



# **US-60/Grand Avenue**

## Corridor Optimization, Access Management, and System Study (COMPASS)

Loop 303 to Interstate 10

### **Technical Memorandum 3**

### **National Case Study Review**

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**List of Abbreviations**

|           |  |
|-----------|--|
| AA        | Alternative Analysis                                       |
| AADT      | Average Annual Daily Traffic                               |
| ACS       | American Community Survey                                  |
| ADA       | Americans with Disabilities Act                            |
| ADEQ      | Arizona Department of Environmental Quality                |
| ADOT      | Arizona Department of Transportation                       |
| AZGFD     | Arizona Game and Fish Department                           |
| AFB       | Air Force Base   |
| APS       | Arizona Public Service                                     |
| ARS       | Arizona Revised Statutes                                   |
| BNSF      | BNSF Railway   |
| BqAZ      | Building a Quality Arizona                                 |
| BRT       | Bus Rapid Transit  |
| CBD       | Central Business District                                  |
| CDOT      | Colorado Department of Transportation                      |
| CIP       | Capital Improvement Program                                |
| COMPASS   | Corridor Optimization, Access Management, and System Study |
| D&R       | Dial-A-Ride  |
| DAR+      | Dial-A-Ride Plus   |
| DCR       | Design Concept Report                                      |
| DDOT      | Detroit Department of Transportation                       |
| DEUR      | Declaration of Environmental Use Restriction               |
| DRCOG     | Denver Regional Council of Governments                     |
| DU        | Dwelling Unit  |
| dnl       | decibel noise level  |
| El Mirage | City of El Mirage  |
| FCDMC     | Flood Control District of Maricopa County                  |
| FEIS      | Final Environmental Impact Statement                       |
| FEMA      | Federal Emergency Management Agency                        |
| FHWA      | Federal Highway Administration                             |
| FTA       | Federal Transit Administration                             |
| FWY       | Freeway  |
| FY        | Fiscal Year  |
| GAMA      | Grand Avenue Merchant's Association                        |
| GARP      | Grand Avenue Rail Project                                  |
| GL        | Grand Avenue Limited                                       |
| Glendale  | City of Glendale   |
| GUS       | Glendale Urban Shuttle                                     |
| HCT       | High Capacity Transit                                      |
| HOV       | High-Occupancy Vehicle                                     |
| I-10      | Interstate 10 Papago Freeway                               |

|          |   |
|----------|---|
| I-17     | Interstate 17 Black Canyon Freeway                        |
| IPaC     | Information, Planning, & Conservation System              |
| ITS      | Intelligent Transportation System                         |
| K&R      | Kiss-n-Ride   |
| LOS      | Level of Service  |
| LQG      | Large Quantity Generators                                 |
| LRT      | Light Rail Transit  |
| L RTP    | Long-Range Transportation Plan                            |
| MAG      | Maricopa Association of Governments                       |
| MassDOT  | Massachusetts Department of Transportation                |
| Massport | Massachusetts Port Authority                              |
| MBTA     | Massachusetts Bay Transportation Authority                |
| MCDOT    | Maricopa County Department of Transportation              |
| MDOT     | Michigan Department of Transportation                     |
| MIS      | Major Investment Study                                    |
| MOC      | Municipal Operating Center                                |
| MP       | Milepost  |
| MPO      | Metropolitan Planning Organization                        |
| NHS      | National Highway System                                   |
| NJDOT    | New Jersey State Highway Department                       |
| NRHP     | National Register of Historic Places                      |
| P&R      | Park and Ride   |
| P3       | Public-Private Partnership                                |
| Peoria   | City of Peoria  |
| Phoenix  | City of Phoenix   |
| RIRO     | Right-In Right-Out Only                                   |
| ROD      | Record of Decision  |
| RPTA     | Regional Public Transportation Authority                  |
| RTD      | Regional Transportation District                          |
| RTP      | Regional Transportation Plan                              |
| RTPFP    | Regional Transportation Plan Freeway Program              |
| SEMCOG   | Southeast Michigan Council of Governments                 |
| SEMTA    | Southeast Michigan Transit Authority                      |
| SHS      | State Highway System                                      |
| SMART    | Suburban Mobility Authority for Regional Transportation   |
| SMART    | Systematically Managed Arterial                           |
| SR       | State Route   |
| SR-101L  | State Route 101 Loop Agua Fria Freeway                    |
| SR-303L  | State Route 303 Loop Bob Stump Memorial Parkway           |
| SRP      | Salt River Project  |
| SRTP     | Short-Range Transit Program                               |
| ST-LUIS  | Sustainable Transportation and Land Use Integration Study |
| STP      | Surface Transportation Program                            |
| Surprise | City of Surprise  |



|           |  |
|-----------|--|
| TOD       | Transit-Oriented Development                           |
| TI        | Traffic Interchange                                    |
| TIGER     | Transportation Investment Generating Economic Recovery |
| TIP       | Transportation Improvement Program                     |
| TLCP      | Transit Life Cycle Program                             |
| TRU       | Transportation Riders United                           |
| UPRR      | Union Pacific Railroad                                 |
| US-60     | United States Route 60                                 |
| USDOT     | United States Department of Transportation             |
| USFWS     | United States Fish & Wildlife Service                  |
| UST       | Underground Storage Tank                               |
| vpd       | Vehicles per Day                                       |
| WA3       | Woodward Avenue Action Association                     |
| WSCA      | Wildlife of Special Concern in Arizona                 |
| Youngtown | Town of Youngtown                                      |

## 1.0 Introduction

The US-60/Grand Avenue COMPASS – Loop 303 to Interstate 10 (I-10) is being conducted by MAG in order to identify a long-term solution for accommodating travel demand and adjacent property access, establish operating principles to improve the effectiveness of traffic operations, and prepare an Access Management Plan that will provide a detailed milepost-by-milepost description of adjacent property access along the Grand Avenue corridor.

A Partnering Charter was signed on February 22, 2012, by the political leadership of the communities within the US-60/Grand Avenue COMPASS corridor. The outcomes of this technical study will address the following goals that were identified in the charter:

- Cooperatively create an overall vision for the US-60/Grand Avenue Corridor that embraces the important regional function of Grand Avenue as a significant high capacity, multimodal corridor and that can recognize the unique character of different sections of the corridor and the communities it passes through.
- Cooperatively define the operational character for the US-60/Grand Avenue Corridor that will enhance economic development, maintain accessibility to adjacent land uses, improve traffic operations, and reduce highway and rail conflicts.
- Establish an access management system that provides an efficient means to accommodate intersecting roadways and access to and from adjacent properties. After the system is recommended and agreed upon, each stakeholder will incorporate the principles and recommendations into their transportation, economic development and community development.
- Develop guidelines for signage, landscaping and aesthetic treatments along the corridor recognizing the different communities along the corridor.
- Work together to provide the affected stakeholders, including daily commuters, local residents, and adjacent property owners and users with information about the project and opportunity to contribute to the study's outcome and recommendations.

### 1.1. Purpose of this Paper

This paper is the third of a series of US-60/Grand Avenue COMPASS documents. Specifically, this Technical Memorandum has been prepared to provide background and perspective regarding planning actions taken in similar travel corridors in other communities within the United States. The majority of the research and evaluations performed for this Technical Memorandum were conducted in early 2013, which may affect the content of the information included herein.

The corridors selected all serve major metropolitan areas with like functionality, and project proponents sought opportunities to modernize the road system to alleviate congestion and accommodate multimodal travel. The review of each corridor is organized in the following manner:

- **Section 1 - Access to Urban/Suburban Areas**  
Identifies how the routes provide access to suburban and urban sections of the metropolitan areas each serves.
- **Section 2 - Corridor Access Control**  
Examines typical design elements relating to access control.
- **Section 3 - Corridor Operations**  
Addresses how travel and transportation modes operate (as appropriate) within the corridor.
- **Section 4 - Interchanges and Intersections**  
Presents and discusses key interchanges and intersections.
- **Section 5 - Owning Agency**  
Identifies the owning agency and summarizes actions taken during corridor development and redevelopment.
- **Section 6 – Other Agency Partners**  
Identifies other agencies and organizations involved in operations and transportation services within the corridor.

## 1.2. Study Area

The US-60/Grand Avenue COMPASS corridor begins at the TI with SR-303L in the City of Surprise, Arizona, at US-60 reference marker 138.051 (expressed in miles) and ends at the Willetta Street intersection in the City of Phoenix, Arizona, at US-60X reference marker 161.880 (expressed in miles). The corridor is oriented northwest-southeast, and passes through portions of the City of Surprise, City of El Mirage, Town of Youngtown, City of Peoria, City of Glendale, City of Phoenix, and unincorporated Maricopa County.

US-60/Grand Avenue is a regionally significant six-lane roadway that is part of the NHS. It serves as a vital link connecting four important regional freeways: I-10, I-17, SR-101L, and SR-303L (**Figure 1**). US-60/Grand Avenue extends north to the community of Wickenburg, where it turns west to western Arizona and California. In Wickenburg, US-60/Grand Avenue connects with US-93, which is the primary link to northwestern Arizona and Las Vegas from the Phoenix metropolitan area.

US-60/Grand Avenue corridor includes the BNSF Railway (BNSF). The BNSF tracks run the full length of the corridor, parallel and adjacent to the roadway. They are situated along the roadway's southern edge south of Olive Avenue, and the northern edge to the north.



## 2.0 Michigan 1 (M-1)/Woodward Avenue – Detroit, Michigan

### 2.1. Access to Urban/Suburban Areas

Woodward Avenue/Michigan Highway 1 (Woodward Avenue) – is one of the five principal roadways serving the greater Detroit metropolitan area. The roadway is one of the world’s premier roadways and is known as “Detroit’s Main Street.” It is the principal roadway connecting Detroit with northern suburban areas, including Royal Oak and Pontiac in neighboring Oakland County (**Figure 2**). Recognized for its historic sites, culture, recreation, and heritage, the roadway was included in the MotorCities National Heritage Area designated by the U.S. Congress in 1998. It was recognized as a Michigan Heritage Route by MDOT in 1999. Later, Woodard Avenue was designated a National Byway® in 2002 and All-American Road® in 2009 by the FHWA. It was given the designation Automotive Heritage Trail in 2009.

The roadway was known as M-10 when the state introduced its State Trunkline Highway System, was later known as US-10 with the creation of the United States Numbered Highway System, and has been known as M-1 since 1970. As the original state trunkline highway with the designation M-1, Woodward Avenue roadway passes through eleven municipalities in two counties (**Table 1**).

Woodward Avenue begins in downtown Detroit, Michigan, and extends 27 miles north to the City of Pontiac, Michigan. Beginning in the heart of downtown Detroit just a few hundred feet from the Detroit River, Woodward Avenue is a local arterial.

Woodard Avenue officially becomes a state trunkline highway north of Adams Avenue and Grand Circus Park, where it becomes a six-lane roadway with a center left-turn lane.

**Table 1 – Michigan 1 (M-1)/Woodward Avenue Counties and Municipalities**

|                          |                        |
|--------------------------|------------------------|
| <b>Oakland County</b>    |                        |
| City of Pontiac          | Bloomfield Township    |
| City of Bloomfield Hills | City of Birmingham     |
| City of Berkley          | City of Royal Oak      |
| City of Huntington Woods | City of Pleasant Ridge |
| City of Ferndale         |                        |
| <b>Wayne County</b>      |                        |
| City of Highland Park    | City of Detroit        |

Left turns are permitted for Woodward Avenue traffic and crossing traffic, although there are some restrictions. Woodward Avenue continues in this general configuration through Highland Park, a distance of six miles.

North of Highland Park, Woodward Avenue has been reconstructed as an 8-lane boulevard with an extra-wide median. MDOT engineers adopted an indirect



left-turn design treatment – often referred to as the Michigan Left-Turn – at most major intersections with median crossovers to accommodate intermediate left-turns (see Corridor Operations, Section 2.3). The roadway design requires motorists to turn right at an intersection and proceed away from the intersection to a median crossover that facilitates a U-turn, permitting the motorist to proceed back through the intersection in the preferred direction. The 8-lane boulevard cross-section exists through the length of Woodard Avenue to South Boulevard in Pontiac.

The redesigned boulevard follows the original alignment of M-1, except in Birmingham, where a bypass around the east side of the downtown was followed. Access to the area's major freeways is possible along Woodward Avenue:

**I-75 Bus/Square Lake Road:** This Interstate segment in Bloomfield Township south of Pontiac provides a connection with US-24 to the west, via Square Lake Road, and I-75 to the east.

**I-696/Walter P. Reuther Freeway (or 10-Mile Road):** This east-west highway, the boundary between Pleasant Ridge and Royal Oak, provides a high-capacity connection between US-24, I-95, and Farmington Hills to the west. To the east, it connects with I-75 and I-95 and the communities of Warren and Roseville.

**M-8/Davison Freeway:** M-8 runs through the center of Highland Park and is the boundary between Wayne and Oakland counties. This highway connects with I-96 and Lansing to the west, and eastern portions of Detroit to the east.

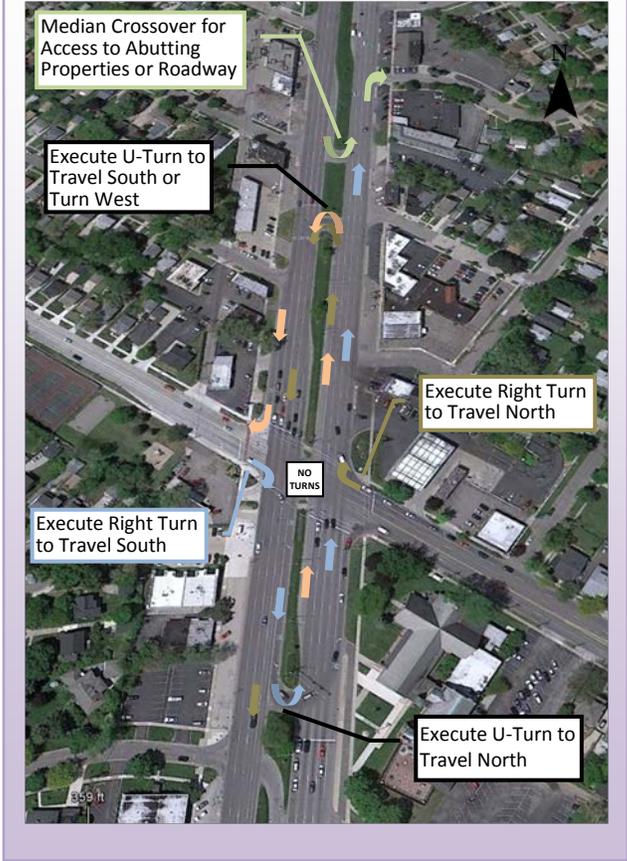
**I-94/Edsel Ford Freeway:** I-94 connects central Detroit to Detroit International Airport, continuing west through Ann Arbor to Lake Michigan, Indiana, and Chicago. To the east, I-94 connects with Port Huron and the international border with Canada at Point Edward.

**I-75:** I-75 connects with I-80 in Toledo, Ohio, and extends north from Detroit to Royal Oak, proceeding through Flint and Saginaw in central Michigan and continuing north to Sault Ste Marie and the international border with Canada.

**2.2. Corridor Access Control**

Woodward Avenue has been constructed with an oversized median. The roadway design improves traffic operations, traffic safety, and avoids the interlocking left-turn movements along this divided highway. The operational protocol of Woodward Avenue is shown in **Figure 3**.

**Figure 3 – Woodward Avenue Indirect Left-Turn Traffic Operations**



Only through movements and right turns are allowed at intersecting arterial roadways. Motorists desiring to turn left on to Woodward Avenue turn right instead and proceed to a “median crossover.” At the median crossover, usually located approximately 660 feet downstream of the intersection, motorists negotiate a U-turn and proceed in the desired direction of travel. A U-turn allows motorists to return to the intersection, where they execute a right turn in the desired direction of travel. This same turning protocol allows motorists on Woodward Avenue to access properties and intervening roadways located on the opposite side of their direction of travel, i.e., pass the destination, make a U-turn, and proceed back to destination. Motorists wanting to make a left turn to exit abutting properties, first turn right and proceed to a median crossover, where they make a U-turn to travel in the desired direction.

The generous building setbacks and ample landscape elements in the median establish a unique character along the corridor. In addition, specialized traffic signal controls may be installed, if necessary, to ensure traffic at the U-turn crossover does not back up on the highway.

### **2.3. Corridor Operations**

Corridor operations are described in terms of traffic volumes and safety. The discussion of safety, in particular, provides additional insight into the operational characteristics of the Michigan indirect left-turn concept.

#### **2.3.1. Traffic Volumes**

Traffic volumes on Woodward Avenue approached 45,000 vpd south of I-75 Bus/Square Lake and 70,000 vehicles per day south of Big Beaver Road [Bloomfield Township Master Plan, March 2007]. Near the center of this segment in Bloomfield Hills, the traffic volume reported in 2005 was approximately 63,000 vpd [Bloomfield Hills Master Plan, May 2009]. Recent traffic surveys conducted by MDOT indicate traffic volumes have decreased slightly, possibly as a result of the global economic downturn (**Table 2**).

Table 2 shows that traffic volumes are higher in Oakland County, with the highest volumes occurring in Bloomfield Hills, Berkley, and Huntington Woods. The highest volumes in Wayne County are present in Highland Park. Generally, the decrease in traffic volumes continued from 2010 to 2011 in Oakland County. In contrast, Wayne County segments of Woodward Avenue, except the two segments in Highland Park, experienced a very slight increase in traffic volumes.

#### **2.3.2. Safety**

According to the Bloomfield Township Master Plan (Master Plan), the Woodward Avenue/Square Lake intersection in Bloomfield Township, where an 8-lane divided boulevard (Woodward Avenue) meets a 6-lane divided boulevard (Square Lake), had a high crash rate in 2007. However, the crash severity was relatively low compared to Oakland County as a whole. The Master Plan notes that continued coordination with MDOT to manage access points, as land uses change, is one way to preserve roadway capacity and increase operational safety. This process of managing access points involves consolidating existing driveways, where possible, to reduce the number of access points, as well as redesigning driveways to minimize disruptions to through traffic.

Recorded data relating to crashes along Woodward Avenue and the locations of the crashes was accessed from the MDOT Web site. Crashes are reported or coded under a number of categories, one of which is the level of

**Table 2 – Average Annual Daily Traffic: M-1/Woodard Avenue, 2010 and 2011**

| From   | To  | Beginning Milepost | Ending Milepost | Average Annual Daily Traffic |        |
|--|---|--------------------|-----------------|------------------------------|--------|
|  |   |                    |                 | 2010                         | 2011   |
| <b>Oakland County</b>  |   |                    |                 |                              |        |
| BL Pontiac in Bloomfield Township at JCT I-75 Bus/Square Lake Road | NCL Bloomfield Hills at Hickory Grove Road                      | 0.00               | 0.61            | 37,031                       | 36,290 |
| NCL Bloomfield Hills at Hickory Grove Road                         | SCL Bloomfield Hills at Big Beaver Road                         | 0.61               | 3.49            | 62,977                       | 61,717 |
| SCL Bloomfield Hills at Big Beaver Road                            | Wimbleton Drive (Birmingham)                                    | 3.49               | 4.24            | 59,484                       | 58,294 |
| Wimbleton Drive (Birmingham)                                       | SCL Birmingham at 14 Mile Road                                  | 4.24               | 5.97            | 55,354                       | 54,247 |
| NCL Royal Oak at 14 Mile Road                                      | SCL Royal Oak/NCL Berkley                                       | 5.97               | 7.78            | 56,630                       | 55,497 |
| SCL Royal Oak/NCL Berkley  | SCL Berkley at 11 Mile Road                                     | 7.78               | 9.58            | 65,468                       | 64,176 |
| NCL Huntington Woods at 11 Mile Road                               | SCL Huntington Woods at Lincoln Drive                           | 9.58               | 10.14           | 63,488                       | 62,218 |
| NCL Royal Oak at Lincoln Drive                                     | SCL Royal Oak at JCT I-696                                      | 10.14              | 10.78           | 59,874                       | 58,677 |
| NCL Pleasant Ridge at JCT I-696                                    | SCL Pleasant Ridge at Oakridge Avenue                           | 10.78              | 11.37           | 52,418                       | 51,370 |
| NCL Ferndale at Oakridge Avenue                                    | South Oakland County Line/SCL Ferndale at JCT M-102/8 Mile Road | 11.37              | 13.03           | 47,445                       | 46,496 |
| <b>Wayne County</b>  |   |                    |                 |                              |        |
| North Wayne County Line/NCL Detroit at JCT M-102/8 Mile Road       | SCL Detroit at McNichols Road                                   | 0.00               | 2.23            | 20,489                       | 22,183 |
| NCL Highland Park at McNichols Road                                | JCT M-8 (Davison Freeway)                                       | 2.23               | 3.37            | 26,270                       | 23,522 |
| JCT M-8 (Davison Freeway)  | SCL Highland Park at Tuxedo Street                              | 3.37               | 4.14            | 24,205                       | 19,237 |
| NCL Detroit at Tuxedo Street                                       | Clairmont/Owen streets  | 4.14               | 4.91            | 13,757                       | 13,895 |
| Clairmont/Owen streets   | Grand Boulevard   | 4.91               | 5.88            | 14,448                       | 14,592 |
| Grand Boulevard  | JCT I-94 (Edsel Ford Freeway)                                   | 5.88               | 6.40            | 20,453                       | 20,658 |
| JCT I-94 (Edsel Ford Freeway)                                      | JCT I-75 (Fisher Freeway)                                       | 6.40               | 8.26            | 20,200                       | 20,402 |
| JCT I-75 (Fisher Freeway)  | Adams Avenue  | 8.26               | 8.45            | 20,257                       | 20,460 |

NOTES: BL – Below; NCL – North City Limits; SCL – South City Limits; JCT – Junction.

Source: Annual Average Daily Traffic Report, Bureau of Transportation Planning, MDOT, 11/12/2012.

access control on Woodward Avenue at the crash location. Within the Access Control group, access crashes are then subdivided into three types: Unlimited Access, Partial Access, and Full Access Control. The locations of each type of crash were compiled in a map form for evaluation.

Upon examination, the maps revealed clusters of crashes and strings of crashes. Clusters generally included five to six or more crashes focused around or at an intersection. Strings generally extended along Woodward Avenue for two or more blocks. The locations of these clusters and strings of crashes are identified in **Table 3**.

Table 3 reveals there are far more crash clusters and strings associated with the Unlimited Access condition than either the Partial Access or Full Access Control conditions. In 2011, there were 1,037 crashes coded as occurring in association with the Unlimited Access condition. In this same year, crashes coded Partial Access totaled 164, and crashes coded Full Access Control totaled only 95. Crash information of the type presented in Table 3 is relatively unique, but useful for examining the operation of the Woodward Corridor. General crash information, identifying types of crashes and circumstances surrounding the crashes, are reported for the purpose of supporting Strategic Highway Safety Plans. However, location-specific information requires accessing more detailed information, and determining crash rates requires access to special databases as well as additional analysis to calculate the rates, which generally are based on the number of crashes per 1,000,000 vehicle miles of travel. Thus, crash rate information was not readily available for this examination of the Woodward Corridor. Detailed traffic analyses prepared in support of adopted design treatments for segments and intersections within the US-60/Grand Avenue Corridor will include more detailed crash analyses to aid in refining geometric design and operational plans.

### 2.4. Interchanges

Woodward Avenue for the most part is an at-grade arterial roadway. The wide medians and indirect left-turn have removed the need for a separate signal phase for left turns at intersections, and the overall operational configuration has expedited traffic flows. However, MDOT engineers found that grade separation was necessary at three area freeways crossing the Woodward Avenue corridor. These freeway locations are shown in **Table 4**.

### 2.5. Owning Agency

MDOT is the active manager and owner of Woodward Avenue. Woodward Avenue is classified as a State Trunkline Highway from Grand River Park/Adams Street in Detroit to its junction with I-17 Business/Square Lake Road in Bloomfield Hills Township south of Pontiac. The State Trunkline Highway System is comprised of all highways in the state designated as Interstate, U.S. Highway, and State Highway. The system is maintained by the MDOT.

Prior to 1970, Woodward Avenue was not known as M-1 but rather as US Highway 10 (US-10). Prior to development of the Interstate Highway System, US-10 was a key highway serving central and west Michigan. The highway connected downtown Detroit with Pontiac, Flint, and Saginaw, gradually traversing western Michigan to Ludington on Lake Michigan, where carferries provided a link to Manitowoc, Wisconsin, and points west – all the way to Seattle, Washington. With completion of Interstate 75/John C. Lodge Freeway in 1970, a direct north-south route linking downtown Detroit with the Upper Peninsula (UP), the US-10 designation for Woodward Avenue was moved to the Interstate highway. Eventually US-10 was truncated in Bay City, where it originally turned west to Ludington. Woodward Avenue was redesignated M-1 in 1970, becoming a part of the

**Table 3 – Highlight of Crash Concentrations Along Woodward Avenue By Type of Access Control: 2011**

| Unlimited Access   | Partial Access   | Full Access Control                          |
|--|--|--|
|  | Cluster at Square Lake Road (I-75 Bus)   |  |
| Cluster at Hickory Grove Road                                |  |  |
| String between Scenic Oaks and Long Wood Drives              |  |  |
| Cluster at Long Lake Road                                    |  |  |
| String at Lone Pine Road                                     |  |  |
| Cluster at Big Beaver Road                                   | String between Strathmore and Redding Roads (includes Big Beaver Road)               |  |
| Cluster at Maple Road  | String between Oakland Avenue and Haynes Street (includes Maple Road)                |  |
| Cluster between Hazel and Bowers Streets                     |  |  |
| Cluster at Lincoln Street                                    | Cluster between Webster Avenue and Lincoln Street                                    |  |
| String between Ruffner and Emmons Avenues                    | String between Lincoln Street and Bennaville Avenue (includes Ruffner Avenue)        |  |
| Cluster at 14-Mile Road                                      |  | String between Smith Avenue and 14-Mile Road |
| String between Berkshire and Samoset roads                   |  |  |
| Cluster at 13-Mile Road                                      | Cluster at 13-Mile Road  |  |
| Cluster at Coolidge Highway                                  |  |  |
| String between Sagamore Boulevard and Woodless Drive         |  |  |
| String North and South of Benjamin Avenue                    |  |  |
| Cluster at 12-Mile Road                                      | Cluster at 12-Mile Road  |  |
| Cluster at Catalpa Drive                                     |  |  |
| String between Forestdale and Princeton Roads                |  |  |
| Cluster at 11-Mile Road                                      | Cluster at 11-Mile Road  |  |
| Cluster at Lincoln Avenue                                    |  |  |
| String between Washington Avenue and 10-Mile Road            |  |  |
| String between Maywood Avenue and Woodward Heights Boulevard | String between Amherst Road and Woodward Heights Boulevard (includes Maywood Avenue) |  |

**Table 3 – Highlight of Crash Concentrations Along Woodward Avenue By Type of Access Control: 2011**

| <b>Unlimited Access</b>                             | <b>Partial Access</b>                                | <b>Full Access Control</b> |
|---|--|----------------------------|
| Cluster at 9 Mile Road                              | String between 9 Mile Road and Leroy/Academy Streets |                            |
| Cluster at 8-Mile Road                              |  |                            |
| Cluster at 7-Mile Road                              |  |                            |
| Cluster at McNichols Road                           |  |                            |
| Cluster at Manchester Street                        |  |                            |
| Clusters at Davison Freeway                         |  |                            |
| Cluster at McLean Street                            |  |                            |
| Cluster at Grand Boulevard                          |  |                            |
| Cluster at Kirby Street                             |  |                            |
| Cluster at Warren Avenue                            |  |                            |
| Cluster at Forest Avenue                            |  |                            |
| String between Forest Avenue and Alexandrine Street |  |                            |
| Cluster at Mack Avenue                              |  |                            |

Source: MTCF Data Query Tool, Map View at <http://michigantrafficcrashfacts.org/datarool/map>.

**Table 4 – Grade-Separated Interchanges on Woodward Avenue, Detroit, Michigan**

| Crossing Roadway  | Aerial Photograph   | Description  |
|---|---|--|
| <b>NOTE: North is up on all aerial photographs shown, unless otherwise indicated.</b> |   |  |
| <b>Oakland County</b>   |   |  |
| Woodward Avenue and Interstate 696 (I-696)/Walter P. Reuther Freeway                  |    | I-696 is an 8-lane highway constructed under the 6-lane Woodward Avenue (M-1) with Woodward Avenue express lanes (two in each direction) depressed below I-696.  |
| <b>Boundary - Wayne and Oakland Counties</b>  |   |  |
| Woodward Avenue and State Route 102/8-Mile Road                                       |   | 8-Mile Road is an 8-lane Michigan Boulevard like Woodward Avenue (M-1). Woodward Avenue and 8-Mile Road are grade separated. This tri-level interchange has exit and entrance ramps or service roads on the mid-level to create four separate intersections. The lane configuration of all intersections accommodates left-turn movements, through/left movements, through movements, and right turns.   |
| <b>Wayne County</b>   |   |  |
| Woodward Avenue and Michigan Route 8/Davison Freeway                                  |  | The interchange with M-8/Davison Freeway is a half-diamond interchange with on- and off-ramps to the west of Woodward Avenue only, extending under 2nd Avenue and merging with the freeway at 3rd Street out of photograph to the left). The eastbound off-ramp has a single left-turn bay at the Woodward Avenue intersection. However, motorists can proceed through the intersection to a grade-separated crossover approximately 600 feet downstream of the intersection. Here, motorists can cross over and return to the intersection (Woodward Avenue). There, they would make a right turn, completing the indirect left turn process. |

Sources: Google aerial imagery, 2011, and Bing Maps, Copyright Microsoft Corporation and Nokia, 2012.



State Trunkline Highway System with its southern limits being downtown Detroit at the corner of Woodward Avenue and Adams Street and the northern extent being the corner of Woodward Avenue and Square Lake Road (Junction (Business I-75 and Business US-24), the boundary between Pontiac and Bloomfield Hills. The entire length of M-1/Woodward Avenue is designated a “Historic Heritage Route,” which is a State Highway with outstanding historic buildings and resources along its length.

## 2.6. Other Agency Partners

A number other agencies and government organizations are actively involved in the planning or provision of transportation services in the Woodward Avenue corridor.

**Southeast Michigan Council of Governments:** SEMCOG is a regional organization that coordinates the planning and development of Detroit’s metropolitan urban and suburban transportation infrastructure. SEMCOG membership includes Wayne County, wherein Detroit is located, and six other southeastern Michigan counties (St. Clair, Macomb, Oakland, Livingston, Washtenaw, and Monroe), which include numerous cities, villages, and townships within the seven county region. As the designated MPO, SEMCOG is responsible for transportation planning and prioritization of funding for improvement projects. An important effort included in its 2012-2013 Work Program is the Woodward Avenue Rapid Transit AA, which will include the entire Woodward Avenue corridor from downtown Detroit to downtown Pontiac, a distance of 27 miles. The agency also is involved in the Woodward Rail Initiative. This effort will be coordinated with a study group comprised of representative from Woodward Corridor communities, MDOT, SMART, and other interest parties and stakeholders.

**Southeast Michigan Transit Authority:** SEMTA, long relegated to coordination and planning of transit services in the Detroit of suburban transit services in Wayne, Oakland, and Macomb counties, may soon be able to go beyond the constraints established for its activities. The Michigan Senate recently passed a bill to create additional responsibilities within a new Southeast Michigan Regional Transit Authority (Authority). Under the new authority, the agency would have the ability to manage and operate its own transit system in Wayne, Oakland, and Macomb counties. The new Authority also would be afforded agency oversight of the DDOT and SMART systems and allow it to eliminate duplicate routes. Although the Michigan House of Representatives must agree with the Senate (and there have been multiple failed attempts in the past to accomplish this task), this new status is particularly important for transportation in the Woodward Avenue corridor. The Secretary of the U.S. Department of Transportation (USDOT) has indicated that such a regional authority must be in place for federal funding to be released for development of the Woodward Avenue light rail transit (LRT) system.<sup>1</sup>

**Suburban Mobility Authority for Regional Transportation:** SMART operates a regional bus system serving suburban areas of Wayne, Oakland, and Macomb counties. SMART operates 234 Fixed Route buses on 43 routes as well as Connector Service for seniors and people with disabilities. SMART partners with 75 municipalities and organizations in the tri-county region to provide local transit service that includes regional connections to downtown Detroit. SMART leverages coordinated service for federal funding. Some SMART routes enter the City of Detroit, providing regional connectivity between suburban communities and downtown Detroit. The system serves the downtown and mid-town cores during the peak hours of travel; however,

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<sup>1</sup> Southeast Michigan Regional Transit Authority Passes in State Senate, Huffpost, Detroit, 11/28/2012.

SMART policy does not permit passengers to be dropped off on outbound routes, or board on inbound routes. This practice avoids service duplication with bus service provide within the City of Detroit by DDOT.

**Detroit Department of Transportation:** DDOT provides public transit serves to the City of Detroit and over 20 suburban communities. The DDOT system includes 38 fixed-route bus lines with a fleet of 445 full-size buses. As reported in the *2012-2013 Work Program for Southeast Michigan*, produced by SEMCOG, “DDOT will continue to explore long-term planning for light rail transit [LRT] and bus rapid transit [BRT] alternatives along the Gratiot, Michigan, Grand River, Eight Mile and other corridors in addition to the Woodward Light Rail Project on Woodward Avenue. DDOT anticipates continuing corridor studies to determine the feasibility of pursuing New Starts funding in advance of conducting a full alternatives analysis.”

**Woodward Avenue Action Association:** WA3 works in partnership with MDOT to collaboratively plan projects, physical improvements, historic preservation, business and tourism development to enhance the economic competitiveness, livability and function of Woodward Avenue.<sup>2</sup> In June 2012, WA3 convened a Steering Group to help shape the process and activities of a Complete Street Master Plan for Woodward Avenue. The Steering Group is comprised of representatives and policy makers from Wayne and Oakland counties, the 11 municipalities along Woodward Avenue, MDOT, M-1 Rail, SEMCOG and associated advocacy groups. WA3 is focused on developing a full range of modal options for safe, efficient travel in the Woodward Avenue corridor. Model options being considered include: driving, biking, walking, bus, taxi, LRT, or a combination of these modes.

**Transportation Riders United:** TRU’s mission is to improve and promote transit services in the greater Detroit region. The organization believes transit can restore urban vitality, ensure transportation equity, and improve the quality of life in the region. A balanced transportation network is sought by this incorporated 501(c)(3) non-profit charitable organization. TRU published in August 2010 a revised report titled *Woodward Avenue Light Rail Transit Project, Analysis and Comparison of Design Options*. This independent analysis recommends the LRT project should utilize a center median alignment and plan for future extensions, as opposed to operations in the second lane from the curb.

**2.7. Woodward Avenue Light Rail Project**

The Woodward Avenue Light Rail Project is a P3 involving over \$100 million in private funding through M-1 Rail, a consortium of private investors pledging funds to the project. The P3 agreement has allowed the City of Detroit to leverage federal funding assistance through the FTA New Start Program. The FTA, as the lead Federal agency, and the City of Detroit, as the project sponsor, jointly prepared and published in June 2011, a FEIS for this project (Supplemental EIS published February 2013). The FTA published the ROD in August, 2011 (Amended ROD published in April, 2013). The FTA



<sup>2</sup> Avenue Action Association Request for Proposals – Complete Streets Master Plan for Woodward Avenue, August 2012.

actions conclude for the city and the region several decades of efforts and numerous studies to identify and develop LRT service along Woodward Avenue.

The full approved project includes construction and operation of a 9.3-mile LRT system in the Woodward Avenue (M-1) corridor. The project is included in SEMCOG’s financially constrained 2035 *Regional Transportation Plan* and has been determined consistent with local land use and transportation plans.

However, the Supplemental EIS and Amended ROD addressed only a 3.4-mile Phase I. The \$140-million Phase I is being initiated with a TIGER grant from the USDOT. The \$25 million TIGER grant in combination with local and independent third party funds is supporting the initial 3.3-mile segment between Larned Street in Downtown Detroit to West Grand Boulevard.

Phase I will connect downtown Detroit with the Detroit Amtrak station and have connecting stations with the Downtown People Mover. The project ultimately was redefined as the Woodward Avenue Streetcar Project, which will employ shorter vehicles and have fewer stations than originally envisioned. Construction of Phase I was initiated in July, 2014, with completion scheduled for late 2016. The system will include 16 curbside and four median passenger stations serving 12 activity centers within the corridor. The modern streetcar line is expected to serve approximately 6,000 riders in the first year of operation. Each station has a corporate sponsor, as shown in the graphic at right.



Source: M1 Donor Map at M-1rail.com.

**3.0 U.S. Route 1, Greater Boston, Massachusetts**

U.S. Route 1, also known as U.S. Highway 1 or US-1, runs more than 2,000 miles from Fort Kent, Maine, at the international border with Canada, to Key West, Florida. Northward out of the City of Boston, US-1 passes through three counties and seven municipalities. The segment of this roadway of interest begins north of Boston and terminates 17 miles north near I-95. This portion of US-1 includes numerous specially designed interchanges to accommodate the web of roadways serving the region and maintains limited access through the installation of medians and “Jersey Barriers.”

**Reinforced Jersey Barrier in the Center of Bennett Highway**



Source: Google earth image.

The “Jersey Barrier,” also called New Jersey Wall, was developed at the Steven Institute of Technology, New Jersey, in the 1950s. It was introduced in its current form in 1959 at the direction of the NJDOT. The design is used to divide multiple lanes on a highway and is specifically intended to minimize damage associated with incidental vehicular contact and reduce the likelihood of a vehicle crossing over into opposing traffic lanes. Widespread use of the Jersey Barrier has led to numerous variations in design and application.

**3.1. Access to Urban/Suburban Areas**

US-1 crosses the Mystic River on the double-decked Tobin Memorial Bridge and enters the City of Chelsea as the Northeast Expressway, a toll road, also known as Adamski Memorial Highway. Continuing through Chelsea and the City of Revere, US-1 becomes the Frank P. Bennett Highway as it enters the City of Malden. US-1/Bennett Highway, after approximately eight tenths of a mile, passes over the “Four Corners” formed by the boundaries of the City of Revere, City of Malden, City of Melrose, and Town of Saugus. Bennett Highway continues north into the Town of Saugus for one-half mile then merges with Broadway. US-1/Broadway continues through Saugus for a distance of approximately four miles before entering the Town of Lynnfield. Exiting south Lynnfield into the City of Peabody, US-1 becomes Newbury Street and continues north through the Town of Danvers. It connects with I-95 approximately one-half mile from the Town’s boundary with the Town of Topsfield. **Table 5** provides a tabular format explaining this complex multi-jurisdictional routing of US-1 between Boston and Topsfield.

**3.2. Corridor Access Control**

The entire length of US-1 between Mystic River in Chelsea and I-95 in Danvers has full-access control with grade-separated intersections or limited-access control employing right-in/right-out (RIRO) intersections. Where the highway has an at-grade cross-street, either jersey barriers have been installed or there is a wide median and only RIRO movements are permitted.

**3.3. Corridor Operations**

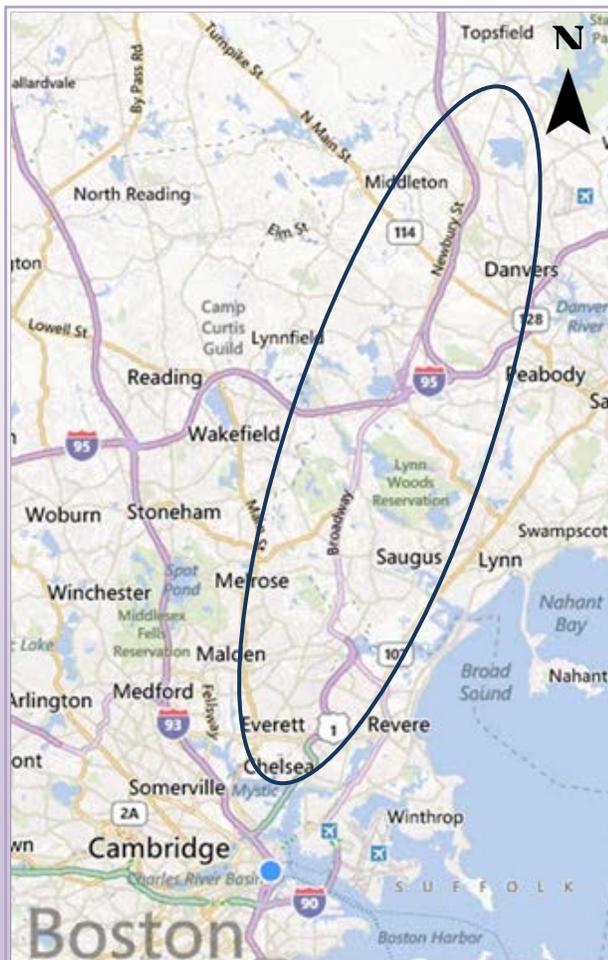
US-1 was developed to serve the North Shore sector of the Boston metropolitan area. **Figure 4** shows the regions served by US-1. The Tobin Bridge, a dual-deck (three lanes in each direction) bridge, was constructed over the Mystic River in the late 1940s, connecting Charlestown, a neighborhood of the City of Boston, with the City of Chelsea to the north. The dual-deck bridge continues for more than one-half mile into Chelsea, where it

**Table 5 – Extents of U.S. Highway 1 Examined for this Case Study**

| County    | Municipality      | Miles from Mystic River (Approx.) | Distance Inside Community | US-1 Name                                     |
|-----------|-------------------|-----------------------------------|---------------------------|---|
| Suffolk   | City of Chelsea   | Begin Tobin Memorial Bridge – 0.0 | 2.0                       | Northeast Expressway/Adamski Memorial Highway |
|           | City of Revere    | 2.0                               | 2.5                       |   |
| Middlesex | City of Malden    | 4.5                               | 0.8                       | Frank P. Bennett Highway                      |
| Essex     | Town of Saugus    | 5.3                               | 4.1                       | Broadway/Newburyport Turnpike                 |
|           | City of Lynnfield | 9.4                               | 1.3                       | Broadway                                      |
|           | City of Peabody   | 10.7                              | 2.9                       | Newbury Street/Newburyport Turnpike           |
|           | Town of Danvers   | 13.6                              | 3.4                       | Newbury Street                                |
|           | Town of Topsfield | 17.0 – End                        | --                        |   |

Source: Google earth, 6/18/2010.

**Figure 4 – US Route 1 Location Map**



becomes a six-lane divided highway with a median barrier. The Boston Region MPO LRTP Needs Assessment indicates the Tobin Bridge is considered a bottleneck relative to regional traffic flow. Hazardous materials transport is prohibited over Tobin Bridge, which is interconnected with a tunnel on the Boston side of Mystic River

The Northwest Expressway, as it is called through Chelsea and the City of Revere, has no at-grade intersections and alternates between being at-grade, elevated over crossing streets, and depressed under crossing streets. The highway cross-section reduces to four lanes (two in each direction) at what is referred to as Bell (or Cutler or Copeland) Circle.

Bell Circle is a relic of early transportation planning actions that identified US-1 through Chelsea and Revere as the preferred route for the new I-95. The design of Bell Circle apparently was undertaken to accommodate both the proposed I-95 and continuation of the US-1/Northwest Expressway. The proposed routing of I-95 also was planned to accommodate a direct route to N. Shore Road (MA-1A) and Revere Beach to the east, which was not constructed. Ultimately, this route for I-95 was abandoned, but not before construction had begun. The remnants of ramps that were to take I-95

northward through the Pines River swamp remain evident today within Bell Circle. The Boston MPO LRTP Needs Assessment reports that the State Freight Plan identifies US-1 at Bell Circle as a freight bottleneck. US-1, referred to as Cutler Highway in this short segment, was improved beyond Bell Circle, extending into the City of Malden as a four-lane, divided highway with a median barrier. Access to the highway is limited via interchange ramps and RIRO intersections. Bell Circle, basically a roundabout, assures access for MA-60/Squire Road, which enters the circle from the east and west.

US-1 continues through Malden as an at-grade, four-lane, divided limited access highway with a median barrier. Commercial properties and intersecting streets are limited to RIRO movements. Major street crossings (many of them constrained Cloverleaf treatments) provide the only means of accessing properties on the opposite side of the highway. US-1 connects with MA-99/Broadway, another major roadway coming out of Boston proper, as it enters the Town of Saugus. US-1/Broadway becomes a six-lane, divided highway with median barrier in Saugus, maintaining its status as a limited access highway. RIRO intersection treatments are numerous, limiting access to properties on the opposite side of the highway for long stretches. At the merge

#### Landscape Highway Median with Guardrail



Source: FHWA

of Broadway with US-1/Bennett Highway in Saugus, a loop back ramp facilitates access to the opposite side of the highway. Also, U-turn ramps, often referred to as Texas U-Turns, have been installed at Salem Street (MA-129) in Lynnfield. These ramps facilitate access to several residential streets and commercial properties on the north and south sides of US-1/Broadway. Again, intervening interchanges at major crossroads, permits some access opportunities. Commercial land uses dominate the highway through Saugus, which results in a number of access points onto the highway. The Boston Region MPO LRTP reports US-1 at Essex Street and MA-129 in Saugus as two of the Top 25 crash locations in the region with 289 and 449 crashes, respectively, reported as recently as 2011.

As US-1 continues north into the City of Lynnfield, access becomes less restrictive. Although there are several RIRO intersection treatments for major commercial land uses and some roadways, many streets, commercial land uses, and even private driveways access the highway. Passing into the City of Peabody, US-1 soon becomes a four-lane divided highway with a wide median and guardrail-type median barrier. Due to the barrier, property and street access is limited to RIRO maneuvers. The number of access points on both sides of the roadway increases significantly along this section of US-1. I-95 parallels US-1 on the east through Peabody and the Town of Danvers. Half way through Peabody, US-1 comes within 500 feet of I-95. Direct connector ramps permit northbound traffic on US-1 to access I-95, and southbound I-95 traffic to access southbound US-1. The divided highway continues through Peabody to the Town of Danvers. There is a traffic interchange with Interstate 95 just inside the City's boundary with the Town of Topsfield. Beyond this interchange, US-1 becomes a four-lane rural arterial for a short distance, transitioning to a two-lane rural road entering Topsfield.

### 3.4. Interchanges and Intersections

US-1 has been in existence for over a century, beginning life as the Quebec-Miami International Highway in 1911. During its history, the highway in the area of interest has repeatedly adapted to changing travel demands generated by the development and growth dynamics of the Boston metropolitan area. As such, there

are a number of interchanges that reflect non-traditional, even unique, solutions to connecting traffic movements between and among the various roadways of the region. Table 6 provides a description of the interchanges and intersections along US-1, which is known by various names according to the community through which it passes (**Table 6**). Aerial images (all from Bing Maps, Microsoft Corporation or Google earth) have been incorporated for reference.

| <b>Table 6 – Interchanges and Intersections on US-1, Chelsea to Danvers, Massachusetts</b> |   |   |
|--|---|---|
| <b>Crossing Roadway</b>  | <b>Aerial Photograph</b>  | <b>Description</b>  |
| <b>NOTE: North is up on all aerial photographs shown, unless otherwise indicated.</b>      |   |   |
| <b>Suffolk County</b>  |   |   |
| Arlington Street and 5th Street  |   | This Partial Cloverleaf (ParClo) design in Chelsea accommodates access to southbound US-1/Northeast Expressway from Arlington Street and 5th Street. US-1 overpasses the Rockport/Newburyport Commuter Rail Line. |
| Carter Street  |  | This Half-Diamond interchange in Chelsea has parking underneath the north half of the interchange with access off Carter Street.  |

**Table 6 – Interchanges and Intersections on US-1, Chelsea to Danvers, Massachusetts**

| Crossing Roadway  | Aerial Photograph   | Description   |
|---|---|---|
| Intersection of County Road, Washington Avenue, and Carter Street |    | An elevated intersection in Chelsea over the US-1/Northeast Expressway (also referred to as the Adamski Memorial Parkway) maintains access between the Malone Park neighborhood (right) and the Revere Beach Parkway (MA-16) via Washington Avenue, as well as Chelsea High School and City's commercial/industrial sector to the south.                                |
| Webster Avenue /Garfield Avenue at MA-16/Revere Beach Parkway     |    | This Modified Half-Diamond interchange in Chelsea accommodates traffic accessing southbound US-1/Northeast Expressway with Revere Beach Parkway northbound lanes flying over and permits access from Webster Avenue and Garfield Avenue.  |
| MA-16/Revere Beach Parkway  |   | A ParClo, on the boundary between Chelsea and Revere, creates in effect a T-intersection. The ParClo accommodates southbound access to US-1/Northeast Expressway for westbound MA-16, and northbound access to US-1 for eastbound MA-16/Revere Beach Parkway. Ramps accommodate access from southbound US-1 to westbound MA-16, and northbound US-1 to eastbound MA-16. |
| Sargent Street  |  | ParClo design has been employed to accommodate exit from northbound US-1/Northeast Expressway to Sargent Street and Washington Avenue.  |

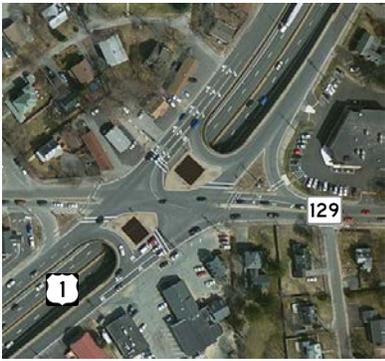
**Table 6 – Interchanges and Intersections on US-1, Chelsea to Danvers, Massachusetts**

| Crossing Roadway                       | Aerial Photograph   | Description   |
|--|---|---|
| MA-60/Squire Road                      |    | <p>This Roundabout interchange, known as Bell Circle (also Cutler or Copeland Circle), evolved from early transportation planning actions that identified US-1 as the route for I-95. The design of Copeland Circle results from attempts to accommodate both the proposed I-95 and existing US-1. The proposed routing of I-95 also was planned to provide direct access to N. Shore Road (MA-1A) and Revere Beach via an extension to the east (arrow). Ultimately, this route for I-95 was abandoned and the remnants of ramps that were to take I-95 northward through the Pines River swamp can be seen in the aerial. US-1 continues north as Cutler Highway, becoming Frank P. Bennett Highway in the City of Malden, a four-lane roadway. Copeland Circle assures access to US-1 and through movements for MA-60/Squire Road, which enters the circle from the east. MassDOT plans to relocate and widen US-1 from four to six lanes from just south of Copeland Circle in Revere to its connection with Broadway in Saugus. The project also will include reconstruction of the Copeland Circle interchange by eliminating the existing rotary and demolishing the bridges constructed for the never-built Interstate highway.</p> |
| <b>Suffolk County/Middlesex County</b> |   |   |
| Salem Street and Lynn Street           |  | <p>This interchange with US-1 (referred to as Cutler Highway in Revere, Suffolk County), and (Frank P.) Bennett Highway in Malden, Middlesex County, employs three RIRO intersections and one off-ramp to accommodate travel between the highway and two intersecting streets. Reconstruction of this interchange is planned as part of the widening/relocation project being pursued for US-1 from just south of Copeland Circle in Revere to its connection with Broadway in Saugus. Seven bridges are planned for replacement, and three others will be upgraded to accommodate new travel lanes.</p>  |

**Table 6 – Interchanges and Intersections on US-1, Chelsea to Danvers, Massachusetts**

| Crossing Roadway  | Aerial Photograph   | Description  |
|---|---|--|
| <b>Essex County</b>   |   |  |
| Merging of US-1/Bennett Highway with Broadway /Newburyport Turnpike (MA-99) |    | This interchange in Saugus serves multiple functions. Southbound traffic on US-1/Bennett Highway can access Broadway/Newburyport Turnpike (MA-99). Northbound traffic on Broadway can access US-1 northbound or US-1 southbound. A loop, which merges for a short distance with the access ramp from Broadway to US-1, is provided to southbound US-1. Northbound traffic on US-1 does not have the option to access Broadway. It is possible for this movement to be accomplished, if desired or necessary, at a downstream Cloverleaf interchange at Essex Street (see below). |
| Essex Street  |  | This constricted Cloverleaf interchange in Saugus shows where Essex Street has been grade separated at US-1 (Broadway/Newburyport Turnpike). The Cloverleaf has been adapted to incorporate the pre-existing at-grade intersection (directly north of the overpass). All essential elements of a Cloverleaf are present. Access has been maintained to properties fronting on the original Essex Street. RIRO intersections facilitate access between the expressway and Essex Street.   |
| Main Street   |  | Main Street in Saugus has been grade separated at US-1 (Broadway/Newburyport Turnpike). The adaptation at this Cloverleaf interchange incorporates a nearby intersection that provides access to a Super Stop-and-Shop and the regional shopping center – Square One Mall – to the south. Like the Essex Street Cloverleaf, RIRO intersections facilitate access between the expressway and Main Street traffic.   |

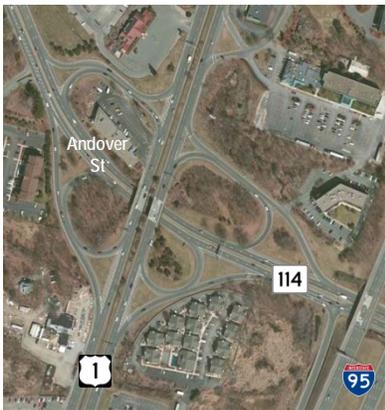
**Table 6 – Interchanges and Intersections on US-1, Chelsea to Danvers, Massachusetts**

| Crossing Roadway                       | Aerial Photograph   | Description   |
|--|---|---|
| Lynn Fells Parkway                     |    | This Trumpet interchange in Saugus facilitates full access between US-1 (Broadway/Newburyport Turnpike) and Lynn Fells Parkway.   |
| Walnut Street<br>(MA-129 west of US-1) |   | A Cloverleaf interchange has been constructed in Saugus to grade separate Walnut Street from US-1/Broadway/Newburyport Turnpike. As with the other Cloverleaf interchanges, RIRO intersections facilitate traffic access between the expressway and Walnut Street. Reconstruction of this interchange is programmed to include widening of the Walnut Street (MA-129) Bridge, ramp modifications associated with the widening of Walnut Street Bridge, and reconstruction of the Walnut Street/US-1 interchange. The work also includes design and construction of four signal systems to be connected in a closed loop system. |
| Salem Street<br>(MA-129 east of US-1)  |  | This at-grade crossing of Salem Street (west) and Lynnfield Street (east) over the depressed US-1 in South Lynnfield incorporates "Texas U-Turns." The U-Turn ramps permit access to several residential streets and commercial properties on the north and south sides of US-1/Broadway.   |

**Table 6 – Interchanges and Intersections on US-1, Chelsea to Danvers, Massachusetts**

| Crossing Roadway   | Aerial Photograph   | Description  |
|--|---|--|
| Interstate 95 and MA-129/Lynnfield Street and Salem Street |    | <p>This extremely complex interchange, just inside Peabody, links US-1 with I-95 and MA-129 (Lynnfield Street). Both southbound and northbound traffic on US-1/Newbury Street can access southbound and northbound I-95. Northbound and southbound traffic on US-1 uses the same exit ramp, with the northbound traffic splitting off to cross over I-95 to go north via the clover leaf. There also is a ramp accommodating southbound movements from I-95 to southbound US-1; it works the same way as the ramp just described only in reverse – southbound I-95 to southbound US-1 traffic crosses over US-1 to the trumpet interchange west of US-1. The U-Turn loop or “jughandle” (see inset) is necessary to facilitate southbound travel on US-1 for traffic associated with the apartment complex, nursery, and other activities on Dearborn Road located on the east side of between US-1 and I-95. Access at Dearborn Road is RIRO. Traffic and signal improvements are planned for this jughandle on US-1.</p> |
| US-1 connection with Interstate 95                         |  | <p>These connector ramps in Peabody facilitate northbound traffic on US-1 (Newbury Street/Newburyport Turnpike) to access northbound and I-95. Southbound traffic on I-95 can access southbound US-1 – Newbury Street/Newburyport Turnpike as well.</p>  |

**Table 6 – Interchanges and Intersections on US-1, Chelsea to Danvers, Massachusetts**

| Crossing Roadway        | Aerial Photograph   | Description  |
|-------------------------|---|--|
| Lowell Street           |    | A Two Quadrant Cloverleaf interchange at Lowell Street in Peabody effectively integrates an intersection with Goodale Street.  |
| Andover Street (MA-114) |   | This Cloverleaf Interchange in Danvers grade separates US-1(Newbury Street/Newburyport Turnpike) from Andover Street (MA-114). The smaller RIRO intersections of Cloverleaf Interchanges are replaced here with longer ramps.  |
| Centre Street           |  | This interchange in Danvers essentially is a T-Cloverleaf combination. Centre Street T's into Armory Road, but a Cloverleaf circulation has been created routing westbound traffic on Centre Street along Amory Road to US-1/Newbury Street southbound. Southbound US-1 accesses eastbound Centre Street via Armory Road. This same loop provides access to the on-ramp for southbound I-95, directly to the east of US-1. Northbound US-1 accesses Centre Street via a merge with the southbound I-95 off-ramp. The Cloverleaf design also provides access to Centre Street and Dayton Street, extending west from US-1. The interchange design also permits southbound traffic on I-95 to access Centre Street and southbound US-1. The bridges (northbound and southbound) over Centre Street are programmed for replacement. |

**Table 6 – Interchanges and Intersections on US-1, Chelsea to Danvers, Massachusetts**

| Crossing Roadway | Aerial Photograph   | Description  |
|------------------|---|--|
| Maple Street     |    | <p>This third Cloverleaf interchange in Danvers integrates surrounding developments and I-95, directly east of US-1/Newbury Street, into the ramp configurations. In the southwest quadrant of the interchange, the ramp connecting eastbound Maple Street to southbound US-1/Newbury Street also serves Kirkbride Drive (which provides access to Beverly Hospital), Hawthorne Avenue, and commercial properties (which abut the original Maple Street). In the southeast quadrant, the ramp integrates Old Maple Street and has an intersection with Conifer Hill Drive, which provides access to the Staples store and the southbound Interstate 95 on-ramp.</p> <p>Note the RIRO intersection north of the interchange. This is a typical access provided to abutting commercial properties and residential streets along the length of US-1.</p> <p>A betterment project is programmed for the bridge structures (northbound and southbound) over MA-62/Maple Street.</p> |
| Interstate 95    |  | <p>At I-95, the expressway characteristics of US-1 come to an end at this hybrid trumpet/loop interchange. The design allows northbound traffic on US-1/Newbury Street to merge with I-95 northbound or continue on US-1. The loop road permits southbound I-95 traffic to travel southbound on the US-1 expressway or connect with northbound US-1. Southbound traffic on this segment of US-1 (east of I-95) can access southbound I-95 or continue south on the US-1 expressway. Northbound I-95 traffic can access US-1 north (to the east), a rural highway, or travel the loop road to continue south on the US-1 expressway.</p>  |

Sources: Google aerial imagery, 2011, and Bing Maps, Copyright Microsoft Corporation and Nokia, 2012.



### 3.5. Owning Agency

The State of Massachusetts maintains the state highway system comprised of state-numbered routes, U.S. Highways, and Interstate Highways. The Highway Division of the MassDOT, which was formed from the Massachusetts Highway Department and Massachusetts Turnpike Authority, is charged with the design, construction and maintenance of the Commonwealth's state highways and bridges. The Tobin Bridge, which connects US-1 in Chelsea with Boston, is under the authority of the Highway Division. The Highway Division is also responsible for overseeing traffic safety and engineering activities associated with the State's highways and bridges, including the Highway Operations Control Center, to ensure safe road and travel conditions.

The Transit Division of MassDOT is responsible for all transit initiatives of the Department. The Transit Division oversees the MBTA, which serves the Greater Boston area, and all Regional Transit Authorities of the Commonwealth. The MassDOT Board of Directors serves as the governing body of the MBTA.

### 3.6. Other Agency Partners

**Massachusetts Bay Transportation Authority:** The MBTA or 'T' was created on August 3, 1964, and charged with implementing a new, bold concept of mass transportation. The MBTA was one of the first agencies to be established in the United States with the combined powers and authority for both regional transportation planning and transit operations. MBTA routes generally do not operate on US-1 (**Figure 5**). One route crosses the Tobin Bridge, connecting Chelsea and Revere to downtown Boston. A second route operates along a short segment of US-1 in the Town of Saugus, providing access to Saugus Plaza and Square One Mall. The MBTA also operates commuter rail service from North Station in Boston. The Rockport/Newburyport Commuter Rail line runs directly north out of Boston two miles to Assembly Square. The line turns east over the Mystic River, crossing US-1 in Chelsea where it turns north to follow the coast line to Rockport, MA, approximately 30 miles northeast of Boston. The Haverhill Commuter Rail line shares the Rockport/Newburyport Commuter Rail line corridor for two miles out of Boston to Assembly Square. It continues in a north-northwest direction approximately 28 miles to Haverhill, MA.

The latest available report on ridership and service of the MBTA (FY 2010) indicates the system's typical weekday ridership was approximately 1.1 million riders (unlinked trips). More than 480,000 were served by the Heavy Rail (i.e., subway) system, 236,000+ riders used the LRT and Trolley systems, 374,000+ riders rode the Bus and

**Figure 5 – MBTA Service Relative to US-1**



Source: Massachusetts Bay Transit Authority (MBTA) System Map, 2013.



Trackless Trolley system (including BRT), and 132,000+ relied on Commuter Rail service. Annual ridership for these four systems was more than 371 million for FY 2010. The Heavy Rail system accounted for 39.6 percent of the ridership, the LRT/Trolley system accounted for 20.4 percent, the Bus/Trackless Trolley system accounted for 30.0 percent, and Commuter Rail accounted for remaining 10.0 percent.

**City of Chelsea:** In addition to maintenance activities associated with the Tobin Bridge, MassDOT is working with Chelsea on two US-1 improvement projects: resurfacing and highway lighting replacement.

**City of Revere:** MassDOT is working with Revere to reconstruct and widen US-1 from just south of the interchange with MA-60 at Copeland Circle to the Bennett Highway in Malden. Revere also is participating in a resurfacing and lighting replacement project with Chelsea. In addition, tide gates at the town line Brook Culvert are being rehabilitated.

**City of Malden:** Malden is participating in the widening/reconstruction of US-1 through its entire length through the community from Revere to Saugus.

**Town of Saugus:** Saugus is participating in the widening/reconstruction of US-1 from Malden to the interchange with MA-99/Broadway. In addition, reconstruction of the MA-129/Walnut Street interchange is programmed.

**City of Peabody:** Peabody is participating in resurfacing and related work on a section of US-1 (Newbury Street/Newburyport Turnpike) and rehabilitation of the US-1 bridge structures (northbound and southbound) over Lowell Street. In addition, traffic signal improvements are planned for the jughandle associated with the Trumpet interchange connecting US-1 with I-95 and MA-129/Lynnfield Street and Salem Street.

**Town of Danvers:** There are three current projects in Danvers under the direction of MassDOT. Resurfacing and related work is planned for US-1/Newbury Street. Two bridge projects are in the works: replacement of the bridges (northbound and southbound) over Centre Street, and a betterment project of the bridge structures over MA-62/Maple Street (southbound).

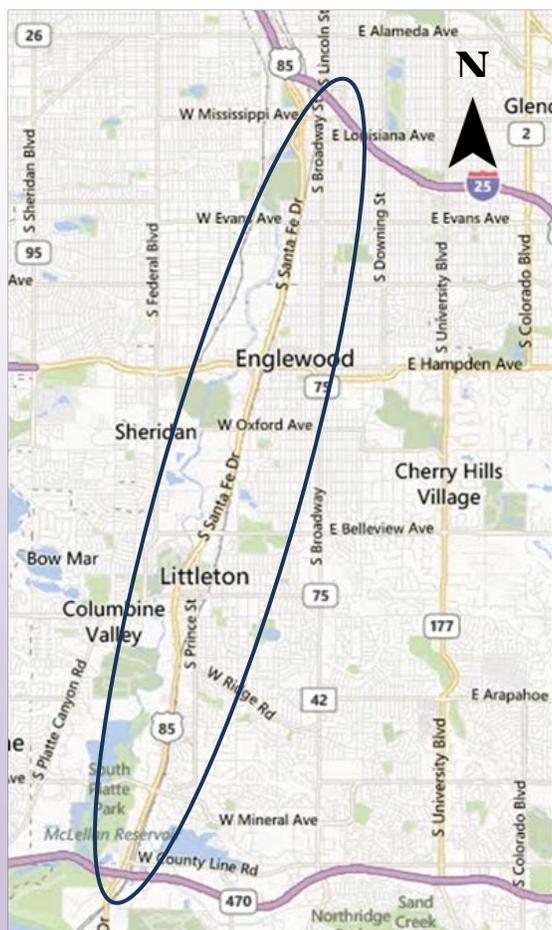
**Boston Region MPO:** The Boston Region MPO is responsible for conducting the federally-required metropolitan transportation-planning process for the Boston metropolitan area. The MPO region includes the eight cities and towns through which US-1 passes in eastern Massachusetts and the three affected counties. The MPO's Long-Range Transportation Plan (LRTP) includes the US-1 improvements through Revere, Malden, and Saugus noted above. The estimated cost of improvements in 2011 was established at more than \$175 million; an additional \$415 million is planned for 2031-2035.

**Massachusetts Port Authority (Massport):** Massport owns and operates Logan International Airport as well as other major port facilities in the Boston area. Massport offers the Logan Express as an express bus service for accessing the airport. Four routes are operated through full-service terminals with secure parking. The Peabody terminal is located on US-1 just south of the connecting interchange with I-95.

## 4.0 US-85/S. Santa Fe Drive – Littleton, Colorado

The original alignment of US-85, the CanAm Highway, stretches from the international border with Canada at Portal, North Dakota, to the international border with Mexico at El Paso, Texas. Through Littleton, Colorado, US-85, known as S. Santa Fe Drive, passes through the Platte River Valley. The highway roughly parallels the river to the west and the BNSF tracks to the east.

**Figure 6 – US-85/S. Santa Fe Drive Location Map**



Source: Bing Maps, Microsoft Corporation.

### 4.1. Access to Urban/Suburban Areas

US-85 connects Littleton with Castle Rock and Colorado Springs to the south, and Sheridan, Englewood and Denver to the north (**Figure 6**). From the southern boundary of the city at Colorado 470 (C-470), S. Santa Fe Drive continues north a distance of approximately 4.75 miles to the city's northern boundary. It continues an additional 5.3 miles north, merging with I-25 in Denver. It also forms the boundary between Sheridan and Englewood, the two suburbs directly north of Littleton. Access to US-285 is less than two miles north of Littleton. US-285 connects with I-25 and I-225 to the east, providing access to the Denver International Airport. To the west, US-285 provides access to and passage through the Rocky Mountains.

### 4.2. Corridor Access Control

Approximately 1/3 of a mile directly south of C-470, S. Santa Fe Drive is categorized as an NR-A: Non-Rural Principal Highway. North of C-470 to Florida Avenue, S. Santa Fe Drive is categorized as an E-X: Expressway, Major Bypass. The Expressway category is defined in the State Highway Access Code as follows:

*This category is appropriate for use on highways that have the capacity for high speed and relatively high traffic volumes in an efficient and safe manner. They provide for interstate, interregional, intra-regional, and intercity travel needs and to a lesser degree, some intracity travel needs. Direct access service to abutting land is subordinate to providing service to through traffic movements.*

North of Florida Avenue, the facility is categorized as an NR-A: Non-Rural Principal Arterial. This segment is split with the northbound lanes on the east side of the Platte River and the southbound lanes on the west side. It has connecting ramps with I-25, passes under the highway, and continues as a one-way street north into Downtown Denver paired with Kalamath Street (southbound). The Non-Rural Principal Arterial category is defined in the State Highway Access Code as follows:

*This category is appropriate for use on non-rural highways that have the capacity for medium to high speeds and provide for medium to high traffic volumes over medium and long distances in an efficient and safe manner. They provide for interregional, intra-regional, intercity, and intracity travel needs in suburban and urban areas as well as serving as important major arterials in smaller cities and towns. Direct access service to abutting land is subordinate to providing service to through traffic movements. This category is normally assigned to National Highway System routes, and other routes of regional or state significance.*

From C-470 north to Sumner Street, S. Santa Fe Drive is a four-lane, divided highway with limited access. With the exception of intersections at County Line Road, Aspen Grove Way (Aspen Grove Shopping Center), which are signal-controlled, access to the roadway from properties on the west side is limited to RIRO movements. Less than one-quarter mile south of Sumner Street, S. Santa Fe Drive effectively has three lanes southbound for three-quarters of a mile, as a special lane has been added to accommodate the RIRO movements at properties and developments abutting the highway.

North of Sumner Street, S. Santa Fe Drive has three lanes southbound and two lanes northbound. A center lane is stripped to permit left turns in the northbound direction only and can be used for entrance into the northbound lanes. North of Church Street, S. Santa Fe Drive has six lanes in both directions to Bowles Avenue. North of Bowles Avenue, the highway continues as a six-lane divided roadway with the center lanes committed to 2+ HOV during the designated peak period; left turns are permitted. Because the highway is divided, the lanes revert to general purpose lanes in the direction of travel outside the designated peak periods. The RIRO operational protocol is maintained for all non-signalized intersections and access points from this point all the way to I-25.

North of Bowles Avenue, the six-lane roadway cross-section continues with center HOV lanes. This cross-section is maintained through the cities of Englewood and Sheridan to Evans Avenue in Denver. North of Evans Avenue, S. Santa Fe Drive becomes an 8-lane highway with center HOV lanes. S. Santa Fe Drive splits north of Florida Avenue, with the northbound lanes continuing as an 8-lane roadway with center HOV lane. The southbound portion of S. Santa Fe Drive is located on the west side of the Platte River south of I-25. The facility becomes an 8-lane roadway (4 lanes south and 4 lanes north) without an HOV lane. The northbound HOV lane, which began at Bowles Avenue ends at I-25, a distance of approximately seven miles. The southbound HOV lane begins just north of Florida Avenue and continues to Bowles Avenue; therefore, it is one mile shorter than the northbound lane. HOV lane use is restricted to vehicles with two or more persons Monday through Friday: Northbound between 6:00am and 8:30am; and southbound between 4:00pm to 6:30pm.

### **4.3. Corridor Operations**

US-85/S. Santa Fe Drive was completely rebuilt through a process that lasted over 20 years, beginning with project planning in the mid-1980s. The “makeover” took about four years at a cost of approximately \$220 million. In 2012, the north end of the highway supported an AADT load of 80,000 vpd, while the south end carries 55,000 vpd.

#### **4.3.1. Background**

CDOT undertook the major reconstruction project to improve traffic conditions of US-85 south of the Denver metropolitan area in a collaborative project with all local jurisdictions and regional interests. This well



## US-60/Grand Avenue COMPASS

Loop 303 to Interstate 10

TM 3 – National Case Study Review

established arterial corridor was characterized by densely developed older strip commercial centers and was plagued with numerous access problems, including substandard access spacing of driveways and open property frontages with no curb or gutter. Signalized intersections were frequent, and the irregular spacing made signal coordination difficult. On both sides, the local street system was underdeveloped with some platted, yet unimproved streets, as well as dead-ends.

Traffic volumes on S. Santa Fe Drive were heavy and projected to become even heavier. As the roadway was the most important north-south arterial and provided direct access to downtown Denver, suburban growth was resulting in increasing traffic volumes. Regional planning efforts also were attempting to address the complex issue of attaining air quality standards while needing to increase roadway capacity. Land uses in the corridor included older industrial, warehousing, some older residential, and retail.

CDOT, coordinating with local and regional entities, determined to convert the old arterial highway into an expressway style facility with limited access and integrated HOV lanes. At-grade signalized intersections were widened with access guidelines established to improve their efficiency, but two major east-west arterials (CO-88/W. Belleview Avenue and US-285/W. Hampden Avenue) were grade separated. A LRT system, operated by the RTD was installed on the east side of the railroad corridor that parallels the highway to the east. A separate hike/bike trail was located to the west, parallel to the facility along the Platte River. Cross links to the trail from the west and east were installed.

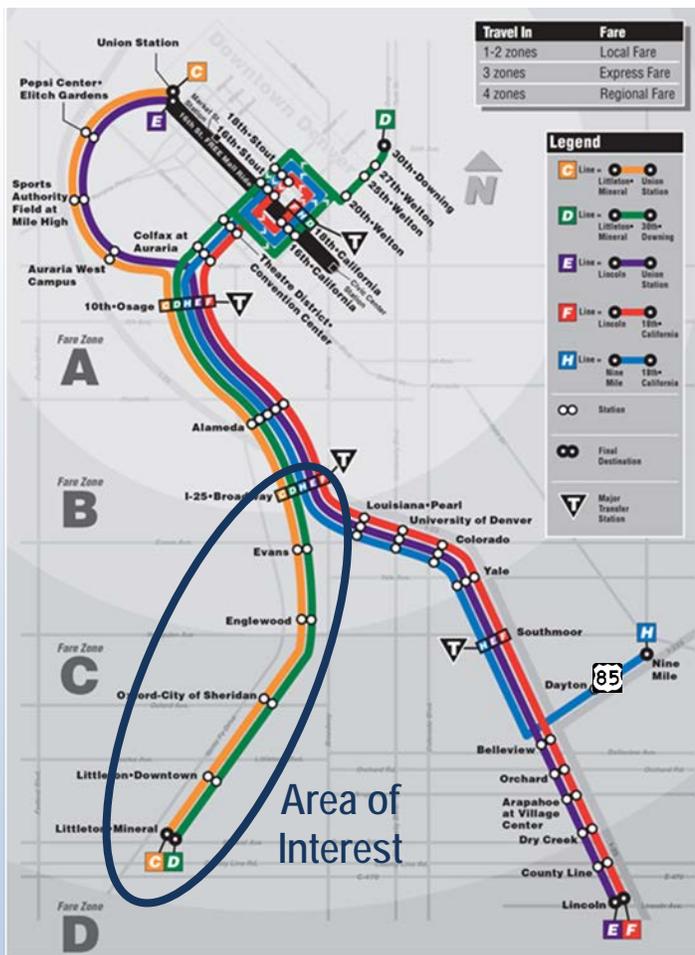
In addition to the capacity and mode improvements made directly within the right-of-way of S. Santa Fe Drive, CDOT used project and local funds to extend and connect local residential streets in the adjacent neighborhood. This effort required off-system condemnation. The completed supporting road network helped maintain commercial and residential property access connections to US-85. This also avoided business damages and mitigated access impacts to the adjacent neighborhood. In combination, all these actions dramatically improved corridor efficiency, capacity, and level-of-service. Improved capacity also resulted in reducing volumes on nearby arterials. S. Santa Fe Drive is now a multimodal travel corridor with much improved traffic conditions.

CDOT was able to use federal STP flexible funds to pay for the local roadway improvements as well as to fund residential right-of-way acquisition and relocation resulting from the extended local roads. The FHWA division office was fully supportive of the approach and deemed the use of STP funds for off-system access improvements as being appropriate. FHWA viewed the use of the flexible STP funds as being no different than the use of these same funds for other project support efforts such as off-site drainage, historic and archeological preservation, wetlands banking, and other forms of environmental mitigation. The key factor considered by FHWA was that the off-system access improvements were part of a broader project to improve traffic conditions throughout the entire travel corridor. Without the local circulation improvements, mainline improvements along the highway would have failed to meet the needs of the local residents and businesses. More direct access to the corridor was necessary, or the overall success of the project would have been diminished.

#### 4.3.2. Transit Services

The BNSF corridor roughly parallels S. Santa Fe Drive corridor on the east (**Figure 7**). This rail corridor has been adapted to accommodate two LRT lines operated by the Regional Transit District: Line C – Union Station to Littleton-Mineral Station and Line D – 30th-Downing Station to Littleton-Mineral Station. The principal difference between the lines is the destination in downtown Denver. Both lines serve five stations within the corridor; a sixth station is planned that will extend the lines south of the Littleton/Mineral Station to C-470, then east along C-470 beyond the area of interest. Average weekday ridership (observed) for the C & D lines in 2011 was reported to be 26,829. Original projections for this \$177.7 million rail line project were 8,400 at opening in 2000 and 22,000 in 2015.

**Figure 7 – Light Rail System Map: Denver Regional Transportation District (RTD)**



Source: Light Rail System Map, Regional Transportation District at [http://www3.rtd-denver.com/LightRail\\_Map.shtml](http://www3.rtd-denver.com/LightRail_Map.shtml).



Source: Southwest Corridor Light Rail Line Facts & Figures at <http://www.rtd-denver.com/FF-SouthwestCorridorLRT.shtml>.

Specific information about each station is provided for reference in **Table 7**. LRT service is operated regularly between the hours of 5:00 am and 1:00 am; additional late night and early morning trips are provided. Regional Transit District LRT operations in what is referred to as the Southwest Corridor are fully grade separated.

**Table 7 – Light Rail Transit Stations in the US-85/S. Santa Fe Drive Corridor, Littleton (C-470) to I-25**

| Station                      | Location                         | Parking      | Bike Racks   | Bike Lockers |
|------------------------------|----------------------------------|--------------|--------------|--------------|
| Littleton-Mineral (Terminus) | City of Littleton                | 1,227 Spaces | 10           | 30           |
| Littleton-Downtown           | City of Littleton                | 361          | 28           | 10           |
| Oxford-City of Sheridan      | City of Sheridan                 | Not Provided | Not Provided | Not Provided |
| Englewood                    | City of Englewood                | 910          | 24           | 32           |
| Yale Avenue Yard-and-Shop    | City of Englewood/City of Denver | N/A          | N/A          | N/A          |
| Evans                        | City of Denver                   | 99           | 10           | 8            |

Source: Light Rail System Map, Regional Transportation District at [http://www3.rtd-denver.com/LightRail\\_Map.shtml](http://www3.rtd-denver.com/LightRail_Map.shtml).

**4.3.3. Freight Rail Operations**

Railroad operations have been part of the corridor since 1871, when the Denver and Rio Grande Railroad reached the area. Sixteen years later, the Atchison, Topeka and Santa Fe (now BNSF Railway) arrived from Pueblo, Colorado. In 1907, an electric trolley line was extended into Littleton, but had a short life and was abandoned in 1926 for more flexible buses that were cheaper to operate. The transportation system changed again in 1938, when a US-85 bypass was rerouted to its current alignment west of downtown Littleton.

The BNSF rail line through the S. Santa Fe Drive area of interest to Colorado Springs is a major coal route. Trains operating on the line routinely carry coal from Wyoming to Arizona, Texas, and other southern states. Coal is provided to the Arapahoe Generating Station located on the west side of South Platte River southeast of the Evans LRT Station. Coal trains to the generating station use a separate branch; through trains to points south use the rail line the runs through Englewood, Sheridan, and Littleton. Trains of the Denver Region of the UPRR operate on the same rail line.

Unit trains carrying grain and petroleum products also are commonly operated along the line. Multiple train operations occur on the rail line, and train lengths of one and one-quarter miles are not uncommon; however, all intersecting streets are grade separated, as well as one drainage channel. Although there are no major rail users in the area of interest, a BNSF transload facility is located approximately four miles south of C-470. According to the *Colorado State Freight and Passenger Rail Plan*, the rail corridor is operating near capacity, and is expected to operating over capacity by the year 2035. This same plan indicates high-speed rail passengers service is being considered between the Denver metropolitan area and Colorado Springs to the south. Also, Intercity Rail service is being considered between Wyoming and Texas. It is conceivable at that these passenger rail services could use the BNSF rail corridor that runs through the area of interest.

**4.4. Interchanges and Intersections**

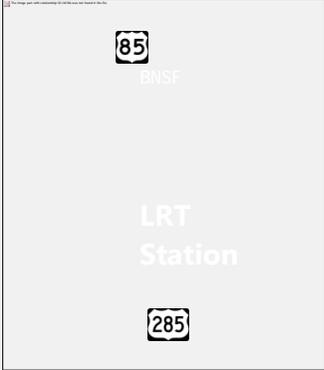
S. Santa Fe Drive has four grade-separated interchanges and eleven signalized intersections between C-470 and I-25. **Table 8** provides a description of these crossings. Aerial images (all from Bing Maps, Microsoft Corporation) have been incorporated to show the interchanges and more complex intersections.

**Table 8 – Interchanges and Intersections on US-85/S. Santa Fe Drive, Littleton to Denver, Colorado**

| Crossing Roadway  | Type of Intersection   | Description   |
|---|--|---|
| <b>NOTE: North is up on all aerial photographs shown, unless otherwise indicated.</b> |  |   |
| <b>Littleton, Colorado, Arapahoe County</b>   |  |   |
| C-470 Loop  |  <p data-bbox="391 737 618 806">Grade-Separated Interchange</p> | <p data-bbox="797 428 1511 842">This interchange is a traditional diamond with extended ramps to the east which pass under the nearby BNSF Railway tracks and over Erickson Boulevard. Work has been completed on the flyover ramp for southbound US-85 traffic to eastbound C-470. A planned extension of the RTD Southwest Rail Line –LRT – from Denver through Littleton will go through this interchange area. A station is planned for Lucent Boulevard approximately 1.5 miles to the east that will include a K&amp;R loop, bus transfer area, and approximately 440 parking spaces.</p> |
| Mineral Avenue  |  <p data-bbox="391 1289 675 1318">At-Grade Intersection</p>    | <p data-bbox="797 854 1511 1230">This is a signalized intersection with LRT service to Denver provided by the Regional Transit District. The Littleton/Mineral LRT station is located on the northeast corner of the intersection. A large P&amp;R lot is located on the northwest corner; access to the LRT station is via an overhead pedestrian bridge. The LRT system terminates today just south of Mineral Avenue. The station includes a K&amp;R loop, bus transfer area, 1,227 parking spaces, 10 bike racks, and 30 bike lockers.</p>  |
| Aspen Grove Way   | At-Grade Intersection  | <p data-bbox="797 1331 1479 1440">This is a signalized T-intersection from the west. It serves the Aspen Grove Shopping Center located on the west side of S. Santa Fe Drive.</p>   |
| Sumner Street   | At-Grade Intersection  | <p data-bbox="797 1453 1317 1478">Four-way, signal-controlled intersection.</p>   |
| Church Street   | At-Grade Intersection  | <p data-bbox="797 1491 1495 1600">Four-way, signal-controlled intersection with right turn/yield ramps for northbound-to-eastbound traffic and westbound-to-northbound traffic.</p>   |
| Bowles Avenue and Main Street/Alamo Avenue  | At-Grade Intersection  | <p data-bbox="797 1612 1463 1793">Four-way signal-controlled intersection with right turn/yield ramps for all movements. Main Street is one-way westbound and Alamo Avenue is one-way eastbound. The two roadways are unified at this intersection.</p>   |
| Prince Street   | At-Grade Intersection  | <p data-bbox="797 1806 1430 1871">Four-way signal-controlled intersection with right turn/yield ramps for all movements.</p>  |

| <b>Table 8 – Interchanges and Intersections on US-85/S. Santa Fe Drive, Littleton to Denver, Colorado</b> |   |  |
|---|---|--|
| <b>Crossing Roadway</b>   | <b>Type of Intersection</b>   | <b>Description</b>   |
| C-88/Bellevue Avenue  | Grade-Separated<br><br><br><br>Single-Point Urban Interchange (SPUI) | S. Santa Fe Drive is elevated over Bellevue Avenue. Bellevue Avenue east of S. Santa Fe Drive passes under the BNSF tracks plus Rio Grande Street and the RTD LRT tracks.  |
| <b>Englewood, Colorado, Arapahoe County</b>   |   |  |
| Union Avenue  | At-Grade Intersection   | Signal-controlled 'T'-intersection from the west.  |
| <b>Sheridan, Colorado, Arapahoe County</b>  |   |  |
| Oxford Avenue   | At-Grade Intersection   | Four-way signal-controlled intersection with right turn/yield ramps for all movements. Oxford Avenue passes under the BNSF tracks and the RTD LRT tracks east of S. Santa Fe Drive. The Oxford LRT station is located on the northwest corner of the intersection. No parking available. |

**Table 8 – Interchanges and Intersections on US-85/S. Santa Fe Drive, Littleton to Denver, Colorado**

| Crossing Roadway                                    | Type of Intersection   | Description  |
|---|--|--|
| <b>Sheridan/Englewood Colorado, Arapahoe County</b> |  |  |
| US-285/Hampden Avenue                               | Grade-Separated Partial Clover Leaf (ParClo) with<br><br>Median Crossovers to permit certain left-turns | Northbound US-85 traffic heading to eastbound US-285 (Hampden Avenue) is accommodated by a singular exit ramp. Westbound Hampden Avenue traffic heading to northbound US-85 is accommodated by a singular entrance ramp. The ParClo permits westbound-to-southbound and southbound-to-eastbound traffic to access desired lanes via a traditional traffic merge; no signal control is present. A signal-controlled intersection is present north and south of Hampden Avenue to accommodate left-turning northbound traffic for access to westbound Hampden Avenue. The signal-controlled intersection south of Hampden Avenue accommodates left-turning eastbound traffic for access to northbound US-85. The Englewood LRT Station and park and ride (shown at right) are located in the northeastern quadrant of this interchange area. The station has 910 parking spaces, 24 bike racks, and 32 bike lockers.  |
| Dartmouth Avenue                                    | At-Grade Intersection  | Four-way, signal-controlled intersection with right turn/yield ramps for all movements.  |

**Table 8 – Interchanges and Intersections on US-85/S. Santa Fe Drive, Littleton to Denver, Colorado**

| Crossing Roadway                      | Type of Intersection  | Description  |
|---------------------------------------|---|--|
| <b>Denver Colorado, Denver County</b> |   |  |
| Evans Avenue                          |  <p>Grade-Separated SPUI</p> | <p>W. Evans Avenue is elevated over S. Santa Fe Drive. The Evans LRT Station located in the southeast quadrant of the interchange area has 99 parking spaces, 10 bike racks, and 8 bike lockers. The angular, narrow design of the interior ramps accommodating left-turns from S. Santa Fe Drive off-ramps to Evans Avenue and from Evans Avenue to S. Santa Fe Drive on-ramps prohibits U-turns; restrictive turn signs are posted (see inset)</p>  |
| Iowa Avenue                           | At-Grade Intersection   | Signal-controlled "T" intersection from the east.  |
| Florida Avenue                        | At-Grade Intersection   | Four-way, signal-controlled intersection.  |

Sources: Google aerial imagery, 2011, and Bing Maps, Copyright Microsoft Corporation and Nokia, 2012.

#### 4.5. Owing Agency

The State of Colorado maintains the state highway system comprised of state-numbered routes, U.S. Highways, and Interstate Highways. CDOT is the responsible state agency. CDOT is responsible for the transportation system of the state, which includes 9,144 miles of highways with close to 3,500 bridges. CDOT has a multimodal mission; therefore, the agency also oversees all transportation system elements focused on moving people, goods, and information.

#### 4.6. Other Agency Partners

**Denver Regional Council of Governments:** The DRCOG is the regional planning and coordination agency focused on fostering cooperation among county and municipal governments in a nine-county Denver metropolitan area. MPO membership includes the cities of Denver, Englewood, Littleton, and Sheridan, as well as Denver and Arapahoe counties. DRCOG prepares and updates the Regional Transportation Plan.

**Regional Transit District (RTD):** As noted earlier, the RTD operates five LRT lines between downtown Denver and suburban communities. The Southwest Rail Line, which runs along the BNSF rail corridor parallel with and directly east of US-85/S. Santa Fe Drive, includes two operational services. The 'C' line operates between the Littleton/Mineral Station and Union Station in the northeastern portion of the downtown. The 'D' line operates between the Littleton/Mineral Station and the 30th/Downing Station in the southeastern portion of the downtown. Currently, there are five LRT stations on the Southwest Rail Line in the area of interest: four have P&R facilities. One more without parking is planned for construction in conjunction with the Yale Avenue LRT yard-and-shop facility. The RTD is managing a \$4 billion funding rapid transit expansion program referred to



as FasTracks. FasTracks includes a 2.5-mile LRT extension from the current Southwest Rail Line end-of-the-line Littleton/Mineral Station south and east to the southwest corner of the C-470/Lucent Boulevard Interchange.

**BNSF Railway:** BNSF, today, is the result of merging or acquiring nearly 400 different railroad lines over the course of 160 years. Its line through the area of interest generally runs parallel and east of S. Santa Fe Drive. The railway has four transload facilities in Colorado; one is located south of Littleton along the line which runs parallel with S. Santa Fe Drive. Transload facilities function to provide shippers and receivers with door-to-door transportation solutions for various goods. The Littleton facility supports warehousing of goods and provide rail and truck docks. A portion of the railroad right-of-way has been adapted for the RTD's Southwest Rail Line.

**Union Pacific Railroad:** The UPRR was incorporated under the Pacific Railroad Act of 1862. The railroad operates in the same corridor as the BNSF; however, it maintains no facilities in this area of interest.

**Other Partnering Entities:** The four cities through which S. Santa Fe Drive passes within the area of interest are: City of Denver, City of Englewood, City of Littleton, and City of Sheridan. CDOT also partners with the two counties within which these cities are present: Arapahoe County and Denver County (City of Denver). One project is underway in the Littleton to reconstruct the twin bridges on US-85 that cross over Dad Clark Gulch.

## 5.0 Conclusion

A National Case Study Review was conducted to identify similar corridors in other metropolitan areas with similar functionality. Three corridors were noted that provide a range of design and operational treatments helpful to evaluating access control and roadway design in the US-60/Grand Avenue corridor. The review addresses regional function, access control methods, operational conditions, key interchanges and intersections, and jurisdictional control. There are five key elements that were sought after in researching the case study locations, including:

- Major metropolitan areas.
- Multimodal travel corridors (auto and transit oriented at a minimum).
- Higher capacity corridors with interchanges (case study corridor volumes ranged from 65,000 – 86,000 vpd, many with unique grade separations and traffic interchanges).
- Presence of freight rail was desired.
- Presence of high capacity transit was critical.

The case studies have provided descriptive and visual identification regarding the application of access management techniques with the US-60/Grand Avenue corridor. The information supports the creation of organizational arrangements to solve complex regional and intercity issues relating to access management to sustain highway capacity and safety while accommodating reasonable access to abutting properties and adjacent communities.

Key themes that were prevalent relating to the three case study locations include:

- All of the corridors studied were originally supposed to be of a higher-level roadway functional classification than they function today.
- All of the case study corridors initially focused on traffic accommodation and vehicle-moving capacity.
- All of the case study corridors evolved to people-moving corridors for enhanced regional mobility.