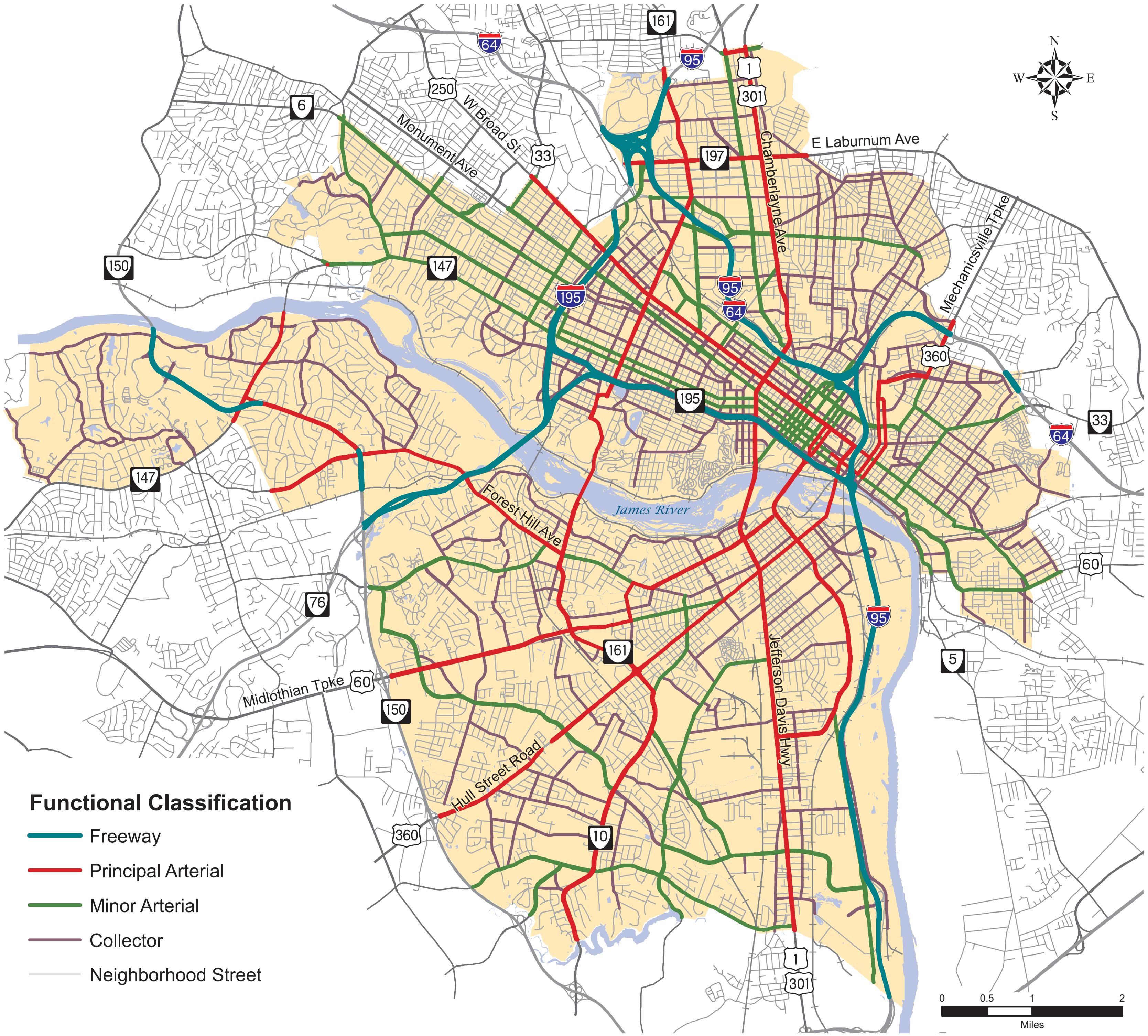
Figure 4: Functional Classification



2: Roadway System

Introduction

According to the Texas Transportation Institute, each commuter within the Richmond Metropolitan Statistical Area (MSA) experiences 20 hours of delay per year due to congestion. Roadway capacity, traffic volumes, accident rates, and operating speeds are factors affecting congestion on roadways and the overall performance of the roadway system. This section reviews the roadway system within the City of Richmond to identify areas of concern due to congestion or safety issues.

Functional Classification

Similar functioning roadways are grouped together into functional classes based on the type of service and amount of traffic the facilities carry. The purpose of a functional classification system is to categorize roadways based on their level of mobility and access. Mobility describes the ability of the road to easily convey vehicles with little interference from conflicting movements. Access describes the number of access points for entering or exiting the roadway to access homes or businesses alongside the roadway. While these two functions are integral to the transportation system, they are often in conflict as users of roadways often have very different origins and destinations. Therefore, functional classification is an attempt to differentiate roadways based on whether their focus is on access, mobility, or some balance between the two. Typically higher functionally classed roadways serve mobility more than access while lower functionally classed roadway prioritize access over mobility, as represented in the graphic below. In Richmond, the roadway system is divided into five functional classes: Freeways, Principal Arterials, Minor Arterials, Collectors, and Neighborhood Streets.

The city's functional class system does not consider surrounding land uses.

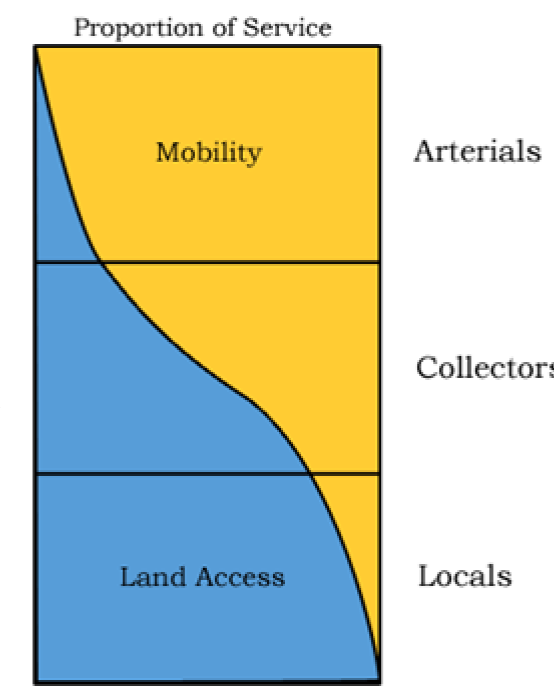


Figure 4 shows the functional classification for all roadways in the city. Freeways include Interstates I-95, I-64 and I-195 as well as the Downtown Expressway (VA 195), the Powhite Parkway (VA 76), and segments of Chippenham Parkway (VA 150). Principal arterials are roadways of regional importance that are intended to serve through traffic on controlled access roadways. Principal arterials within the city include Hull Street and Mechanicsville Turnpike US 360), Midlothian Turnpike (US 60), Jefferson Davis Highway/ Chamberlayne Avenue (US 1/US 301), and Broad Street (VA 250). The city street network also contains numerous minor arterials such as State Route 6 (Patterson Avenue), State Route 147 (Cary Street), and State Route 5 (Main Street). Numerous collector and neighborhood streets serve lower volumes of traffic along roadways with local significance.

A major feature missing from the city's functional classifications system is consideration of the roadway context. As a city with a diverse built environment, the consideration of the surrounding land use and built environment is important to understanding how a roadway operates and how it should function. Other cities have addressed this issue by revising their functional classification systems to incorporate surrounding land use and density context into the definition of the roadway function.

Traffic Levels

Average Annual Daily Traffic (AADT) depicts the traffic volume or number of vehicles using a roadway on an average day over the course of a year. Figure 5 shows the pattern of traffic volumes in the city. Within the city, higher traffic volumes are predominately found on highways. Roads with traffic volumes over 25,000 vehicles include sections of Chippenham Parkway (VA 150), Midlothian Turnpike (US 60), River Road/Cary Street Road (VA 147), and Belvidere Street (US 1/ US 301) from the Robert E. Lee Bridge to Interstate I-64/I-95. Segments of Forest Hill Avenue, as well as segments of Hull Street (US 360) entering Chesterfield County and Mechanicsville Turnpike (US 360) entering Henrico County also had traffic volumes greater than 25,000 vehicles per day.

In 2009, 2.7 million vehicle miles were travelled on the 1,895 lane miles of roadway under City control.

Over 4.9 million vehicle miles were traveled in the City of Richmond in 2009. Of these, 36% were on the Interstate Highways even though the interstates are only about 2% of the total roadway miles in the city. Another 9% were on other Freeways and Expressway such as the Downtown Expressway and Chippenham Parkway. Thus, 45% of all vehicle miles travelled are on the 3% of roadway miles outside the city's control. The remaining 55%, or about 2.7 million vehicle miles, were traveled on the arterials, collectors, and local streets under the city's control. These roadways comprise 97%, or about 824 miles, of the roadway length in the city. These 824 miles of roadway include 1,895 total lane miles on city owned and maintained roads.

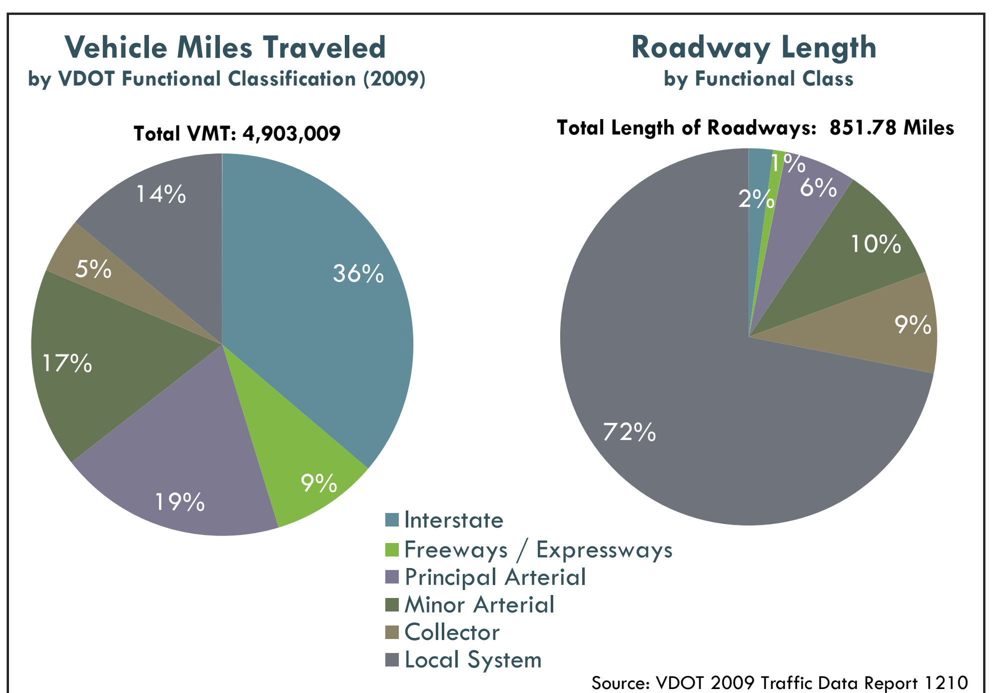


Figure 5: Average Annual Daily Traffic on City Roadways

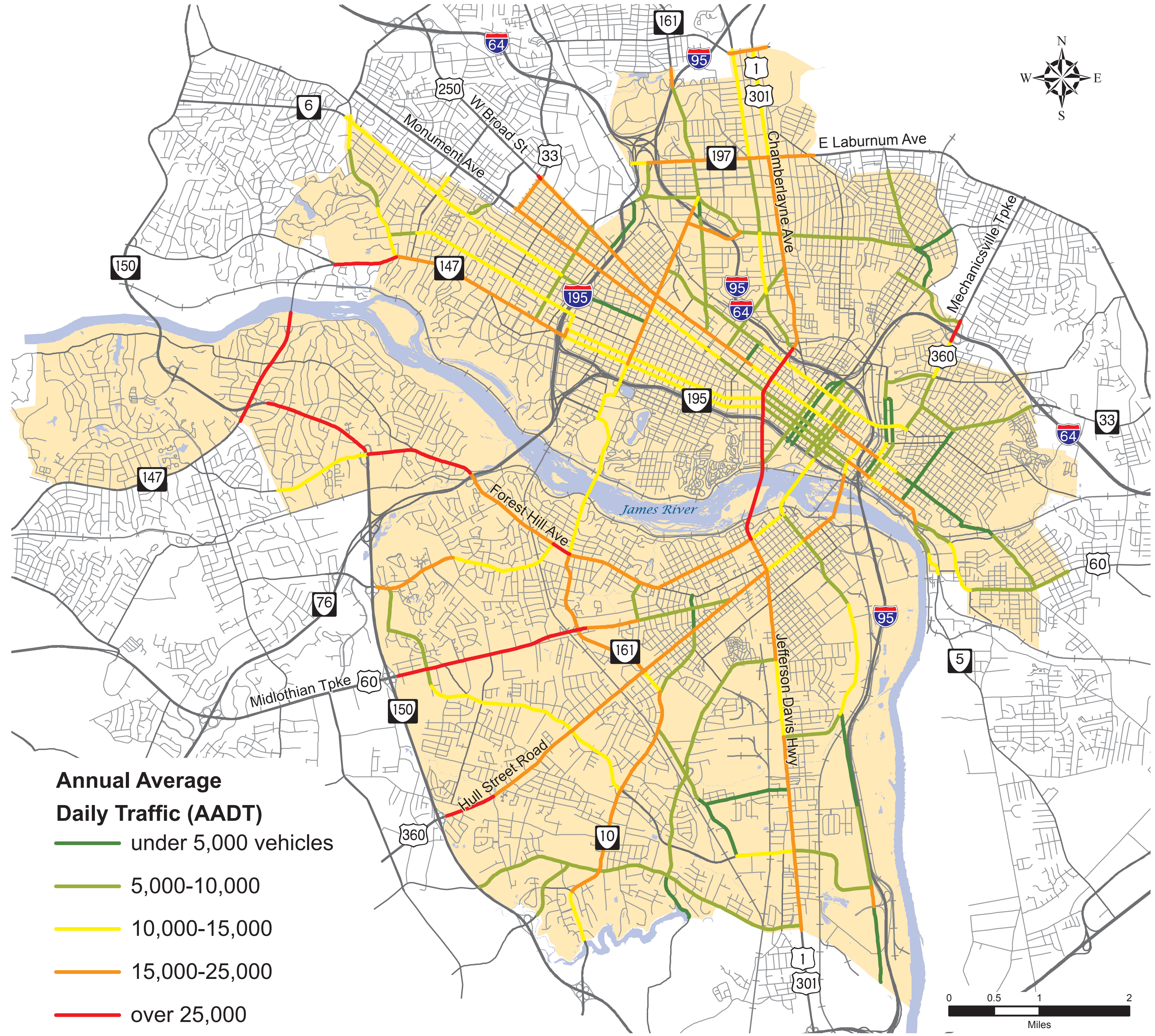
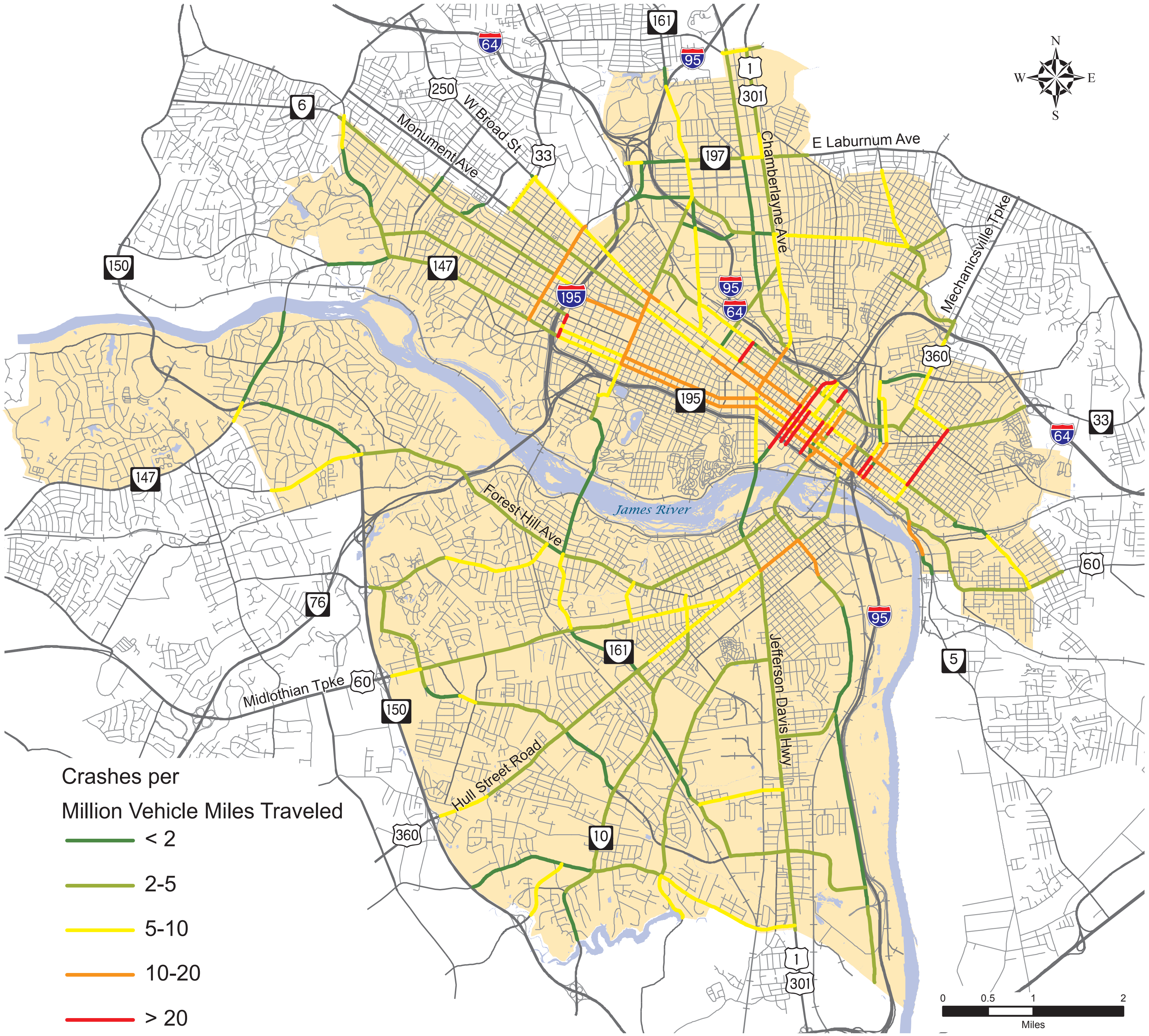


Figure 6: Crash Rates for Major Routes (2008-2010)

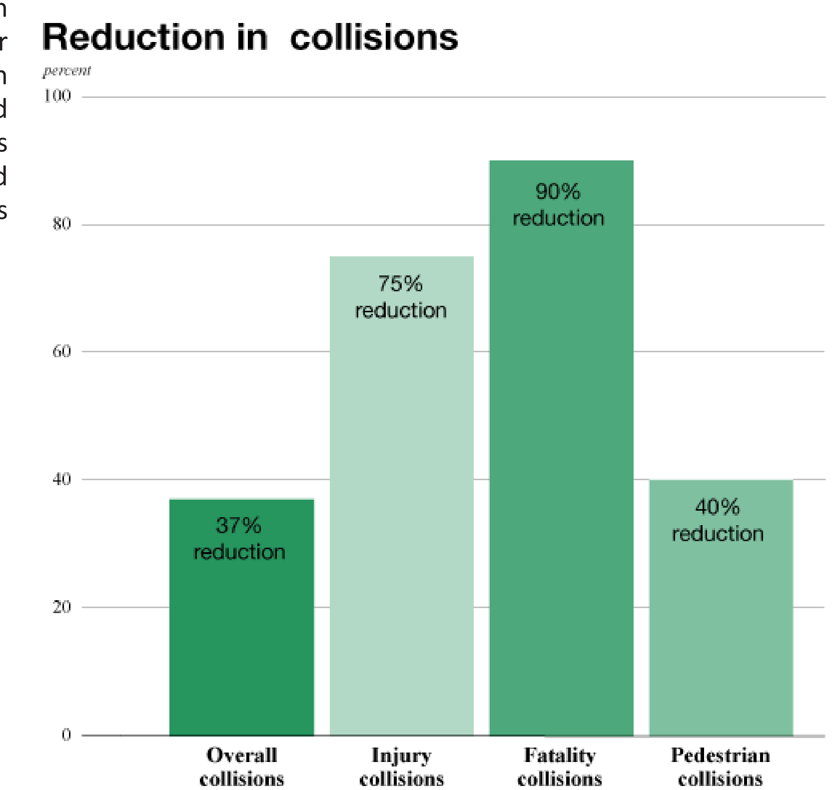


Crash Incidents

Roadway safety is a primary concern for all citizens. The Richmond Police Department provided a database of 12,650 roadway crashes that occurred between 2008 and 2010. Of these, 9,276 occurred along major corridors such as Broad Street. These major corridors were analyzed to determine the crash incidents along roadways by calculating the number of crashes per million vehicle miles traveled (VMT). Figure 6 shows the crash rates for all analyzed roadways in the city. Roadways with high crash rates, over 20 crashes per million VMT, were predominately located in the downtown core along north-south routes. Other roadways with high crash rates were Thompson Street between Grove Avenue and Cary Street, Harrison Street between Leigh Street and Broad Street, and 25th Street in Church Hill. Roadways west of I-195, south of the James River and north of I-95/I-64 tended to have lower crash rates than roadways within the urban core of the Fan and central business district. The higher crash densities within the urban core are most likely associated with the higher density of intersections occurring within these areas where conflicting movements of vehicles and pedestrians creates an environment where crashes are more likely. While fatality data was not available, crashes in the downtown area are less likely to be fatal or lead to critical injuries as traffic speeds are generally lower than in less dense areas where speed limits are higher and traffic is less congested.

Roadways with the highest crash rates are generally downtown, but crashes in this area tend to be less severe due to slower speeds.

Crashes in urban and suburban environments most often occur at intersections, due to the numerous potential conflicts between vehicle paths. One solution the city has begun implementing to reduce this risk is to replace typical signalized or stop controlled intersections with roundabouts. While modern roundabouts can seem difficult to unfamiliar drivers, the reduction in conflict points compared to typical intersections combined with the forced slowing of vehicles makes roundabouts much safer.



Source: Federal Highway Administration and Insurance Institute for Highway Safety (FHWA and IHS)

Corridor Level of Service

Level of service (LOS) is a qualitative description of the operating conditions of a traffic stream on a transportation facility based on quantitative measures of volume and capacity. There are six LOS categories (LOS A through LOS F) used to rate facilities. LOS A represents the best operating conditions with no congestion and LOS F the worst with heavy congestion. LOS C or better is generally considered an acceptable LOS. LOS D in urban areas such as Richmond is generally acceptable since it often is not cost effective to make necessary improvements to achieve LOS C. Corridor LOS was analyzed for arterial roadways and key connecting roads using VDOT's Average Annual Daily Traffic counts from 2009. The analysis used data from the City's GIS database, including the speed limit, number of lanes, functional classification, signal spacing, and other attributes that affect roadway congestion. These factors were combined to classify roadways based on their general capacity characteristics and threshold capacity volumes. The actual volume counts were then compared to the thresholds to determine the LOS for each corridor segment. The key data generated from the capacity analyses is the LOS for each corridor link.

Overall, corridor level of service is acceptable on most city streets, but certain corridors are well over capacity.

Level of Service Category	Traffic Condition Description
LOS A or B	Excellent or good conditions with light to moderate traffic at free flow speeds.
LOC C	Fair conditions with moderate to heavy traffic and a decline in free flow speeds.
LOS D	Poor conditions with heavy traffic at or near roadway capacity. Speeds severely reduced.
LOS E	Bad conditions with heavy traffic above roadway capacity. Speeds severely reduced.
LOS F	Extremely bad conditions with heavy traffic above roadway capacity. Congestion limits speeds to "stop-&-go" conditions.

Figure 7 shows the Corridor Level of Service for all analyzed roadways in the city. Industry standards, including the city and VDOT, deem roadways with LOS grades of E & F to be deficient for urban areas. Deficient roadway segments are scattered across the city, but are predominately found south of the river on Forest Hill Avenue and Chippenham Parkway, in the east end of the city along Main Street, west of downtown on Main Street and Cary Street Road, as well as The Boulevard through Byrd Park and across the Boulevard Bridge.

Numerous other roadways, such as Broad Street, Cary Street, Hull Street, Midlothian Turnpike (east of Belt Boulevard), Leigh Street, and Lombardy Street, operate at LOS D, indicating that there is limited excess capacity along these corridors. A few major corridors, such as Jefferson Davis Highway, Commerce Road, Chamberlayne Avenue, Brook Road, Patterson Avenue, and Grove Avenue (west of I-195), operate at LOS C or better indicating some excess capacity exists in these corridors.

Figure 7: Corridor Level of Service

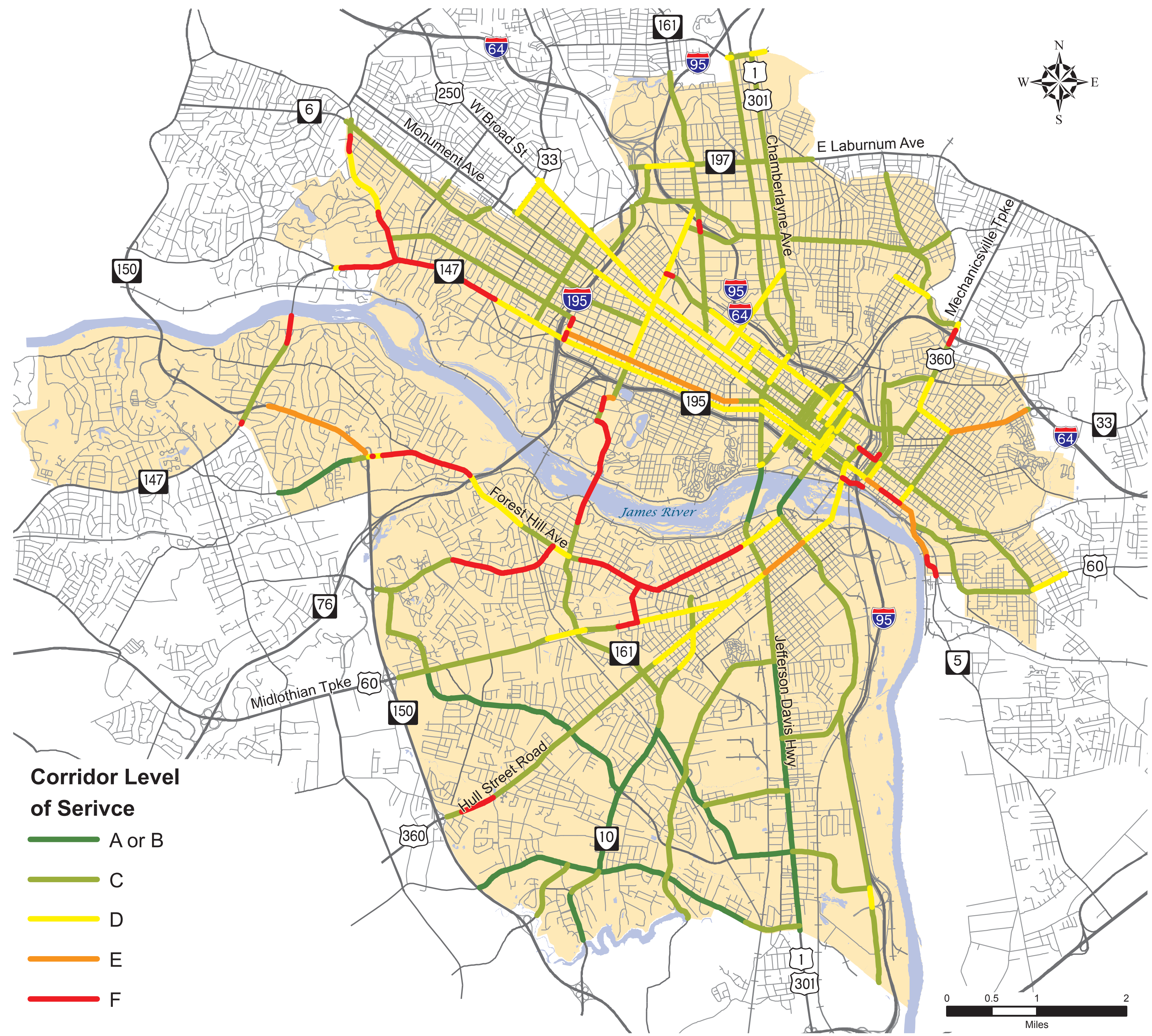
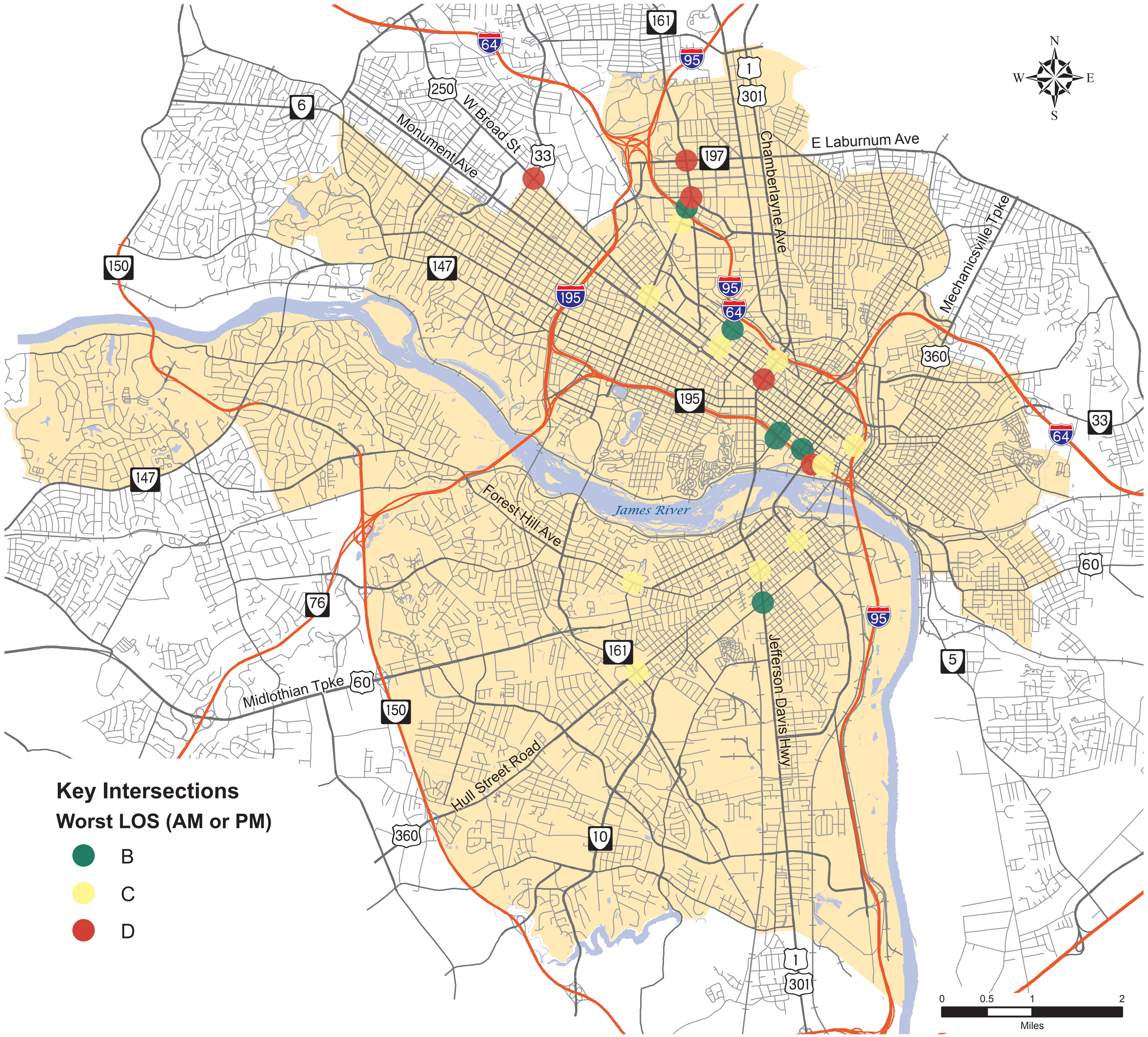


Figure 8: Key Intersection Level of Service



Key Intersection Level of Service

Capacity analyses were conducted for the existing conditions at 21 key intersections identified by city staff as critical to moving vehicular traffic through the city. City staff provided the AM and PM peak hour existing conditions Synchro models with intersection count data from the 2008-2009 period and up-to-date traffic signal timing and phasing information.

Most key intersections operate at an acceptable level of service, both AM and PM but a few high volume intersections operate poorly, particularly in the PM peak hour.

The output of the Synchro models is shown in Figure 8, where the key intersections are color coded by the worst LOS, either AM or PM. Of the 21 intersections analyzed, five intersections operate at LOS D in either the AM or PM peak periods: Broad Street at Belvidere Street, Broad Street at Staples Mill Road, Laburnum Avenue at Hermitage Road, Boulevard/Hermitage Road at Westwood Avenue/Brookland Parkway and 10th Street at Byrd Street (near the Downtown Expressway on-ramp). Ten other intersections operate at LOS C in one peak period while five intersections operate at LOS B or better in both peak periods.

Broad Street and Belvidere Street (above) and Broad Street and Staples Mill Road (below) are two of the busiest intersections in the city.

Physical Roadway Conditions

The physical condition of the roadway is critical to its ability to function for vehicles and bicyclists. Pedestrians also face difficulty crossing streets that are in a poor state of repair. Furthermore, roadways in poor physical condition imply an area may be in decline and add costs to roadway users by increasing overall maintenance costs for vehicles due to damage caused by potholes and other roadway hazards. Poor roadway conditions also add to roadway noise due to rattling of vehicle frames and additional braking and acceleration noise. In severe cases, poor roadway conditions can contribute to higher crash rates as drivers can lose control of vehicles after hitting severe potholes and when drivers change direction suddenly to avoid poor roadway conditions. The City of Richmond faces numerous problems trying to maintain high quality roadway condition. Many roadbeds in the city are hundreds of years old with many layers of various types of pavement including cobblestone, concrete, and asphalt. Industrial areas in the city generate significant truck traffic and the high level of GRTC bus activity on some streets speeds the roadway degradation process.

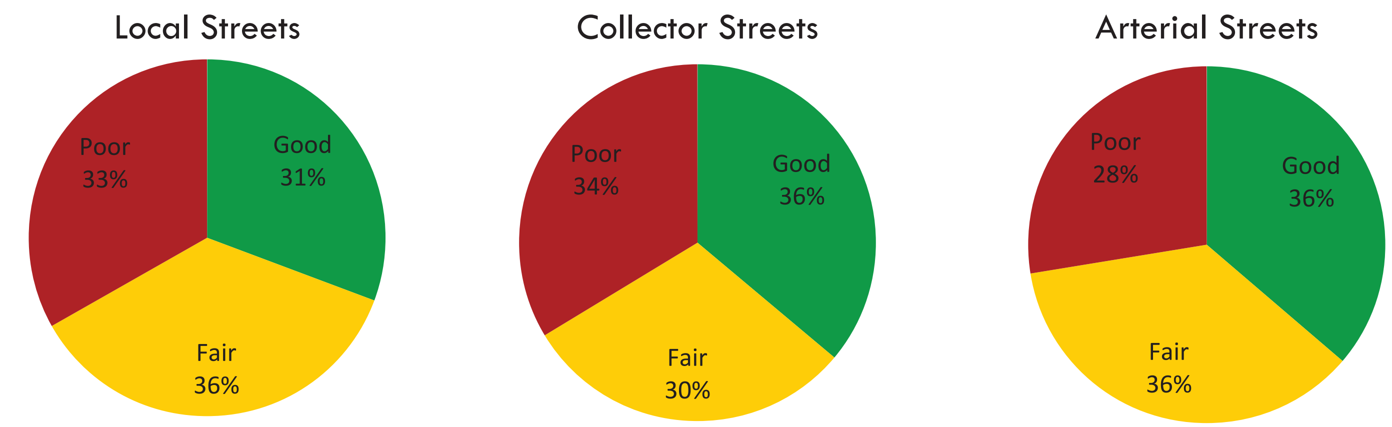
One-third of City streets are in a poor state of repair but the planned paving program should greatly improve roadway conditions by 2015.

Overall, about one-third of city streets are in a poor state of repair as of a December 2010 assessment. The city's Department of Public Work 2009-2015 Paving Program should repave nearly 60% of city roads, reaching about 9% of roads per year. Such a program would significantly improve roadway conditions over the period. Some roadway condition problems go deeper than the surface pavement, however, and may require more substantial rebuilding of the roadbed to achieve a long-lasting improvement in roadway conditions.

The City of Richmond owns and maintains a total of 81 structures (57 bridges and 24 culverts). Most of these structures are over 40 years old and regular maintenance is necessary to keep these bridges operating properly.

Pothole on Nansemond Street, 2011. Photo courtesy of Peter Feddo.

Roadway Conditions by Street Type



Department of Public Works 2009-2015 Paving Program							
Calendar Year	Local Lane Miles		Collector Lane Miles		Arterial Lane Miles		Total
	1,083.2		144.8		681.9		1,909.9
2009 Actual	80.9	7.5%	11.9	8.2%	62.5	9.2%	155.5
2010 Actual	102.9	9.5%	22.5	15.5%	57.0	8.4%	182.7
2011 *(based on $6M)*	82.5	7.6%	15.0	10.4%	52.5	7.7%	150.0
2012 *(based on $6M)*	82.5	7.6%	15.0	10.4%	52.5	7.7%	150.0
2013 *(based on $6M)*	82.5	7.6%	15.0	10.4%	52.5	7.7%	150.0
2014 *(based on $6M)*	82.5	7.6%	15.0	10.4%	52.5	7.7%	150.0
2015 *(based on $6M)*	82.5	7.6%	15.0	10.4%	52.5	7.7%	150.0
Totals	**596.3**	**55.1%**	**109.4**	**75.5%**	**382.0**	**56.0%**	**1,087.7**
						% of Roads Paved from 2009-2015	**57%**