD @ PARADISE RD	40	EB	50 min	0.65	610	19,696

Table B-6

Performance Summary: Charleston Blvd – Hollywood Blvd to Clark County 215 (17.4 miles)

March 1st to June 1st, 2016

4:00 PM to 6:00 PM, Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Westbound	35.14	1.04	68.8	2.42	23.43	44.69	1.57
Eastbound	34.29	1.06	66.7	2.42	23.75	44.09	1.6

7:00 AM to 9:00 AM, Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Westbound	27.86	0.86	60.09	2.12	26.01	40.26	1.42
Eastbound	26.43	0.87	56.81	2.06	27.24	38.45	1.39

Charleston Blvd - Top Bottleneck Locations - March 1st to June 1st , 2016

Location	Overall Regional Rank	Direction	Average Duration	Average Maximum Length (miles)	Number of Occurrences	Impact Factor
1) CHARLESTON BLVD AT I-15	55	WB	49 min	0.81	425	16,884
2) CHARLESTON BLVD @ NELLIS BLVD	101	WB	44 min	1.12	270	13,342
3) CHARLESTON BLVD @ NELLIS BLVD	112	EB	55 min	1.36	170	12,722

Table B-7

Performance Summary: Sahara Avenue – Clark County 215 to Nellis Boulevard (15.31 miles)

March 1st to June 1st, 2016

4:00 PM - 6:00 PM, Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Westbound	25.02	0.86	53.95	2.21	25.38	36.2	1.48
Eastbound	28.18	0.99	56.69	2.35	25.21	36.46	1.51

7:00 AM - 9:00 AM, Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Westbound	21.3	0.79	48.18	1.97	28.19	32.6	1.34
Eastbound	18.61	0.73	44.26	1.84	30.35	30.28	1.26

Sahara Avenue – Top Bottleneck Locations – March 1st to June 1st, 2016

Location	Overall Regional Rank	Direction	Average Duration	Average Maximum Length (miles)	Number of Occurrences	Impact Factor
1) SAHARA AVE @ I-15	18	WB	56 min	1.33	415	30,966
2) SAHARA AVE @ JONES BLVD	30	EB	54 min	1.4	307	23,240
3) SAHARA AVE @ RAINBOW BLVD	48	WB	38 min	1.27	366	17,660

Table B-8

Performance Summary: Maryland Parkway – Bruce Street to Russell Road (6.59 miles)

March 1st to June 1st, 2016

4:00 PM -6:00 PM, Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Southbound	15.27	1.01	30.44	2.44	18.71	21.12	1.69
Northbound	15.6	1.03	30.81	2.42	19.02	20.9	1.64

7:00 AM-9:00 AM, Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Southbound	12.34	0.87	26.45	2.12	21.63	18.27	1.46
Northbound	11.08	0.76	25.67	2.01	21.26	18.7	1.47

Maryland Parkway – Top Bottleneck Locations - March 1st to June 1st, 2016

Location	Overall Regional Rank	Direction	Average Duration	Average Maximum Length (miles)	Number of Occurrences	Impact Factor
1) MARYLAND PKWY AT TROPICANA AVE	125	SB	39	0.56	569	12,457
2) MARYLAND PKWY AT DESERT INN RD	214	NB	38	1.23	194	9,079
3) MARYLAND PKWY AT RUSSELL ROAD	279	SB	56	1.07	130	7,817

Table B-9

Performance Summary: Eastern Avenue from Bruce St to Anthem (15.68 miles)

March 1st to June 1st, 2016

4:00-6:00 PM Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Southbound	34.29	1.15	64.07	2.54	23.58	39.89	1.58
Northbound	32.68	1.08	62.93	2.49	23.68	39.86	1.58

7:00 AM - 9:00 AM Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Southbound	27.39	0.96	55.99	2.22	26.12	36.02	1.43
Northbound	28.46	0.99	57.22	2.27	25.64	36.81	1.46

Eastern Avenue – Top Bottleneck Locations - March 1st to June 1st, 2016

Location	Overall Regional Rank	Direction	Average Duration	Average Maximum Length (miles)	Number of Occurrences	Impact Factor
1) EASTERN AVE @ WARM SPRINGS ROAD	12	SB	1 hr 5 min	1.4	412	37,398
2) EASTERN AVE@ ST ROSE PARKWAY	44	SB	42 min	1.33	327	18,302
3) EASTERN AVE @ HORIZON RIDGE PKWY	96	NB	28 min	1.21	406	13,806

Table B-10

Performance Summary: Decatur Boulevard from Rancho Drive to Clark County 215 (9.93 miles)

March 1st to June 1st, 2016

4:00-6:00 PM Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Southbound	19.13	0.96	39.12	2.4	23.09	25.82	1.59
Northbound	19.73	0.91	41.47	2.54	22.35	26.66	1.63

7:00 AM - 9:00 AM Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Southbound	16.52	0.94	34.03	2.09	27.41	21.76	1.34
Northbound	16.95	0.91	35.59	2.18	25.04	23.79	1.46

Decatur Boulevard- Top Bottleneck Locations, March 1st through June 1st, 2016

Location	Overall Regional Rank	Direction	Average Duration	Average Maximum Length (miles)	Number of Occurrences	Impact Factor
1) DECATUR BLVD @ TROPICANA AVE	58	NB	40 min	1.15	355	16,375
2) DECATUR BLVD @ CLARK COUNTY 215	114	SB	42 min	1.33	227	12,717
3) DECATUR BLVD @ FLAMINGO ROAD	119	SB	36 min	0.82	426	12,636

Table B-11

Performance Summary: Nellis Boulevard – Craig Road to Hacienda (10.24 miles)

March 1st to June 1st, 2016

4:00-6:00 PM Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Southbound	21.76	1.18	40.19	2.54	24.04	25.55	1.62
Northbound	23.25	1.26	41.77	2.64	23.52	26.11	1.65

7:00 AM - 9:00 AM Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Southbound	17.7	1	35.42	2.24	26.15	23.5	1.49
Northbound	16.99	0.92	35.44	2.24	25	23.85	1.55

Nellis Boulevard – Top Bottleneck Locations - March 1st to June 1st, 2016

Location	Overall Regional Rank	Direction	Average Duration	Average Maximum Length (miles)	Number of Occurrences	Impact Factor
1) NELLIS BLVD @ CHARLESTON BLVD	19	SB	50 min	0.86	704	30,312
2) NELLIS BLVD @ LAKE MEAD BLVD	39	NB	52 min	1.45	262	19,768
3) NELLIS BLVD @ WASHINGTON AVENUE	41	NB	48 min	0.88	439	18,589

Table B-12

Performance Summary: Lake Mead Boulevard – Buffalo Drive to Nellis Boulevard (12.66 miles)

March 1st to June 1st, 2016

4:00-6:00 PM, Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Westbound	17.27	0.74	40.56	1.97	26.23	28.96	1.41
Eastbound	19.99	0.89	42.54	2.13	26.02	29.09	1.46

7:00 AM - 9:00 AM, Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Westbound	14.87	0.64	38.26	1.86	27.11	28.02	1.36
Eastbound	17.27	0.78	39.28	1.97	27.09	27.95	1.4

Lake Mead Boulevard - Top Bottleneck Locations - March 1st to June 1st, 2016

Location	Overall Regional Rank	Direction	Average Duration	Average Maximum Length (miles)	Number of Occurrences	Impact Factor
1) LAKE MEAD BLVD AT CIVIC CENTER DR	159	EB	44 m	0.94	261	10,803
2) LAKE MEAD BLVD AT US 95	215	EB	32 m	0.86	328	9,040
3) LAKE MEAD BLVD at NELLIS BLVD	327	EB	36 m	1.09	178	7,008

Table B-13
Rancho Drive - US 95 North to Sahara Avenue (9.55 miles) -
March 1st to June 1st, 2016

4:00-6:00 PM, Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Southbound	15.72	0.94	32.45	2.24	26.67	21.49	1.48
Northbound	13.27	0.82	29.52	2.11	27.86	19.69	1.41

7:00 AM - 9:00 AM Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Southbound	14.77	0.87	31.68	2.19	27.26	21.02	1.45
Northbound	12.75	0.81	28.52	2.04	27.92	19.64	1.4

Rancho Drive - Top Bottleneck Locations- March 1st to June 1st, 2016

Location	Overall Regional Rank	Direction	Average Duration	Average Maximum Length (miles)	Number of Occurrences	Impact Factor
1) RANCHO DRIVE @ US 95 EXPWY	138	SB	38 min	1.2	260	11,857
2) RANCHO DRIVE @ US 95 EXPWY	186	NB	36 min	1.22	222	9,723
3) RANCHO DRIVE @ US 95 EXPWY NORTH	366	NB	39 min	0.59	280	6,487

Table B-14
Desert Inn Road - Boulder Highway to Clark County 215 (14.14 Miles) - March 1st to June 1st. 2016

4:00 PM to 6:00 PM Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Westbound	20.66	0.86	44.62	2.11	27.66	30.66	1.45
Eastbound	21.99	0.93	45.74	2.17	27.29	31.09	1.48

7:00 AM to 9:00 AM Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Westbound	16.84	0.71	40.48	1.91	29.56	28.7	1.36
Eastbound	15.46	0.68	38.35	1.82	30.64	27.69	1.31

Desert Inn Road – Top Bottleneck Locations - March 1st to June 1st, 2016

Location	Overall Regional Rank	Direction	Average Duration	Average Maximum Length (miles)	Number of Occurrences	Impact Factor
1) DESERT INN RD between LAS VEGAS BLVD and PARADISE RD	30	WB	57 m	1.39	299	23,634
2) DESERT INN RD @ MCLEOD DRIVE	84	EB	42 m	1.16	296	14,418
3) DESERT INN RD @ PARADISE ROAD	95	EB	37 m	1.13	331	13,832

Table B-15
Lake Mead Parkway - I-215 to Lake Las Vegas Parkway (6.4 miles) -
March 1st to June 1st, 2016

4:00 PM to 6:00 PM, Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Eastbound	N.A.	N.A.	15.3	I	39.86	10.61	1.13
Westbound	N.A.	N.A.	15.3	1.63	39.86	10.61	1.13

7:00 AM to 9:00 AM, Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Eastbound	N.A.	N.A.	15.47	1.65	40.01	10.57	1.13
Westbound	N.A.	N.A.	18.91	1.6	40.25	13.81	1.17

Lake Mead Parkway- Top Bottleneck Locations - March 1st through June 1st, 2016

Location	Overall Regiona l Rank	Directio n	Average Duration	Average Maximum Length (miles)	Number of Occurrence s	Impact Factor
1) LAKE MEAD PKWY @ W VAN WAGENEN ST	88	EB	52 m	0.57	481	14,197
2) LAKE MEAD PKWY @ EASTGATE RD/FIESTA HENDERSON BLVD	112	WB	34 m	0.52	720	12,762
3) LAKE MEAD PKWY @ BOULDER HWY	251	WB	34 m	0.45	549	8,371

Table B-16
Tropicana Avenue from Clark County 215 to Boulder Highway (13.4 miles), March 1st to June 1st, 2016

4:00 PM to 6:00 PM, Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Westbound	N.A.	N.A.	68.08	2.99	21.2	38	1.67
Eastbound	N.A.	N.A.	61.17	2.77	23.13	34.98	1.58

7:00 AM to 9:00 AM, Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Westbound	N.A.	N.A.	57.46	2.52	24.64	32.7	1.44
Eastbound	N.A.	N.A.	52.69	2.38	26.83	30.15	1.36

Tropicana Avenue - Bottleneck Locations - March 1st to June 1st, 2016

Location	Overall Regional Rank	Direction	Average Duration	Average Maximum Length (miles)	Number of Occurrences	Impact Factor
1) TROPICANA AVENUE @ BOULDER HWY	5	EB	1 h 7 m	1.33	731	65,299
2) TROPICANA AVENUE @ SWENSON	7	WB	1 h 3 m	1.23	648	50,039
3) TROPICANA AVENUE @ NELLIS BLVD	16	EB	1 h 4 m	1.23	438	34,518

Table B-17
US Highway 93 (Boulder City) from Lakeshore Road to US 95 (6.93 miles)
March 1st to June 1st, 2016

4:00 PM to 6:00 PM	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Southbound	10.06	1.11	19.1	2.15	38.88	10.69	1.2
Northbound	2.36	0.26	11.6	1.29	43.67	9.57	1.06

7:00 AM to 9:00 AM	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Southbound	2.24	0.24	11.4	1.27	44.03	9.49	1.06
Northbound	1.89	0.2	11.14	1.25	43.09	9.65	1.08

US 93 (Boulder City) - Top Bottleneck Locations - March 1st to June 1st, 2016

Location	Overall Regional Rank	Direction	Average Duration	Average Maximum Length (miles)	Number of Occurrences	Impact Factor
1) US 93 @ BUCHANAN BLVD	18	NB	59 m	1.5	365	32,283
2) US 93 @ VETERANS MEMORIAL DRIVE	256	SB	1 h 38 m	2.12	40	8,301
3) US 93 @ US 95 JUNCTION	270	NB	42 m	0.53	363	8,056

Table B-18
Martin L. King Jr Blvd - from Oakey to Craig Road (6.17 miles)
March 1st to June 1st 2016

4:00 PM to 6:00 PM	**Buffer time (minutes)**	**Buffer index**	**Planning time (minutes)**	**Planning time index**	**Speed (mph)**	**Travel time (minutes)**	**Travel time index**
Southbound	13.54	1.14	25.38	2.58	24.31	15.22	1.55
Northbound	14.24	1.14	26.76	2.63	21.93	16.88	1.66

7:00 AM to 9:00 AM	**Buffer time (minutes)**	**Buffer index**	**Planning time (minutes)**	**Planning time index**	**Speed (mph)**	**Travel time (minutes)**	**Travel time index**
Southbound	13.9	1.14	26.1	2.65	23.89	15.49	1.57
Northbound	11.11	0.94	22.95	2.26	24.17	15.32	1.51

Martin L. King Jr Blvd – Top Bottleneck Locations - March 1st to June 1st, 2016

Location	**Overall Regional Rank**	**Direction**	**Average Duration**	**Average Maximum Length (miles)**	**Number of Occurrences**	**Impact Factor**
1) MARTIN L KING JR BLVD @ CHARLESTON BLVD	33	SB	1 h 31 m	0.97	261	22,999
2) MARTIN L KING JR BLVD @ CHEYENNE AVE	106	NB	48 m	1.18	235	13,263
3) MARTIN L KING JR BLVD @ US-95	109	SB	1 h 4 m	0.59	346	13,156

Table B-20
US 95 from Clark County 215 to I-215 -
March 1st to June 1st, 2016

4:00 PM to 6:00 PM	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Southbound	14	0.51	41.42	1.58	53.3	26.47	1.21
Northbound	30.53	1.03	60.12	2.22	45.56	38.29	1.41

7:00 AM to 9:00 AM	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Southbound	12.78	0.46	40.68	1.55	55.17	30.74	1.17
Northbound	21.61	0.78	49.33	1.82	55.85	32.89	1.21

US 95 Expressway - Top Bottleneck Locations - March 1st to June 1st, 2016

Location	Overall Regional Rank	Direction	Average Duration	Average Maximum Length (miles)	Number of Occurrences	Impact Factor
1) I-515 @ I-15/EXIT 76A	1	NB	4 h 49 m	3.46	120	120,118
2) US-95 @ I-15/EXIT 76B	8	SB	1 h 48 m	1.65	248	44,247
3) I-515 @ CASINO CENTER BLVD/EXIT 75	20	NB	1 h 48 m	2.43	114	29,904

Table B-21

St. Rose Parkway (NV-146) from Interstate 15 to Interstate 215 (6.63 miles)

March 1st to June 1st, 2016

4:00 PM to 6:00 PM, Weekdays	**Buffer time (minutes)**	**Buffer index**	**Planning time (minutes)**	**Planning time index**	**Speed (mph)**	**Travel time (minutes)**	**Travel time index**
Westbound	10.04	1.08	19.33	2.24	33.74	11.8	1.37
Eastbound	9.27	0.98	18.77	2.17	33.29	11.87	1.37

7:00 AM to 9:00 AM, Weekdays	**Buffer time (minutes)**	**Buffer index**	**Planning time (minutes)**	**Planning time index**	**Speed (mph)**	**Travel time (minutes)**	**Travel time index**
Westbound	10.04	1.08	19.33	2.24	33.74	11.8	1.37
Eastbound	9.27	0.98	18.77	2.17	33.29	11.87	1.37

St Rose Parkway (NV-146) - Top Bottleneck Locations – March 1st to June 1st, 2016

Location	**Overall Regional Rank**	**Direction**	**Average Duration**	**Average Maximum Length (miles)**	**Number of Occurrences**	**Impact Factor**
1) NV-146 @ SEVEN HILLS DRIVE	27	WB	48 m	0.86	594	24,591
2) NV-146 @ EASTERN AVE	85	EB	37 m	0.93	417	14,304
3) NV-146 @ I-215	91	WB	1 h	0.93	251	14,053

Table B-22

Blue Diamond Road (NV-160) from Rainbow Drive to Las Vegas Blvd (4.32 miles)

March 1st to June 1st, 2016

4:00 PM to 6:00 PM, Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Westbound	4.94	0.72	11.76	1.91	32.85	7.89	1.28
Eastbound	3.34	0.49	10.09	1.66	37.41	6.94	1.14

7:00 AM to 9:00 AM, Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Westbound	3.08	0.45	9.93	1.61	37.43	6.93	1.12
Eastbound	2.88	0.41	9.88	1.62	38.21	6.8	1.12

Blue Diamond Road (NV 160)- Top Bottleneck Locations – March 1st to June 1st, 2016

Location	Overall Regional Rank	Direction	Average Duration	Average Maximum Length (miles)	Number of Occurrences
1) NV-160 @ JONES BLVD	WB	31 m	1.08	265	8,891
2) NV-160 @ DECATUR BLVD	EB	27 m	1.43	186	7,171
3) NV-160 @ I-15	WB	32 m	1.64	133	6,962

Table B-23:
Lamb Boulevard, I-15 to Boulder Highway (8.7 miles)
March 1st to June 1st, 2016

4:00 PM to 6:00 PM Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Southbound	13.62	0.87	29.25	2.13	26.07	20.02	1.46
Northbound	15.98	1.01	31.82	2.31	25.23	20.7	1.5

7:00 AM to 9:00 AM, Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Southbound	13.64	0.88	29.1	2.12	26.42	19.75	1.44
Northbound	12.94	0.82	28.74	2.09	26.24	19.9	1.44

Lamb Boulevard – Top Bottleneck Locations – March 1st to June 1st, 2016

Location	Overall Regional Rank	Direction	Average Duration	Average Maximum Length (miles)	Number of Occurrences	Impact Factor
1) LAMB BLVD @ CHARLESTON BLVD	72	NB	49 m	1.35	231	15,230
2) LAMB BLVD @ BONANZA ROAD	88	SB	53 m	1.17	229	14,158
3) LAMB BLVD @ CHARLESTON BLVD	92	NB	1 h 6 m	1.56	136	14,033

Table B-24
Rainbow Blvd from Craig Road to Tropicana Avenue (10.52 miles)
March 1st to June 1st,
2016

4:00 PM to 6:00 PM, Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Southbound	16.56	0.85	36.05	2.12	25.85	24.42	1.43
Northbound	21.14	1.06	41	2.4	23.6	26.69	1.56

7:00 AM to 9:00 AM, Weekdays	Buffer time (minutes)	Buffer index	Planning time (minutes)	Planning time index	Speed (mph)	Travel time (minutes)	Travel time index
Southbound	14.16	0.76	32.88	1.93	28.14	22.43	1.32
Northbound	13.79	0.72	32.89	1.92	27.89	22.59	1.32

Rainbow Blvd - Top Bottleneck Locations - March 1st to June 1st, 2016

Location	Overall Regional Rank	Direction	Average Duration	Average Maximum Length (miles)	Number of Occurrences	Impact Factor
1) RAINBOW BLVD @ CHARLESTON BLVD	33	NB	41 m	1.25	444	22,755
2) RAINBOW BLVD @ US 95	34	NB	51 m	1.6	255	20,826
3) RAINBOW BLVD @ TROPICANA	36	NB	31 m	0.96	683	20,430

Appendix C – RTC Traffic Model Findings

RTC Travel Demand Model Heat Map Diagrams-

As part of the process for developing the Regional Transportation Plan, the RTC relies on a travel demand model to simulate scenarios for future transportation conditions both with and without the construction of transportation improvements. The measures of this include vehicle miles traveled (VMT), VMT per capita, travel time, system-wide average travel time by trip purpose, congested travel time, and the ratio of estimated traffic volume to the facility capacity.

The following diagrams, called “heat maps” represent the differences in travel times to a common central point (either the Clark County Government Center or the intersection of Las Vegas Boulevard) in the year 2035. The year 2035 data was developed using demographic population and employment projections into a grid of traffic analysis zones superimposed across the city. Two centrally located TAZ’s with familiar landmarks (the Clark County Government Center complex and the intersection of Las Vegas Boulevard and Flamingo Road) were designated as destinations for estimating the travel times from each TAZ. This process resulted in a diagram of concentric time bands showing the incremental increase in estimated travel times with distance. The size of the bands was influenced by whether the available 2035 road network in the model included programmed projects from 2013-2035 or remained in a no-build scenario, loading 2035 volumes onto the 2013 network.

**Figure C.1 – Build scenario-
modeled 2035 demand with 2035 network
Auto time from all traffic analysis zones (TAZ) to TAZ 528
(Clark County Government Center)**

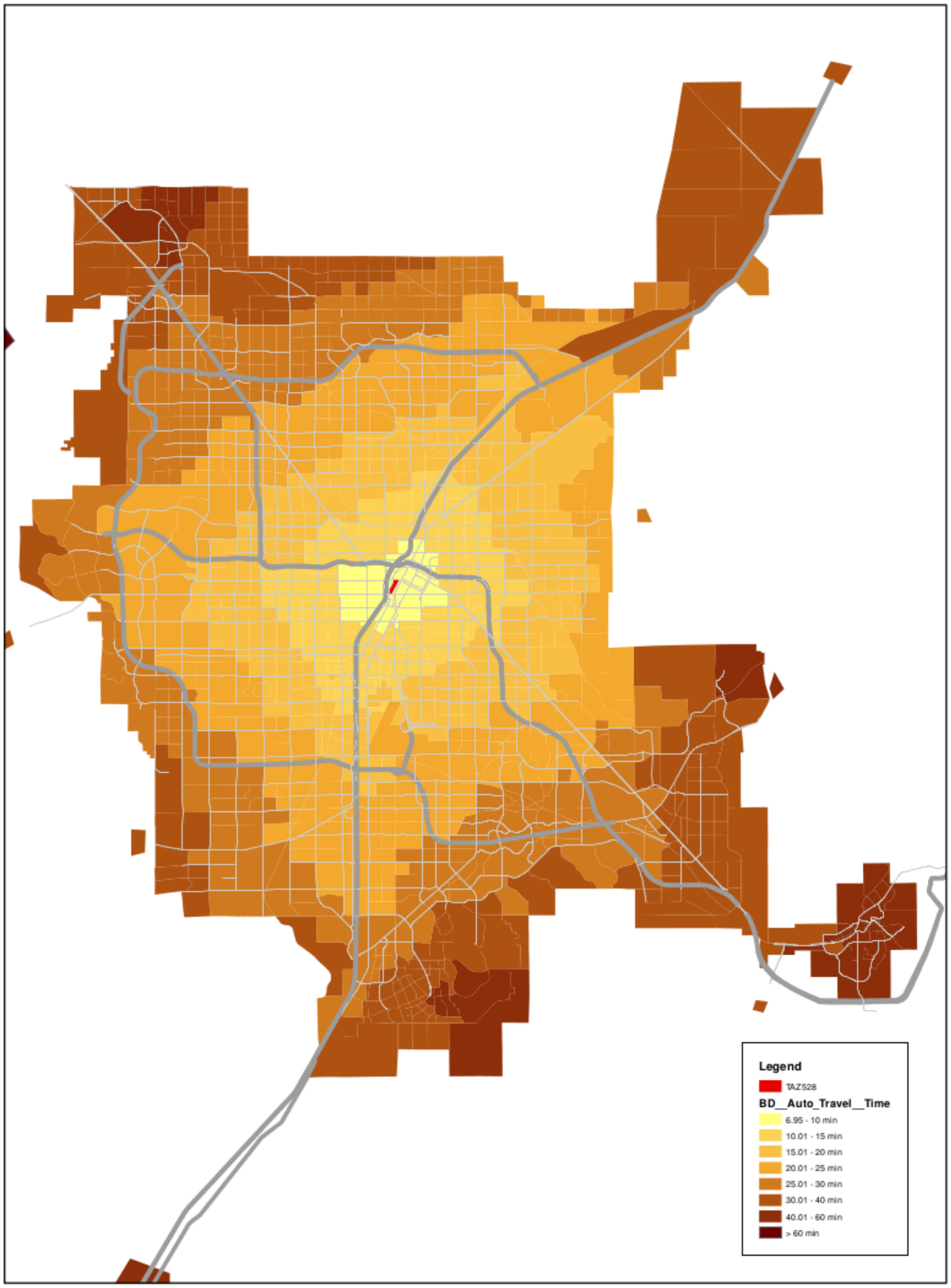


Figure C.2– No-Build scenario-
modeled 2035 demand with 2013 network
Auto time from all traffic analysis zones (TAZ) to TAZ 528
(Clark County Government Center)

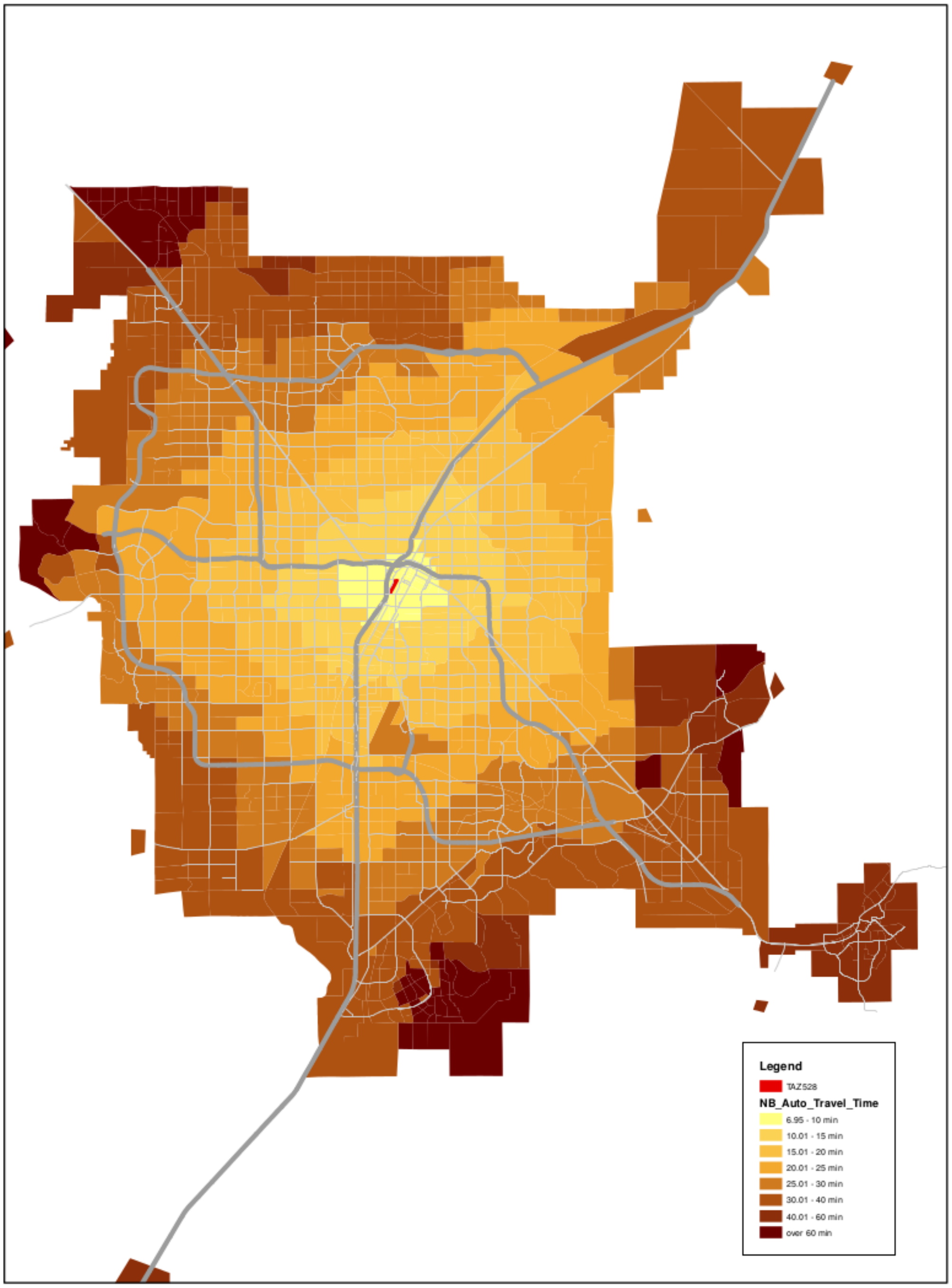


Figure C.3- – Build scenario-
modeled 2035 demand with 2035 network
Auto time from all traffic analysis zones (TAZ) to TAZ 687
(Flamingo Rd at Las Vegas Blvd)

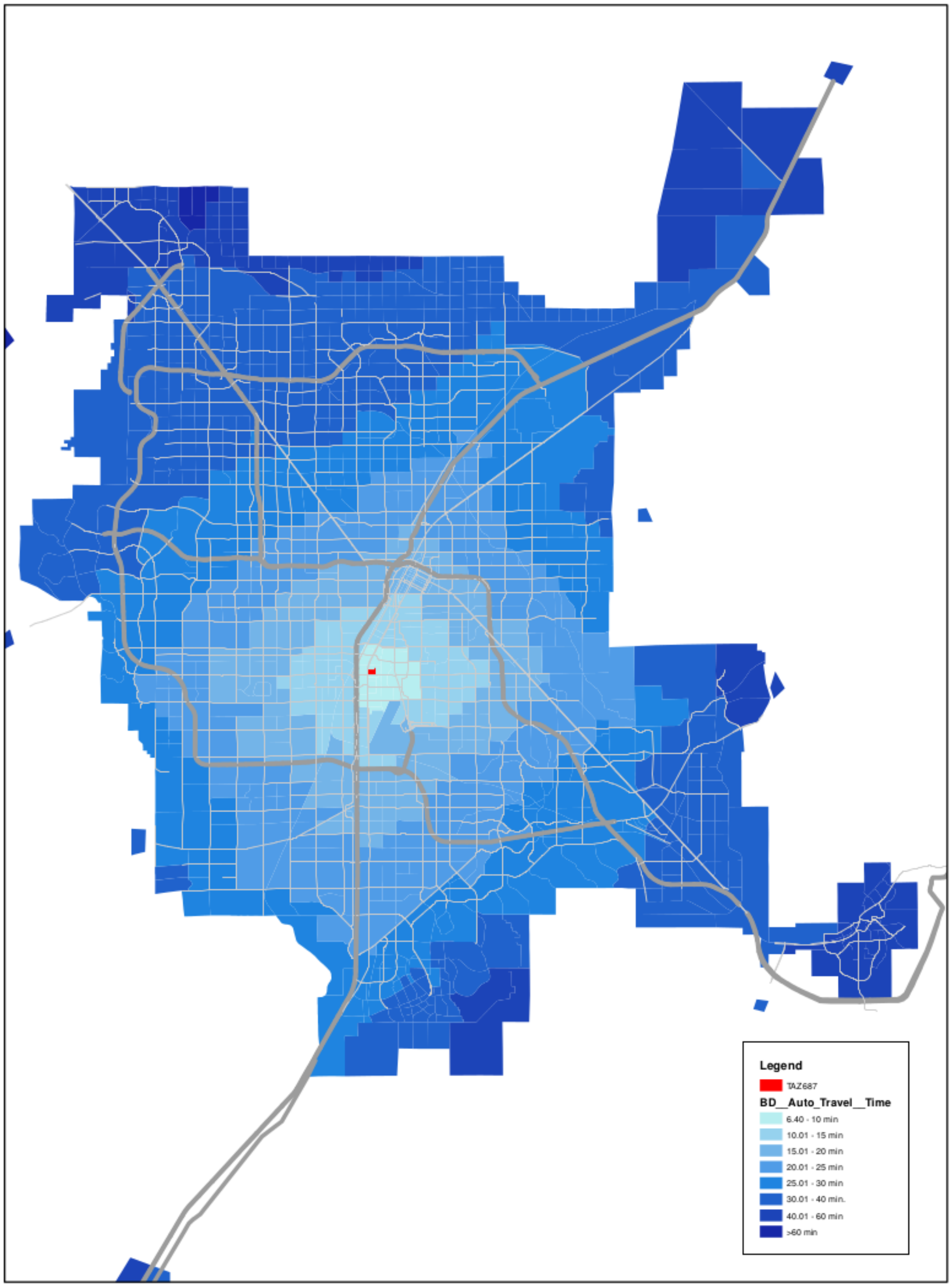
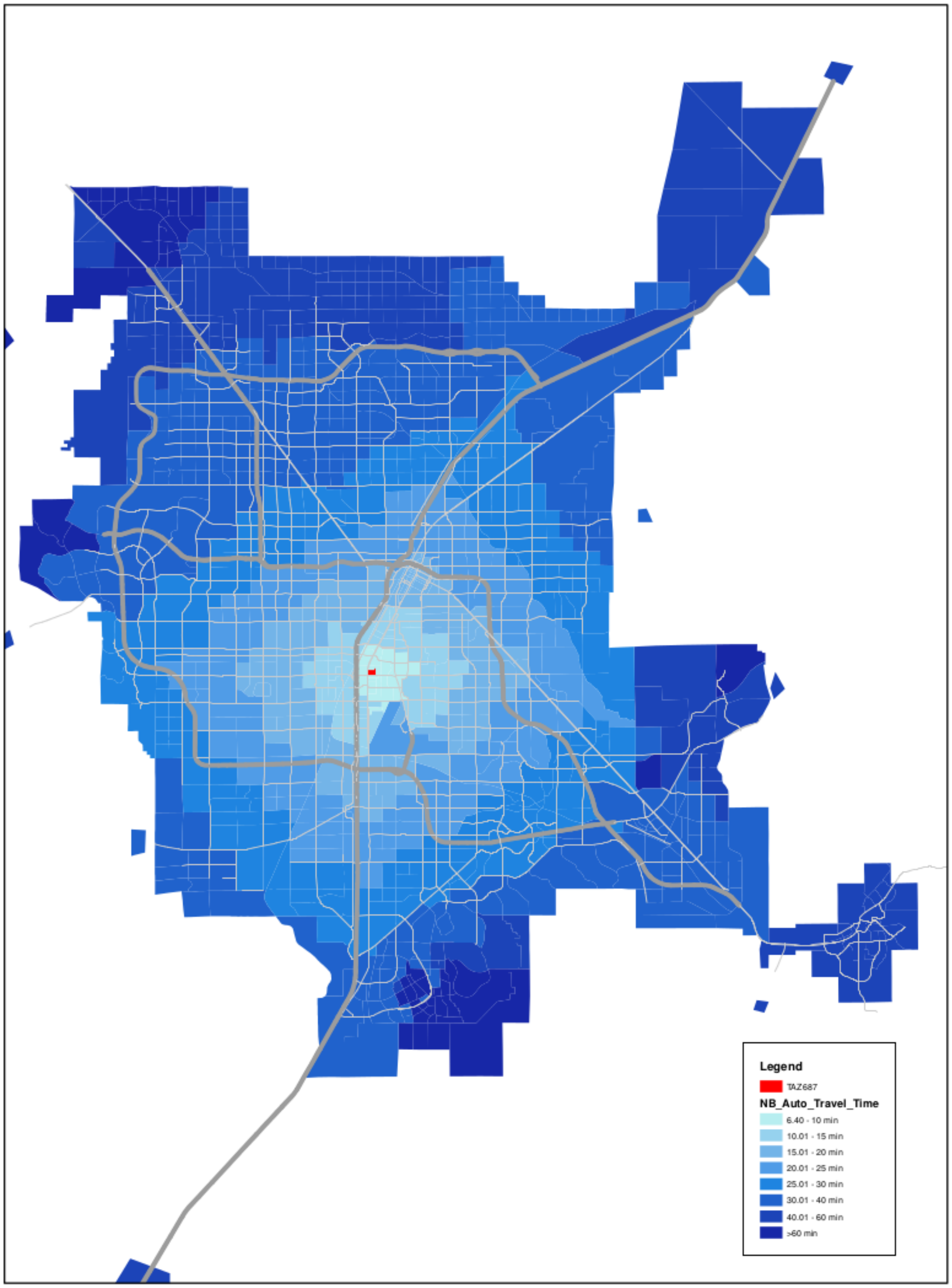


Figure C.4 – No-Build scenario-
modeled 2035 demand with 2013 network
Auto time from all traffic analysis zones (TAZ) to TAZ 687
(Flamingo Rd at Las Vegas Blvd)



Appendix E-1- Congestion Strategy Matrix	**Possible Effectiveness of Strategy**	**Recommendation**
Tier 1: Strategies to Reduce Person Trips or Vehicle Miles Traveled		
1.01 - Transportation Demand Management - The RTC has a Transportation Demand Management (TDM) program called "Club Ride" Commuter Services. The Club Ride program works with employers and employees to establish customized commute option programs which incentivize use of alternative modes of transportation for getting to and from work, such as transit, carpooling, van pooling, bicycling or walking.	Low Medium High	
1.02 - Alternative Work Hours- These more evenly distribute employee working hours across the day and contribute to reducing congestion. There are three types of alternatives, flex time, staggered hours and compressed work weeks.	Low Medium High	
1.03 - Telecommuting- This allows employees to work at home or at a regional center instead of going into a central office.	Low Medium High	
1.04 - Preferential Parking for Carpools - This provides incentives for employees to carpool with preferred or free parking.	Low Medium High	
Tier 2: Strategies to Shift Automobile Trips to Other Modes		
2.01 Increasing bus route coverage or frequencies- This strategy provides better accessibility to transit to a greater share of the population. Increasing frequency makes transit more attractive to use.	Low Medium High	
2.02 Providing real-time information on transit routes- The RTC already provides real time information on bus location and projected arrival times via smart phone application and the world wide web. Stops could be equipped with signs able to display next bus arrival information.	Low Medium High	
2.03 Providing exclusive bus right-of-way- includes busways, bus-only lanes, and bus bypass ramps.	Low Medium High	
2.04 New sidewalk connections- Encourages people to walk for short trips as opposed to driving.	Low Medium High	
2.05 Bicycle Lanes – Provision for bicycle accommodation, bike share or bike lanes at facility.	Low Medium High	
2.06 - Complete Streets- Design a corridor for pedestrians, bicyclists, transit users and motorists.	Low Medium High	

	Possible Effectiveness of Strategy	Recommendation
Tier 3: Strategies to Improve Roadway Operations -		
3.01 Traffic Signal Coordination- Signals can be set to run on different pre-timed plans or to run based on actuation from specific events, such as the arrival of a vehicle, a transit bus, a pedestrian or an emergency vehicle. The phasing plans can be optimized for ongoing conditions.	Low Medium High	
3.02 Dynamic Messaging- These electronic message signs provide motorists with information concerning travel time estimates to destinations and have the capability of displaying alternate route detour information, information on special events or emergency closures.	Low Medium High	
3.03 Advanced Traveler Information Systems (ATIS) — Information is provided to travelers via the FAST web site as well as via text messages and soon a customized app for smart phone users.	Low Medium High	
Tier 4 - Strategies to Add Capacity		
4.01 Bottleneck Removal — This strategy is aimed correcting at short segments of roadway which have temporary lane reductions or other design limitations that cause physical capacity to be limited. As heavier flows of upstream traffic arrive at the bottleneck point, vehicles can back up due to the sudden constriction.	Low Medium High	
4.02 Channelization — this separates turning traffic from the through lanes at intersections. This can take the form of lane markings or in some instances concrete islands. Consideration for pedestrians needs to be given if considering placing right turn channels.	Low Medium High	
4.03 Intersection Improvements — Intersections can be widened and lanes re-striped to increase capacity as well as safety. Elements of this may include the construction of left (and/or right) turn lane(s), widening the shoulders, applying changes to the traffic control at the intersection.	Low Medium High	
4.04 New travel lanes added along an existing roadway- This will provide increased capacity and reduce congestion and travel delays for existing levels of traffic. It could also result in less traffic on parallel side streets and arterials as vehicles divert to the widened road.	Low Medium High	
4.05 New or Extended Roadway – This is a new road along a separate right of way to serve newly developed or developing areas or an extension of an existing roadway to complete a network. It is applicable to areas experiencing new development or relieving an existing severely congested corridor.	Low Medium High	

<u>Appendix E-2 – Safety Matrix</u>
(Symbol denotes road condition where incidents are prevalent).

		NV Strategic Highway Safety Plan Five Focus Areas						
	Related Crash Types	**Impaired Driving**	**Safety Belts**	**Intersections**	**Lane Departures**	**Pedestrians**	**Crash Frequency Along Corridor (choose one)**	**Standard Mitigation Options**
Engineering	Angle and left turn crashes occurring at stop controlled intersections						**N/A LOW MED HIGH**	Provide advance warning signage on approaches to intersection. Double up on traffic control signs. Provide warning flashers. Evaluate for possible signalization. Redesign intersection approaches (2)
	Angle and left turn crashes occurring away from signalized intersections						**N/A LOW MED HIGH**	Channelize to prohibit a specific movement. Close median to prohibit all movements.
	Crashes that involve left turning vehicles						**N/A LOW MED HIGH**	Provide turn lanes, increase left turn storage, provide positive offset.
	Crashes that involve right turning vehicles						**N/A LOW MED HIGH**	Provide turn lanes, prohibit right turn on red, provide receiving lane for channelized right turn.
	Crashes that result from vehicle making U-Turn						**N/A LOW MED HIGH**	Prohibit U-turns at signalized intersection where there are conflicts with channelized right turns. Prohibit U-Turns along corridors where sight distance is determined to be inadequate or there are conflicts.
	Rear end crashes with injuries.						**N/A LOW MED HIGH**	Provide advance signal warning sign at signalized intersections. Provide advance street name signs.
	Crashes that occur during night-time hours						**N/A LOW MED HIGH**	Provide street lighting to increase night visibility. Options include advance warning (or intersection) signs with post mounted beacons, in-sign flashing lights, stop signs with post mounted beacons (9)

<u>Appendix E-2 – Safety Matrix</u>
(Symbol denotes road condition where incidents are prevalent).

		Strategic Highway Safety Plan Five Focus Areas						
	Related Crash Types	**Impaired Driving**	**Safety Belts**	**Intersection**	**Lane Departure**	**Pedestrian**	**Crash Frequency Along Corridor (choose one)**	**Standard Mitigation Options**
Engineering	Crashes that involve vehicles leaving the roadway, including single vehicle collisions with fixed objects.						**N/A LOW MED HIGH**	Improving horizontal curves through enhanced delineation, signing, friction treatments and reconstruction (1,4,7,8). Installation of "Safety Edge" for roadways without curb and gutter (1) Restrict or eliminate parking on intersection approaches
	Crashes that occur at driveways away from signalized intersections						**N/A LOW MED HIGH**	Consolidate driveways to decrease vehicular conflict points. Provide raised medians.
	Crashes that involve motorcycles						**N/A LOW MED HIGH**	Evaluate pavement friction. Evaluate shoulders to ensure proper drainage. Increase speed enforcement.
	Crashes that involve pedestrians or bicyclists						**N/A LOW MED HIGH**	Provide countdown heads for signalized intersections, refuge islands for unsignalized crossings, sidewalks along roadways, consolidate driveways to decrease vehicle/pedestrian conflict points. Improve geometry of pedestrian and bicycle facilities (2, 3, 7)
	Crashes involving heavy trucks						**N/A LOW MED HIGH**	Provide adequate clearance for heavy trucks reduced stopping distance at signals or provide dilemma zone detection at signals. Provide passing lanes, and acceleration / deceleration lanes. Increase turn radius.


RTC