CONGESTION MANAGEMENT PROCESS

Grand Valley Metropolitan Council
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Contents

Introduction

Federal transportation legislation requires Metropolitan Planning Organizations with population exceeding 200,000 (also called Transportation Management Areas or TMAs) to develop and implement a Congestion Management Process (CMP) as part of the metropolitan transportation planning process (23 CFR 450.320).

As a designated TMA for the Grand Rapids Metropolitan area, GVMC is required to develop and implement a CMP to manage and reduce congestion in the region. A CMP is intended to be a systematic way of monitoring, measuring, and diagnosing the causes of current and future congestion on a region's multi-modal transportation systems; evaluating and recommending alternative strategies to manage or mitigate current and future regional congestion; and monitoring and evaluating the performance of strategies implemented to manage or mitigate congestion.

This CMP document describes objectives, network, roadway performance monitoring and congestion identification, as well as mitigation strategies for improving regional congestion.

Background

The CMP includes an ongoing method to provide information on the performance of the transportation system and on alternative strategies to alleviate congestion and enhance mobility. The CMP emphasizes effective management of existing facilities through use of travel demand and operational management strategies. In cases where these methods are deemed ineffective to resolve the congestion issue of a corridor, capacity enhancing projects may be selected as the preferred alternative.

This CMP defines congestion deficiencies by peak periods based on GVMC's travel demand model, which was updated in FY2023. In addition, real-time speed data from Regional Integrated Transportation Information System (RITIS, www.ritis.org) was used to evaluate the roadway performance measures in the region, such as level of travel time reliability, truck travel time reliability, user delay etc.

CMP Characteristics

The GVMC Congestion Management Process consists of 9 major characteristics. These characteristics include:

1. Developing Congestion Management Objectives
2. Identifying Area of Application
3. Developing the CMP Network
4. Developing Performance Measures
5. Collecting data/Monitor System Performance
6. Analyzing Congestion Problems and Needs
7. Identifying and Evaluating Strategies
8. Programming and Implementing Strategies/Improvements
9. Evaluating and Monitoring Effectiveness

1. Develop Congestion Management Objectives

The first step in a CMP is to develop the regional objectives, which define what the region wants to achieve with regard to congestion management. The following are objectives designed in the GVMC region to address many types of congestion on many types of facilities, as shown in the GVMC 2050 MTP (Metropolitan Transportation Plan),

Objective 1a: Enhance the integration and connectivity of the transportation system, across and between modes, for people and freight

Objective 1d: Implement strategies to promote efficient system management and operations that result in the safe and reliable movement of people and freight

Objective 2d: Reduce the reliance on Single Occupancy Vehicles (SOVs) by developing policies that encourage the use or development of active and low-impact modes of transportation and promoting services, such as Rideshare, that increase vehicle occupancy rates

Objective 2e: Employ the Congestion Management Process to systematically monitor, measure, diagnose, and recommend travel management alternatives and system improvements for current and future congestion on our region's multi-modal transportation system

Objective 2f: Promote and advance travel demand management (TDM) practices and strategies to manage future traffic growth, improve system efficiency, mitigate congestion, and spread the travel demand evenly throughout the day, where feasible, in line with the GVMC Regional TDM Plan

Objective 2g: Support the use of Intelligent Transportation Systems (ITS) and incident management to reduce the potential for secondary traffic incidents and non-recurring congestion, and promote sharing ITS data between agencies to streamline and improve incident management response

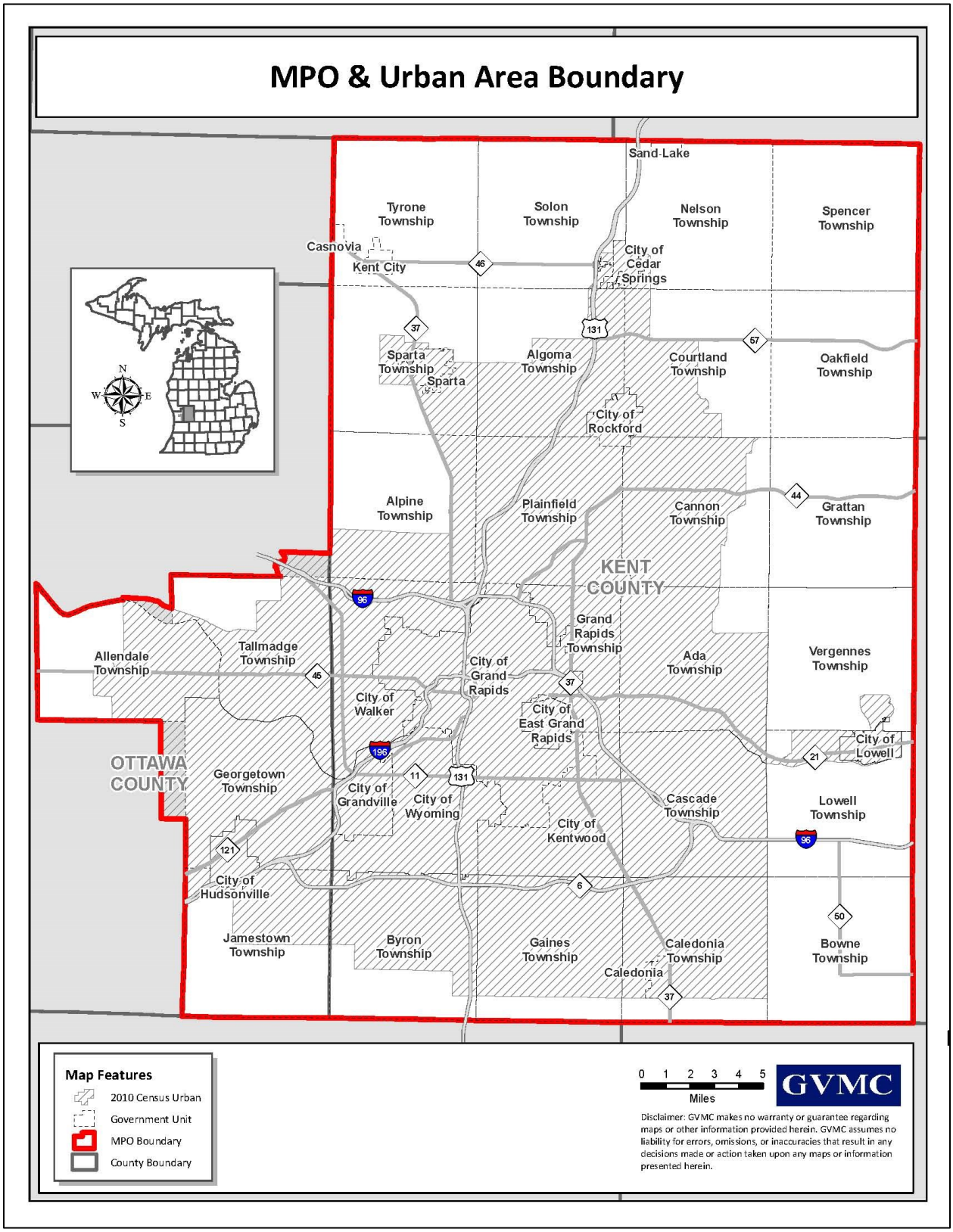
Objective 2h: Improve the travel time reliability of the system in support of federal performance measures to create a consistent experience for all road users

Objective 3a: Improve safety of the transportation system for motorized, nonmotorized and vulnerable road users in support of federal performance measures by identifying and prioritizing projects that will reduce the likelihood or severity of crashes, promoting complete streets, and incorporating safety improvements with all transportation projects where feasible and practical

2. Identify Geographic Area of Application

For each of the eight CMP objectives, "Areas of Application" must be determined. At a minimum the Area of Application should be the MPO study area. For the GVMC CMP this Area of Application has been determined to be all of Kent County and the eastern portions of Ottawa County including Allendale, Georgetown, Jamestown and Tallmadge Townships as well as the City of Hudsonville. The map below depicts the Area of Application for the GVMC CMP.

Figure 2-1: GVMC Area of CMP Application

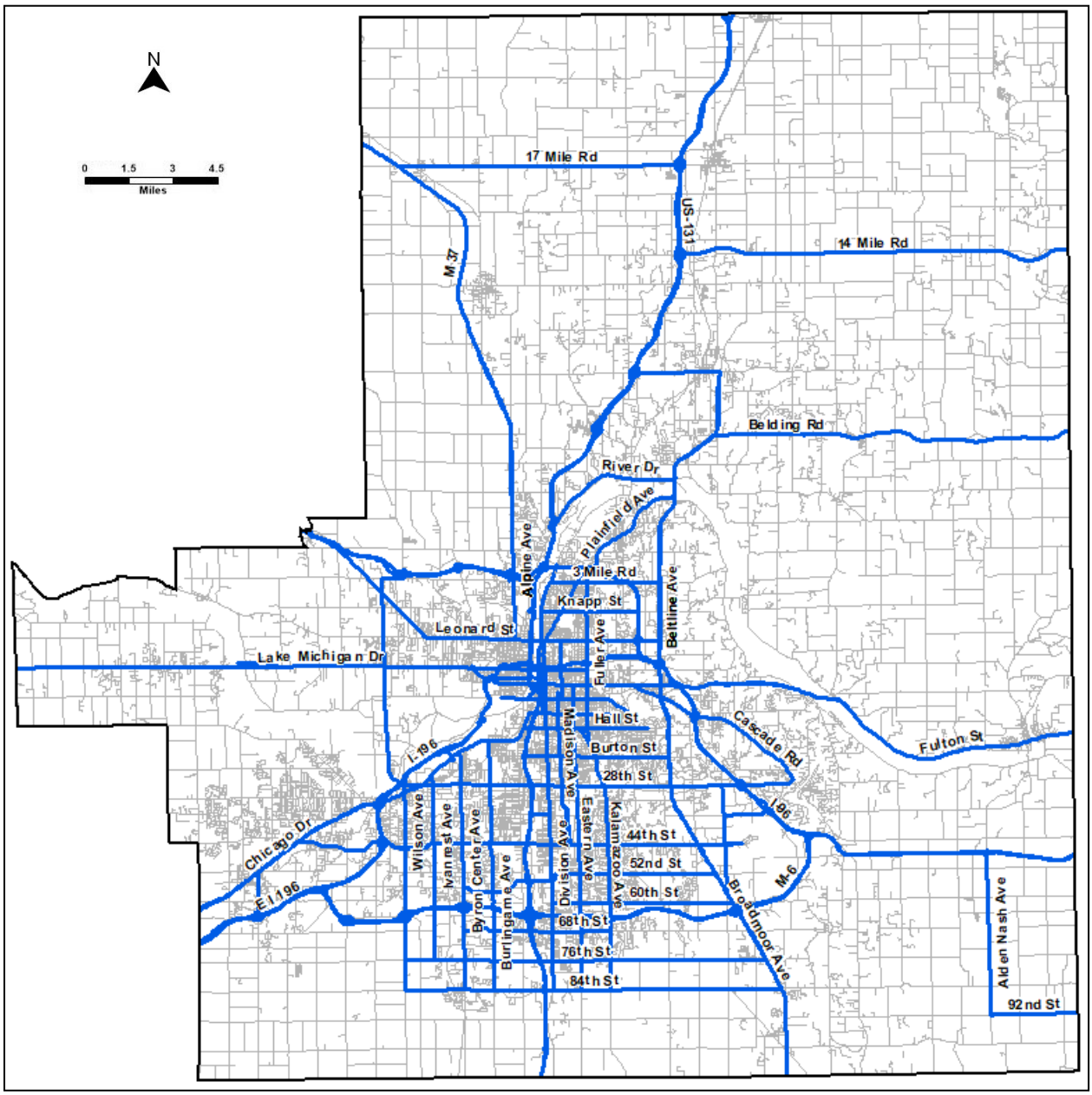


3. Define CMP Network

A CMP Network is the specific transportation subset within the Area of Application that will be the focus of a particular portion of the CMP. Traditionally, the entire MPO Metropolitan Area Boundary (MAB) would be the area of focus for the CMP. The GVMC CMP Network was selected in 3 steps as described below,

1) The federal-aid transportation system in the GVMC area was used as the baseline for the CMP network
2) The monitored roadway network in the National Performance Measure Research Data Set (NPMRDS) was then used to further define the CMP network based on data availability and congested links and locations. NPMRDS provides vehicle probe-based travel time data in five-minute increments 24 hours a day, seven days a week for National Highway System routes
3) The final CMP network was selected based on road classification, data availability, and congestion analysis by MPO staff and professional stakeholders, and includes freeways, state trunklines, urban principal arterials, and congested or potentially congested roadways identified in either the RITIS system over the past few years or in the GVMC travel demand model (see Figure 3-1).

Figure 3-1: GVMC CMP Network



4. Develop Performance Measures

The use of performance measures to assess the effectiveness and efficiency of the transportation network and of operations has greatly increased in recent years. Many of these measures are designed for more effective communication both with members of the public and with appointed and elected officials. Rather than using highly technical measures such as level of service, measures such as speed, travel time, and delay are used to describe mobility and access at various levels, from the entire regional system to specific corridors of significance, and even intersection level.

The GVMC CMP defines performance measures at both regional and corridor levels. At the regional level, performance measures can be used to monitor the overall performance of the CMP network and regional transportation system and evaluate various plan alternatives in the process of MTP development, to determine which alternatives can achieve the best outcome with regard to the CMP objectives. They also can be used to monitor and track progress toward the objectives. At the corridor level, performance measures are used to monitor the performance of the priority corridors in the CMP network and identify currently congested locations or anticipated congested locations in the future. They also are used by decision makers to assess and select congestion mitigation strategies and evaluate implemented strategies. The performance measures at the regional and corridor levels are shown in the Table 4-1 and Table 4-2 below,

Table 4-1: Regional/System Level Data and Performance Measures

Data Type	Data Source	Availability	Performance Measures
Crash Data	Michigan Traffic Crash Facts (MTCF) program	All reported crashes in the GVMC Region	Number of traffic fatalities
			Number of serious injuries
			Number of non-motorized fatalities and serious injuries
Travel Time Data	National Performance Management Research Data Set (NPMRDS)	National Highway System	% of person-miles traveled on the Interstate that are reliable
			% of person-miles traveled on the non-interstate national highway system that are reliable
Freight Movement Data	National Performance Management Research Data Set (NPMRDS)	Interstate System	Truck travel time reliability index
Average Roadway Clearance Data	West Michigan Traffic Operation Center	GVMC region	Roadway clearance time

Table 4-2: Corridor/Project Level Data and Performance Measures

Data Type	Data Source	Availability	Performance Measures
Travel Time Data	National Performance Management Research Data Set (NPMRDS)	National Highway System	Level of travel time reliability (LOTTR)
			AM Peak LOTTR
			PM Peak LOTTR
Traffic Volume Data	GVMC travel demand model	GVMC region	Volume/Capacity ratio (V/C)
Freight Movement Data	National Performance Management Research Data Set (NPMRDS)	Interstate System	Truck travel time reliability index

The definition of the performance measures are described below,

- Level of Travel Time Reliability (LOTTR), which is defined as the ratio of the 80th percentile travel time to the 50th percentile travel time for four time periods including 6AM to 10AM, 10AM to 4PM, 4PM to 8PM for weekdays and 6AM to 8PM for weekends.
- Truck Travel Time Reliability (TTTR) Index, which is defined as the ratio of the 95th percentile truck travel time to the 50th percentile truck travel time. The TTTR is calculated for each segment of Interstate freeways for five time periods including 6AM to 10AM, 10AM to 4PM, 4PM to 8PM for weekdays and 6AM to 8PM for weekends, and 8PM to 6AM for all days.
- Volume to capacity Ratio (V/C), which measures the traffic volume on a specific roadway relative to the amount of traffic the roadway was designed to accommodate.
- Roadway Incident Clearance Time, which is defined as the time between incident confirmation and the time that all lanes are open to traffic.

5. Data Collection and Monitoring of System Performance

The Final Rule on Metropolitan Transportation Planning calls for "a coordinated program for data collection and system performance monitoring to assess the extent of congestion, to contribute in determining the causes of congestion, and evaluate the efficiency and effectiveness of implemented actions."

NPMRDS

Historically, the availability of data has been the greatest challenge when determining if performance measures are meeting their mark. GVMC initially used probe data and detector data to collect travel time information. Due to the limited resources and data availability, it was difficult to perform any other type of analysis. With the advent of technology for freeway and arterial management, data is

increasingly available for major facilities in many metropolitan areas. The Federal Highway Administration (FHWA) has contracted with Inrix Inc. to provide comprehensive and consistent data for the National Performance Management Research Data Set (NPMRDS) as a tool for performance measurement for the National Highway System. Inrix Inc, a leading company in connected car services and transportation analytics, collects and aggregates GPS probe data from commercial vehicles, connected cars and mobile apps to deliver historical and real travel time data for National Highway System routes. Based on Inrix data, The University of Maryland Center for Advanced Transportation Technology Lab (CATT Lab) operates the Regional Integrated Transportation Information System (RITIS, www.ritis.org) that provides transportation planners and decision makers with analyzed and visualized road performance such as travel time, travel speed, travel time index, user delay, system reliability, and other transportation-related measurements.

With the available NPMRDS data source, GVMC is able to view transportation management information through innovative visualizations and monitor travel speed, incidents, events and other types of data.

Travel Demand Model

The GVMC's travel demand model is a four-step model, including trip generation, trip distribution, mode choice, and trip assignment. The model is used for various travel forecasting applications, providing both current conditions and future projections of congestion levels. In relation to the GVMC's CMP, the travel demand model has been used to estimate traffic volumes, volume-to-capacity ratio (V/C ratio), speed, and travel time for each network link under current and future travel conditions, and identify congested current and future congestion hotspots based on the Volume to Capacity(V/C) ratios. GVMC will maintain and update a transportation travel demand model to project the impact of transportation and development projects on congestion levels on the transportation system. The greater of morning peak and afternoon peak V/C ratio is used as performance in the GVMC CMP.

Traffic Count Program

Since the mid 1980's when the MPO was known as GRETS, the area has been a leader in the collection and dissemination of transportation related data. Currently, GVMC maintains a traffic count database that includes nearly 2,000 locations. Each of the links in the modeled federal aid network is counted a minimum of every three years. As part of the performance monitoring plan, GVMC will continue to maintain the traffic count database on the entire network. Count data will be collected at each location in the modeled network.

Traffic Safety Database

The University of Michigan Transportation Research Institute (UMTRI) provides public access to state traffic crash data through its Michigan Traffic Crash Facts (MTCF) program. Roadsoft, which is developed and maintained by Michigan Technological University, also contains information related to traffic safety for the State of Michigan, including safety ranking for segments and intersections for the highway

system. GVMC staff uses crash data from these databases to track crash statistics and conduct safety analyses.

West Michigan Traffic Operation Center

According to a research conducted by Federal Highway Administration (http://www.ops.fhwa.dot.gov/aboutus/opstory.htm), around 25% of all non-recurring congestion are caused by traffic crashes. Therefore, it is important for the incident management agencies to work together on implementing strategies to ensure safe and quick clearance of traffic crashes. As an incident management agency for MDOT grand region, the West Michigan Transportation Operation Center (WMTOC) operators have been monitoring freeways and arterials in the 13 counties in West Michigan, including the GVMC MPO area. The West Michigan Transportation Operation Center (WMTOC) provides the public and local agencies with traffic monitoring and incident management support. WMTOC's annual and monthly reports provide information about roadway incident clearance time, crash hot spot, and high-impact incidents, etc.

6. Analyze Congestion Problems and Needs

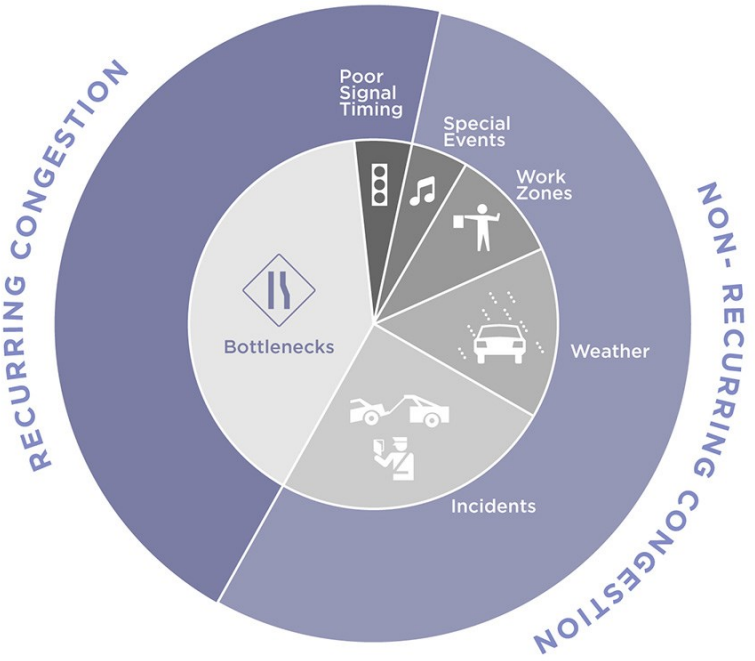
This section describes the definition of congestion in the GVMC region and identifies various congestion issues and needs pertaining to the regional transportation system. The congestion issues and needs presented in this section were determined through the analysis conducted by GVMC staff, utilizing the previously mentioned performance measures.

6.1 Defining Congestion

To effectively evaluate regional congestion concerns and requirements, it is essential to establish a clear definition of congestion. According to FHWA, congestion is defined as the level at which the performance of the transportation system becomes unacceptable due to excessive travel times and delays (23 CFR 500.109). This definition serves as the basis for defining congestion in the GVMC CMP.

The ability to identify and measure different types of congestion is key to developing appropriate responses. Recurring congestion is defined as the relatively predictable congestion caused by routine traffic volumes operating in a typical environment. Recurring congestion happens when too many people routinely attempt to drive on a roadway at the same time. Non-recurring congestion is defined as unexpected or unusual congestion caused by unpredictable or transient events such as traffic crashes, inclement weather, or construction, as shown in Figure 6-1 below.

Figure 6-1: The Source of Congestion



Source: FHWA " Incorporating Travel-Time Reliability into the Congestion Management Process"

In alignment with the federal definition, GVMC defines congestion as the level at which the performance of the transportation system becomes unsatisfactory due to excessive travel times and delays. Where data is available, the following congestion indicators/thresholds are used to identify segments of the regional transportation system ,

Table 6-1: Congestion/Reliability Thresholds

Congestion Indicator	Data Source	Performance Threshold
Level of Travel Time Reliability (LOTTR)	National Performance Management Research Data Set (NPMRDS)	LOTTR is greater than or equal to 1.50
Truck Travel Time Relibility (TTTR)	National Performance Management Research Data Set (NPMRDS)	TTTR is greater than or equal to 1.75
Volume to Capacity Ratio (V/C)	GVMC Travel Demand Model	Moderate congestion: V/C ratio is greater than or equal to 0.80 and lower than 1.0 Severe Congestion: V/C ratio is greater than or equal to 1.0

The congestion indicators/thresholds presented in Table 6-1 serve the purpose of identifying and evaluating both recurring and non-recurring congestion problems related to the CMP network. A segment on the CMP network was deemed congested based on the thresholds of congestion/reliability performance measures listed in Table 6-1, along with input from both staff and GVMC committee members.

6.2 Regional Level Analysis

The regional level analysis aims to evaluate the overall regional performance in reducing congestion and improving the safety of the regional transportation system. This assessment utilizes the performance measures at the Regional/System Level included in Table 4-1.

The table below provides a summary of the analysis conducted at the regional level.

Table 6-2: Regional Level Performance Measures

Performance Measure	Analysis Area	2019	2020	2021	2022	Target
Number of traffic fatalities	All reported crashes in the GVMC region	55	59	74	60	Reduce number of fatal and serious injury crashes
Number of serious injuries		464	426	463	493	
Number of non-motorized fatal and serious injuries		68	68	63	58	
% of person-miles traveled on the Interstate that are reliable	National Highway System	90.6%	100%	97.8%	99%	75%
% of person-miles traveled on the non-interstate national highway system that are reliable		84.7%	94%	93.4%	94.1%	70%
Truck travel time reliability index	Interstate System	1.78	1.29	1.42	1.79	1.75
Average Roadway clearance time (Mins)	GVMC region	49	53	47	49	N/A

6.3 Corridor Level Analysis

The corridor level analysis is intended to evaluate the progress achieved in reducing congestion, enhancing travel time reliability, and improving safety within the freeways, state trunklines, urban principal arterials, and congested or potentially congested roadways as identified in the previously defined CMP network. These analyses were conducted using the performances measures at the corridor level included in Table 4-2.

Table 6-3 through Table 6-5 and Figure 6-2 and Figure 6-3 below display the congested freeway and non-freeway segments, while Table 6-6 and Table 6-7 provide a list of top 20 congested segments and intersections, respectively. Maps displaying V/C ratios are available in Appendix B.

Table 6-3: Performance Measures for Freeway Corridors

Corridor	Limits	Direction	LOTTR				TTTR				V/C	
			2019	2020	2021	2022	2019	2020	2021	2022	2019	2050
I-196	I-96 to Fuller Ave	East	3.29	1.34	1.11	1.18	4.87	2.54	1.51	2.84	0.90	0.77
		West	1.1	1.07	1.09	1.07	1.41	1.16	1.22	1.32	0.94	0.81
I-196	Fuller Ave to College Ave	East	1.25	1.1	1.08	1.07	2.91	1.3	1.32	1.32	0.54	0.65
		West	1.13	1.08	1.11	1.13	1.68	1.22	1.31	1.66	0.55	0.67
I-196	College Ave to Ottawa Ave	East	1.13	1.14	1.15	1.08	1.54	1.44	1.41	1.45	0.62	0.73
		West	1.35	1.12	1.13	1.14	4.05	1.49	1.46	2.97	0.61	0.73
I-196	Ottawa Ave to US-131	East	1.14	1.12	1.13	1.11	1.62	1.48	1.51	1.48	0.86	0.97
		West	1.26	1.14	1.1	1.27	2.38	1.41	1.6	2.86	0.89	0.77
I-196	US-131 to Lane Ave	East	1.24	1.13	1.65	1.15	3.25	1.38	3.47	3.75	0.73	0.79
		West	1.15	1.15	1.15	1.31	1.69	1.78	1.85	2.03	0.71	0.77
I-196	Lane Ave to Lake Michigan Dr	East	1.15	1.1	1.11	1.07	1.73	1.34	2.22	1.47	0.93	1.01
		West	1.11	1.13	1.1	1.13	1.52	1.73	1.28	1.41	0.91	1.01
I-196	Lake Michigan Dr to Market Ave	East	1.11	1.15	1.08	1.08	1.62	1.57	1.22	1.37	0.88	0.96
		West	1.1	1.1	1.08	1.1	1.95	1.44	1.31	3.39	0.81	0.95
I-196	Market Ave to Chicago Dr	East	1.09	1.15	1.07	1.1	1.45	3.79	1.18	1.31	1.02	1.07
		West	1.1	1.07	1.08	1.11	1.85	1.19	1.6	3.97	1.00	1.08
I-196	Chicago Dr to Wilson Ave	East	1.09	1.08	1.07	1.18	1.58	1.28	1.18	4.06	1.02	1.07
		West	1.08	1.06	1.17	1.08	1.4	1.15	1.47	1.48	1.02	0.78
I-196	Wilson Ave to Chicago Dr(Exit 69)	East	1.15	1.12	1.06	1.11	2.08	1.39	1.32	3.11	0.74	0.81
		West	1.11	1.07	1.13	1.1	1.43	1.21	1.3	1.28	0.71	0.79
I-96	MI-50 to MI-6	East	1.05	1.04	1.03	1.03	1.33	1.09	1.22	1.2	0.75	0.91
		West	1.04	1.04	1.04	1.34	1.37	1.09	2.25	2.99	0.73	0.90
I-96	28th St to Cascade Rd	East	1.07	1.07	1.04	1.05	1.31	1.12	1.16	1.3	0.83	0.94
		West	1.48	1.06	1.19	1.18	2.87	1.4	2.61	2.19	0.84	0.97
I-96	Cascade Rd to M-21	East	1.07	1.06	1.04	1.09	1.36	1.09	1.12	1.45	0.99	0.59
		West	2.02	1.06	1.91	1.57	2.87	1.93	2.45	2.12	0.94	0.60
I-96	M-21 to East Beltline	East	1.21	1.06	1.04	1.08	1.63	1.2	1.17	3.51	0.81	0.57
		West	1.2	1.05	1.13	1.08	2.11	1.18	1.41	1.3	0.79	0.69

Table 6-3 (Continued): Performance Measures for Freeway Corridors

Corridor	Limits	Direction	LOTTR				TTTR				V/C	
			2019	2020	2021	2022	2019	2020	2021	2022	2019	2050
I-96	M-37 to I-196	East	1.76	1.07	1.07	1.09	2.55	1.27	1.26	4.89	1.14	0.74
		West	1.17	1.06	1.11	1.06	1.8	1.14	1.46	1.34	0.93	0.52
I-96	I-196 to Leonard St	East	1.76	1.07	1.05	1.06	4.38	1.12	1.17	1.49	0.70	0.64
		West	1.14	1.05	1.09	1.06	1.55	1.13	1.2	1.36	1.09	0.65
I-96	Leonard St to Plainfield Ave	East	1.54	1.07	1.03	1.04	5.25	1.1	1.19	1.37	0.72	0.83
		West	1.39	1.06	1.04	1.05	2.57	1.1	1.14	1.39	0.66	0.81
I-96	Plainfield Ave to US-131	East	1.11	1.08	1.14	1.11	1.5	1.19	1.45	1.52	0.86	0.94
		West	1.43	1.07	1.07	1.08	1.85	1.21	1.23	1.4	0.87	0.96
I-96	US-131 to Alpine Ave	East	1.1	1.08	1.06	1.06	1.51	1.28	1.57	1.4	0.82	0.86
		West	1.1	1.06	1.1	1.1	1.41	1.25	1.33	1.43	0.68	0.75
I-96	Alpine Ave to Walker Ave	East	1.09	1.06	1.04	1.05	1..85	1.15	1.24	1.26	0.93	0.98
		West	1.08	1.06	1.05	1.06	1.55	1.16	1.19	1.30	0.95	1.00
I-96	Walker Ave to Fruit Ridge Ave	East	1.08	1.08	1.05	1.06	1.49	1.18	1.22	1.28	0.89	0.93
		West	1.08	1.07	1.05	1.05	1.37	1.13	1.23	1.25	0.88	0.93
US-131	I-196 to Leonard St	North	1.52	1.1	1.18	1.28	2.29	1.85	1.87	3.85	0.91	0.93
		South	1.25	1.11	1.21	1.12	1.92	1.37	4.07	1.47	0.90	0.93
US-131	Leonard to Ann St	North	1.16	1.07	1.12	1.17	1.68	1.37	1.48	1.58	0.88	0.90
		South	1.41	1.06	1.07	1.08	2.64	1.19	2.24	1.33	0.85	0.88
US-131	Ann St to I-96	North	1.1	1.07	1.09	1.18	1.91	1.39	2.01	1.67	0.83	0.87
		South	1.72	1.06	1.06	1.08	3.53	1.14	1.35	2.44	0.79	0.85
US-131	I-96 to River Dr	North	N/A	1.09	N/A	1.26	N/A	1.87	N/A	2.57	0.73	0.78
		South	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.73	0.80
US-131	36th St to 28th St	North	1.95	1.1	1.1	1.25	N/A	N/A	N/A	N/A	0.98	1.02
		South	1.08	1.08	1.08	1.09	N/A	N/A	N/A	N/A	0.96	1.00
US-131	28th St to Burton St	North	2.37	1.1	1.37	1.77	N/A	N/A	N/A	N/A	0.98	1.01
		South	1.08	1.07	1.08	1.09	N/A	N/A	N/A	N/A	0.98	1.02
US-131	Burton St to Hall St	North	N/A	1.13	2.31	1.95	N/A	N/A	N/A	N/A	1.01	1.06
		South	1.12	1.07	1.07	1.09	N/A	N/A	N/A	N/A	1.01	1.06
US-131	Hall St to Franklin St	North	1.69	1.15	2.81	1.69	N/A	N/A	N/A	N/A	1.03	1.07
		South	1.23	1.07	1.11	1.11	N/A	N/A	N/A	N/A	1.06	1.09
US-131	Franklin St to Wealthy St	North	1.41	1.13	1.68	1.34	N/A	N/A	N/A	N/A	1.09	1.12
		South	1.35	1.07	1.24	1.13	N/A	N/A	N/A	N/A	1.05	1.11
US-131	Wealthy St to Market St	North	1.36	1.09	1.28	1.16	N/A	N/A	N/A	N/A	0.92	0.93
		South	1.38	1.08	1.36	1.11	N/A	N/A	N/A	N/A	0.91	0.94
US-131	Market St to Pearl St	North	1.54	1.08	1.24	1.16	N/A	N/A	N/A	N/A	0.91	0.94
		South	1.35	1.09	1.33	1.13	N/A	N/A	N/A	N/A	0.91	0.93
US-131	Pearl St to I-196	North	1.69	1.08	1.17	1.14	N/A	N/A	N/A	N/A	0.81	0.82
		South	1.25	1.09	1.21	1.10	N/A	N/A	N/A	N/A	0.79	0.81

Table 6-4: Performance Measures for Non-Freeway Corridors

Corridor	Limits	Direction	LOTTR				V/C	
			2019	2020	2021	2022	2019	2050
M-11 (28th St)	Patterson to I-96	East	1.53	1.53	1.36	1.49	0.91	0.96
		West	1.52	1.52	1.31	1.29		
M-11	Lake Eastbrook BLVD to East Beltline Ave	East	1.50	1.44	1.34	1.32	0.68	0.70
		West	1.71	1.57	1.56	1.53		
M-11	East Beltline Ave to Shaffer Ave	East	1.57	1.50	1.26	1.24	0.85	0.85
		West	1.57	1.57	1.28	1.27		
M-11	Shaffer Ave to Breton Ave	East	1.27	1.30	1.17	1.21	0.84	0.86
		West	1.39	1.33	1.25	1.22		
M-11	Breton to Kalamazoo Ave	East	1.46	1.3	1.71	1.38	0.84	0.86
		West	1.29	1.31	1.13	1.16		
M-11	Madison to Division Ave	East	1.36	1.33	1.25	1.34	0.84	0.89
		West	1.54	1.40	1.20	1.26		
M-11	Buchanan to US-131	East	1.65	1.53	1.6	1.54	1.02	1.12
		West	1.38	1.35	1.25	1.27		
M-11	US-131 to Clyde Park Ave	East	1.51	1.38	1.24	1.27	0.78	0.86
		West	1.32	1.26	1.20	1.25		
M-11	Chicago Dr. to I-196	East	1.28	1.27	1.30	1.26	0.79	0.83
		West	1.77	1.58	1.64	1.74		
M-11 (Wilson Ave)	I-196 to Butterworth St	North	1.73	1.91	1.75	1.68	0.73	0.86
		South	1.93	1.81	1.93	1.72		
M-11 (Wilson Ave)	Butterworth St to Obrien St	North	1.23	1.12	1.20	1.15	0.96	1.09
		South	1.19	1.11	1.18	1.25		
M-11 (Wilson Ave)	O Brien St. to Lake Michigan Dr	North	1.59	1.39	1.90	1.66	0.82	0.78
		South	1.29	1.33	1.48	1.42		
M-37	29th St. to 28th St.	North	1.66	1.6	1.66	1.56	0.44	0.50
		South	1.5	1.58	1.61	1.45		
M-37	Burton to Lake Dr	North	1.25	1.26	1.19	1.21	0.95	1.01
		South	1.44	1.19	1.20	1.22	0.89	0.93
M-37	Fulton St. to Michigan St.	North	2.02	1.29	2.63	3.58	0.90	0.83
		South	1.29	1.25	1.25	1.25	0.87	0.82
M-37	Michigan to I-96	North	1.92	1.75	1.84	1.81	0.91	0.80
		South	1.57	1.45	1.54	1.41		
M-37	76th St. to 84th St.	North	N/A	N/A	N/A	N/A	0.89	0.71
		South	N/A	N/A	N/A	N/A		
M-45	8th Ave to M-11(Wilson Ave)	East	1.51	1.41	1.92	1.72	0.70	0.81
		West	1.38	1.30	1.50	1.43		

Table 6-4 (Continued): Performance Measures for Non-Freeway Corridors

Corridor	Limits	Direction	LOTTR				V/C	
			2019	2020	2021	2022	2019	2050
44th St.	Burlingame to Byron Center Ave.	East	1.30	1.25	1.15	1.16	0.64	0.75
		West	1.95	1.34	1.30	1.59		
44th St.	Division Ave. to US-131	East	1.44	1.41	1.51	1.51	0.68	0.77
		West	1.51	1.39	1.24	1.26		
54th St.	Clyde Park Ave. to US-131	East	2.25	1.99	1.83	1.71	0.75	0.90
		West	1.91	1.91	1.86	1.74		
68th St.	Clyde Park Ave. to US-131	East	1.70	1.67	1.57	1.50	0.43	0.55
		West	1.68	1.79	1.38	1.48		
84th St.	Division Ave. to US-131	East	1.53	1.47	1.82	1.47	0.41	0.57
		West	1.65	1.61	1.83	1.58		
Burton St.	Clyde Park Ave. to US-131	East	N/A	N/A	N/A	1.66	0.84	0.93
		West	N/A	N/A	N/A	1.53		
Burton St.	Division Ave. to US-131	East	1.66	1.56	1.97	1.67	1.01	1.12
		West	1.73	1.49	1.45	1.43		
Division Ave.	76th St. to 68th St.	North	1.45	1.48	1.57	1.59	0.51	0.62
		South	1.43	1.48	1.32	1.36		
Division Ave.	Oakes St. to Wealthy St.	North	1.42	1.50	1.34	1.37	0.44	0.77
		South	1.70	1.55	1.88	1.52		
Division Ave.	Oakes St. to Fulton St.	North	1.75	1.60	1.73	1.74	0.57	0.63
		South	1.63	1.50	1.30	1.27		
Division Ave.	Fulton St. to Pearl St.	North	1.56	1.70	1.64	1.50	0.75	0.69
		South	1.53	1.56	1.44	1.49		
Franklin St.	Division Ave. to Madison Ave.	East	1.31	1.31	N/A	0.74	0.74	0.80
		West	1.87	1.40	N/A	1.55		
Franklin St.	US-131 to Grandville Ave	East	1.45	1.46	1.58	1.63	0.53	0.69
		West	1.78	1.70	1.71	1.62		
Fuller Ave.	Michigan St. to Fulton St.	North	1.47	1.42	1.24	1.22	0.78	0.79
		South	1.67	1.43	1.48	1.53		
Fulton St.	Lexington Ave. to Seward Ave.	East	N/A	N/A	N/A	1.90	0.56	0.65
		West	1.46	1.13	N/A	1.29		
Fulton St.	Seward Ave. to Grandville Ave.	East	1.67	1.50	1.28	1.55	0.73	0.90
		West	1.54	1.43	1.33	1.60		
Fulton St.	Monroe Ave. to Ottawa Ave.	East	2.13	2.00	1.39	1.73	0.76	0.77
		West	2.00	1.83	1.47	1.70		
Fulton St.	Ottawa Ave. to Ionia Ave.	East	1.67	1.65	1.29	1.56	0.66	0.80
		West	1.83	1.69	1.60	2.17		
Fulton St.	Ionia Ave. to Division Ave.	East	1.76	1.78	1.39	1.74	0.69	0.75
		West	1.79	1.83	1.45	1.78		
Fulton St.	Prospect Ave. to College Ave.	East	1.33	1.30	1.21	1.56	0.60	0.64
		West	1.50	1.42	1.36	1.36		

Table 6-4 (Continued): Performance Measures for Non-Freeway Corridors

Corridor	Limits	Direction	LOTTR				V/C	
			2019	2020	2021	2022	2019	2050
Fulton St.	Portmouth Pl. to Lake Dr.	East	N/A	N/A	N/A	1.52	0.69	0.77
		West	1.53	1.55	N/A	1.50		
Fulton St.	Cascade Rd. to M-37	East	1.69	1.52	1.33	1.50	0.79	0.91
		West	1.39	1.42	1.33	1.28		
Hall St.	Grandville Ave. to US-131	East	1.45	1.60	1.57	1.50	0.69	0.81
		West	1.73	1.70	1.55	1.63		
John J Oostema Blvd	GRR to Patterson	East	2.06	1.46	1.84	1.64	0.16	0.20
		West	1.30	1.67	1.56	1.32	0.15	0.20
Kalamazoo Ave.	68th St. to M-6	North	1.70	1.64	1.40	1.47	0.79	0.91
		South	1.62	1.59	1.73	1.51		
Leonard St.	Walker Ave. to Alpine Ave.	East	1.42	1.44	2.00	1.72	0.64	0.76
		West	1.39	1.30	1.42	1.29		
Leonard St.	Alpine Ave. to US-131	East	1.71	1.72	1.80	1.57	0.73	0.79
		West	1.53	1.38	1.52	1.47		
Leonard St.	US-131 to Fuller Ave.	East	1.32	1.30	1.30	1.33	0.72	0.84
		West	1.64	1.35	1.41	1.60		
Leonard St.	I-96 to E Beleline Ave.	East	2.11	1.79	1.53	1.59	0.44	0.67
		West	1.56	1.46	1.45	1.42		
Leonard St.	E Beltline Ave. to Crahen Ave.	East	1.54	1.39	N/A	1.41	0.63	0.58
		West	1.61	1.63	N/A	1.66		
Market Ave.	Wealthy St. to US-131	North	1.50	1.43	1.49	1.56	0.64	0.84
		South	1.65	1.64	1.67	1.55		
Market Ave.	US-131 to Fulton St.	North	1.67	1.50	1.89	1.55	0.50	0.85
		South	1.64	1.53	1.75	1.73		
Michigan St.	Monroe Ave. to Ottawa Ave.	East	1.78	2.11	1.55	1.63	0.48	0.61
		West	1.83	1.75	1.45	1.59		
Monroe Ave.	Fulton St. to Pearl St.	North	1.44	1.50	1.44	1.52	0.50	0.51
		South	1.43	1.48	1.38	1.52		
Monroe Ave.	Pearl St. to Michigan St.	North	1.67	1.67	1.46	1.56	0.82	0.89
		South	1.56	1.45	1.59	1.50		
Patterson Ave.	Broadmoor Ave. to 52nd St.	North	1.49	1.40	1.33	1.27	0.56	0.67
		South	1.76	1.48	1.42	1.85		
Pearl St.	US-131 to Monroe Ave.	East	1.63	1.61	1.74	1.47	0.69	0.80
		West	1.71	2.00	1.80	1.71		
Plainfield Ave.	3 Mile Rd. to I-96/M-37	North	2.15	1.76	1.88	1.67	0.52	0.61
		South	2.07	1.48	1.72	1.75		
Wealthy St.	Lafayette Ave. to Division Ave.	East	N/A	N/A	N/A	1.36	0.62	0.68
		West	N/A	N/A	N/A	1.72		
Wealthy St.	US-131 to Division Ave.	East	1.70	1.80	1.45	1.49	0.96	1.12
		West	1.86	2.00	1.55	1.67		
Wilson Ave.	Chicago Dr. to 28th St.	North	N/A	N/A	N/A	1.81	0.51	0.64
		South	N/A	N/A	N/A	1.64		

Table 6-5: Congested/Unreliable Segments for Truck Travel Based on TTTR

Road Name	From	To	TTTR
I-96 EB	I-196	M-37	4.40
I-196 (EB)	M-11 (28th Street)	Chicago Drive (Wyoming)	4.06
I-196 (WB)	Market Avenue	Chicago Drive (Wyoming)	3.97
US-131 NB	Michigan Street	Leonard Street	3.85
I-196 (EB)	Lane Avenue	US-131	3.75
I-96 EB	M-37	Fulton Street	3.51
I-196 (WB)	Lake Michigan Drive	Market Avenue	3.39
I-96 EB	28th Street	36th Street	3.37
I-96 (WB)	Alden Nash Avenue	M-6	2.99
I-196 (WB)	College Avenue	Ottawa Avenue	2.97
I-196 (WB)	Ottawa Avenue	US-131	2.86
I-196 (EB)	Fuller Avenue	I-96	2.84
I-196 (WB)	32nd Avenue	48th Avenue	2.64
N US 131/I 96	N US 131	Bridge 4752	2.57
US-131 NB	I-96	West River Drive	2.57
US-131 SB	I-96	Ann Street	2.44
I-96 (WB)	28th Street	Cascade Road	2.19
I-96 (WB)	Cascade Road	M-21 (Fulton St)	2.12
I-196 (WB)	US-131	Lane Avenue Off Ramp	2.03
I-196 (EB)	Lake Michigan Drive	Lane Avenue	1.82

Table 6-6: Top 20 Congested Segments (Based on 2022 LOTTR)

Corridor	Direction	From	To	LOTTR			
				2019	2020	2021	2022
M-37 (E Beltline Ave.)	Northbound	Fulton St.	Michigan St.	2.02	1.29	2.63	3.58
Fulton St.	Westbound	Ionia Ave.	Ottawa Ave.	1.83	1.69	1.60	2.17
US-131	Northbound	Burton St.	Hall St.	N/A	1.13	2.31	1.95
Fulton St.	Eastbound	Lexington St.	Seward Ave.	N/A	N/A	N/A	1.90
Patterson Ave.	Southbound	52nd St.	Broadmoor Ave.	1.76	1.48	1.42	1.85
M-37 (E Beltline Ave.)	Northbound	Michigan St.	I-96	1.92	1.75	1.84	1.81
Wilson Ave.	Northbound	Chicago Dr.	28th st.	N/A	N/A	N/A	1.81
Fulton St.	Westbound	Division Ave.	Ionia Ave.	1.79	1.83	1.45	1.78
US-131	Northbound	28th St.	Burton St.	2.37	1.10	1.37	1.77
Plainfield Ave.	Southbound	I-96	3 Mile Rd	2.07	1.48	1.72	1.75
54th St.	Westbound	US-131	Clyde Park Ave.	1.91	1.91	1.86	1.74
Fulton St.	Eastbound	Ionia Ave.	Division Ave.	1.76	1.78	1.39	1.74
Division Ave.	Northbound	Oakes St.	Fulton St.	1.75	1.60	1.73	1.74
Fulton St.	Eastbound	Monroe Ave.	Ottawa Ave.	2.13	2.00	1.39	1.73
Market Ave.	Southbound	Fulton St.	US-131	1.64	1.53	1.75	1.73
Leonard St.	Eastbound	Walker Ave.	Alpine Ave.	1.42	1.44	2.00	1.72
M-11 (Wilson Ave.)	Southbound	I-196	Butterworth St.	1.93	1.81	1.93	1.72
M-45	E	8th Ave.	M-11	1.51	1.41	1.92	1.72
Wealthy St.	W	Lafayette St.	Division Ave.	N/A	N/A	N/A	1.72
54th St.	E	Clyde Park Ave.	US-131	2.25	1.99	1.83	1.71

Table 6-7: Top 20 Congested Intersections (Based on 2022 LOTTR)

Corridor	Direction	Intersection	LOTTR			
			2019	2020	2021	2022
Remembrance Rd.	SB	Leonard St.	2.86	3.17	3.86	3.17
54th St.	EB	Clyde Park Ave.	2.40	1.43	1.00	3.00
Cascade Rd.	WB	Fulton St.	N/A	N/A	N/A	2.86
Gezon PKWY	EB	Clyde Park Ave.	3.22	3.50	2.61	2.80
68th St.	EB	Kalamazoo Ave.	3.00	2.80	2.31	2.75
Sheridan Ave	WB	Franklin St.	2.75	2.83	2.83	2.75
3 Mile Rd.	EB	Fruit Ridge Ave.	2.23	N/A	2.46	2.70
Leonard St.	EB	E Beltline Ave.	2.78	2.75	3.48	2.70
68th St.	WB	Kalamazoo Ave.	2.75	2.29	2.08	2.70
Oakes St.	WB	Division Ave.	N/A	1.57	2.80	2.67
Patterson Ave.	SB	Broadmoor Ave.	2.71	2.56	2.78	2.62
W River Dr.	WB	Northland Dr.	2.78	N/A	1.97	2.60
Byron Center Ave.	NB	44th St.	2.17	N/A	2.60	2.50
W River Dr.	EB	Northland Dr.	2.91	N/A	2.64	2.50
Leonard St.	WB	E Beltline Ave.	3.13	2.86	2.33	2.49
36th St.	WB	Patterson Ave.	2.71	2.24	2.31	2.45
Michigan St.	EB	Fuller Ave.	2.07	2.29	2.23	2.43
M-11 (Wilson Ave.)	SB	3 Mile Rd.	N/A	2.30	1.88	2.36
44th St	WB	Rivertown PKWY	N/A	N/A	N/A	2.33
M-44	WB	Belding Rd.	2.67	N/A	N/A	2.29

Figure 6-2: 2022 GVMC LOTTR map on CMP Corridors

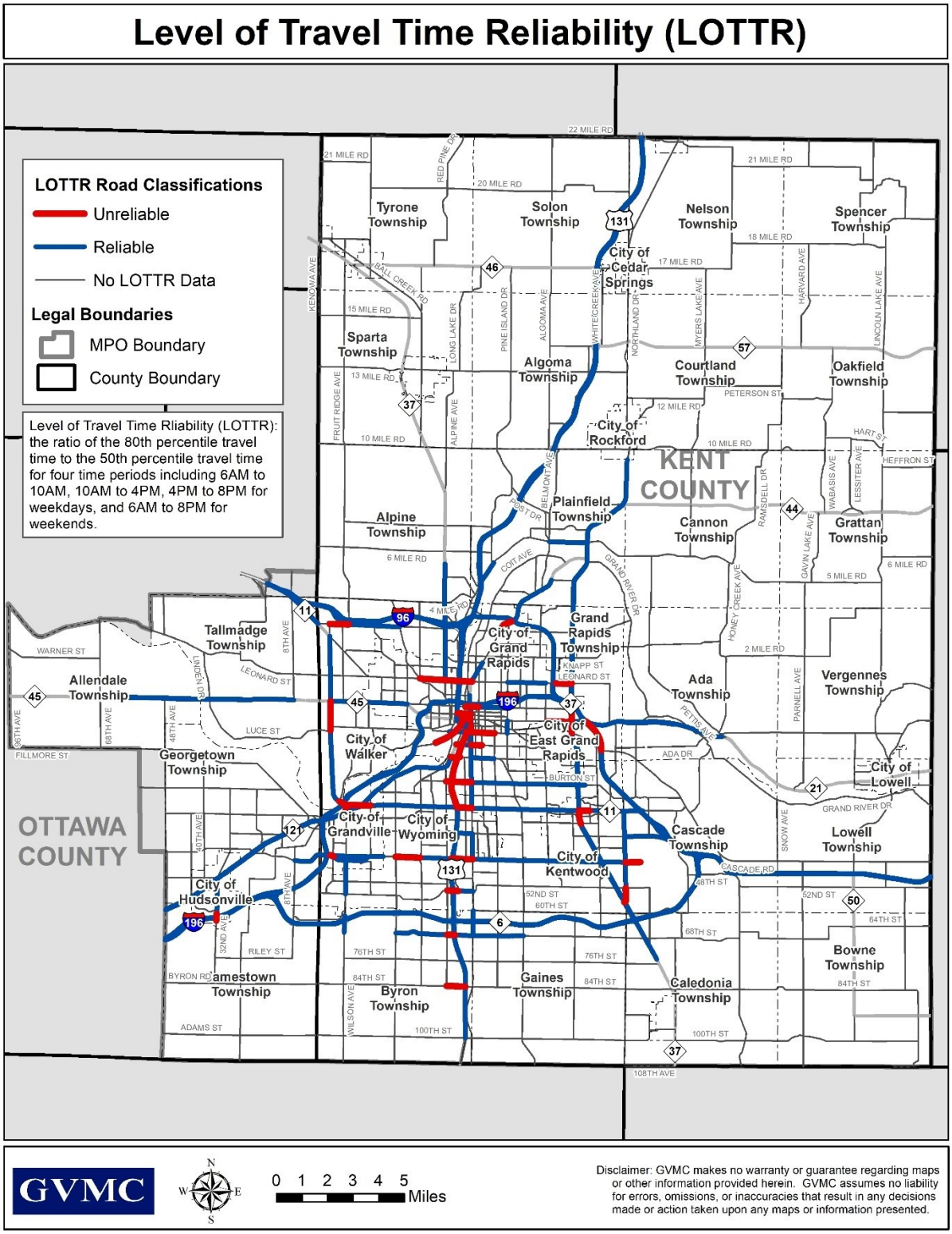
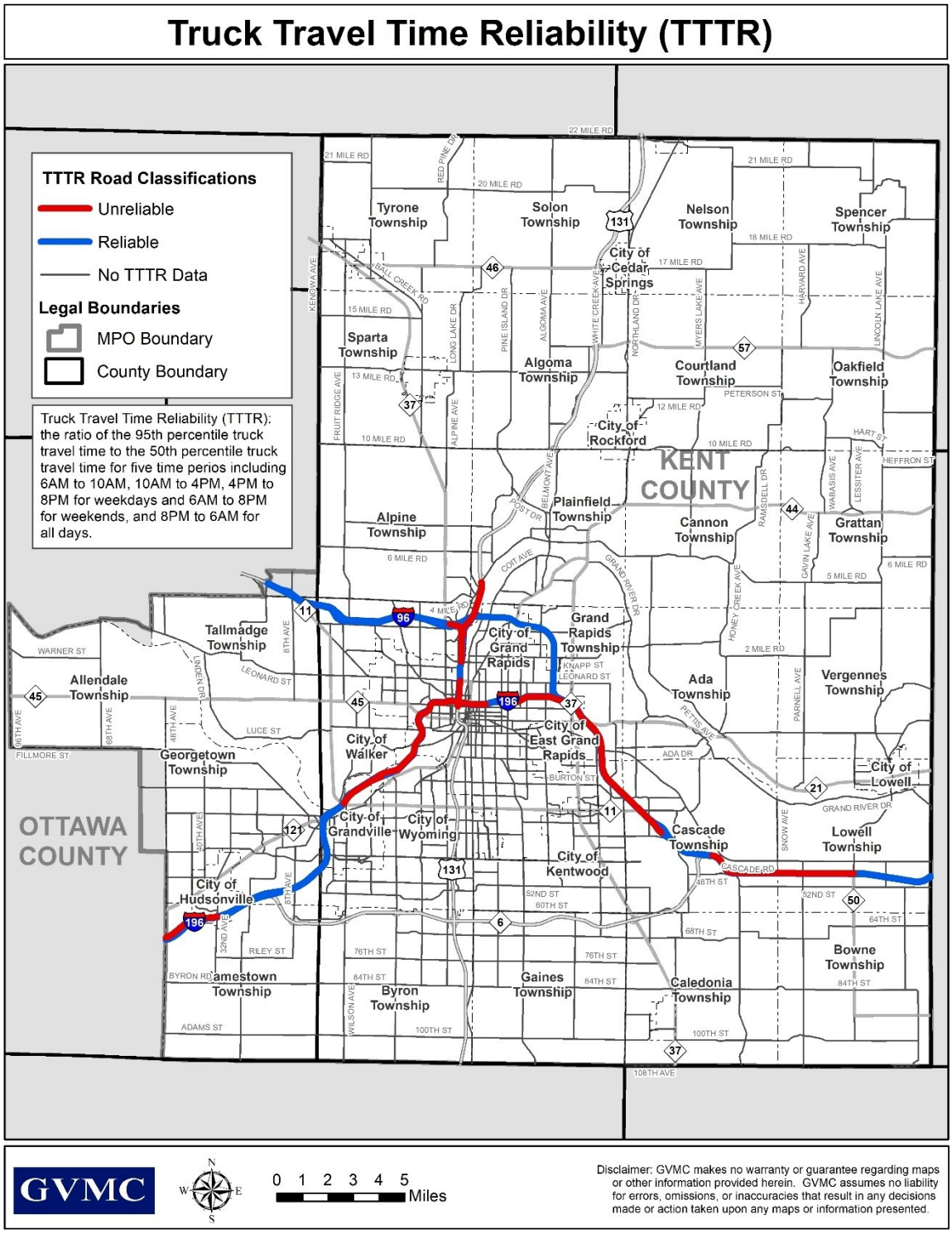


Figure 6-3: 2022 GVMC TTTR map on CMP Corridors



7. Identify and Evaluate Strategies

Selection of the appropriate performance measures, analytical tools, and available data enables the identification of congested locations. Congestion may be recurring or non-recurring, and the CMP should be capable of analyzing both types. Recurring congestion, which takes place at predictable intervals at particular locations, can generally be traced to a specific cause, such as a physical bottleneck or to conditions such as sun glare. Causes of non-recurring congestion may be more difficult to isolate, and solutions may require non-traditional strategies.

The GVMC CMP provides information about a wide range of congestion management strategies applicable to the Grand Rapids area. Using CMP strategies, the MPO committees can select the appropriate solution for congested locations.

The intent of the CMP strategies is to provide a reference for the development of alternatives for consideration when investment strategies and Corridor Studies are required. These efforts, which may be conducted within the context of the Grand Rapids metropolitan transportation planning process, will lead to an identified preferred alternative or set of preferred alternatives. Preferred alternatives that do not require this level of further analysis may proceed directly to the MTP as identified.

GVMC CMP strategies include the following:

- Highway Projects
- Transit Projects
- Intelligent Transportation System (ITS) and Transportation System Management (TSM) Strategies
- Transportation Demand Management (TDM) Strategies
- Land Development Strategies
- Bicycle and Pedestrian Projects
- Access Management Strategies

Highway Projects

The Metropolitan Transportation Plan for the area presents the potential highway infrastructure projects that may be applicable for the Grand Rapids area. The regional travel demand model is the primary analysis tools to assess transportation impacts. The travel demand model can be used to forecast conditions for the future land use scenarios and future network including programmed TIP projects. Outputs from the regional travel demand model can also be used to evaluate the impact of CMP strategies such as development of certain areas or corridors and the capacity expansion projects in the existing network.

Transit Projects

Transit services and infrastructure projects have traditionally been implemented in regions to provide an alternative to automobile travel potentially reducing peak-period congestion and improving mobility and accessibility for commuters. The Rapid's recently completed Comprehensive Operations Analysis and their Transit Master Plan currently under development may include projects that are applicable for the area. These projects reduce system wide VMT, improve corridor and system wide accessibility, improve roadway travel times, and decrease congestion on the roadway system. While much of the identified congestion in the region is in spot locations, when congested corridors are identified through

the MTP process, The Rapid and GVMC staff can work cooperatively to determine if a transit solution might be a viable alternative.

Intelligent Transportation System (ITS) and Transportation System Management (TSM)

Intelligent Transportation System (ITS) and Transportation System Management (TSM) strategies have traditionally focused on improving the operation of the transportation system without major capital investment and cost. While ITS strategies may be costly compared to more traditional TSM strategies, their relative congestion reduction impacts can be significant. Appendix A presents the ITS and TSM strategies that may be applicable for the Grand Rapids area. The strategies identified in Appendix A can build upon current ITS initiatives in the region such as the traffic signal coordination program.

Transportation Demand Management (TDM) Measures

Transportation demand management (TDM) strategies are used to reduce travel during the peak, commute period. They are also used to help the area meet air quality conformity standards and are intended to provide ways to provide congestion relief/mobility improvements without high-cost infrastructure projects. Appendix A presents the TDM strategies that may be applicable for the region. These strategies can potentially build upon current initiatives being planned and implemented in the region from GVMC's recently completed TDM Plan as well as the local ride share program, funded through the MPO. The Rapid maintains the region's ride share program which is charged with determining and implementing the strategies that are deemed appropriate for the region.

Land Development Strategies

Land development strategies have been used in some areas to manage transportation demand on the system and to help agencies meet air quality conformity standards. Land development strategies can include limits on the amount and location of development until certain service standards are met, or policies that encourage development patterns better served by public transportation and nonmotorized and active modes.

Bicycle and Pedestrian Projects

Active modes of transportation, such as biking and walking, are often overlooked as alternatives for alleviating congestion. Investments in these modes can increase safety and mobility in a cost-efficient manner, while providing a zero-emission alternative to motorized modes. The strategies listed can be implemented in the area with relatively little cost but tend to have local rather than system wide impacts. The effectiveness of an investment in active travel depends heavily on coordination with local land use policies and connections with other modes, such as transit, for longer distance travel. Safety and aesthetics should also be emphasized in the design of bicycle and pedestrian facilities in order to increase their attractiveness.

Access Management

Access management is a broad concept that can include everything from curb cut restrictions on local arterials to minimum interchange spacing on freeways. Restricting turning movements on local arterials can reduce accidents and prevent turning vehicles from impeding traffic flow. Similarly, eliminating merge points and weaving sections at freeway interchanges increases the capacity of the facility. The access management strategies listed in Appendix A are applicable to the area, and can be used in either the modification or original design of a facility.

8. Programming and Implementation of Strategies

This step involves the implementation and management of the defined strategies. GVMC will work closely with its member agencies throughout the implementation of congestion management strategies and activities. It is at this point that information gathered through the CMP process will be applied to establish priorities in the Metropolitan Transportation Plan and Transportation Improvement Program thereby facilitating the implementation of the congestion management process. This ensures a linkage between the CMP and funding decisions.

Integration into MPO planning process

The GVMC CMP is only one component of the overall metropolitan planning process. It is integrated with the Metropolitan Transportation Plan (MTP), Transportation Improvement Program (TIP) and Corridor Studies through its data and analysis functions. The process for the MTP works as follows:

1) Using the model results from the GVMC Travel Demand Model and RITIS, GVMC staff identifies corridors or locations within corridors that are congested or projected to be congested.
2) Depending on the level of congestion expected to occur in the future year, GVMC – working with other stakeholders (The Rapid, MDOT, local jurisdictions) – apply elements listed within the strategies that do not add single occupant vehicle capacity in an attempt to alleviate the congested conditions in the future. An analysis is completed to determine if this process was successful in alleviating congestion. Projects/programs that result from this analysis typically get completed using local funding.
3) If the congestion could not be alleviated using non-capacity adding alternatives, a determination is made whether the congestion expected to occur is severe enough to warrant added capacity or if the condition is something that the region can manage or "live with."
4) If non-capacity adding alternatives are selected, an analysis of constraint is then completed to determine if the facility is constrained in any manner. Constraints can come in many forms including but not limited to financial, environmental, physical, political, and general consensus.
5) Only after all other alternatives have been exhausted does GVMC turn to adding capacity to a facility. If a determination is made that adding capacity is required, an analysis of the least intrusive cross section is completed and forwarded as the preferred alternative.

The relationships to the MTP and TIP are summarized below.

Relationship to the MTP

The GVMC CMP is related to the development of the regional Metropolitan Transportation Plan in three ways:

- The CMP provides system performance information which may be used by GVMC staff to identify corridors or segments for detailed analysis in corridor or investment strategies studies, as recommended by the MTP;
- The CMP strategies provide alternative congestion management strategies for consideration in MIS and Corridor Studies, which ultimately provide recommendations for preferred strategies to be incorporated into the MTP; and
- The CMP provides system performance information for local jurisdictions which sponsor improvements. This information may influence their recommended projects for incorporation in the MTP.

Relationship to the TIP

The GVMC CMP is related to the development of the regional Transportation Improvement Program in three ways:

- The CMP provides system performance information for project sponsors, which may influence their recommended projects for incorporation in the TIP;
- The CMP provides system performance information for use by GVMC in evaluating projects nominated for inclusion in the TIP; and
- The CMP provides information about alternative congestion management strategies considered for SOV capacity projects to be advanced using federal funds.

9. Evaluate and Monitor the Effectiveness of Strategies

GVMC as administrators of the CMP will periodically evaluate the effectiveness of strategies identified in the CMP. GVMC will continue to utilize the performance measures developed through the CMP to determine the effectiveness of the selected strategies. In assessing the degree to which the CMP strategies addressed the identified congestion, GVMC will also assess the issue of how well, and to what extent the strategies were implemented, and will continue to consider factors that may have contributed to the success or failure of the selected projects or programs. This evaluation will take place prior to each full update of the region's Metropolitan Transportation Plan and reported to the GVMC Technical and Policy Committees as the data/reports are completed.

To identify congested corridors on the GVMC network, the GVMC travel demand model and RITIS database will be used to obtain peak hour volume to capacity (V/C) ratio and LOTTR and TTTR. Those data will be updated on a regular basis before each update to the Metropolitan Transportation Plan. Comparisons will be made to previously recorded travel times and an analysis/report will be completed outlining the various improvements that were completed since the last travel time. Conclusions will be made on the effectiveness of the improvements and recommendations will be made on future efforts.

Based on the feedback from the assessment process, GVMC will make appropriate adjustments. These adjustments may be with respect to the strategies considered or may reflect the performance measures used, the data collection and management component of the process, or the analytical methods and tools applied. The CMP will be subject not only to periodic review, but to a timetable for upgrading the tools and methods to keep pace with current practice.

Appendix A: GVMC CMP Strategies

Potential Transit Strategies in the GVMC CMP

Strategies/Projects	Congestion and Mobility Benefits
Alternative: Implementing Park-and-Ride Lots These can be used in conjunction with HOV lanes and/or express bus services. They are particularly helpful for encouraging HOV use for longer distance commute trips	• Reduced regional VMT • Increased mobility and transit efficiency
Alternative: Increasing Bus Route Coverage or frequencies This provides better accessibility to transit to a greater share of the population. Increasing frequency makes transit more attractive to use.	• Increased transit ridership • Decreased travel time • Reduced daily VMT
Alternative: Bus Rapid Transit (BRT) This provides a more attractive transit mode by removing typical bus delay and carrying more passengers.	• Increased transit ridership • Decreased travel time • Reduced daily VMT

Potential ITS/TSM Strategies in the GVMC CMP

Strategies/Projects	Congestion and Mobility Benefits
Alternative: Ramp Metering This allows freeways to operate at their optimal flow rates, thereby speeding travel and reducing collisions	• Decreased travel time
Alternative: *Highway Information Systems* These systems provide travelers with real-time information that can be used to make trip and route choice decisions.	• Reduced travel times and delay • Peak period travel shift
Alternative: *Advanced Traveler Information Systems* This provides an extensive amount of data to travelers, such as real time speed estimates on the web or over wireless devices, and transit vehicle schedule progress.	• Reduced travel times and delay • Peak period travel shift
Alternative: Traffic Signal Coordination/Activation This improves traffic flow and reduces emissions by minimizing stops on arterial streets.	• Improved travel time • Reduced number of stops
Alternative: Freeway Incident Detection and Management System This is an effective way to alleviate nonrecurring congestion. Systems typically include video monitoring, dispatch systems, and sometimes roving service patrol vehicles.	• Reduced accident delay • Reduced travel time

Potential TDM Strategies in the GVMC CMP

Strategies/Projects	Congestion and Mobility Benefits
Alternative: Alternative Work Hours This allows workers to arrive and leave work outside of the traditional commute period. It can be on a scheduled basis or true flextime.	• Reduced peak period VMT • Improved travel time for participants
Alternative: Telecommuting This involves employees working from home or a regional telecommute center instead of going into the office. They might to this all the time or only one or more days per week.	• Reduced VMT • Reduced SOV trips
Alternative: Mixed-Use Development This allows many trips to be made without automobiles. People can walk to restaurants and services rather than use their vehicles	• Increased walk trips • Decreased SOV trips • Decreased VMT and VHT
Alternative: Ridesharing This is typically arranged/encouraged through employers or transportation management agencies, which provide ride-matching services.	• Reduced work-related VMT • Reduced SOV trips

Potential Land Development Strategies in the GVMC CMP

Strategies/Projects	Congestion and Mobility Benefits
Alternative: Transit-Oriented Development This clusters housing units and/or businesses near transit stations in walkable communities	• Decreased SOV share • Increased transit usage • Decreased vehicle VMT
Alternative: Infill and Densification This takes advantage of infrastructure that already exists, rather than building new infrastructure on the fringes of an urban area	• Decreased SOV trips • Increased transit usage • Decreased VMT per dwelling

Potential Active Transportation Strategies in the GVMC CMP

Strategies/Projects	Congestion and Mobility Benefits
Alternative: New Sidewalks and Designated Bicycle Lanes on Local Streets. Enhancing the visibility of bicycles and increased mobility and access to pedestrian facilities increases the perception of safety. In many cases, bike lanes can be added to existing roadways	• Increased mobility and access • Increased active mode share • Reduced nonmotorized crashes
Alternative: Improved Bicycle Facilities at Transit Stations and Other Destinations Bicycle racks and bike lockers at transit stations and other trip destinations increase security. Additional amenities such as locker rooms with showers at workplaces provide further incentives for using bicycles.	• Increased bicycle mode share • Reduced congestion at major trip generators
Alternative: *Improved Safety for Existing Bicycle and Pedestrian Facilities* Maintaining lighting, signage, striping, traffic control devices, and pavement quality, and installing curb ramps, curb extensions, median refuges, and raised crosswalks can increase bicycle and pedestrian safety.	• Increased active mode share • Reduced non-motorized crashes
Alternative: *Exclusive Non-Motorized Rights-of-Way.* Abandoned rail rights-of-way and existing parkland can be used for medium-to-long distance bike trails, improving safety and reducing travel times.	• Increased mobility • Reduced congestion on nearby roads

Potential Access Management Strategies in the GVMC CMP

Strategies/Projects	Congestion and Mobility Benefits
Alternative: Left Turn Restrictions; Curb Cut and Driveway Restrictions Turning vehicles can impede traffic flow and are more likely to be involved in crashes	• Increased capacity and efficiency • Improved mobility and travel time
Alternative: Turn lanes and New or Relocate Driveways and Exit Ramps In some situations, increasing or modifying access to a property can be more beneficial than reducing access	• Increased capacity/ efficiency • Improved mobility/safety • Improved travel times

Potential Highway Strategies in the GVMC CMP

Strategies/Projects	Congestion and Mobility Benefits
Alternative: Increasing Number of Lanes without Highway Widening Uses "excess" width in the highway cross section used for breakdown lanes or median	• Increased capacity
Alternative: Geometric Design Improvements This includes widening to provide shoulders, additional turn lanes at intersections, auxiliary lanes to improve merging and diverging	• Increased mobility • Reduced congestions by improving sight lines, which improve bottlenecks • Increased traffic flow and improved safety
Alternative: HOV Lanes This increases corridor capacity while at the same time providing an incentive for single-occupant drivers to shift to ridesharing. These lanes are most effective as part of a comprehensive effort to encourage HOVs, including publicity, outreach, park-and-ride lots, and rideshare matching services.	• Reduced regional trips • Increased vehicle occupancy • Improved travel time • Increased transit use efficiency • Reduced regional VMT
Alternative: Highway Widening by Adding Lanes Traditional method for relieving congestion	• Increased capacity and reduced congestion in the short term. Long term effects depend on local conditions.

Appendix B: V/C Ratio Maps

Figure 1: 2019 AM PEAK V/C ratio map on CMP Corridors

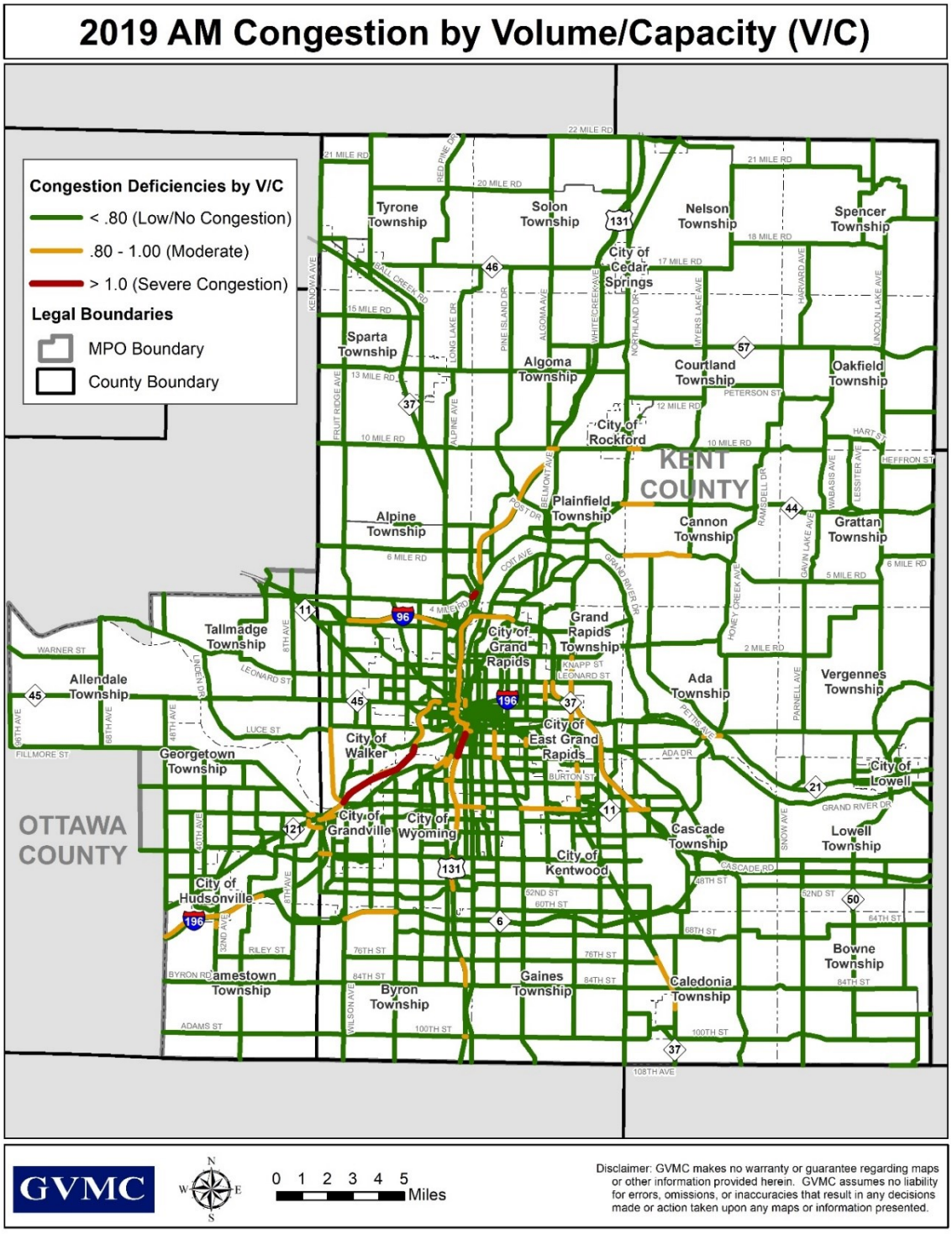


Figure 2: 2019 PM PEAK V/C ratio map on CMP Corridors

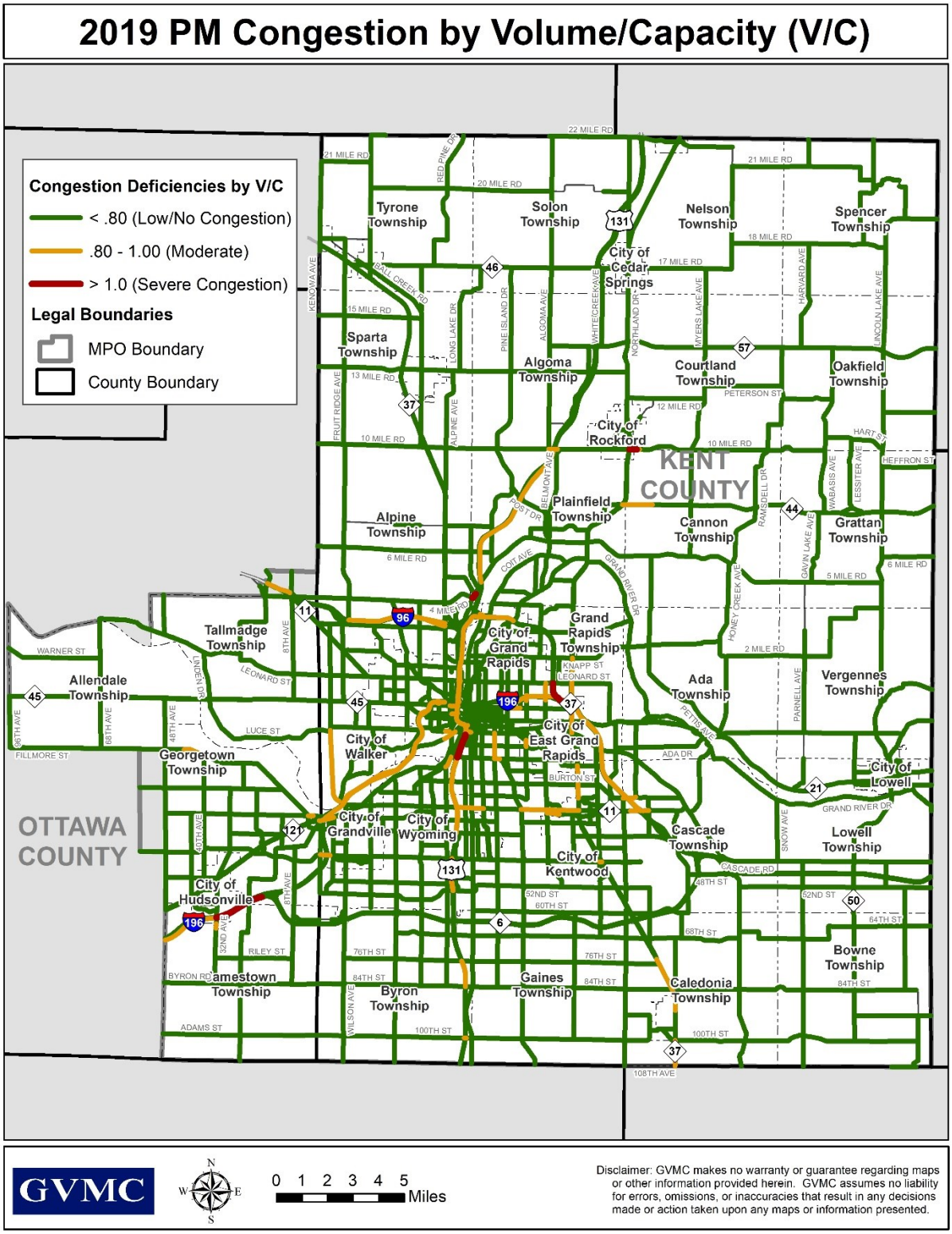


Figure 3: 2050 AM PEAK V/C ratio map on CMP Corridors

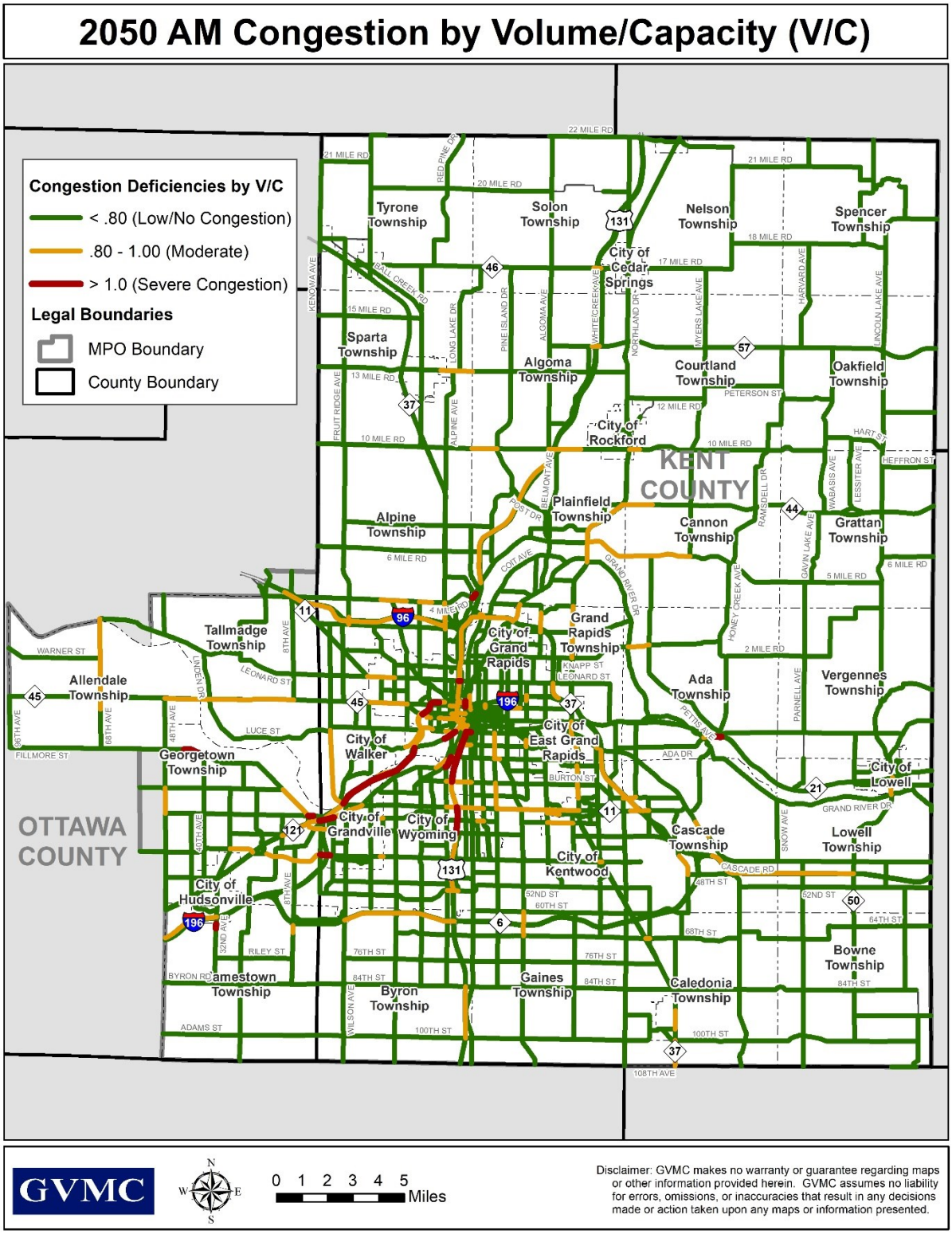


Figure 4: 2050 PM PEAK V/C ratio map on CMP Corridors