# Intelligent Transportation Systems (ITS) Visualization Portfolio

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Roanoke Valley Area MPO Metropolitan Planning Organization

newva

Roanoke Valley Alleghany Regional Commission

# Preface

The costs of traditional highway and road construction have risen faster than inflation in the last several years. This is primarily due to the steep rise in costs for both asphalt and concrete, which are in demand on a global scale. This creates an environment in which, the application of computational and communications technology to better manage existing transportation infrastructure, may provide both operational improvement and cost savings. This approach is commonly termed Intelligent Transportation Systems (ITS).

In recent years staff has tried to promote ITS strategies for equal consideration during the Long-Range Transportation Planning process. Staff commonly provided verbal or written descriptions of ITS strategies at settings such as: neighborhood groups, civic leagues, chambers of commerce and/or economic development agencies meetings. These written and verbal summaries usually fail to elicit interest or to even foster conversation. The problem is not that ITS strategies are unworthy of consideration; rather, the problem usually lies in the fact that citizens and stakeholders rarely have first hand experience with ITS. Sometimes verbal descriptions of ITS strategies conjure up mental images of computer programmers, jargon and mysterious back room processes. Thus, the public policy conversation stops before it has even had a chance to get started.

The purpose of this document is to bridge that gap, and to act as a conversation starter for ITS strategies. This is done by creating visual representations of what various conceptual ITS strategies would look like in our region. This document literally "creates a vision" by using computer rendered images that place conceptual ITS elements on various transportation facilities throughout the region. It is hoped that by visual communication, this document will be the first step towards a larger discussion of ITS implementation for the area. Of course, before any ITS Strategies are deployed in the field, appropriate safety and operational studies will have to be performed. Nevertheless, all journeys begin with a first step. The purpose of this document is to be that first step.

# Disclaimer

This report was prepared by the Roanoke Valley-Alleghany Regional Commission (RVARC) on behalf of the Roanoke Valley Area Metropolitan Planning Organization (RVAMPO) in cooperation with the Federal Highway Administration (FHWA), the Federal Transit Administration (FTA), the Virginia Department of Rail and Public Transit (VDRPT), and the Virginia Department of Transportation (VDOT). The contents of this report reflect the views of the staff of the Roanoke Valley Metropolitan Planning Organization (MPO). The MPO staff is responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the FHWA, VDOT, FTA, VDRPT or RVARC. This report does not constitute a standard, specification, or regulation. FHWA, FTA, VDOT or VDRPT acceptance of this report as evidence of fulfillment of the objectives of this planning study does not constitute endorsement/approval of the need for any recommended improvements nor does it constitute approval of their location and design or a commitment to fund any such improvements. Additional project level environmental impact assessments and/or studies of alternatives may be necessary.

# Introduction

It is often difficult to communicate a vision of the benefits of Intelligent Transportation Systems (ITS) using words or written narrative.  Many citizens may not have first hand experience with different techniques of applying communications and computer technology to better manage transportation infrastructure.  What is needed is a way to visually communicate how various ITS technologies could hypothetically be applied in our region.

**What is the purpose of this document?**

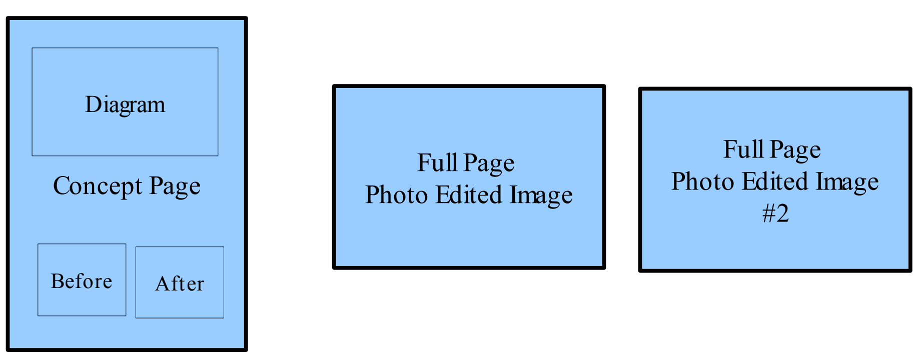
The purpose of this portfolio is to literally “create a vision” for ITS by providing plausible representations of ITS technologies applied to familiar transportation facilities such as I-81, I-581, Route 460, US 220 and Route 419.  This document is intended to serve as a first step towards a larger public discussion about the feasibility of greater use of ITS in our region.

**Who is the audience for this document?**

This document is intended for those who are currently unfamiliar or have little familiarity with Intelligent Transportation Systems (ITS).  This may include citizens, elected officials, appointed officials, business leaders or even some technically sophisticated professionals, who are interested in transportation issues.

**How is this document organized?**

Each ITS concept is presented on a concept page and followed by one or more full page photo edited images, depicting how the concept could be applied in this region.  The concept page contains a diagram explaining the particular ITS concept, a brief written description and “before” (unaltered image) and “after” (photo edited image) thumbnail images.  The full page images depict the ITS concept as applied to one or more transportation facilities in the region.



# Relationship to Metropolitan Planning Organization (MPO) and Long-Range Transportation Plan

### What is the Metropolitan Planning Organization (MPO)?

Federal law requires MPOs for urban areas with a population of 50,000 or greater. MPOs are responsible for approving the use of all federal surface transportation funds through the Regional Constrained Long-Range Transportation Plan (CLRTP) and the short range Transportation Improvement Program (TIP).

### What is the Constrained Long-Range Transportation Plan (CLRTP)?

The CLRTP has a 20-year time horizon and is updated at least every 5 years. The CLRTP sets long-range transportation priorities by constraining anticipated federal funds to specific projects or specific categories of projects.

### How does ITS relate to the Constrained Long-Range Transportation Plan?

Goal A on Page 7 of the *RVAMPO Long-Range Transportation Plan 2025* relates to technology and innovation in transportation. ITS strategies directly address Goal A.

**GOAL A: Partner with the New River Valley (NRV) to establish the combined "Roanoke Valley and NRV" as a premier transportation research and innovation region.**

- Capitalize on the proximity of the smart road and the research facilities at Virginia Tech to enhance the synergy between the Roanoke Valley and NRV by:
  - Encouraging the use of the Roanoke Valley as a "small to medium sized "**urban test bed" for emerging transportation technologies.**
  - Encouraging the combined Roanoke Valley + NRV to market itself as a home to innovative transportation industries.
- Facilitate and encourage the deployment of technology to monitor and manage traffic flow in order to increase safety and efficiency.
  - Investigate strategies to manage speed differentials between vehicles on the highway, coordinate traffic control signals, and improve safety and operations characteristics of the transportation system.
- Encourage innovative uses of ridesharing, car sharing, light rail and passenger rail possibilities.
- Encourage the transportation land use connection especially as it applies to transportation and travel demand, new urban development, transit oriented development and financial and policy initiatives.
- Encourage pedestrian use of and safety on major transportation arterials, and research on retrofitting existing transportation structures for pedestrian use.

**This goal incorporates planning factors I, II, V and VI**

***Excerpt from page 7 of RVAMPO Long-Range Transportation Plan 2025***

In addition close to $5,000,000 in federal funds was set aside for ITS and other infrastructure management improvements in the Long-Range Transportation Plan.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Improvements | | | | | | | and Bicycle enhancements |
| #16 | Signal and ITS Improvements | | | | $4,855,289 | $0 | $4,855,289 | Interconnection and coordinated signal systems & miscellaneous ITS improvements |
| #17 | [illegible] Miscellaneous Spot Improvements | | | | [illegible] | [illegible] | [illegible] | Isolated [illegible] turn lanes, geometric improvements, and other minor physical improvements |
| | | | | Total Additional Funding Needs: | | | $97,105,773 | |
| | | | | Projected Funding Available: | | | $97,105,773 | |

RVAMPO LONG-RANGE TRANSPORTATION PLAN (2025) PAGE 13

***Excerpt from page 13 of RVAMPO Long-Range Transportation Plan 2025***

## Are there any safety considerations?

Yes, application of ITS strategies may require a change in driver behavior and/or driver attention. Before any ITS strategies are applied in the field all appropriate engineering and safety studies should be performed.

## Are there any other considerations?

Yes, ITS strategies can make a visual impact and send a signal that the region is serious about applying technology to better manage infrastructure. This positive signal could make a positive impression on residents, visitors, business leaders and economic development prospects. The "goodwill" image generated by ITS is intangible, but it could be important to linking transportation to other community and economic development goals.

## Are there any economic development implications?

Perhaps, the original construction of the Eisenhower Interstate System in the 1950s, 60s and 70s opened up markets that were previously unserved by limited access transportation facilities. However, today small additions to the largely complete interstate system only add marginal value. On the other hand, a new "operations and management" approach to maximizing existing transportation infrastructure may provide a competitive advantage for early adopters. Additionally, the deployment of technology could directly benefit the regional cluster of technology companies. Finally, deployment of ITS technologies could send a signal that the region is progressive and interested in managing its own assets.

## What about costs?

ITS systems typically cost less to implement than traditional construction projects. This is because ITS systems don't often need large rights-of-way, and rarely need to displace businesses or residences. In many cases, prices for construction materials have been increasing faster than inflation. However, prices for electronic equipment and computers typically remain the same or even go down in real and inflation adjusted terms.

# Table of Contents













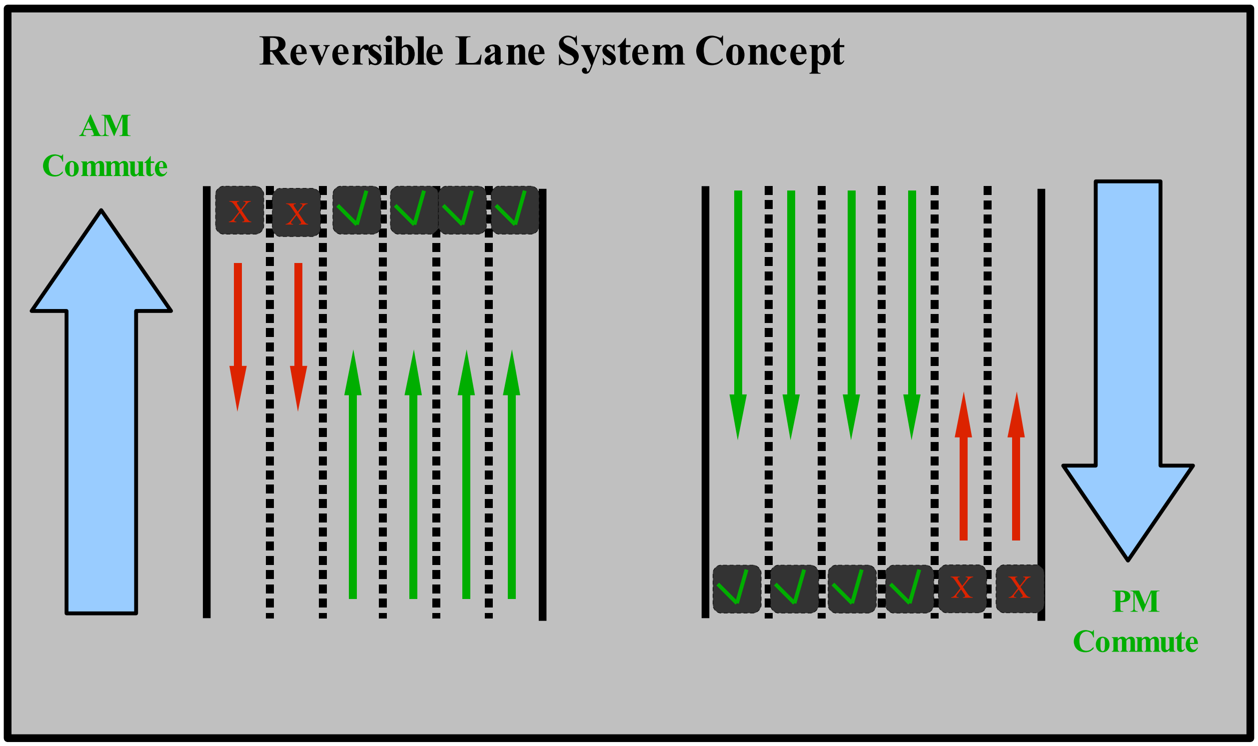

**<u>Continued on Next Page</u>**

# Table of Contents – Continued




## "Reversible Lane System" Concept

The following diagram illustrates the reversible lane system concept:




A reversible lane system concept would allow for reconfiguration of travel lanes on an existing roadway system. In the diagram above 4 of 6 lanes (left) would be dedicated to the morning commute into the urban area. Likewise, 4 of 6 lanes would be dedicated to the evening commute from the urban area. A reversible lane system is an excellent way to better manage the infrastructure already paid for by public funds, thereby reducing the need for costly facility expansion. The basic relationship between "before" (unaltered) and "after" (altered) images is presented below.

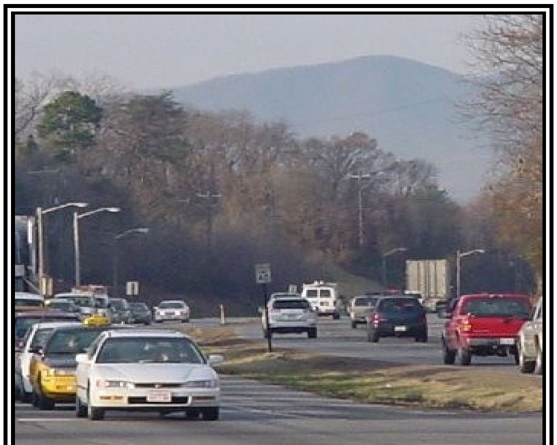


*Illustration 1: Orange Avenue Before*

*Illustration 2: Orange Avenue After*

# Conceptual Reversible Lane System
# US Route 220 Clearbrook Area


Reversible Lane infrastructure form High Point Road – Greensboro NC

# Conceptual Reversible Lane System on Route 419 Near Tanglewood Mall


Reversible lane system element from High Point Road, Greensboro, NC

# Conceptual 4-Lane Reversible System Route 24 Vinton

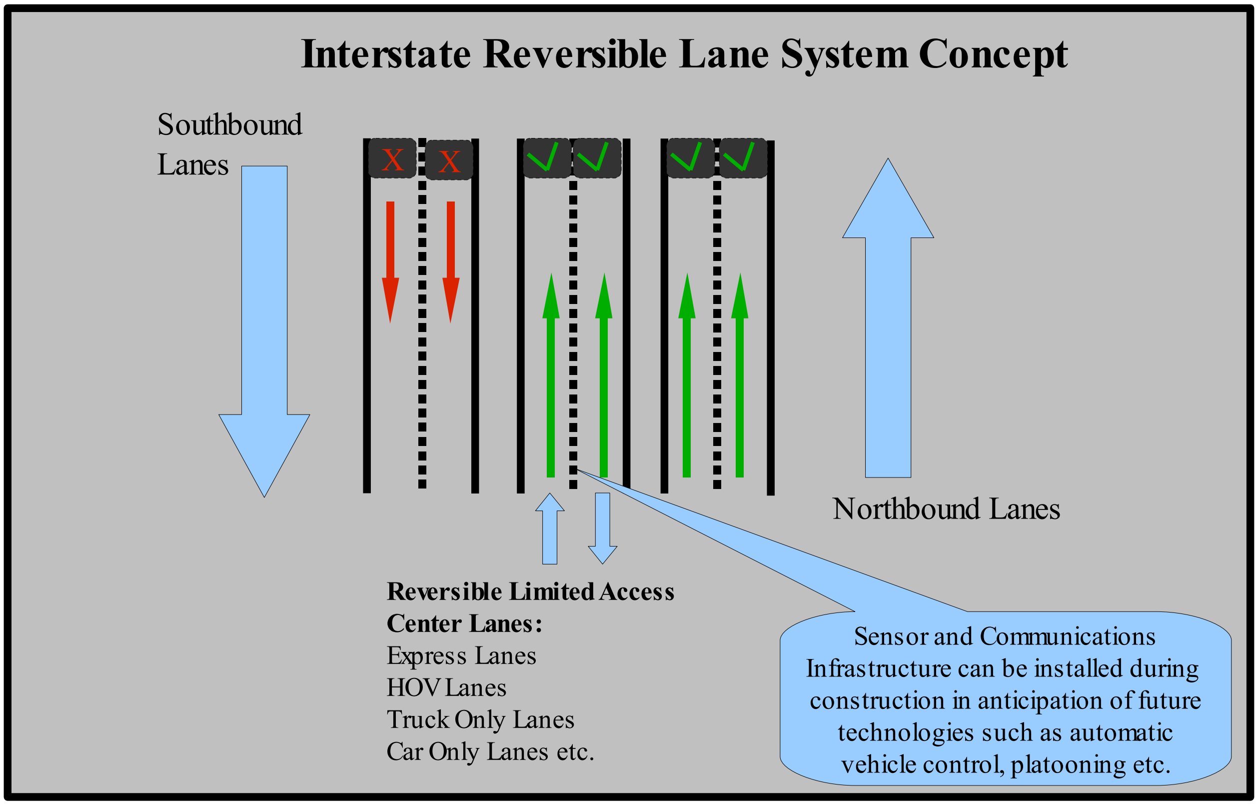

Reversible lane signals from Trois-Rivieres Quebec (Canada)
Unaltered Background Image B&W  - Reversible Signals Color

# Conceptual Reversible Lane System on Orange Avenue (Route 460) in the City of Roanoke


Reversible lane system element from High Point Road, Greensboro, NC

**Interstate Reversible Lane System Concept**

The following diagram illustrated the Interstate Reversible Lane System concept:

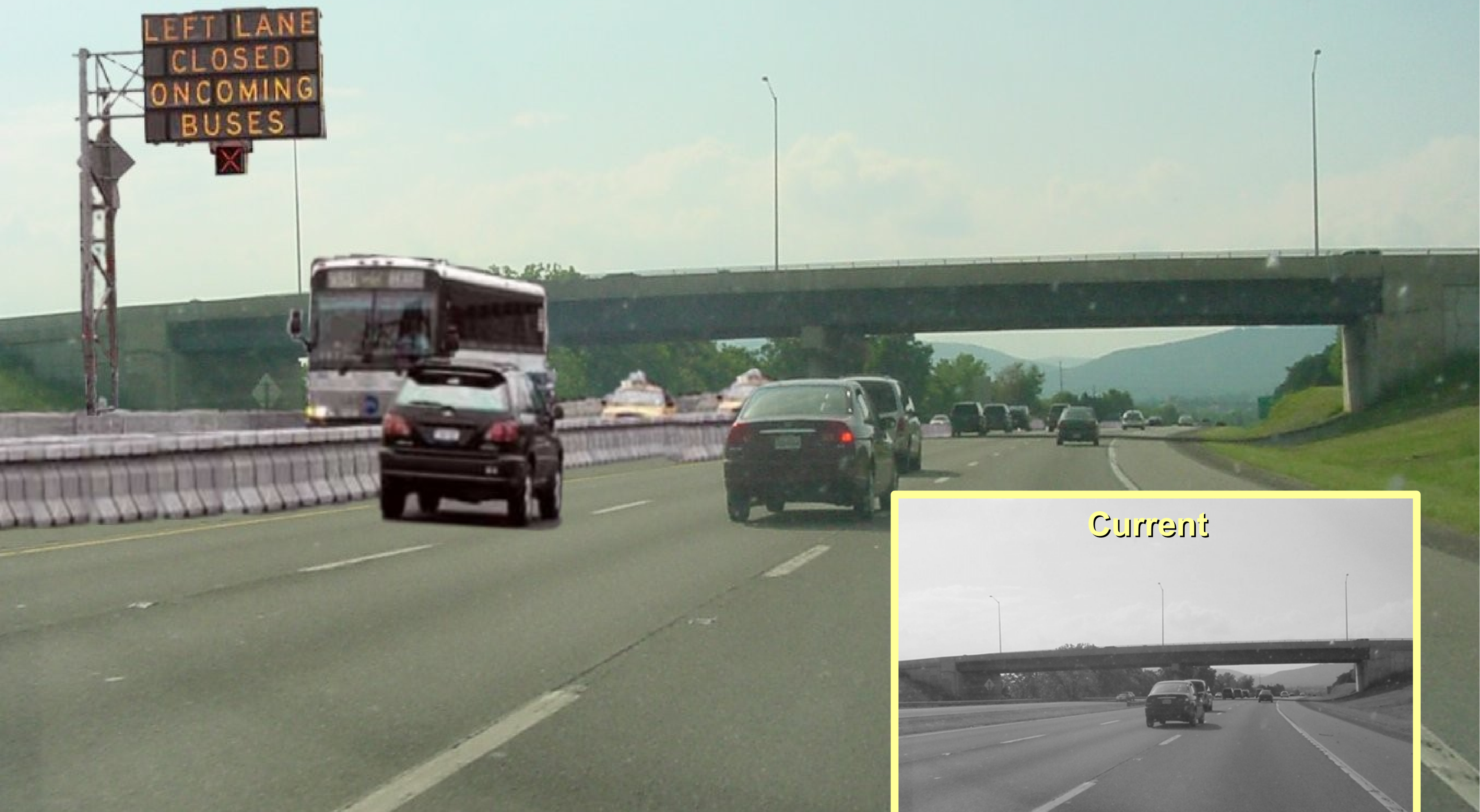



An interstate reversible lane system concept is similar to a conventional reversible lane system concept. The main difference is that the center reversible lanes are limited access and separated from the conventional interstate lanes. Vehicles enter and exit the reversible lanes through access gates at pre determined locations. The reversible lanes can be used as express lanes from Roanoke to the New River Valley, HOV lanes, car only lanes, truck only lanes etc. The reversible lanes could be used by combining the above functions, for instance, HOV lanes for commute times, express lanes during the day, truck lanes at night. Fiber optics, sensors and other technology can be installed during construction facilitation future technology such as automatically controlled platoon of trucks etc[1].


*Illustration 1: Workers laying fiber optic cables during construction*

1 Illustration of workers laying fiber optic cable courtesy of www.boulder.noaa.gov

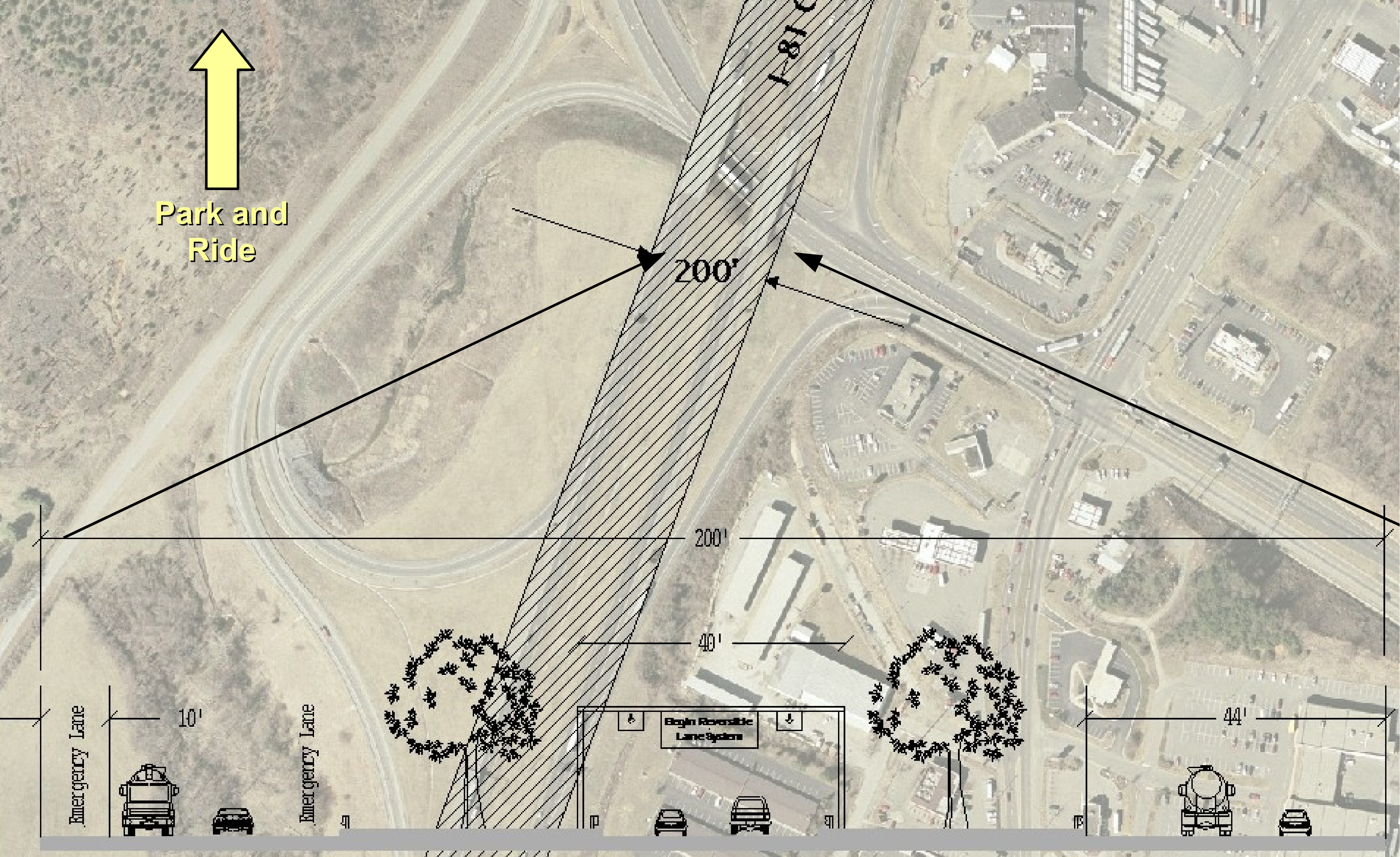
# Conceptual I-581 Reversible Lane for Transit, HOV and Taxis




Managed lane graphics from Figure 8-1 “Freeway Management and Operations Handbook” published by Federal Highway Administration (FHWA)

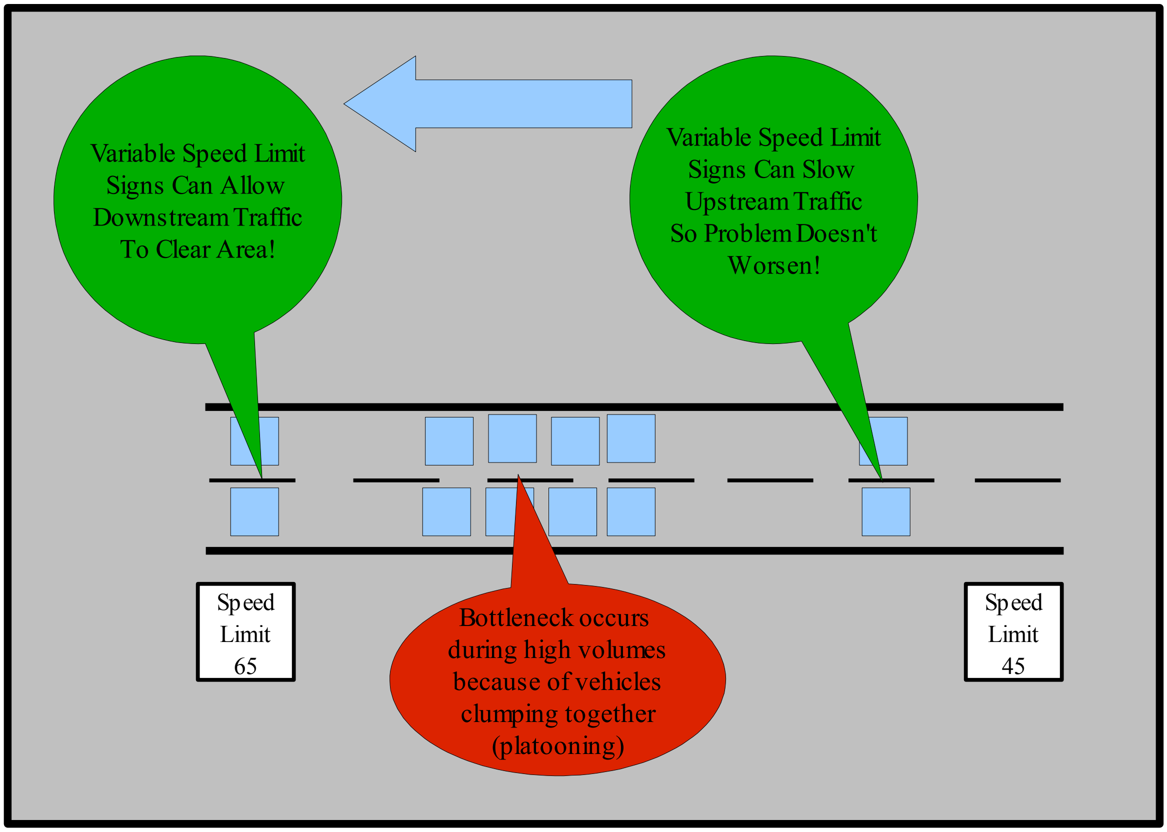
# Interstate 81 Reversible Lane Concept

# Interstate 81 Reversible Lane Concept Continued



**Traffic Flow Management**
**"Variable Speed Limit Zone" Concept**

The following diagram illustrates the "Variable Speed Limit Zone" concept:

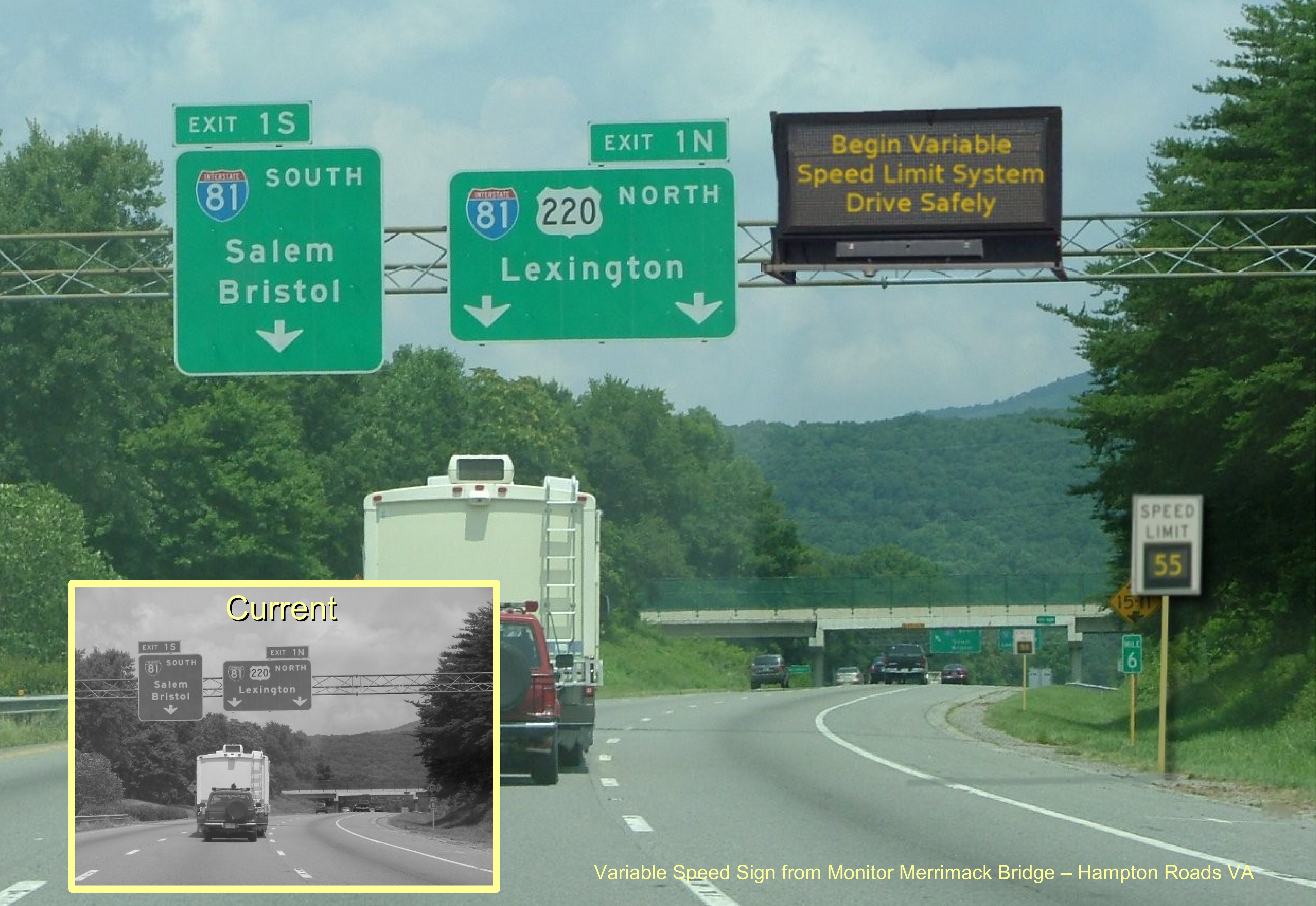



A variable speed limit zone on an interstate or divided highway section would allow speed limit adjustments in response to traffic flow conditions. Images on the following pages have been edited to include elements of a traffic flow management system. The basic relationship between "before" (unaltered) and "after" (altered) images is presented below.


*Illustration 1: I-81 Before*

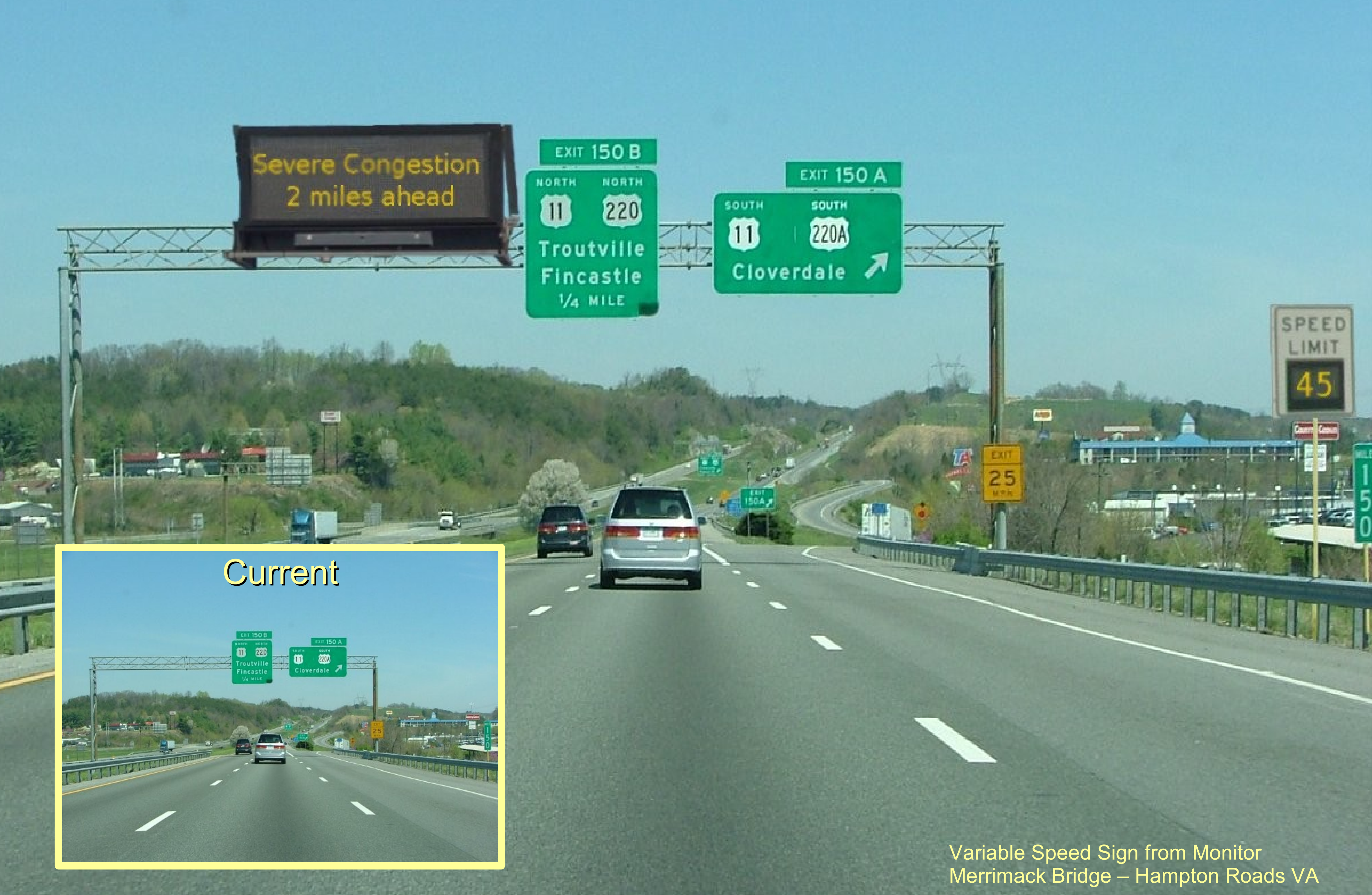

*Illustration 2: I-81 After*

# Variable Speed Limit Concept for I-581 and I-81




Variable Speed Sign from Monitor Merrimack Bridge – Hampton Roads VA

# Conceptual Variable Speed Zone I-81




Current

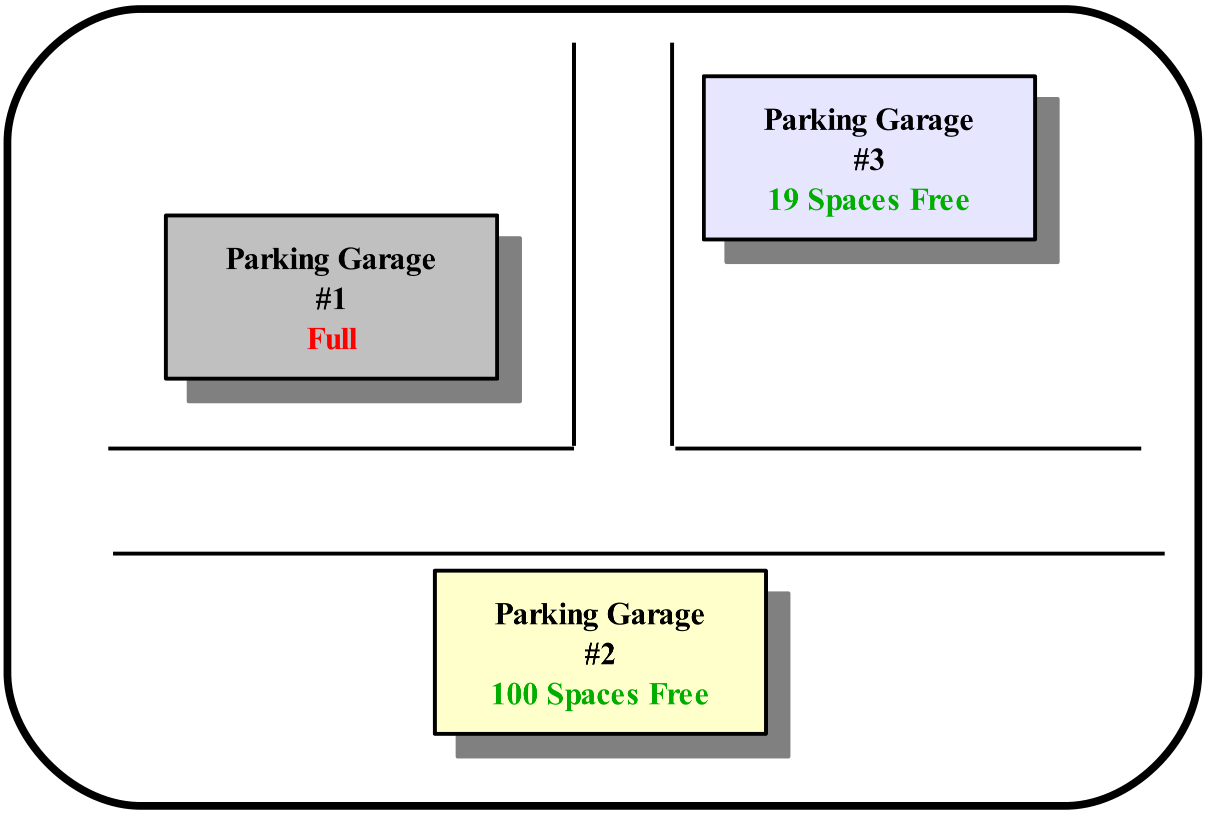
Variable Speed Sign from Monitor
Merrimack Bridge – Hampton Roads VA

# Conceptual Variable Speed Limit Zone
# US Route 220 Clearbrook Area


Reversible Lane infrastructure form High Point Road – Greensboro NC

**“Parking Management” Concept**

The following diagram illustrates the parking management concept:




In this concept Variable Message Signs would warn drivers which parking garages are full and direct drivers to parking garages with available space. This system could be combined with a common parking pass or common parking payment system to facilitate parking management. The basic relationship between “before” (unaltered) and “after” (altered) images is presented below.

*Illustration 1: Jefferson Street Before*

*Illustration 2: Jefferson Street After*

# Parking Management Variable Message Sign

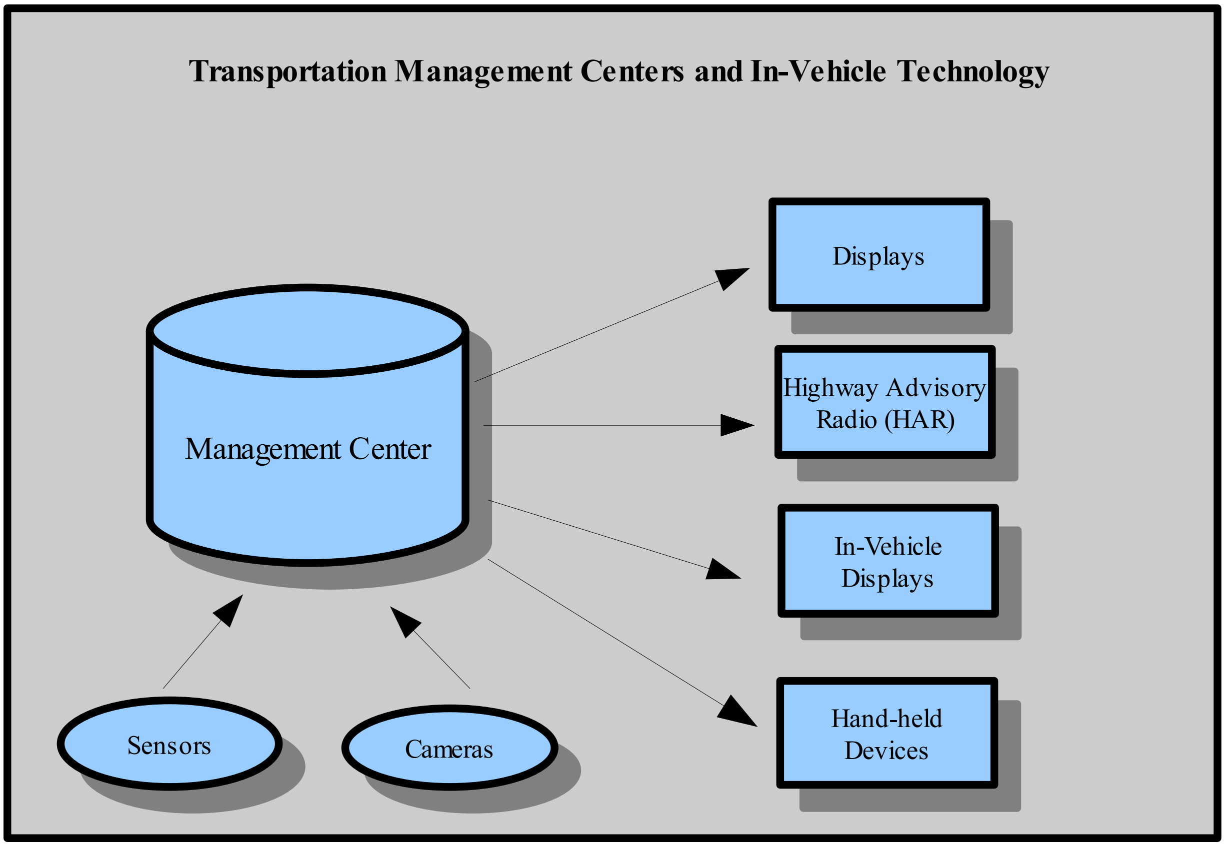

Parking Management Sign Element thanks to City of the Hague, Netherlands


# Conceptual Parking Garage Variable Message Sign System (Downtown)

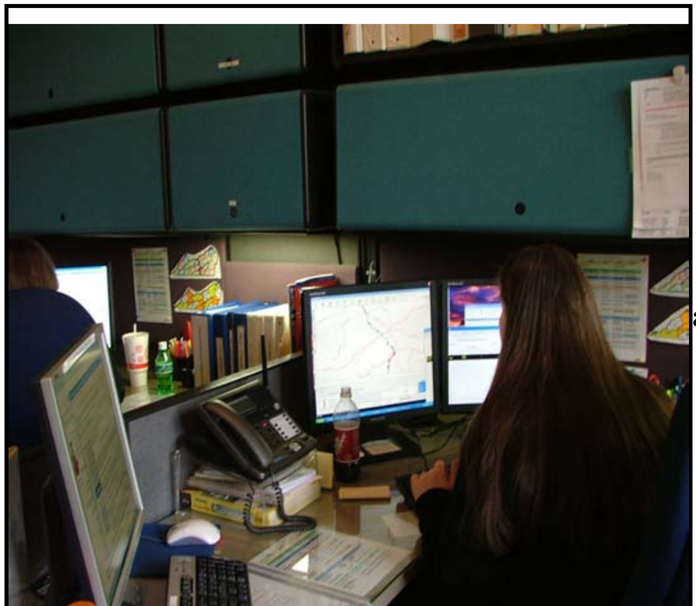
Computer Generated VMS developed by RVARC Staff

# Multi pay Street Parking System and Car Stack Parking System at Corner of Jefferson and Church

**“Transportation Management Centers, In-Vehicle Technology and Hand-held Devices ” Concept**




This concept involves behind the scenes data gathering, data analysis and information dissemination. For the vast majority of ITS concepts presented in this portfolio to work, data needs to be collected and analyzed and then given to the public in a meaningful way.


*Temporary Smart Travel Center - Salem VA*

The In-vehicle variable message sign (VMS) display, introduced in the following pages, is a conceptual idea that should be easy to produce in reality. Essentially, the messages displayed on full size VMS could be sent to a small receiver that would display the same message in the vehicle. It is likely that this could be accommodated through a conventional radio frequency.

# In-vehicle Variable Message Sign (VMS) - Conceptual


Conceptual In-vehicle VMS would receive a wireless signal that displays the same message as the nearest VMS.

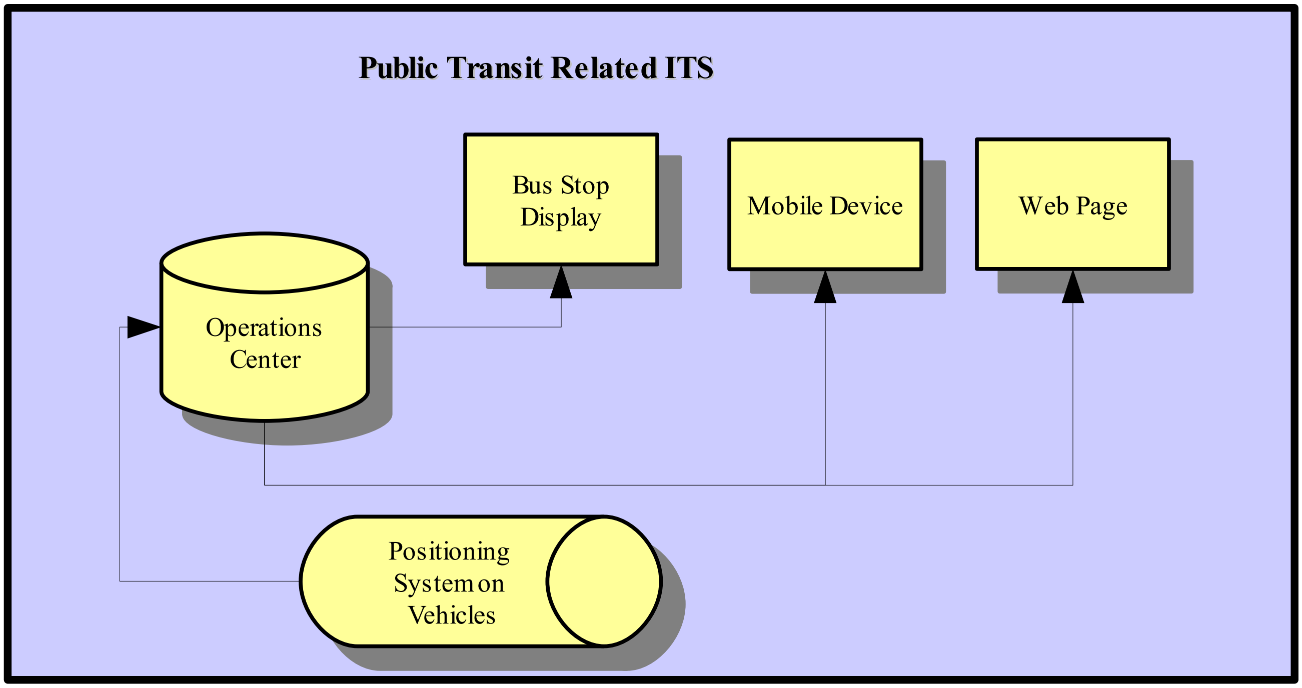
In-vehicle Mapping System (GPS)


Conceptual
Hand-held Device
Park and Ride
Exit 142
12 Spaces
Available
Accident
Exit 150
25 minute
Delay
Accident
Exit 150
25 minute
Delay

# Transportation Management Centers

Temporary location for Smart Travel Center – VDOT Salem District. Centers like this serve as the backbone for many of the ITS elements featured in this portfolio.

## “Public Transportation Related ITS” Concept




The main goal of many public transportation related ITS strategies is to get good information into the hands of the transit user or potential user. In order to provide up-to-date information transit vehicles such as buses would be outfitted with an Automatic Vehicle Location (AVL) system. This would allow operations managers to display up-to-date bus arrival times at bus stops and to display current vehicle locations on websites or through compatible mobile and hand held devices.

This technology could open up additional ridership markets to transit systems. For example, a downtown employee could park a car once and take transit (using arrival time information) in order to avoid “in-and-out” parking changes. It would also benefit traditional transit customers.


***Before***


***After***

# Bus Arrival Variable Message Sign


Bus Arrival VMS Courtesy of Rex Gephart –
City of Los Angeles, CA

# Bus Arrival VMS at Smart Way Stop


Variable Message Sign Image Courtesy of Translink (Vancouver BC, Canada)


0403
STOP REQUESTED
0403
D STREET & WINDS
In Vehicle Variable Message Signs

**"Virginia Tech Transportation Institute (VTTI) Research"**

The Virginia Tech Transportation Institute (VTTI) is an interdisciplinary, multi-disciplinary, university-level research center of Virginia Tech. VTTI was established in August 1988 in response to the U.S. Department of Transportation's University Transportation Centers Program. In cooperation with the Virginia Department of Transportation, VTTI's primary mission is applied research, which is accomplished by attracting a multi-disciplinary core of researchers and by educating students in the latest transportation technologies through hands-on research and experience. In 1996, the Institute was designated as one of three Federal Highway Administration/Federal Transit Administration Intelligent Transportation Systems (FHWA/FTA ITS) Research Centers of Excellence. Since then, VTTI has grown tremendously and has garnered a reputation as one the leading transportation research institutions in the nation. Its cutting-edge research is effecting significant change in public policies in the transportation domain on both the state and national levels.[2]

*Virginia Tech Transportation Institute (VTTI)*

The Smart Road in southwest Virginia is a unique, state-of-the-art, full-scale research facility for pavement research and evaluation of Intelligent Transportation Systems (ITS) concepts, technologies, and products. It is currently a 2.2 mile two-lane road and includes a 2,000 foot bridge, which is one of the highest in Virginia standing at 170 feet. When the entire 5.7 mile project is completed, the Smart Road will be a four-lane, limited access highway between Blacksburg and Interstate 81.[3]

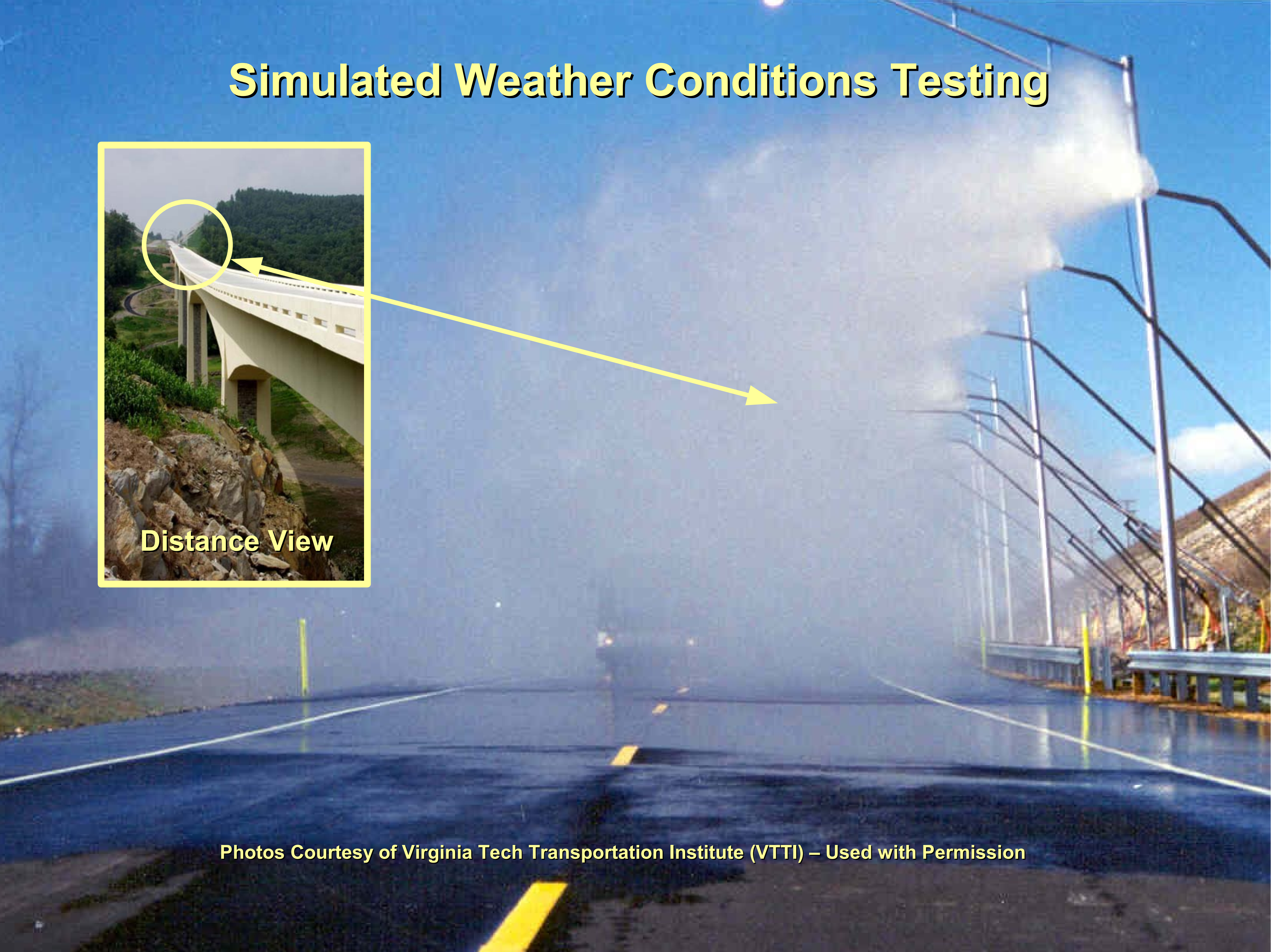
VTTI is just 45 minutes from most localities served by the Roanoke Valley Area Metropolitan Planning Organization (RVAMPO). As such there can be a natural connection between technologies and products tested at VTTI and their eventual deployment in the RVAMPO Study Area. The following pages contain images from two aspects of VTTI research that should have positive effects on transportation safety in the RVAMPO Study Area. The first image deals with school bus safety enforcement. VTTI recently tested an automatic camera system that would photograph vehicles that illegally pass stopped school buses, thus endangering boarding and exiting school children. The second image depicts the all weather testing capabilities of the smart road. These facilities allow VTTI to test technologies ranging from improved pavement markings to in-vehicle anti-skid systems.

These two images demonstrate the interdisciplinary nature of many ITS systems. These systems allow public officials to think about transportation solutions in new ways. Future transportation safety or transportation congestion problems will likely be solved using a combination of technology, management and bricks and mortar approaches.

2 Narrative from http://www.vtti.vt.edu/
3 Ibid.


# School Bus Enforcement (School Bus Passing Enforcement)

Photos Courtesy of Virginia Tech Transportation Institute (VTTI) – Used with Permission


Simulated Weather Conditions Testing
Distance View
Photos Courtesy of Virginia Tech Transportation Institute (VTTI) – Used with Permission