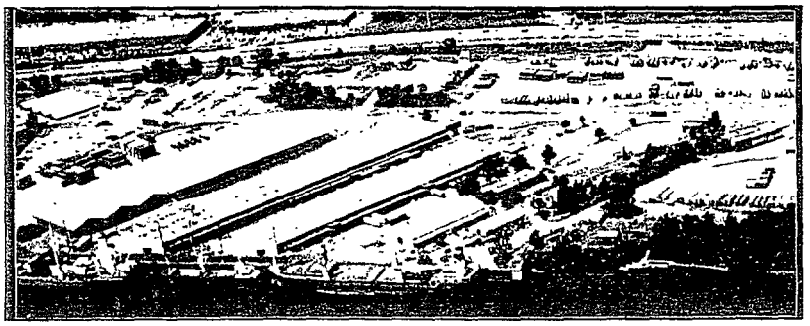
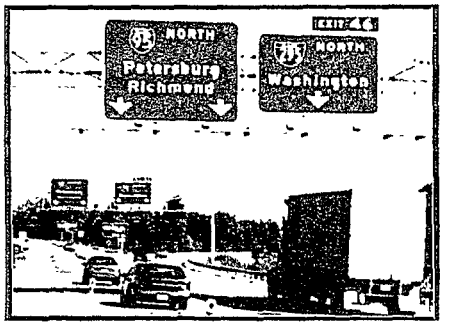
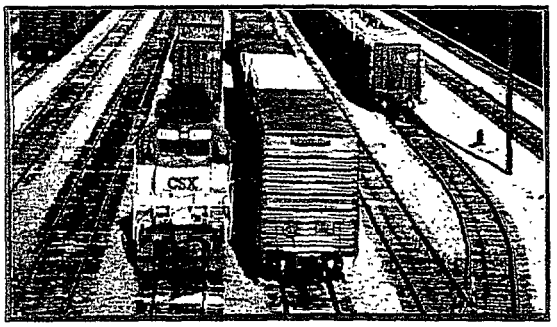
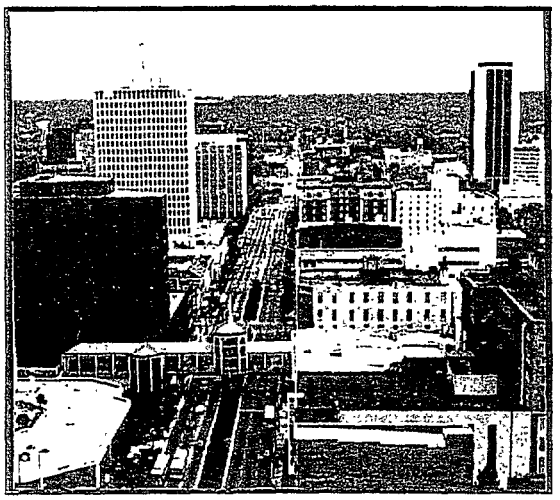
Virginia Department of Transportation

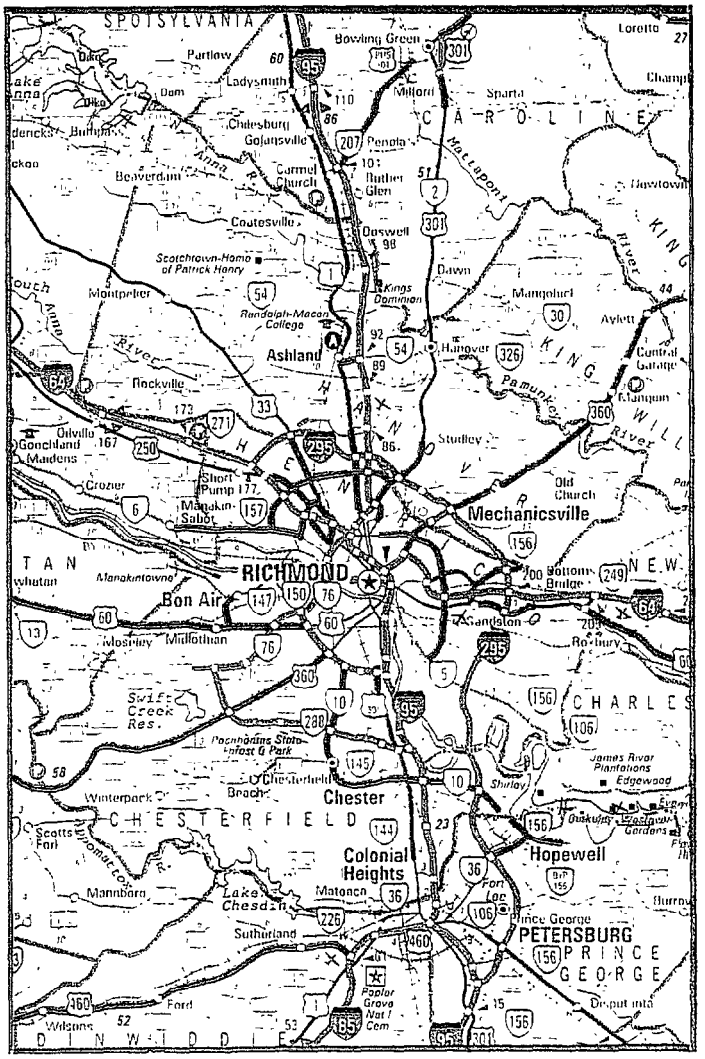
ITS Early Deployment Study
Richmond/Tri-Cities Area
User Service Plan











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Frederic R. Harris, Inc.
Fairfax, Virginia

May 1996

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EXECUTIVE SUMMARY

INTRODUCTION

The Richmond/Tri-Cities Intelligent Transportation Systems (ITS) Early Deployment Study (EDS) Project is following the ITS planning process guidelines established by the Federal Highway Administration (FHWA) and contained in the "IVHS Planning and Project Development Process" document. The first eight steps of this process, shown in Figure S-l, will be completed as a part of the current project. The remaining two steps involve the actual implementation of the projects that are selected on the basis of these initial activities.

The essence of the ITS planning process is to develop each ITS program on the basis of the needs of the users and operators of the transportation facilities. Although the process is the same nationwide, the results are customized in each community to address their particular set of local needs.

As shown in Figure S-l, this User Service Plan marks the midpoint of the study and documents the results of the initial steps in the ITS planning process. This documentation of the conclusions and results that have been reached so far also provides the rationale for the orientation the project will take in its remaining steps.

The results of the interviews, data collection activities, analyses and discussions with the project steering committee are presented in this report. A series of Appendices has also been prepared containing the details of this work.

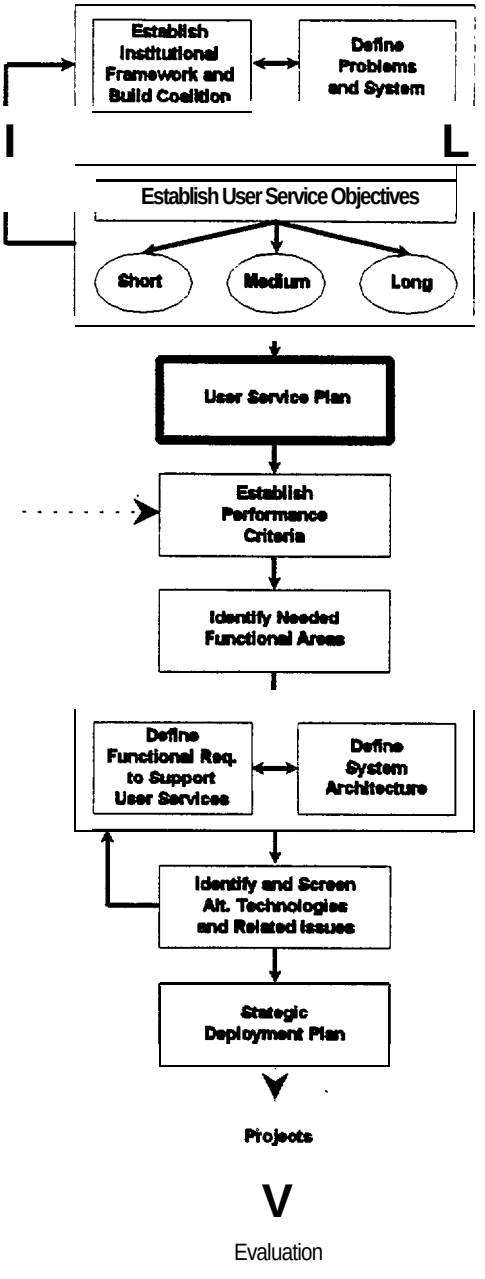

Figure S-l
ITS **PLANNING PROCESS**

PROBLEM DEFINITION AND OPPORTUNITIES

A major component of the work performed on the project has been the identification of key problem areas and issues that can be addressed through the use of ITS technologies.

The first step in identifying these key problem areas and issues was developing an understanding of the transportation systems in the Richmond/Tri-Cities region. This initial step consisted of gathering and assimilating current data regarding these systems.

The data review established the basis for collecting additional information through meetings, interviews, and focus group sessions with individuals and groups associated with the regional transportation systems. The objective was to identify the key problems and issues to be addressed in this project. Data collection included:

- **Interviews with Federal Transportation Agencies -** Interviews with representatives from the Federal Highway Administration (FHWA) and Amtrak Rail.

- **Interviews with State Transportation Agencies** - Interviews with representatives from the Virginia Department of Motor Vehicles (DMV) and the Department of Railways and Public Transportation.

- **Interviews with VDOT District Staff and Other Agencies** - Interviews with representatives from the 6 VDOT residencies in the Richmond District, including the District and Central Offices, Maintenance, Traffic Engineering, Transportation Planning and Urban Divisions and the Powhite Parkway Extension. Interviews with representatives from the Virginia State Police.

- **Interviews with Local Government** - Interviews with representatives from the following counties: Charles City, Chesterfield, Dinwiddie, Goochland, Hanover, Henrico, New Kent, Powhatan, Prince George. Interviews also included representatives from the following cities: Colonial Heights, Hopewell, Petersburg, Richmond, and the Town of Ashland. An interview was also conducted with the Town of Ashland Police.

- **Interviews with Authorities and Commissions** - Interviews with representatives from the following authorities and commissions: Richmond Metropolitan Authority, Capital Region Airport Commission, Crater Planning District Commission, Richmond Regional Planning District Commission and the Port of Richmond Commission

- **Interviews with Private Sector Organizations -** Interviews with representatives from the following private organizations: AAA of Virginia, Overnite Transportation Company, Greater Richmond Transit Company, Metro Traffic Control, Norfolk Southern Corporation, Robinson Transportation Company, Old Dominion Freight, Ridefinders and VPSI Commuter Vanpools.

- **Public Outreach Effort Including Interviews with Community and Civic Groups** - Interviews and focus group sessions with community and civic groups including: the Goochland County Planning Commission Comprehensive Plan Transportation Committee, MPO Citizens' Transportation Advisory Committee, Richmond Highway Safety Commission, Virginians for Better Transportation/Virginia Road and Transportation Builders Association, City of Hopewell Transportation Safety Commission, Huguenot Neighborhood Team Process Group, Henrico County Highway Safety Commission, Colonial Heights Chamber of Commerce, Midlothian Neighborhood Team Process Group, East District Neighborhood Team Process Group, Far West Neighborhood Team Process Group and the Petersburg Chamber of Commerce.

SYNTHESIS OF PROBLEMS AND OPPORTUNITIES

Based on the system data collected, compiled and obtained from these interviews, a comprehensive list of Richmond/Tri-Cities regional problems and issues that could be addressed by ITS technologies was established. This list is shown in Table S-l.

DEVELOPMENT OF THE VISION STATEMENT

A vision statement is a way of identifying the project and its individual components to the general public. Just as commercial enterprises attach their slogan to their products and use it to present a corporate identity, the vision statement gives an identity to the Richmond/Tri-Cities ITS program and to the individual projects that will emerge from it. The theme in this vision statement is expressed in terms that everyone can understand: how the lives of the travelers in the region will be improved by the deployment of ITS technologies.

The Steering Committee, with assistance from the consultant, created the Vision Statement for this project. The first step to drafting a statement was for the consultant to explain its purpose and how it might be used. The committee, working in four groups of four or five individuals, proposed an initial series of vision statements. Then, through discussion, the committee members exchanged ideas on their and each other's statements. The groups then reconvened and drafted refined versions of their vision statements. The consultant then polled the group and did final editing on a consolidated vision statement. This statement was presented to the group again at a subsequent Steering Committee Meeting and accepted by the committee members. It is:

"Safely moving and informing the region of better choices."

This statement summarizes the ideals of the committee, and all ITS projects developed out of this study will ultimately reflect the concept of this statement.

TABLE S-l
SUMMARY OF PROBLEMS AND OPPORTUNITIES

Travel and Transportation Management

- There is inadequate information for tourists, local residents and businesses about tourist attractions, alternate routes or planned construction activities.
- There is a lack of regular traffic reports in some areas outside of the City of Richmond.
- There is interest in providing real-time information via telephone and cable TV.
- Need to improve intersections and signal system coordination and timing.
- Red light running, speed enforcement, railroad crossings, maintenance and snow removal efforts are regional concerns.
- We need to collect information for traffic 'management and increase surveillance at the l-95/1-64 interchange.
- VMS units will be constructed on l-95 N and S of the l-95/I-295 interchanges.
- The region has strong mutual aid agreements, but coordination and field communications among VDOT, VSP, fire departments and local administration should be improved.
- Diversion routes with older bridges may be inadequate for some links on major interstates.
- The VDOT TEOC is a resource that might be better used.
- The University of Richmond and Virginia Commonwealth University present FM radio traffic broadcasting opportunitjes with their stations.
- Improvements to AM broadcasting facilities should be investigated.

Travel Demand Management

- There should be more promotion of car pooling/ride sharing, targeting employers in addition to individual workers.
- Ridefinders actively promotes ridesharing.
- Additional park and ride lots should be constructed where needed.
- Parking downtown is limited and expensive.
- Improvements to local road networks are needed to improve accessibility to new developments, but getting approvals from residents and jurisdictions can be difficult.

Public Transportation Operations

- Dispatchers should have the ability to call drivers in emergencies.
- Bus service should be coordinated on a regional basis and should include businesses, malls, medical facilities and transportation centers.
- Bus service for the disabled could be improved.
- Taxi service needs to be improved.
- Bus shelters should be provided at key locations.
- There are locations along the Amtrak routes that present opportunities for use and upgrading service. The downtown multi-modal center will have a Greyhound bus terminal in 2003.

Electronic Payment

- Electronic toll systems will be installed at the airport and are being considered by the RMA and VDOT.

Commercial Vehicle Operations

- The Port has a lack of clearance for double stack trains and poor rail service connections.
- CSX operates a terminal in the Richmond area, which serves as a point of distributing freight from rail to other transport modes.

Emergency Management

- A separate cellular non-emergency call number would be of benefit for reporting all minor incidents to the VSP.
- VDOT needs to develop a heavy-duty wrecker list that includes only those providers that meet minimum standards.
- Some fire fighting equipment is incompatible from county to county.

ITS USER SERVICES

The May 1994 Draft of the "National Program Plan for Intelligent Vehicle-Highway Systems" (IVHS) established six "bundles" which represent logical groupings of the then recognized 28 IVHS User Services. The March 1995 release of the "National ITS Program Plan" reorganized these user services into seven bundles and reflected the addition of Emissions Testing and Mitigation, the 29th user service. Table S-2 shows the most current listing of the user service bundles and these user services.

ITS USER SERVICE IMPLEMENTATION LEADERSHIP

The ITS User Services listed in the preceding table will be implemented through the leadership of many organizations. In some instances the organizations leading the implementation efforts are public agencies, in others they are private sector firms, and in a few a public-private partnerships. In several cases leadership opportunities exist for both the public and the private sector.

A preliminary screening was performed to identify the user services that require the leadership of the public sector and those that are primarily dependant upon private sector leadership. This screening was also based on materials contained in the "National Program Plan for Intelligent-Vehicle Highway Systems", as well as the discussions that have taken place with VDOT staff and the other members of the Steering Committee, interviews with agency representatives, and the focus group meetings.

It seems clear that the Richmond/T+Cities ITS Early Deployment Project will have limited influence on ITS User Services in which the private sector must take the lead. The implementation priorities for the user services whose leadership rests primarily with the private sector will be determined by the private sector's evaluation of the risks and rewards associated with these user services. However, for purposes of this project these user services will be considered as part of the long-term deployment group.

In addition, although the Automated Highway System (AHS) has 'some leadership opportunities in the public sector, it will also be considered as a user service with a long-term implementation time frame. Implementation of this user services will clearly be based on a public-private partnership that will be addressed as part of a national program. Moreover, the deployment time-frame for the AHS is far enough in the future that it is unlikely that any short- or medium-term actions could be take as part of the current project to advance its implementation.

The efforts and resources of this project will, therefore, be concentrated on the ITS User Services in which there are leadership opportunities for the public sector.

TABLE S-2
ITS USER SERVICES

TRAVEL AND TRANSPORTATION MANAGEMENT	COMMERCIAL VEHICLE OPERATIONS
• En-Route Driver Information • Route Guidance • Traveler Services Information • Traffic Control • Incident Management • Emissions Testing and Mitigation [1]	• Commercial Vehicle Electronic Clearance • Automated Roadside Safety Inspection • On-Board Safety Monitoring • Commercial Vehicle Administrative Processes • Hazardous Materials Incident Response • Freight Mobility [3]
TRAVEL DEMAND MANAGEMENT	**EMERGENCY MANAGEMENT**
• Pretrip Travel Information • Ride Matching and Reservation • Demand Management and Operations [2]	• Emergency Notification and Personal Security • Emergency Vehicle Management
PUBLIC TRANSPORTATION OPERATIONS	**ADV. VEHICLE CONTROL AND SAFETY SYSTEMS**
• Public Transportation Management • En-Route Transit information • Personalized Public Transit • Public Travel Security	• Longitudinal Collision Avoidance • Lateral Collision Avoidance • Intersection Collision Avoidance • Vision Enhancement for Crash Avoidance • Safety Readiness • Pre-Crash Restraint Deployment • Automated Highway Systems
ELECTRONIC PAYMENT	
• Electronic Payment Services	

1 Added March 1995
2 Renamed from Travel Demand Management
3 Renamed from Commercial Fleet Management

ITS USER SERVICE PRIORITIES

Priorities for the remaining ITS User Services were selected in conformance with the guidelines developed by FHWA. The three major factors used to determine the short-, medium-, and long-term user service objectives are: the ability of the user services to address the goals identified for this project; the need for these user services in the community; and the ability to implement these user services. These factors were evaluated independently for each of the ITS User Services. The results of these independent analyses were then combined to produce the overall ranking for the user services shown below in Table S-3.

TABLE S-3
OVERALL ITS USER SERVICE IMPLEMENTATION PRIORITIES

SHORT-TERM (1-3 Year Implementation)	MEDIUM-TERM **(4-7 Year Implementation)**
Incident Management*	**Traveler Services Information**
En-Route Driver information *	**Public Transportation Management**
Pre-Trip Travel Information	**Demand Management and Operations**
Ride Matching and Reservation	**Personalized Public Transit**
Traffic Control	**Electronic Payment Services**
LONG-TERM PUBLIC AND PUBLIC/PRIVATE SECTOR (7-20 **Year Implementation)**	**LONG-TERM PRIVATE SECTOR** (7-20 Year Implementation)
Route Guidance	**Longitudinal Collision Avoidance**
Emergency Vehicle Management	**Lateral Collision Avoidance**
En-Route Transit Information	**Intersection Collision Avoidance**
Emissions Testing and Mitigation	**Vision Enhancement for Collision Avoidance**
Public Travel Security	**Safety Readiness**
Automated Roadside Safety Inspection	**Pre-Crash Restraint Deployment**
Commercial Vehicle Administrative Processes	**Automated Highway Systems**
Hazardous Materials Incident Response	**On-Board Safety Monitoring**
Commercial Vehicle Electronic Clearance	**Freight Mobility**
	Emergency Notification and Personal Security

*** Immediate action implementation plans should be developed for these User Services.**

SECTION 1
INTRODUCTION

1.1 DESCRIPTION OF THE EARLY DEPLOYMENT STUDY

1.1.1 Project Objectives

This project has three overall objectives. The first is to identify opportunities for the application of ITS technology in the Richmond/Tri-Cities area. The second is to develop a Strategic Deployment Plan that integrates these improvements with the existing systems. The third is to enhance the ability of the jurisdictions in the region to coordinate their transportation related activities.

These applications of ITS technologies must address the needs of the community that were identified through the interviews with the agency staff, business representatives, and the focus groups sessions comprised of people from various communities. These improvements should not be viewed as isolated systems that are implemented independently. Indeed, whenever possible, their implementation should be integrated into other transportation improvement projects.

It is anticipated that several of the existing systems will serve as linchpins that will help bind these new systems and improvements together. These include the signal systems operated by the City of Richmond and the Virginia Department of Transportation (VDOT), as well as VDOT's Transportation Emergency Operations Center (TEOC).

Through their implementation, these technological improvements will make enhanced coordination among the jurisdictions possible. However, it is equally, if not more, important for these physical improvements to be complemented by institutional agreements that reflect a desire for improved working relationships among the jurisdictions.

1.1.2 Program Process

This ITS Early Deployment Study is following the basic steps defined in the Federal Highway Administration's "IVHS Planning and Project Deployment Process." This ten-step process is shown in Figure l-l. The first eight of the steps will be completed as part of this Early Deployment Study. The remaining two steps, project implementation and evaluation, will be completed later. One minor change that has been incorporated into this figure is the order of the activities involving the preparation of the User Service Plan and the Establishment of Performance Criteria.. These steps will be conducted in the order shown in this figure, in keeping with the practice on other projects and the recommendations contained in the "Evaluation of the ITS Planning Process" prepared by the Virginia Transportation Research Council.

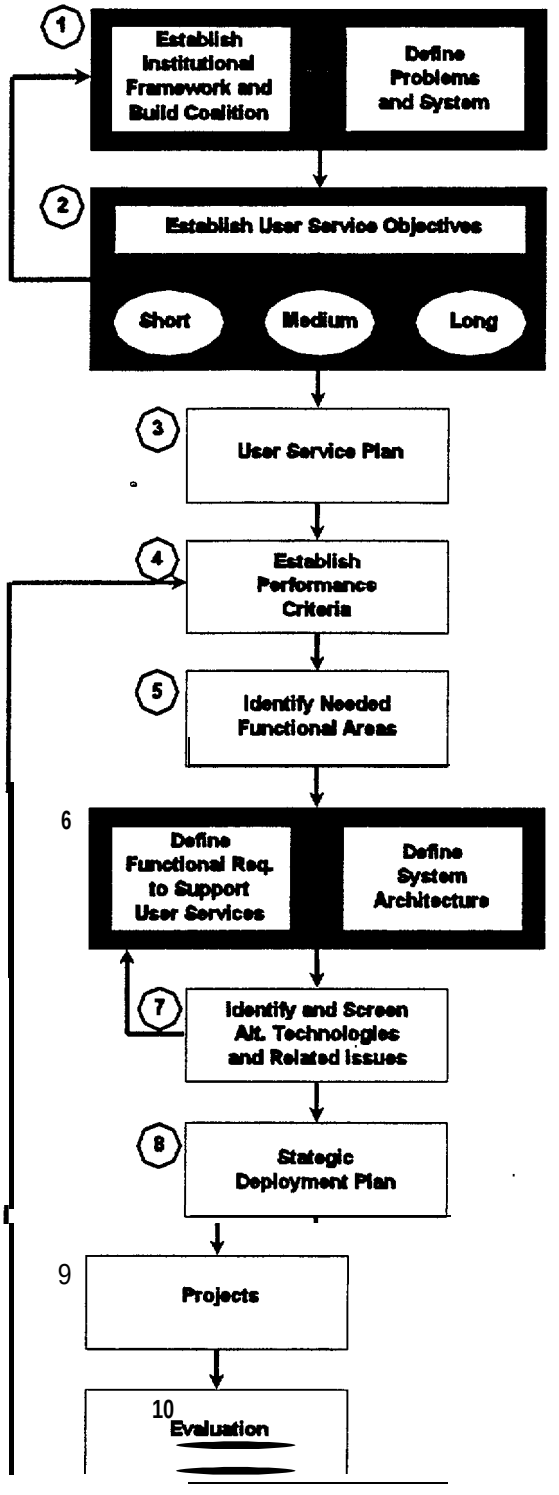

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Figure I-I

IVHS Planning and Project Deployment Process

It should also be noted that this process is being conducted by the Frederic R. Harris project team with the aid of the Steering Committee. This Steering Committee is a critically important part of this effort. It has furnished data, assisted in the evaluations that have taken place, and provides guidance that is sensitive to local needs and conditions.

1.1.3 Topics to be Addressed in the Final Recommendations

Step Eight of the Planning and Deployment Process is the preparation of the Strategic Deployment Plan. This plan is, in essence, the final product and final report for the project. The document will include the following materials:

- identification of the ITS user services and functions appropriate for implementation in the Richmond/T+Cities area, and the time frame for their deployment;

- a schedule for the selected services to be implemented in the short-term that includes a time line and cost estimates, and the identification of key institutional issues that must be resolved in order to ensure successful deployment;

- documentation of the functions, functional requirements, technology analysis, and system architecture; and

- an operations plan for implementing the ITS Strategic Deployment Plan that addresses operations and maintenance requirements, and that includes estimates of the annual operations and maintenance budgets required to adequately support the recommended implementation.

1.1.4 Project Goal

The overall goal of the project is to provide VDOT and the local jurisdictions in the Richmond/T&Cities area with a "road map" for integrating ITS capabilities into the transportation systems of the region. This road map will consist of a vision that concisely states what the Strategic Deployment Plan is trying to achieve, a series of projects showing the steps that will be taken to achieve this result, a system architecture that indicates how all of the pieces and projects fit together, performance criteria that will be used to measure improvements in the ITS User Services that are important to the region, and funding options that can be used to finance the achievement of this goal.

1.2 DEVELOPMENT OF THE VISION STATEMENT

1.2.1 What is a Vision Statement?

The Richmond/T&Cities ITS Early Deployment Study will have far-reaching effects. Geographically, the study encompasses an area of more than 2,000 square miles and a resident population of nearly 900,000. Diversity is, therefore, an inherent element of this project. The goals, objectives, and methods of accomplishing these objectives are subject to a variety of interpretations. The vision statement is an effort to summarize the project in a manner that represents a consensus and verbalizes this consensus in a short, memorable statement.

The vision statement is also a vehicle for identifying the project and its individual components to the general public. Just as commercial enterprises attach their slogan to their products and use it to present a corporate identity, the vision statement gives an identity to the Richmond/Tri-Cities ITS program and to the individual projects that will emerge from it. The theme in this vision statement is expressed in terms that everyone can understand: how the lives of the travelers in the region will be improved by the deployment of ITS technologies.

1.2.2 Development of the Vision Statement

The Steering Committee, with assistance from the consultant, created this Vision Statement by working in small groups and as a whole. The first step to drafting a statement was for the consultant to explain its purpose and how it might be used. The committee, working in four groups of four or five individuals, proposed an initial series of vision statements. Some of the groups also drafted a slogan as a shorter version of their longer vision statements. Then, through discussion, the committee members exchanged ideas on their and each other's statements. The groups then reconvened and drafted refined versions of their vision statements. The consultant then polled the group and did final editing on a consolidated vision statement. This statement was presented to the group again at a subsequent Steering Committee Meeting and accepted by the committee members. It is:

"Safely moving and Informing the region of better choices"

This statement summarizes the ideals of the committee, and all ITS projects developed out of this study will ultimately reflect the concept of this statement.

1.3 RELATIONSHIP OF THE USER SERVICE PLAN TO THE OVERALL PROGRAM

1.3.1 What is a User Service Plan

This User Service Plan is an important interim milestone in the Deployment Study process. It has two separate but related objectives: first, to document the results of the problem identification task and identify the key characteristics of the existing systems that can be incorporated into a regional ITS System; and second, to identify and prioritize the ITS User Services that are most important for the community based on an assessment of the users' needs.

1.3.2 Development of the User Service Plan

This User Service Plan fulfilled the objectives identified in the preceding paragraph through a series of activities that are reported in the following sections of this document and the associated appendices. These activities focused on gathering information about the area's transportation systems, and the analyses of these data. These analyses determined which of the ITS User Services are most important to the region and the priorities for these user services. Through this process, the User Service Plan provides answers to the following questions:

- Which ITS User Services can the agencies help implement through their leadership?
- Which ITS User Services will be implemented by the private sector?
- Which ITS User Services best address the goals of the community?
- Which ITS User Services best address the transportation needs of the community?
- Which ITS User Services are most easily implemented or improved in some form, and which are the most difficult to implement or improve?

1.3.3 Why this User Service Plan is Necessary

The next activities in the ITS Planning Process will decide how to implement the ITS User Services that are most important to the community. It is critically important that the Steering Committee reflect and confirm the selection of user services. A correctly prioritized list of the recommended user services will ensure that the remaining steps in the planning process will be focused properly. These steps include:

- establishing performance criteria that will measure the effectiveness of the user services;
- identifying the functions that are needed to implement the user services;
- defining a systems architecture will link these functions, and the jurisdictions, together to serve the community;
- identifying the technologies that can be used to implement the functions most appropriate for deployment in the Richmond/T&Cities area; and
- preparing of the Strategic Deployment Plan that will document these efforts and provide the road map.

1.4 INFORMATION GATHERING ACTIVITIES

As indicated previously, the first objective of this User Service Plan is to document the results of the problem identification task and identify the key characteristics of the existing systems that could be incorporated into an ITS System that best serves the needs of the community. This problem identification effort was conducted through: an extensive series of interviews with agency personnel and selected representatives of the businesses in the area; focus group sessions with representatives of the residents of the community; and discussions with the project Steering Committee. These activities are summarized in the following subsections.

1.4.1 Interviews

Interviews were held with personnel from the local agencies and selected businesses in the greater Richmond/Tri-Cities area. The selection of the jurisdictions, agencies and people that were interviewed was oriented toward obtaining a comprehensive set of data, facts, opinions and subjective judgements from all of the agencies that might benefit from the implementation of an ITS program. A list of the agencies and other organizations that were interviewed is shown in Table l-l.

TABLE l-l
ORGANIZATIONS INTERVIEWED

STATE

Virginia Department of Motor Vehicles
Virginia Department of Rail and Public Transportation
VDOT - Central Office Maintenance Division
VDOT - Richmond District Traffic Engineering Division
VDOT - Traffic Engineering Division
VDOT - Transportation Planning Division
VDOT - Urban Division
Virginia State Police
VDOT - Powhite Parkway Extension
Virginia Transportation Research Council

LOCAL

Charles City County Government
Chesterfield County Government
City of Colonial Heights
City of Hopewell
City of Petersburg
City of Richmond
Dinwiddie County Government
Goochland County Government
Hanover County Government
Henrico County Government
New Kent County Government
Powhatan County Government
Prince George County Government
Town of Ashland

AUTHORITIES AND COMMISSIONS

Richmond Metropolitan Authority
Capital Region Airport Commission
Crater Planning District Commission
Port of Richmond Commission
Richmond Regional Planning District Commission

PRIVATE SECTOR

CSX Corporation
Greater Richmond Transit Company
Metro Traffic Control
Norfolk Southern Corporation
Overnight Transportation Company Freight Line
Ridefinders
Robinson Transportation
VSPI Commuter Vanpools
AMTRAK

These meetings had multiple goals and objectives. One of these was to brief the individual(s) on the nature of this ITS study. This was done as part of the introductory discussion, Other objectives included:

- establishing the existence and extent of an inventory of existing and proposed transportation systems and transportation management systems for which the interviewee has responsibility;
- identifying specific plans for the significant enhancements to these systems;
- identifying a list of problems and an assessment of their magnitude; and
- defining the organizational relationships with other agencies and institutions with respect to ITS.

As part of this process, the person(s) interviewed was asked to provide copies of his or her improvement program of future projects and other relevant documents.

Although these interviews did not follow a fixed format, the project staff did develop a framework for the discussions that was generally followed. (This framework is shown in Appendix A). This framework included a series of topics that included: the transportation systems, communications systems, transportation management systems, transportation plans, area deficiencies, and the institutional framework that guides the activities of the organization.

1.4.2 Focus Groups

The focus group meetings were held with people living in the communities within the project area. They were conducted to gain additional insight into the nature of the transportation deficiencies within the area. It was anticipated that these discussions would reflect the problems identified by the managers and operators of the transportation systems. However, the managers and operators occasionally have their views of problems constrained by the boundaries and limits determined by the jurisdictions within which they operate and the responsibilities of their organizations. Travelers and users of these systems view them as a whole – from "door-to door" – no matter what jurisdictional boundaries or changes occur between the origin of the trip and its final destination.

A list of the organizations that took part in these focus group sessions is shown in Table l-2. These groups were identified with the aid of the Steering Committee. The procedure that was followed in conducting these focus group sessions was to contact representatives of the group to schedule a session that would fit into one of their existing meetings. At the meetings the attendees were asked to fill out a short form (shown in Appendix B) that asked some basic questions about their particular travel patterns. (It should be noted that the intent of this form was primarily to make sure that people representing the entire region were included in these discussions. It was not intended to be a statistical survey of the travel patterns of the community

at large.) A discussion of transportation issues then took place that was guided by a list of questions that had been developed by the project team. These questions are shown in Table l-3. When topics appeared to be of particular interest to the group, the project team members at the session prompted the people there to generate additional discussion and elaboration on key points. In order to avoid biasing the discussion, a summary of the project was not presented until after these group discussions were completed.

TABLE l-2
FOCUS GROUP SESSIONS

- **Goochland County Planning Commission Comprehensive Plan Transportation Committee**
- **MPO Citizen's Transportation Advisory Committee**
- **Richmond Highway Safety Commission**
- **Virginians for Better Transportation/Virginia Road and Transportation Builder's Association**
- **City of Hopewell Transportation Safety Commission**
- **Huguenot Neighborhood Team Process Group**
- **Henrico County Highway Safety Commission**
- **Colonial Heights Chamber of Commerce**
- **Midlothian Neighborhood Team Process Group**
- **East District Neighborhood Team Process Group**
- **Far West Neighborhood Team Process Group**
- **Petersburg Chamber of Commerce**
- **Crater Road Association (Petersburg)**

While many of the items brought up for discussion at these sessions involved site-specific problems, similar problems were mentioned by people in different communities indicating that some of the problems were regional in nature. Although this ITS Early Deployment Project is not directed at solving site-specific problems, these issues and problems, viewed as examples of regional concerns, are of direct interest.

TABLE 1-3
QUESTIONS ABOUT TRANSPORTATION
DISTRIBUTED AT THE FOCUS GROUP SESSIONS

- **What transportation problems do you have?**
- **Are there situations where you would have made your trip differently if you knew about some traffic related event?**
- **Would you change your normal route to work or other destinations if you knew there was a long delay?**
- **How long?**
- **How do you get traffic, transit or carpool information now?**
- **How would you rate the quality of this information?**
- **What kind of traffic, transit or carpool related information would be useful to you?**
- **How would you use this information?**
- **Where would you like to get this information?**
  (Where could include: at home, in the car, at a bus stop, at the place of work, etc.)
- **How would you like to get this information?**
  (How would include: large variable message signs over the road, TV, commercial radio stations, traffic information only radio stations)

1.3.3, Steering Committee

Part of the initial work on the project, that has been incorporated into this User Service Plan, was performed in conjunction with the project's Steering Committee. As shown in Table l-4, this committee is composed of representatives of the jurisdictions in the area.

The Steering Committee plays several important roles during the project. It provides direction on the relative importance that is given to different activities within each task; serves as a source of contacts for organizations and people who can provide supplementary information on a particular topic; and the committee participates in the evaluation of alternatives through the activities at the meetings and correspondence that take place between meetings. The activities at the first four meetings are summarized in the following paragraphs.

Steering Committee Meeting No. 1 - November 30. 1995

This initial "kick-off" meeting familiarized the members of the Steering Committee with the project team, and the goals and objectives of the project. An overview of the process was presented and, as part of the process of introducing the concept of ITS, the video IVHS Technologies for Transportation was shown. There was a round table discussion in which attendees shared their views on the transportation issues that affect the area.

Steering Committee Meeting No. 2 - January 4. 1996

The main objective of this meeting was to provide the participants with an update on the status of the interview and focus group activities, and the problems and opportunities that had been identified as part of this effort. Further comments from the Steering Committee members were also identified through this review. This meeting concluded with an introduction to the vision workshop and goal weighting activities that would take place at the next meeting.

Steering Committee Meeting No. 3 - February 1. 1996

This meeting focused on two major topics: the vision for the project and the weighting of the regional goals. The Committee, working simultaneously as four small groups, developed four versions of the vision statement which were then given to the project team to finalize and present at the next meeting. The goal weighting was also conducted in these four groups and resulted in the goal weights that are presented in Section 4 of this document.

Steering Committee Meeting No. 4 - March 7. 1996

The vision statements produced at the 3rd meeting were combined into a single statement at this meeting'. The final consensus statement appears on the cover of this document. A follow-up discussion concerned the name of the project, and the Committee was invited to submit names for consideration. The results of the goal weighting exercise were also reviewed with the Committee. The new items that were discussed with the committee included an initial assessment of the ability to implement the user services. The Committee was asked to comment on the implementability ratings that were assigned to the user services and return their comments to the project team. Similarly, the Committee was asked to assign a high, medium, or low rating to a synthesized set of 37 problem and opportunity statements that represent a digest of the comments that were made at the interviews and focus group meetings.

TABLE 1-4
STEERING COMMITTEE MEMBERSHIP

NAME	ORGANIZATION
Harrison Jones	Charles City County Department of Public Works
Danny W. Best	AMTRAK
R.J. McCracken	Chesterfield County Department of Transportation
Robert E. Taylor	City of Colonial Heights
Clinton H. Strong	City of Hopewell
Michael D. Briddell	City of Petersburg
Ralph H. Rhudy, P.E.	City of Richmond
Edward L. Priestas, P.E.	County of Henrico
Joe Vinsh	Crater Planning District Commission
Charles W. Burgess, Jr.	Dinwiddie County
Tom Jennings	Federal Highway Administration
Doug Harvey	Goochland County
Keith Parker	Greater Richmond Transit Company
Rebecca Draper	County of Hanover Department of Public Works
Larry Gallagher	New Kent County Department of Public Works
Roy Crawford	Powhatan County Department of Planning
John G. Kines, Jr.	Prince George County
Jim Kennedy	Richmond Metropolitan Authority
Marty Moynihan	Port of Richmond Commission
Dan Lysy	Richmond Regional Planning District Commission
Howard Jennings	Ridefinders
H. Stephen Yarus	Town of Ashland
Steve Mondul	VDOT Maintenance Division
Travis Bridewell	VDOT Richmond District
Robb Alexander	VDOT Traffic Engineering Division
Herbert Pegram	VDOT Transportation Planning Division
Reggie H. Beasley, Jr.	VDOT Urban Division
Darrell Feasel	Virginia Department of Rail and Public Transportation
Captain David Conklin	Virginia State Police
Todd D. Sheller	Capital Region Airport Commission
Robert E. Parsons	Parsons Transportation Associates
W. R. Britton, Jr.	Charles City County Department of Planning . .
Gail Clayton	Charles City County
Betsy Langhorne	Metro Richmond Visitors Center

SECTION 2
DISCUSSION OF STUDY AREA

2.1 GEOGRAPHY

The Richmond/Tri-Cities project study area has geographic characteristics that are unique and that define the transportation system. Figure 2-l shows these important characteristics.

The Richmond/T&Cities area is located in the Mid-Atlantic region of the United States and directly in the path of Interstates 64 and 95. Interstate 64 runs from Interstate 81 in western Virginia to the Norfolk/Virginia Beach area and provides a direct connection between the metropolitan areas of Charlottesville, Richmond, and Norfolk. Interstate 95, the busiest route of the National Interstate Highway System, connects the Richmond/Tri-Cities area with major eastern cities from Boston, Massachusetts to Miami, Florida. Interstate 85 terminates within the study area at Interstate 95 in Petersburg and serves as a link between the Richmond/T&Cities area; Raleigh and Charlotte, North Carolina; and Atlanta, Georgia. In addition to these major interstate routes, the Richmond/T+Cities area is served by U.S. Routes 1, 17, and 301 to the north and U.S. Routes 360 and 460 west to Lynchburg, Roanoke, and Danville.

Both Norfolk Southern and CSX have rail lines that ship coal to the Norfolk/Hampton Roads area and pass directly through the study area. Additionally, CSX, who is the major rail shipper along the Eastern U.S., has major rail lines serving north-south commerce passing directly through the study area.

The Richmond/TriCities project study area is situated along the general boundary of eastern Virginia and the Piedmont region. Eastern Virginia is generally defined by the Chesapeake Bay and its tributaries on the east and the “fall line”, a noticeable drop in elevation across the state, to the west. As a result of environmental and cost constraints, the roadway network in eastern Virginia is oriented primarily towards a few major routes and river crossings. These constraints also affect areas west of Richmond, with the James River dividing the study area into northern and southern portions.

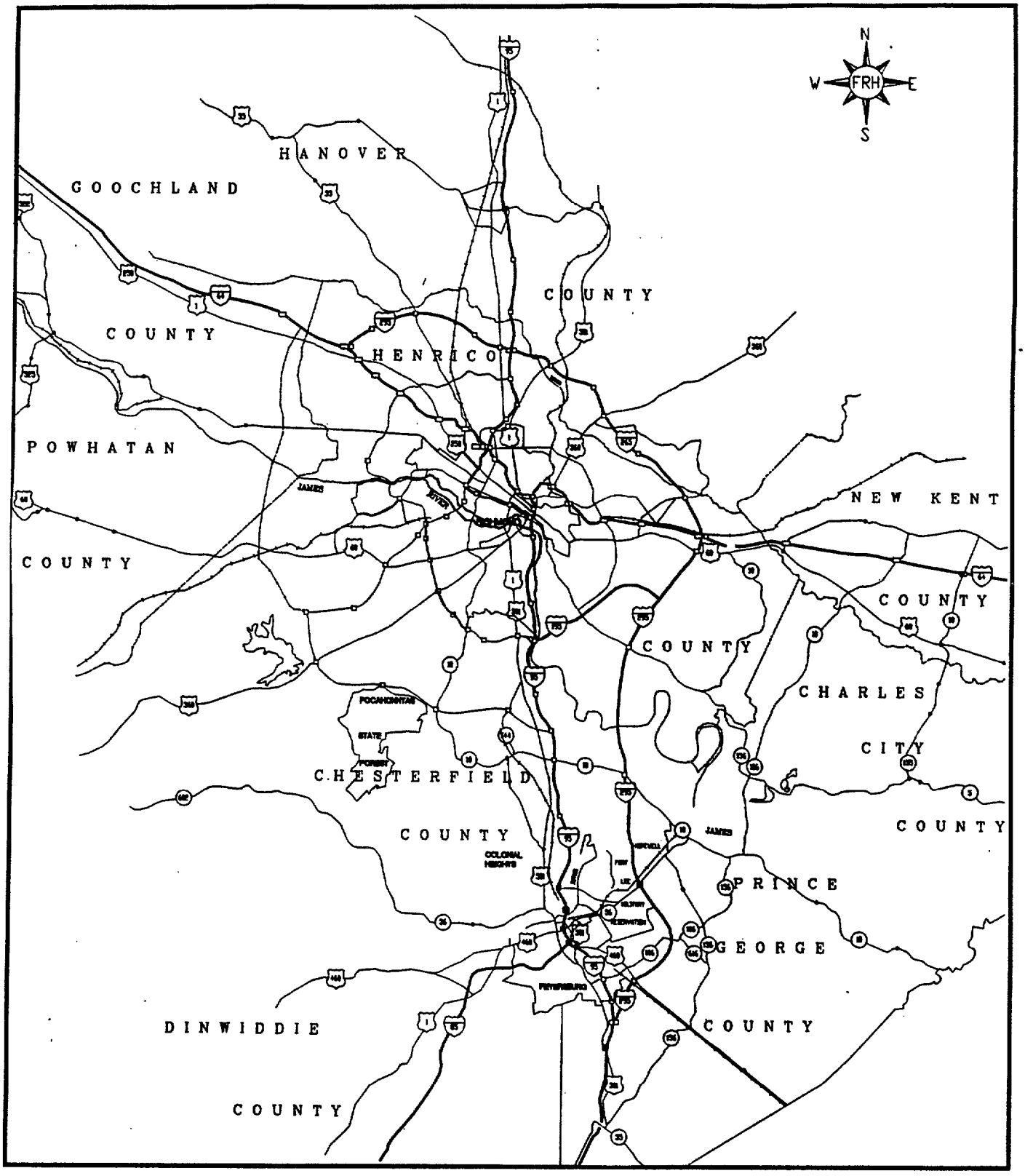

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Figure 2-1
Regional Highway System

The socioeconomic growth of Virginia is also dictated by its geography. The Chesapeake Bay and its tributaries provide water resources and convenient ocean access. The mountainous western portions of the state makes large scale commercial development difficult. The transportation system of the Piedmont region is generally defined by the constraints of eastern and western Virginia and the interactions between the regions. This limits the transportation network in the Piedmont relative to its overall land area. As a result, the vast majority of the growth activity in Virginia, both currently and in the foreseeable future, is focused in a corridor defined by the Norfolk/Hampton Roads area at the southeast, the Richmond/Tri-Cities area in the center, and the Metropolitan Washington/Northern Virginia area in the north. Located at its center this region has been nicknamed the "Golden Crescent of Virginia" due to its shape and the extensive amount of high quality development that has moved to the region. The Richmond/Tri-Cities area is an integral part of the "Golden Crescent". Almost all road and rail transportation networks pass through this area.

The importance of Virginia's activity on the Richmond/Tri-Cities area's transportation system is further emphasized by the substantial number of military facilities and tourist attractions. The numerous military bases in the state, as well as those in neighboring jurisdictions, have operations that require the use of the Golden Crescent road network. The tourist trade in Virginia, both historical (Williamsburg, Richmond, Petersburg and Washington) and contemporary (Virginia and North Carolina beaches, amusement parks and state and national capitals), relies heavily on the roadway network of both the Golden Crescent and the Richmond/Tri-Cities area.

Airport activity in the study area is defined by regional and statewide needs. The study area offers direct connections to Tidewater and the Metropolitan Washington Region. The air transportation activity in the study area, while sizeable, is locally oriented and serves as a terminus rather than a hub for interstate or international activity, which are served by the Tidewater and Metropolitan Washington airports.

One last major component of the Richmond/Tri-Cities area transportation system that is defined by its geography is the Port of Richmond. The James River offers a waterway to support ocean going vessels which provide some provincial shipping for various business activities in the study area.

2.2 JURISDICTIONS

The Richmond/T+Cities area consists of urban, suburban, and rural components governed by city, town and county governments (the term "Tri-Cities" refers to the cities of Petersburg, Hopewell, and Colonial Heights). Some are fully developed urban areas, such as the cities of Richmond, Petersburg and Hopewell. Some are only partially developed with both urbanized and open spaces such as the City of Colonial Heights and the Town of Ashland. Some are fast growing such as Henrico and Chesterfield Counties. Some are partially developed but are beginning to grow faster, such as Hanover and Prince George Counties. On the other hand, Powhatan and Charles City Counties are undeveloped and are growing very slowly.

While the jurisdictions share common interests in relation to geography and national commerce, they vary widely in how they perceive to best serve their constituency. They also must conform to the laws of the State of Virginia regarding the rights and responsibilities of cities, towns and counties. Figure 2-2 shows the jurisdictional boundaries within the study area.

The State of Virginia takes a leading role on issues that cross jurisdictional boundaries, such as transportation. Each jurisdiction has some authority and responsibility for strictly local issues. For transportation, the key state departments that regulate the study area include the Departments of Transportation, Aviation, Rail and Public Transportation, Emergency Services, Motor Vehicles and State Police.

Additionally, there are regional agencies and commissions that coordinate the activities among the jurisdictions with regards to transportation. These include the planning district commissions (PDC's), the metropolitan planning organizations (MPOs), the Capitol Region Airport Commission, the Richmond Metropolitan Authority (RMA) and the Greater Richmond Transit Company (GRTC) and Petersburg Area Transit Authority. Each of these agencies/commissions have charters that were developed to address specific issues. As previously discussed, the jurisdictions vary widely as to what is important to their constituency and as a result, none of these agencies serve all the jurisdictions that make up the study area;

The Virginia Department of Transportation (VDOT) has a more intense regional presence in the study area. VDOT's Richmond District operations cover 14 counties, many of which are within the study area. As a part of these districtwide operations, VDOT has transportation responsibilities within the counties.

The cities of Richmond, Petersburg, Hopewell and Colonial Heights are in complete control of all operations on the roadways that are within their jurisdictional boundaries. The only notable exception to this is the interstate system which is the responsibility of either VDOT or the RMA. City responsibilities include design, construction, maintenance and operations of roads, signs, pavement markings, traffic signals (except rail-highway crossing signals), driveway access and snow removal. City residents are the sole recipients of local taxes that are generated within their boundaries.

The Town of Ashland is also in control of all operations on the roadways within its boundaries. The Town does not have responsibility for interstate operations. Local tax revenues generated by their residents must be shared with Hanover County for some services that'are provided by County agencies. Currently, there are no revenue sharing arrangements between Ashland and Hanover that pertain to transportation.

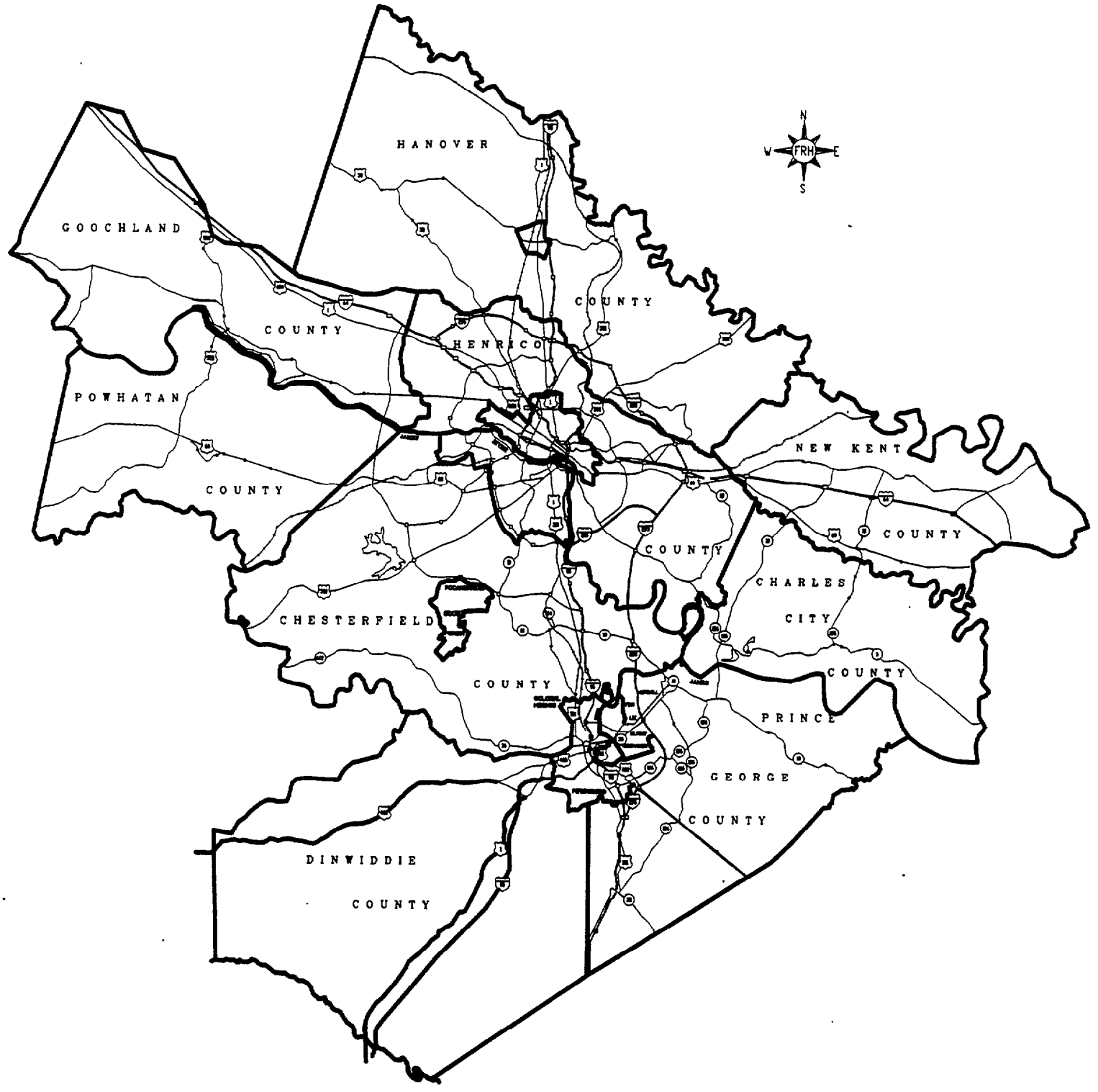

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Figure 2-2
Richmond/Tri-Cities Regional Area

The County of Henrico is one of only two counties in Virginia that operates and maintains its own secondary roadways (VDOT controls the primary roads, which includes the interstate system and U.S. routes). Where a primary road intersects a secondary road, VDOT's responsibility extends up to the right-of-way line on the primary road alignment. The County is responsible for intersection traffic control on the secondary road, except for the traffic signal system equipment, such as the placement of, and maintenance of, lane lines, stop bars, some movement restriction signs and raised median treatments. These are under the control of the County, whether or not they are on the County's right-of-way.

The remaining jurisdictions within the study area are the Counties of Hanover, Goochland, Powhatan, Chesterfield, Dinwiddie, Prince George, Charles City and New Kent. These jurisdictions do not have responsibility for the transportation system within their boundaries. Hanover and Chesterfield, by agreements with VDOT, have implemented policies that allow for some design and construction activity to take place under the auspices of the Counties themselves. While this gives them more refinement and responsiveness of their secondary roads fund spending, it does not usurp VDOT responsibility for all of their County roadway infrastructure. The military installations within the study area, Defense General Supply Center (DGSC) and Fort Lee army base, control transportation facilities within their boundaries.

Hanover, Dinwiddie and Chesterfield Counties own municipal airports. Control of their transportation operations is directed by agreement between local, regional and state agencies.

The Richmond Port Commission, as an agency of the City, controls and operates the deep water terminal within Richmond.

The Richmond Metropolitan Authority operates the Powhite Parkway, the Downtown Expressway, the Boulevard Bridge and several parking garages, along with the professional baseball stadium, located in Richmond.

The MPOs for Richmond and the Tri-Cities area work under federal mandates that require jurisdictional involvement in order to secure federal funds. Much of these funds are earmarked for transportation infrastructure planning and coordination. This has recently become much more prominent with the Intermodal Systems Transportation Efficiency Act ('ISTEA) of 1990 and the mandated designation of a National Highway System (NHS) adopted in early 1996.

2.2.1 State Agencies

The State Departments of Motor Vehicles, Emergency Services and Police provide for and control the movement of people and goods along the study area roadways through the use of licensing, permitting and regulation. Additionally; the DMV and State Police have an information gathering and distribution system coordinated with the State Information Technology Department.

There are four public universities (Virginia Commonwealth, Virginia Union, Virginia State and the University of Richmond), one college (Randolph-Macon), and two community colleges (J. Sargeant Reynolds and John Tyler) within the study area.

2.2.2 Private Transportation Infrastructure

CSX and Norfolk Southern Railroad companies own the rail lines, rail spurs and road crossings within the study area. Additionally they and AMTRAK own and operate the vast majority of the rail cars that move goods and people along the tracks in the study area.

The trucking industry is an important element of the transportation system in the study area. Trucking companies contribute revenues through taxes and user fees and required services such as roadway assistance and safety inspections.

Major employment centers, such as Phillip Morris, Virginia Power, Bell Atlantic, Allied Signal, and the future Motorola manufacturing plant exist in the study area. These employers are sufficiently large that small incremental changes in their transportation operations, can affect the overall transportation system in the study area.

2.3 POPULATION

This subsection provides various demographic data on the twelve jurisdictions making up the study area. The data was derived from "The 1990 Census Transportation Planning Package" (CTPP), which tabulates the 1990 census data and tailors the results to meet the needs of transportation planners.

The population data is divided into several categories. Each category is presented alone, and then in the context of travel patterns within the study area. First, population by jurisdiction is examined. Then household size, age, and income are each examined.

2.3.1 Population Densities by Jurisdiction

The population as a whole, and its composition in particular, are very useful in planning and determining the needs of the transportation infrastructure for a given region. Table 2-l shows the population for each jurisdiction. The population of the entire study area is 14% of the total population of Virginia, and large portions of it are growing at a rate higher than that of both Virginia and the United States.

TABLE 2-1
POPULATION BY LOCAL JURISDICTION

JURISDICTION	1990 POPULATION	% OF TOTAL	1995 POPULATION	% OF TOTAL	PROJECTED 2005 POP.	% OF TOTAL
Goochland County	14,163	1.7	15,300	1.7	16,300	1.7
Hanover County	63,306	7.4	68,400	7.5	72,700	7.6
Chesterfield County	209,274	24.5	224,700	24.8	237,600	25.0
Dinwiddie County	20,960	2.4	21,700	2.4	22,574	2.4
Henrico County	217,881	25.5	234,300	25.8	247,900	26.1
City of Richmond	203,056	23.7	212,100	23.4	219,000	23.0
Powhatan County	15,328	1.8	16,100	1.8	16,278	1.7
Charles City County	6,282	0.7	6,600	0.7	6,671	0.7
Prince George County	27,394	3.2	28,100	3.1	29,092	3.1
City of Petersburg	38,386	4.5	39800	4.4	40,766	4.3
City of Hopewell	23,101	2.7	23,700	2.6	24,533	2.6
City of Colonial Heights	16,064	1.9	16,700	1.8	17,060	1.8
TOTAL	855,195	100	907,500	100	950,474	100

Chesterfield and Henrico Counties along with the City of Richmond make up almost three quarters of the population for the entire study area. Hanover County is more than 7 % , while Petersburg makes up 4.5%. The remaining jurisdictions make up the rest of the population with portions ranging between 3.2% and 0.7% of the entire study area. Both the Richmond and Tri-Cities Planning District Commisions (PDCs) predict steady increases in population in their 2015 Long Range Plans. Combined, they predict growth greater than 33% between 1990 and 2015. While the MPO's do 'not include the entire study area for this project, they do cover the majority of it.

2.3.2 Household Size

Table 2-2 shows the average household size for each jurisdiction, derived by dividing the total population as stated in the 1990 census by the total number of households. Thirty-three percent of the households in the study area contain two persons. Single-person households comprise 25% while households with four or more persons comprise 23% of the total; the remaining 19% are households with three or more persons.

TABLE 2-2
AVERAGE HOUSEHOLD SIZE BY JURISDICTION

JURISDICTION	NUMBER OF HOUSEHOLDS	AVERAGE HOUSEHOLD SIZE
Hanover County	22,650	2.80
Henrico County	89,026	2.45
Richmond	85,268	2.38
Goochland County	4,868	2.91
Powhatan County	4,659	3.29
Chesterfield County	73,665	2.84
Dinwiddie County	7,519	2.79
Prince George County	8,315	3.29
Charles City County	2,173	2.69
Hopewell	8,943	2.58
Petersburg	14,664	2.62
Colonial Heights	6,332	2.54
Total	328,082	2.61

2.3.3 Age

The age and sex of a population can have effects on the labor force and the types of services that must be provided to a community. The size and composition of the labor force can have a significant impact on transportation related services, both in implementation and usage.

According to the 1990 Census data the largest segment in the study area is 25 to 44 year olds, making up 35.4 % of the population. The estimated working population, consisting of those persons between the ages of 18 and 64, accounts for 64.4% while the non-working segment, those under 18 and over 65, make up 35.6% of the study area population. Men make up 47.9% of the working population, 52.1% are women.

2.3.4 Income

Earnings of workers can have an impact on travel patterns. The actual number of persons Working in the study area is approximately 436,400, of which almost 28% earn between $10,000 and $20,000. Those earning less than $10,000 make up 20.4% while 22.1% of the working population earns between $20,000 and $30,000. A significant number of workers, 19.8%) earn between $30,000 and $50,000. The remaining workers earn more than $50,000, with a small percentage having no earnings.

The mode of transportation used to get to places of employment typically changes according to earnings. While driving alone is clearly the most frequently used mode of transportation, it

increases steadily as earnings rise. Single drivers make up 64.3% of those workers earning less than $10,000, while 86.5% of those earning between $30,000 and $50,000 drove alone. Bus ridership decreases steadily as earnings rise, from 6.9% of those earning less than $10,000 to less than 1% of those earning between $30,000 and $50,000. Car pooling shows a decrease as earning rise as well, but not so dramatic a change as that for bus riders. The number of persons working out of their homes does not appear to have any correlation to earnings. Table 2-3 shows the average household income by mode of travel.

2.4 EMPLOYMENT

The economy of a region can be the driving force which defines transportation needs. The workers of this study area are employed by a wide range of industries including manufacturing, retail and various services. Public administration, military, agriculture, mining and construction are represented, but play a lesser role in the employment makeup of the region.

2.4.1 Categories

a. Service - As a whole, service industries provide more than 40% of the employment in the study area. Within this broad category are some specific service fields that stand out: finance, insurance, and real estate make up 9.6% of the total employment base. Health and educational services represent 8.7% and 7.6% respectively, while "other professional and related services" comprise 6.8% of the jobs in the region.

b. **Manufacturing-** A slow decrease has marked the manufacturing sector's presence in the job market for the last few decades. Presently manufacturing of both durable and non-durable goods comprises 14.1% of the total jobs for all industries in the study area.

c. **Retail** - The retail industry makes up 15.9% of all jobs in the region, making it the largest employment sector. Major retail employment centers such as the Southpark Mall, which employs approximately 3,000 persons itself, along with other malls and shopping strips make this industry a leader in employment opportunities.

d. **Armed Forces** - Although the armed forces make up only 1.3 % of the total industrial makeup of the region, they do play a major role in the areas directly surrounding the facilities.

e. **Agriculture** - Agriculture no longer plays a large role directly in the makeup of the employment base in the study area. Only 1.1% of the jobs in the region are supplied by agriculture, forestry, and fisheries. There is however, an indirect impact felt by the region by the tobacco industry. Several of the region's larger employment centers are either headquarters to, or processing facilities for, tobacco companies.

TABLE 2-3
HOUSEHOLD INCOME BY MODE OF TRAVEL

MODE\HOUSEHOLD INCOME (in $s)	< 10,000	10,000-19,999	20,000-29,999	30,000-49,999	50,000-74,999	>75,000	No earnings
Total, all means of transportation	88,887	120,843	96,322	86,312	22,646	11,574	**9,840**
Drove alone	**57,192**	**89,797**	**79,739**	**74,689**	**19,843**	**10,504**	**5,261**
In 2-person carpool	**11,478**	**14,600**	**10,114**	**7,402**	**1,550**	**543**	**1,494**
In 3-person carpool	**1,682**	**2,644**	**1,558**	**952**	**139**	**42**	**202**
In 4-or-more-person carpool	**996**	**1,179**	**638**	**580**	**139**	**26**	**200**
Bus or trolley bus	**6,093**	**5,952**	**1,779**	**763**	**125**	**37**	**874**
Streetcar, trolley car, subway, or elevated	17	49	20	24	12	0	0
Railroad	4	6	9	13	0	13.	0
Bicycle or walked	6,266	3,288	944	702	244	95	738
Taxicab, ferryboat, motorcycle, or other means	1,282	1,337	469	263	115	79	266
Worked at home	3.877	1.991	1.052	924	479	235	805

2.4.2 Maior Employers and Employment Centers

Major employers cannot only affect the economy of a region, but can influence traffic patterns as well. The location and size of existing and planned employment centers necessitate advanced planning and continuous monitoring of transportation systems in order to minimize disruptions to traffic flow and commerce.

a. **Existing** - The Richmond/Tri-Cities region is home to many large employers, representing many industries. The Tri-Cities area is influenced greatly by the presence of Fort Lee, which employs more than 3,000 people. Daily traffic congestion occurs at the intersections and entrances to the base. The Southpark Mall not only employs approximately 3,000 people, but serves as a major trip generator as well. While the mention of all major employers is not practical, some examples worth noting are: The American Tobacco Company and Perdue Farms employ about 600 people each. Wal-Mart and Food Lion distribution centers also employ about 600 persons each and generate truck traffic onto I-85. An example of high employment in satellite counties is Charles City County. The Roxbury Industrial Business Park, located in Charles City County, houses at least 20 small businesses which employ over 570 people. Of the total number of employees in the Roxbury area, 76% commute into Charles City County to work.

Virginia State University, located in Chesterfield County, employs 800. Some samples taken from the list of The Richmond Area's Ton 50 Employers include Philip Morris USA (8,000) and Reynolds Metals (4,300). Ranks including Crestar, Signet, and Nations provide employment to more than 7,000 persons. Hospitals in the Richmond area employ over 5,000 people, exclusive of the University hospitals. Virginia Power employs over 4,000 people with facilities in both the Richmond and Tri-Cities areas.

b. Future - The study area is becoming home to new major employers either through the addition of new facilities or the expansion of existing facilities. These factors must be taken into consideration while planning any deployment of transportation infrastructure or technology. One example of a new employer is Motorola, which is constructing a manufacturing plant in Goochland County. While only in its initial stages of development, it is expected that over 5,000 new jobs will be created at this site over the next 10 years.

Carter-Wallace, Inc., a manufacturer of health care and personal hygiene products, is currently expanding one of its manufacturing facilities located in Chesterfield County. Currently, 208 people are employed at this site, with an additional 300 employees scheduled to begin work as early as summer 1996.

2.5 MILITARY

2.5.1 Fort Lee Military Reservation

Fort Lee is situated between the Tri-Cities of Colonial Heights, Hopewell, and Petersburg. It covers an area of over 5,000 acres and is home to some two dozen different defense-related tenants. Besides the over 3,000 civilians employed on the base, there are over 3,000 military personnel and almost 3,000 family members on base. Another 2,500 family members live off base. A base of this size generates not only rush hour traffic, but off-peak and weekend traffic as well. Many trips to retail establishments are generated by the presence of Fort Lee, some of which are made by taxi.

2.5.2 Defense General Supply Center

The Defense General Supply Center is situated on 261 acres outside of Richmond. It is home to several military tenants as well as a branch of the Small Business Administration and an office of the Virginia Department of Emergency Services. The Center employs over 2,500 civilians and a small number of military personnel.

2.5.3 Defense Distribution Depot

The Defense Distribution Depot is located on 350 acres outside of Richmond. More than 800 persons, mostly civilian, are employed at the Depot.

2.6 TRANSPORTATION INFRASTRUCTURE

2.6.1 Highway System

The major transportation infrastructure that affects both the region and the state the most is the roadway network. The Richmond/Tri-Cities area has many interstate roads, including routes 64, 85, 95 and 295. Interstates 95, 64, and 85 have already been discussed. Interstate 295 is a bypass route for Interstate 95 and bypasses Petersburg, Colonial Heights and Richmond. Interstate 295 was built to mitigate congestion on Interstate 95 through Richmond, improve safety and promote commercial development.

Additionally, Interstate Route 895 is a planned corridor which will connect Interstate 295 to Chippenham Parkway (SR 150), which is a circumferential route around Richmond to the west. Interstate 895 will also provide a new and strategic crossing of the James River.

As important as the interstate system is, other components of the road network are equally important. As previously discussed, a National Highway System has been adopted by the federal government, which considers all important roadways from a regional as well as a state and interstate basis. From the perspective of accessibility for commercial operations, tourism, and local transit, the Richmond/Tri-Cities region contains some of the most important and heavily

utilized roadway systems along the Fast Coast. These roadways range from local roads which provide intra-regional accessibility to State and major interstate highway systems, both of which provide coastal access for freight operations and seasonal tourists. US Routes 1 and 301 have been identified in the National Highway System as promoting such interstate accessibility. US Routes 360 and 460 have been identified as promoting intrastate accessibility and State Routes 150 and 288 as providing access on an intra-regional basis. Some routes, such as Parham Road in Henrico County and the Downtown Expressway in the City of Richmond, provide inter-regional access even though the systems are wholly located in one jurisdiction.

2.6.2 Rail System

Rail represents another important transportation component in the study area. CSX and Norfolk Southern are major carriers of raw material and finished goods in the eastern U.S. Amtrak is the sole rail passenger carrier. Rail transportation is heavily utilized in the study area.

Figure 2-3 shows the major rail system in place in the study area, not including the lesser spur lines used for local business use. CSX not only owns and operates rail lines going north-south and east-west through the study area, but also provides the lines that Amtrak uses for passenger service. CSX also owns and maintains the rail yards in Richmond.' These yards are used to collect and distribute rail cars from one engine, and routing to another. They are also the destination point for trains that originate north of Richmond which then continue eastward toward Norfolk/Hampton Roads. Overseas container cargo is an important component of this traffic.

Rail crossings of roads are maintained by the track owners (CSX and Norfolk Southern) and regulated by the State Department of Rail and Public Transportation. Depending upon the level of traffic on the road and the rail line, the type of crossing is then determined, along with the type of traffic control. In situations where a road crosses a rail line and a downstream traffic signal could potentially queue the motor vehicles back onto the tracks, a traffic signal preemption plan may be established for the signal. The plan is implemented when a train is approaching the crossing. It assures that the signal provides a sufficient right-of-way to the queued movement to clear the tracks of motorists before the train arrives at the crossing. This preemption plan, which is a part of the traffic signal control, is usually designed and maintained by the traffic signal maintenance jurisdiction. However, the actual preemption hardware is owned and maintained by the track owners.

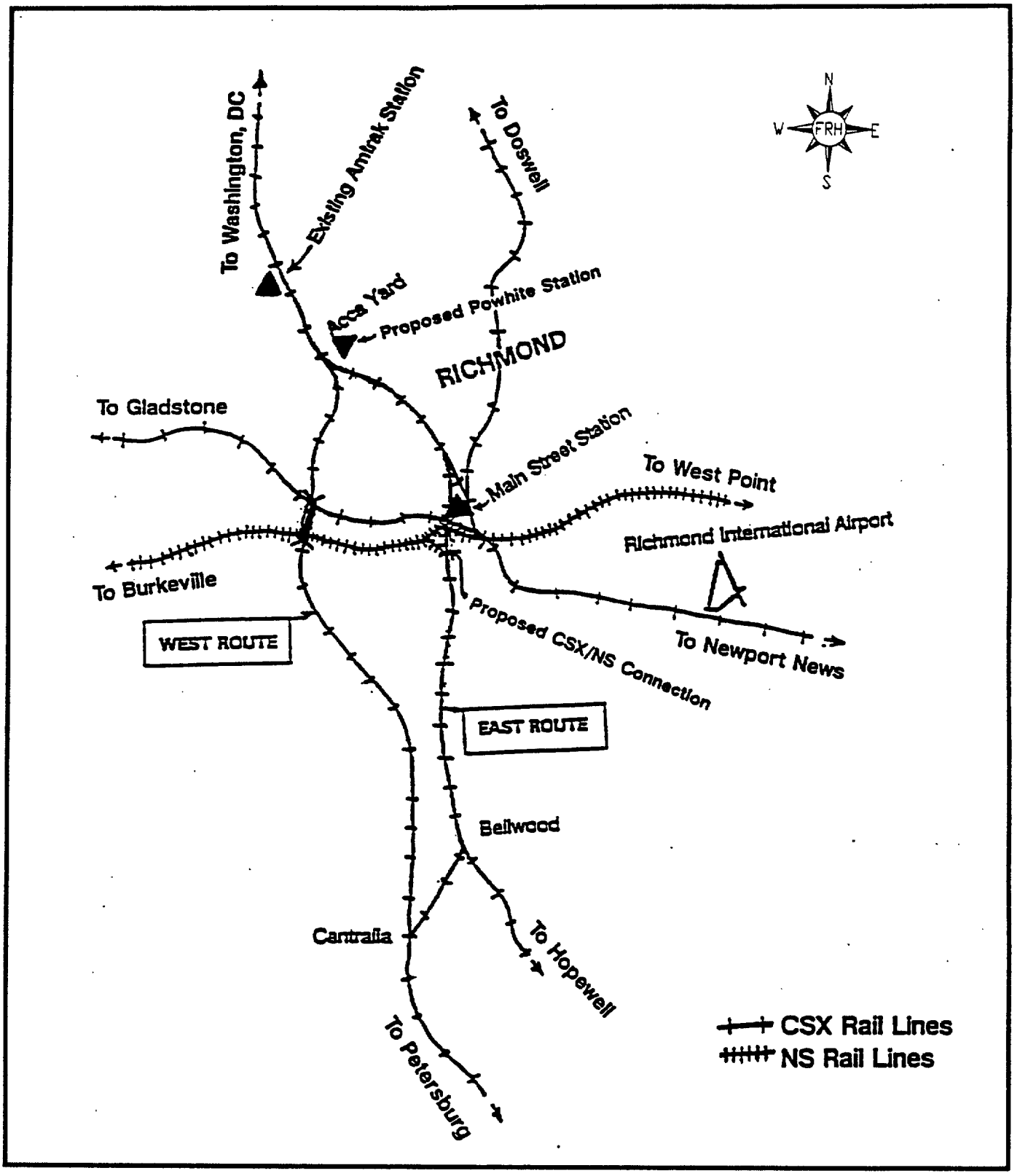

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Figure 2-3
Richmond Area Rail Lines

2.6.3 Parking Systems

As the motor vehicle is the dominant mode of travel in the study area, parking is therefore an important ancillary function, Since the majority of the study area is suburban or undeveloped in nature, parking is mostly dispersed along the road network, via either on-street parking or provencial off-street parking, such as private driveways or separate parking lots for individual developments.

There is no central parking authority for the Richmond/T+Cities project study area. The majority of the organized parking lots not associated with individual developments are owned and operated by private enterprises. The notable exception to this is the downtown Richmond parking deck over the downtown expressway, which is owned and operated by the Richmond Metropolitan Authority, and the Richmond International Airport parking lots at the terminal, which are under the jurisdiction of the Capitol Airport Commission.

Other organized parking systems are the park and ride lots owned and maintained by VDOT and Henrico County. These lots are used by the motorists to then either car/van pool to their destinations (usually work) or catch an express bus to downtown Richmond. These lots, while popular, are currently more important to the convenience of the individuals using the lots than to the overall study area transportation system. They hold potential as one element of any travel demand management program that might be implemented.

2.6.4 Transit

The Richmond/Tri-Cities area is served by two transit agencies, the Greater Richmond Transit Company (GRTC) and the Petersburg Area Transit Authority (PAT). The GRTC serves the City of Richmond and Henrico County with a fleet of 181 buses that operate on 53 routes. The PAT currently provides transit service to the City of Petersburg and the Ettrick portion of Chesterfield County with eight fixed-route buses.

With regard to paratransit, residents in the City of Richmond and Henrico County are served by the Specialized Transportation Assistance for Richmond (STAR) paratransit program under contract to GRTC. This is a fully ADA-compliant curb-to-curb service for qualified citizens. Citizens in the Petersburg area receive complementary paratransit services through a local church that operates on subsidies from the City of Petersburg.

2.6.5 Air

There are four separate airport facilities in the Richmond/Tri-Cities area: the Richmond International Airport and the three municipal airports in Chesterfield, Dinwiddie and Hanover Counties.

The majority of the airport activity is centered in the Richmond International Airport located in eastern Henrico County. The operation of the airport and its on-site facilities are planned and

constructed by the Capital Region Airport Commission. The commission is chartered by the State and directed by an appointed board of elected officials in the region. Off-site facilities, however are either privately owned and operated, or owned, maintained, and/or regulated by Henrico County. The exception to this is the National Guard Air Reserves, which has an operation at the airport.

The other airports are general aviation, municipal ownership and are very locally service oriented. Hanover's airport, however, is designated as the overflow destination for air travel originally destined to the Richmond International Airport. Additionally, there are plans underway to expand their facilities to better serve the adjacent industrial park and future development. As was previously discussed, Richmond International Airport serves as the major air destination point for the region. Some of the air activity is oriented outside of the study area toward Norfolk and the Metropolitan Washington area, which has regional hub activity. However, the vast majority of air usage for the study area is focused towards Richmond.

2.6.6 Port

The City of Richmond has a shipping port on the James River that allows direct shipping via the Atlantic Ocean. While the major port activity in the State is located in the Norfolk/Hampton Roads area, Richmond's port serves the area's commerce. Some local shipping utilizes the James River. Ships move raw material for the heavy industrial and manufacturing activity in South Richmond and Hopewell. Other transportation modes are then used for delivery of the finished product.

2.7 ANCILLARY INFRASTRUCTURE

2.7.1 Police

2.7.1.1 Virginia State Police

The Virginia State Police (VSP) consists of seven divisions throughout the State, each of which has jurisdictional boundaries over a specific geographical area. Each of these areas consists of several counties and/or cities and towns. The First Division has responsibility for the City of Richmond, the Tri-Cities and 21 surrounding counties.

The VSP is responsible for law enforcement, compliance with traffic laws, incident management, the Virginia Criminal Information System (VCIS) and commercial vehicle inspections on all interstate highways within the Commonwealth of Virginia.

The First Division of VSP consists of approximately 240 officers and supervisors. Each officer is assigned duty to a specific geographic area within a county or city, with at least four on-duty officers on patrol in each county at all times. In more urbanized areas, six or more on-duty officers are always on patrol. Patrol coverage is present from 16 to 18 hours a day-24 hours in areas having interstate highways.

The VSP operates emergency call centers, which are located in each county throughout the study area. Each county and city has its own call center and is responsible for processing and directing emergency calls. After calls are processed, the centers then dispatch local respondents to incident location(s). All cellular phone 911 calls are answered by the First Division communications center, which is staffed and operated 24 hours a day, 365 days a year. These calls are then directed to the local police jurisdictions as applicable. All local phone calls, originating from homes and other fixed locations, are handled directly by the local police jurisdictions.

The VSP operates a motorist assistance patrol program, which is funded by VDOT. Motorist assistance patrol cars are white and are configured with yellow flashing warning lights, as opposed to the blue cruisers configured with blue flashing emergency lights. The motorist assistance vehicles patrol Richmond area highways in search of stranded motorists. Patrollers are required to be somewhat mechanically inclined, to attempt to assist the motorist, and to call a wrecker and/or use bumper pads configured on their vehicles to push disabled vehicles to a safe location. The VSP also maintains a tow truck/wrecker service rotation list for dispatching to incidents. Currently, any service can be added to the rotation list provided that they can pass an inspection conducted by VSP.

A computer-aided dispatch (CAD) system is anticipated to be operational by the end of Summer 1996, the first in the state. Other VSP Divisions throughout the State will be brought on-line over a period of 20 months, commencing with the completion and testing of the First Division CAD system. Local police jurisdictions will have dedicated line access to the CAD system for retrieving information.

2.7.1.2 Local Police (County, City, and Town)

The Richmond/T&Cities area is a typical Virginia metropolitan area, housing a complex government structure as a result of having both towns and cities residing within counties. Each county, as well as each town and city, operates its own administration. Agreements have been established for the purposes of providing emergency services toneighboring cities, towns and counties when necessary. For example, the Town of Ashland resides within Hanover County. Even though these areas are politically and jurisdictionally separate from one another, a situation may occur within the Town of Ashland that would necessitate the assistance of Hanover County Police. Depending upon the severity of the situation, such as a hostage crisis or a multi-vehicle accident on a major roadway, it may also be necessary for the State Police to get involved. Cooperation during times of inter-jurisdictional emergencies has been noted as good; however, staffing has been reportedly insufficient.

All local police operations have some variation of a 24-hour rotating shift. Some administrations operate on an overlapping, 9 hour, 3-shift sequence. Others incorporate two 12-hour shifts. Either way, at least two officers are always on patrol.

2.7.2 Fire and Rescue Services

Volunteer and professional fire and rescue services are available throughout the study area, with volunteer services more commonly located in rural areas. Each county, city, or town staffs and operates its own emergency call center and dispatches rescue services as needed. Most county fire and rescue services will respond to incidents within cities and towns when necessary; however, inter-jurisdictional cooperation can be more difficult. This is due to the variance of some fire fighting equipment from county to county, which makes systems incompatible. It was reported that policy stipulates that all ambulances operating in the study area are tied to the nearest hospital in need of immediate services.

2.7.3 Virginia Department of Transportation

The Virginia Department of Transportation (VDOT) consists of nine districts, 46 residencies, and 243 area headquarters throughout the Commonwealth of Virginia. The Richmond/T&Cities area houses the 4th District, six residencies, and various maintenance and operations headquarters.

VDOT operates and maintains the Transportation Emergency Operations Center (TEOC) located in the City of Richmond.

2.7.4 Virginia Department of Motor Vehicles (DMV)

The DMVs primary role is in the area of vehicle regulations. For example, it is responsible for the collection of all tines given to commercial vehicle weight violators. These fines are referred to as "liquidated damages", and all of the money collected goes into the state transportation fund established to pay for road construction and maintenance within state borders. The DMV runs the Commercial Drivers License Information System (CDLIS) for checking commercial driver license information. It also issues all commercial and private driver's licenses, titles, tags and registrations for residents of Virginia.

2.7.5 Metropolitan Planning Organizations (MPOs) and Planning District Commissions (PDCs)

2.7.5.1 Richmond Regional Planning District Commission (RRPDC)

The RRPDC is a regional commission with planning functions in transportation. The Commission was formed by local governments in 1968 under the authority of the Virginia Area Development Act and re-authorized by the Regional Cooperation Act of 1995. It is comprised of elected officials and citizens who address mutual problems and work out solutions for the local governments which benefit from intergovernmental cooperation. Voting members include representatives from the Town of Ashland, Charles City County, Chesterfield County, Goochland County, Hanover County, Henrico County, New Kent County, Powhatan County and the City of Richmond. Also participating as voting members are representatives of state

government, commissions, and authorities; these include representatives from the Capital Region Airport Commission, the Greater Richmond Transit Company, the Richmond Metropolitan Authority and the Virginia Department of Transportation. The RRPDC is governed by a 30-member board appointed from nine member jurisdictions.

The RRPDCs major objectives are: (1) to identify opportunities of an inter-jurisdictional nature; (2) to establish plans for addressing those regional opportunities; (3) to identify ways and means for state and local governments and the private sector to implement programs; (4) to help promote cooperation among state and local governments; and (5) to provide technical assistance and information services to its member jurisdictions.

2.7.5.2 Richmond Area MPO

The RRPDC serves as the contracting agent for the Richmond Area MPO and provides the administrative and technical staff. The MPO is the federally designated regional transportation planning organization that serves as the forum for cooperative transportation decision-making in the Richmond area. The MPOs geographic area of concern is that area projected to be urbanized within the next 20 years.

The primary products of the MPO are a regional long range 20-year transportation plan, a 3-year transportation improvement program and related plans and studies. Within the regional MPO framework, local governments and state and local transportation agencies refine project proposals which are submitted to the MPO for review and approval as part of its Transportation Improvement Program (TIP).

2.7.5.3 Crater PDC

The Crater PDC is responsible for regional planning activities in the Tri-Cities area. The Commission is involved in areas such as coastal resource management, solid waste management and environmental analysis. The CPDC also serves as the technical staff for the Tri-Cities MPO. In addition to its role in regional planning, the CPDC provides planning assistance to its member jurisdictions.

2.7.5.4 Tri-Cities MPO

The Tri-Cities MPO Study area is comprised of the Cities of Petersburg, Colonial Heights, and Hopewell, and portions of Chesterfield County, Prince George County and Dinwiddie County. Representatives from each of the six localities within the study area, along with representatives from VDOT, the Crater Planning District Commission (CPDC), Petersburg Area Transit (PAT), the U.S. Department of Transportation (USDOT), and the FHWA comprise the Tri-Cities MPO.

The MPO is responsible for conducting the continuing, cooperative and comprehensive transportation planning process as required by the Federal Highway Act of 1962. The MPO is assisted by the Technical Committee, which is comprised of representatives from public works,

engineering, zoning, planning, and traffic engineering staffs of the six local jurisdictions, VDOT and CPDC. The District Administration from the Virginia Department of Transportation, the Deputy Director of Facilities Engineering at Fort Lee, and a representative of the National Park Service at Petersburg National Battlefield also serve on the technical committee in an ex-officio capacity.

The Tri-Cities MPO currently addresses federal regulations as set forth by the Intermodal Surface Transportation Efficiency Act as applicable to the Tri-Cities area. The MPO cooperates with affected local, state and federal agencies in the area.

In terms of background information affecting compliance with applicable ISTEA requirements, two designations need to be noted. First, several of the local governments in the Tri-Cities Transportation Study area have been designated by the U.S. Environmental Protection Agency (EPA) as having exceeded the National Ambient Air Quality Standards for ozone pursuant to the Clean Air Act Amendments of 1990. Subsequently, these jurisdictions have been designated by the EPA along with others located in the Richmond-Petersburg management system area as a moderate non-attainment area for ground level ozone. Federal air quality and transportation legislation contains specific requirements for moderate ozone non-attainment areas. These requirements include a federal finding that transportation plans and programs will not contribute to a further decline in attainment of national air quality standards.

The Tri-Cities MPO requested and was granted Transportation Management Area (TMA) status by the Federal Highway Administration (FHWA) and the Federal Transit Administration in March of 1994. While urbanized areas over 200,000 in population were automatically designated Transportation Management Areas, the Tri-Cities area requested designation. This designation would help assure consistency in the development of transportation and transportation-related air quality plans and programs by the two area MPOs. MPOs which are designated as TMAs have an enhanced project selection role in cooperation with the State for federal transportation funding in programs other than National Highway System, Bridge, and Interstate Maintenance.

2.7.6 Greater Richmond Chamber of Commerce

The Greater Richmond Chamber of Commerce has created various committees and task forces in order to promote transportation strategies for the Richmond area. Two of these organizations include the "Virginians for Better Transportation" committee and the "Transportation Task Force". The Transportation Task Force (TTF) was created in October, 1994 to recommend transportation strategies to the Chamber's Board of Directors. More particularly, the TTF was charged with evaluating the potential role of the business community in improving and expanding the region's transportation system and developing new transportation strategies to serve the Richmond Metropolitan Area. Following a May 1995 TTF report that validated private sector involvement in regional transportation initiatives, the Transportation Study Task Force was created to evaluate the nature and scope of private sector involvement.

2.7.7 Information Dissemination Through Media

2.7.7.1 Television

The Richmond/Tri-Cities area offers occasional traffic reports on most local television (TV) networks. With the exception of Henrico County, where scheduled special events and snow emergencies are announced on cable TV, the study area generally does not utilize cable TV to offer any regional traffic information. VDOT has received numerous requests from the media for video coverage of roadways in and around the City of Richmond during morning and rush hours. Interest has been shown by some agencies to provide such information on public access networks via cable TV.

Metro Traffic Control (MTC) has a virtual monopoly for reporting traffic information in the study area, MTC operates from 5 A.M. to 7 P.M. Monday through Friday. Traffic reporters observe and report traffic conditions by airplane in the Richmond Metropolitan area between 1.5 to 2.5 hours each weekday morning and evening. MTC provides about four reports per hour and markets them to television for broadcasting. MTC occasionally broadcasts items of interest to regional travelers; however, only large events or incidents make the news. In the interest of becoming more innovative, MTC may be willing to work out a joint effort with local television networks to incorporate video coverage with traffic reports.

2.7.7.2 **Radio**

Traffic Information on Local Radio Stations

MTC also markets their traffic information to various radio stations in the study area. WRVA 1140 AM in the City of Richmond obtains traffic news from police monitors, and its own fleet of helicopters, and is also MTC's biggest radio news information customer.

Traffic information via radio broadcasts has reportedly been a popular source of information about major collisions and incidents, but is not very effective for reporting minor incidents. It has been reported that reception on some AM radio frequencies in and around the study area is poor.

The University of Richmond and Virginia Commonwealth University are located in the City of Richmond, and both operate campus FM radio frequencies. Currently, these stations do not broadcast traffic information for the Richmond area. The possibility of coordinating with the Universities for this purpose remains open.

Highway Advisory Radio

Highway Advisory Radio (HAR) is a means of providing highway and traffic-related messages to the driver using his existing AM radio receiver. Typically, the service is provided at either end of the AM band, but any unused frequency may be used. HAR locations and frequency are

restricted to avoid interference with commercial or other broadcasters (National Park Service, Forest Service, Airports, Coast Guard, etc.) in the vicinity. Use of these frequencies can be authorized by the Federal Communications Commission (FCC) on a developmental license, or under FCC Rules and Regulations without a license.

Outlined below are some of the reported problems experienced by HAR users in the Richmond/Tri-Cities area:

- the range of coverage is limited
- the content is insufficient
- it needs improvement before it can be considered a serious media for disseminating information
- AM frequencies are too difficult to administer
- AM frequencies are prone to insufficient reception due to skipping
- FM stations transmit more reliably, but are more difficult to acquire.

These problems need to be addressed if HAR is to be an effective means of delivering traffic information in the study area.

RAM Communications Study

Various municipalities in the study area share the desire to improve interoperability between all emergency communications systems on a Wide Area Network (WAN). A number of joint operations have been used to facilitate communications between agencies, and others have shown interest in upgrading their systems. In response to this need, the RAM Communications Study is being conducted in the Richmond/T+Cities area by RAM Communications Consultants.

The RAM Communications system, as proposed, will operate most similarly to those 800 MHz systems used by cellular communications vendors. As the user travels out of the range of one vendor, the call is automatically transferred to the next vendor without disrupting service. A pilot study for the system is being conducted ‘in the study area. Study areas are divided into two groups: the Richmond Metropolitan Group (North) and the Crater Group (South). The Northern study group consists of the Greater Richmond metropolitan area, including the Richmond International Airport, Henrico, Hanover, and Chesterfield counties, and the City of Richmond. The Southern study group participants include Fort Lee, Chesterfield and Dinwiddie counties, and the Cities of Petersburg, Hopewell, and Colonial Heights. The goal of the study is to offer interoperability and provide various agencies with the capability to continue communications during emergency situations while traveling from one jurisdiction to the next. For example, a police officer may radio an approaching county for assistance while continuing the pursuit of a vehicle destined to cross county borders.

Police/Emergency Frequencies

The Statewide Interagency Radio System (SIRS) is a radio communications network established solely for emergency communications between the VSP and public safety/police organizations. The SIRS currently provides radio communications strictly between these agencies. Communications between VDOT, VSP, and other agencies is not possible at this time due to variations in radio frequencies used.

2.7.7.3 Newspaper

The Richmond Times-Dispatch is a source of traffic information that is readily available to citizens and visitors of the study area. VDOT is responsible for notifying the Richmond Times-Dispatch about road conditions in and around the Richmond area where road improvement projects are taking place Because Henrico County maintains its own road system, they also notify the paper when and where construction activities take place. The Times-Dispatch will print in its "Virginia" section VDOT- and Henrico-County sponsored advertisements which describe road closings, expected delays and construction.

2.7.8 Information Dissemination Through Other Sources

Fliers

VDOT commonly puts fliers on vehicles that are in the proximity of future construction projects. Information generally includes the tentative dates of the improvements, the location, the expected duration and a contact person and phone number for questions or concerns.

Public Toll-Free/Information Numbers

The TEOC operates the "Highway Helpline", a toll-free number available nationwide within the continental United States. By using this number (l-800-367-ROAD), citizens can report road hazards and get information on road conditions affected by inclement weather, highway accidents and work zones. On average, the TEOC receives approximately 2,000 calls per month. During the June/July floods of 1995, the TEOC staff responded to more than 40,000 calls.

The VDOT Central Office operates a toll-free number that is used by the public to voice their concerns. If the caller includes his/her name and number, the call can then be directed to the appropriate District and the person can be contacted by a VDOT representative.

Fax Services

Fax Services are a means of getting traffic information out to the public and the media in real time. Currently, the TEOC regularly faxes road and traffic condition reports to the media. Ridefinders goes one step further by broadcast faxing updated traffic information, weather

forecasts and air quality reports to a database consisting of at least 1600 area employers in an effort to generate ridesharing.

130 of these employers have formal contact with Ridefinders, and operate formal ridesharing programs using posters, contact persons and other promotional materials. The employer, database was developed and supplied to Ridefinders by the Greater Richmond Chamber of Commerce.

On-Line Services

No on-line services are currently used to transmit transportation information to the public in the study area; however, VDOT and the TEOC are currently developing an on-line information service for the public. This on-line service will be accessible via the Internet from personal computers and possibly kiosks in key public locations, such as rest areas and tourist centers. The public will be able to get information regarding traffic and road conditions, construction and maintenance activities, special events, weather and other transportation related information.

2.7.9 Incident Management

2.7.9.1 State Agencies

The Transportation Emergency Operations Center (TEOC) is located in Richmond and is staffed by VDOT. It is the nerve-center of emergency support for Virginia's Department of Rail, Department of Aviation, Port Authority, DMV, State Police and Coast Guard. The Virginia TEOC facility is staffed 24 hours a day, 365 days a year and is capable of handling all transportation-related emergency calls. The VDOT Richmond District has its own emergency operations center to handle emergency requests within Richmond District boundaries; however, it does not operate on a 24-hour basis. The TEOC handles all off-hour requests in lieu of the VDOT Richmond District.

Staff members of TEOC include a Director, Assistant Director/Hazmat Officer, EOC Supervisor, and six Watch Officers. The center has twenty-two computer-equipped workstations accessing the Emergency Information System that is used in tracking incidents, road conditions, maintenance, resources, weather, and construction areas. When conditions warrant, all of these workstations are staffed by representatives of appropriate transportation agencies, both state and federal. Emergency training procedures, resources, and specific roles of the TEOC and VDOT during peace and war-time disasters are outlined in the ***Commonwealth of Virginia Emergency Operations Plan, Volume VII (Transportation Section).***

The TEOC operates an Information Exchange Network computer to share information with the I-95 Corridor Coalition for traffic management information from Maine to Virginia. A 10 foot x 10 foot screen is used to project specific computer screens and has video-projection capability. The TEOC utilizes a wide-area network (WAN) to communicate with VDOT field offices. The center is computer linked to the following VDOT facilities:

- All nine district VDOT headquarters statewide
- The Northern Virginia Transportation Operations Center
- The Hampton Roads Traffic Management Systems Center

The TEOC is also linked with the Virginia Department of Emergency Services and has "dial in" capability for mobile, field and other state and agency access.

VDOT's role in transportation incidents is to provide resources, support, and coordination. Actual response and clean-up activities are the responsibility of the dispatched units. These include fire/rescue, emergency medical services (EMS), police, hazardous materials (HAZMAT) teams, wrecker services and other emergency response agencies.

2.7.9.2 Inter-Agency Coordination

Frequently multiple agencies respond to an emergency. The efforts of the various personnel must be coordinated. Logistical management of these situations must be handled in a professional, efficient manner. It has been reported that a good level of coordination exists between the VSP and VDOT, especially during storms and other major situations. Any trouble with cooperation usually occurs on a person-to-person level and not at an agency level. Because of its involvement with commercial vehicle operations, the VSP also works very closely with the DMV.

Cooperation between the VSP and local fire departments has been relatively good; however, there is a need for better coordination between VDOT and various fire departments. The organizations do not currently have a common policy that covers issues of coordination during response to roadway incidents. Such a policy would allow proper response and clean-up by the fire department while providing safer and more efficient routing of traffic.

In an effort to improve safety at road construction sites, VDOT has implemented the "Construction Safety Zone Program". At the request of VDOT, one State Police officer may volunteer to be posted at construction sites which would normally be a hazardous situation for both the construction worker and the passing motorist. The police officer would monitor traffic and ensures the safety of construction workers by providing a visual warning to approaching motorists. The blue lights on the police vehicle would draw the attention of motorists and indicate that caution should be taken while passing through the construction sites..

2.7.9.3 Regional Coordination

Statewide Incident Management Committee (SIMC)

The Statewide Incident Management Committee was originally established to develop broad-based incident management strategies within the Commonwealth of Virginia. The organization has now been in existence for approximately two years, and has focused its efforts on specific tasks that help the participating orgnaizations coordinate, communicate, and cooperate on highway incidents and projects.

Examples of current task groups include:

- The Statewide Development Plan for VMS and HAR Task Group
- The Safety Service Patrols/Towing & Recovery Task Group
- The Experimental Incident Management Sign Color Task Group
- The Outreach and Training Task Group
- The Olympic Travel Task Group
  (for the 1996 Summer Olympic Games in Atlanta)
- The Code of Virginia Task Group
- The Clear the Road Task Group

Although most of the committee members are VDOT personnel, the committee members also include representatives from: the Virginia Towing and Wreckers Organization (VATRO), Fairfax County Fire and Rescue, Fairfax County Police, the Virginia Department of Fire Programs, the Virginia State Fire Chiefs Association, the Virginia State Police, the FHWA, the Virginia Transportation Research Council (VTRC), Delaware DOT, Maryland State Highway Association, North Carolina DOT, West Virginia Department of Highways, the Virginia Department of Emergency Services, the Virginia Tech Transportation Research Group, Frederic R. Harris, Inc., De Leuw, Cather, & Co. and the I-95 Corridor Coalition.

Traffic Diversion Plans

VDOT's Richmond District office has developed and maintains traffic diversion plans for interstate and other major state roads within the District's jurisdiction. The diversion plan specifies routes, signage, personnel, and other specifics for rerouting traffic in tbe 'event of an incident.

HAZMAT Incidents

The County of Henrico houses the study area's only HAZMAT Incident Response Team. This team has been established to be trained for, and respond to, any incidents involving the spillage of hazardous materials in the Richmond area; however HAZMAT teams sometimes respond to incidents as well.

All permits for the transport of hazardous materials are issued by VDOT. During incidents, VDOTs role is to provide the cones, equipment for detours, routing and sometimes a front end loader. VDOT provides equipment that may help out in the clean-up and keeps traffic moving.

2.8 TRANSPORTATION RELATED ISSUES

The following subsections present the problems and opportunities that the Richmond/Tri-Cities area faces in meeting the needs of the regional transportation system. First, the types of problems and opportunities will be discussed and then the sources of information consulted to identify those problems and opportunities is presented. Finally, a synthesis of the problems and opportunities is presented to set the ground for evaluating the usefulness of the ITS User Services in addressing the needs of the Richmond/Tri-Cities area.

2.8.1 Types of Problems and Opportunities

The problems and opportunities were divided first into two broad classes: (1) location specific; and (2) general. The location specific problems and opportunities can be tied to a specific geographic location; for example, recurring congestion, accident "hot spots", or an inadequate bridge. General problems and opportunities are likely to represent issues having to do with an infrastructure network, jurisdiction, or agency; for example, inter-jurisdictional cooperation during incident response, issues about regional economic development, or opportunities for improved commercial vehicle operations.

2.8.2 Information Sources

During the initial phases of this study, several sources were consulted for gathering information. They include:

- interview summaries from federal agencies, state agencies, local agencies, and private organizations; and
- planning documents and other materials produced by various agencies and organizations.

2.8.3 Synthesis of Problems and Opportunities

The following presents an overview of the problems and opportunities that were noted from discussions with transportation system providers and users. Information was also gathered from published documents issued by these organizations. For a more detailed listing of the problems and opportunities, refer to the technical memorandum ***Synthesis of Problems and Opportunities.*** Location specific issues are presented first, followed by general issues affecting the Richmond/Tri-Cities area.

2.8.3.1 Location Specific Problems and Opportunities

As described above, the location specific problems and opportunities address issues in a specific geographic location.

a. Interstate Highways. The interstate highways that provide regional access to the RichmondlTri-Cities area includes I-64, I-85, I-95, I-195, and I-295. Congestion on these interstates is one of the major transportation problems for the region. The congestion can be classified into two categories: recurring congestion and non-recurring congestion. Recurring congestion is traffic congestion that occurs at a given location on a frequent basis. Non-recurring congestion is traffic congestion that is caused by unpredictable or infrequent circumstances – for example, incidents on the road, special events, construction/maintenance activities, severe storms, or any other event that severely reduces the flow of traffic.

(I) Recurring Congestion. A number of locations on the interstates were pinpointed where recurring congestion is a problem. Table 2-4 provides a summary of recurring congestion on the interstate highways in the Richmond/Tri-Cities area by indicating the total number of spots pinpointed for each highway. A more detailed description and location for each spot are given in Appendix C.

TABLE 2-4
RECURRING CONGESTION ON INTERSTATE HIGHWAYS

HIGHWAY .	NUMBER OF RECURRING CONGESTION SPOTS
interstate 64	9
Interstate 85	1
Interstate 95	17
Interstate 195	1
Interstate 295	3

(2) ***Non-recurring Congestion.*** Most of the reports of non-recurring congestion on the Interstate highways pertain to I-64 and I-95. This makes sense in light of the fact that the recurring congestion reports tabulated in Table 2-4 show that I-64 and I-95 have the most congestion. Incidents and other traffic induced events are more likely to occur on facilities that experience heavier recurring traffic congestion. Non-recurring congestion was also noted on I-85 in Petersburg; however, this non-recurring congestion is less frequent than that in Richmond and it does not result from recurring congestion.

b. Primary and Secondary Routes.

(1) ***Recurring Congestion.*** The recurring congestion problems on primary and secondary routes are generally caused by demand that exceeds current capacity. This is especially prevalent in surrounding counties and other areas that are experiencing rapid residential and/or commercial development. For a comprehensive list of specific primary and secondary routes that have recurring. congestion, see Appendix C. This appendix contains two tables that list the congested links on primary and secondary routes in the Richmond Regional Planning District and the Crater Planning District.

(2) Non-reaming Congestion. The non-recurring congestion on primary and secondary routes is generally caused by incidents, special events, train crossings, and other events that may not be a factor on the Interstates. Aside from accidents and other emergencies, each jurisdiction has its own special events, railroad crossings, and other unique features that are responsible for non-recurring congestion.

C. **Maintenance.** VDOT maintains Interstates, primary routes, and secondary routes in all counties, except Henrico County – the County of Henrico maintains its own secondary roads.

d. Toll Facilities. There are several opportunities for implementing electronic toll collection (ETC) in the Richmond/Tri-Cities area. Several agencies, including the Richmond Metropolitan Authority (RMA), VDOT, and Richmond International Airport (RIC), currently operate toll facilities. These agencies are in the process of examining electronic toll collection (ETC) alternatives and reaching a consensus on adopting a standard system that is compatible across agencies and toll facilities in the Richmond/Tri-Cities area. A summary of these operating facilities is given in Table 2-5.

TABLE 2-5
EXISTING AND PROPOSED TOLL FACILITIES

TOLL FACILITY	EXISTING OR PROPOSED	OPERATING AGENCY	LENGTH (MILES)/ # OF SPACES
Downtown Expressway	Existing	RMA	3.97 N/A
Powhite Expressway	Existing	RMA	2.4 / N/A
Boulevard Bridge	Existing	RMA	.38
Powhite Extension	Existing	VDOT	10.3
Richmond Intnl. Airport Parking	Existing	RIC	4,176
I-895 (whole portion)	Proposed	Private Firm	8.8
I-288 (from Powhite to I-64)	Proposed	Private Firm	16.5

The following is a list of particular problems and opportunities with regard to toll facilities:

- The **Virginia Department of Transportation** (VDOT) has conducted a survey that demonstrates solid support for implementation of electronic toll collection' (ETC) on the Richmond Expressway System.

- Local **jurisdictions** have mixed positions on support of tolls on I-288 and I-895. Despite the general public's severe aversion to tolls, financial restraints indicate that the placement of tolls on these new facilities may be the only way to pay for them. This has resulted in varying positions that revolve around the issue of whether new roads should be constructed as toll roads.

- The **RMA** participated in the survey with VDOT on the Electronic Toll Collection for the Richmond Expressway System. The RMA has not yet committed to a particular ETC system, but is participating in discussions of a standard system for the Richmond/Tri-Cities area. Current rush hour queues at some RMA toll plazas are 1/2 to 3/4 mile in length. Previous attempts to eliminate or raise toll gates resulted in high toll evasion rates.

- **The Richmond International Airport** has decided to implement the FASTOLL electronic toll collection system developed for the Dulles Toll Road electronic toll and traffic management (ETTM) system. RIC plans to deploy this system to serve their parking facilities and support the use of this system on I-895. The RIC is presently adding 1,500 garage parking spaces to their existing parking facilities, with plans to add 750 more spaces by June 1996.

e. Construction/Maintenance Zones. The Richmond/Tri-Cities area will experience an increase in road and bridge construction activity over the next ten years. The projects that are currently planned are the result of aging surface transportation infrastructure, urban growth, and increasing demand on road capacities. A number of road and bridge infrastructure projects are currently in progress in the study area. These projects have the potential to cause additional congestion and incidents near the construction zones; however, if planned and managed properly, the effects will be minimized and the motoring public may show an increased confidence in the state and local transportation agencies. Since the study area is likely to have a prolonged period 'of construction projects, the benefits of good construction zone management are great.

2.8.3.2 General Problems and Opportunities

General problems and opportunities address issues that are not tied to a specific geographic location.

a. **Public Transit.** Problems and opportunities relating to transit are organized into several categories corresponding to different transit modes: rail, bus, taxi, ride sharing, and general. While there are a variety of public transit modes in Richmond and the Tri-Cities area, these services have generally struggled to hold up under decreasing ridership. However, enactment of the Inter-modal Surface Transportation Efficiency Act of 1991 (ISTEA) has renewed a certain amount of interest in the public transit system.

(1) ***Rail.*** Several opportunities now exist for new and upgraded rail service to the Richmond/Tri-Cities area. These opportunities include a -multi-modal transit center at Main Street in downtown Richmond, new rail sidings in the Town of Ashland, and reactivation of the Providence Forge Amtrak rail stop in New Kent County, and Rocksbury at Route 106 at the intersection of the CSX line in Charles City County. There are also plans to upgrade tracks from Richmond to Union Station in Washington, D.C.

(2) ***Bus.*** A majority of the comments about bus service indicated problems with decreasing bus ridership and a lack of service in some areas. Perhaps increasing automobile usage and less reliance upon transit in general have contributed to decreasing ridership. The lack of service in some of the jurisdictions appear to be related to institutional issues and funding.

(3) ***Taxi.*** The primary concern regarding taxis is that there is a noted lack of taxi service in downtown Richmond and at a limited number of other locations throughout the Richmond/Tri-Cities area. While taxi service is generally not viewed as a viable transportation mode, it does serve a limited need for personalized public transportation within the area. Since taxis are licensed by municipalities and counties in accordance with individual taxi ordinances, taxi service is a function of individual arrangements by jurisdictions.

(4) Ride Sharing. Comments about ride sharing and car pooling indicate that this alternative may be a good option for reducing the use of Single Occupant Vehicles (SOVs) in the downtown Richmond area and other high-density employment areas in the region. The park-and-ride lots that have been established are being utilized by commuters, indicating that car pooling and ride sharing promotion could be effective. Ridefinders, a commuter ride sharing service, is working with major employers in the Richmond/Tri-Cities area to provide service on a broad scale. By working with the large employers, Ridefmders provides another way to reach commuters and maximiie market penetration of ride sharing service. One other opportunity for reaching commuters who may wish to car pool is through a computer bulletin board system (BBS); however, it is

noted that reaching individual commuters may be hindered by a person's reluctance to have his or her name placed in a database.

(5) ***General.*** In general, the demand for public transit in the Richmond/Tri-Cities area is low. Increasing automobile ownership, increasing regional population, good schools, suburban land use patterns, and other factors have resulted in recent increases in highway congestion. According to current perceptions, this growth of congestion in the Richmond area has occurred principally over the past five or six years. As this trend accelerates, the desire for ride sharing and other transit modes may gain favor. Federal and state legislation such as ISTEA, Clean Air Act Amendments (CAAA), and Energy regulations may contribute to a renewed interest in public transit.

b. **Ports and Water.** The Port of Richmond Terminal (PORT) represents a significant opportunity for expanding multi-modal freight transport within the Richmond/Tri-Cities region. The PORT is the primary marine terminal within the area and, consequently, the PORT is at the center of most of the problems and opportunities associated with water transportation in the region. Two particular problems at the PORT are: limited railroad service because of poor connections and service into the PORT, and there is no double-stack rail service at the PORT because double-stack cars do not clear many of the underpasses leading to the PORT facility. Although there are some limited access problems at the PORT, there are some plans for expansion of the facility in the near future, including "piggybacking" of freight operations. Two ports are currently in use within Charles City County. One, a permitted barge port, is in use above the Benjamin Harrison Bridge on Route 106. The second port is currently being used and upgraded at Rt. 614 and the James River off of Route 5.

c. **Airports.** Richmond International Airport (RIC), located in Henrico County, is the primary airport for serving air passengers and freight in the Richmond/Tri-Cities region and beyond. The airport also draws many passengers from central Virginia and other areas. RIC is currently classified by the Federal Aviation Administration (FAA) as a "small hub", but is on the verge of becoming classified as a "medium hub". The airport is currently undergoing a $224 million renovation and expansion project, including expanded parking and road facilities. With this expanded service, RIC offers many opportunities for implementing new technologies that will assist intermodal travelers. The following summarizes current and planned technology opportunities:

- RIC currently operates a *RIC cellular phone number for disseminating travel information.
- RIC is developing a presence on the World Wide Web. This will serve as an information source for those travelers or other citizens with Internet access.
- RIC has expressed interest in testing the new R-Nav data link system that is being targeted for initial testing in Virginia.

- RIC is developing the first Electronic Toll Collection (ETC) system in the Richmond/Tri-Cities area. This system will be based on Automatic Vehicle Identification (AVI) technology and an electronic tag system for electronically charging customers for use of airport facilities.

d. **Rail Freight.** Freight service in the Richrnond/Tri-Cities area is operated by two railroad companies – CSX Corporation and Norfolk-Southern Corporation. The vulnerability of these freight operations to incidents or natural disasters is somewhat limited because there are dual sets of tracks running in the North-South and East-West directions to provide redundant access to the region. In the event of an incident or disaster the two rail companies coordinate efforts to maintain operating capacity. CSX Corporation operates a Bulk Intermodal Distribution Service (BIDS) terminal. The BIDS terminal serves as a point of distribution for freight being carried by different modes – rail, truck, etc. This facility presents an opportunity for coordination of multi-modal freight transport in the Richmond/Tri-Cities area.

e. **Parking Facilities.** One of the parking facility issues of regional interest is the use of park-and-ride lots to serve commuters and others who wish to car pool. The park-and-ride lots that have been constructed to date have been successful and are an opportunity to reduce some highway congestion. Given the current road congestion and the noted lack of parking in downtown Richmond, the park-and-ride lots for suburban and rural commuters may serve dual purposes – reduce overall congestion caused by commuters and reduce the number of required parking spaces in downtown Richmond. Another issue that may be of regional interest is the potential to allow parking fees to be paid electronically via the ETC system that RIC is implementing.

f. **Economic Development and Land Use.** The problems and opportunities associated with economic development and land use appear to revolve around the issues of tourism and commercial land development. Given the historical nature of the Richmond/Tri-Cities region and the proximity to major travel routes, tourism plays a sizable role in the economic vitality of the area. Similarly, various land development projects throughout the region are presenting new challenges and opportunities, especially in the suburban ring that surrounds the Richmond metropolitan area.

With regard to tourism, the primary observation has been that tourism must be a regional effort in order to generate reasonable revenues, labor resources, and support. Individual counties and local jurisdictions can not handle the cost of promoting tourism alone. The Richmond/Tri-Cities region should take advantage of the opportunity for sharing resources and coordinating on matters of policy. Currently, Prince George County, in cooperation with the City of Petersburg, is developing a formal historical association. Perhaps such an association can serve as a resource for coordinating tourism efforts. The difficulty that the City of Hopewell has had in getting signs located to advertise its historic district is one example of how a lack of coordination has affected individual

jurisdictions. Another issue that has been noted is that signs do not properly describe attractions and roads for tourists unfamiliar with the area. Coordination of tourism efforts would most certainly serve to help resolve issues such as this.

The paramount issue concerning land development is that development tends to have a priority over transportation. In order to better service the Richmond/Tri-Cities area, land development and transportation planning must have a synergistic relationship. It is imperative that economic development opportunities be balanced with the need for a robust surface transportation system so that adverse impacts on transportation efficiency are minimized. In fact, it has been pointed out that an improved transportation system will help to improve commerce in the region. One of the largest development projects in the region is the Colonial Downs Thoroughbred Horse Racing Facility and Legends Golf Course in eastern New Kent County.

g. Incident Management. Incident management issues are one of the strongest concerns according to the number of comments received. In general, the comments seemed to point out a number of areas for improvement in the way incident management is conducted. These improvements represent opportunities for more efficient incident response, resulting in reduced congestion, reduced operating costs, and fewer injuries and fatalities. Table 2-6 lists the improvement areas and the suggested solutions as presented by the interviewees.

TABLE 2-6
INCIDENT MANAGEMENT IMPROVEMENTS

IMPROVEMENT AREA	RECOMMENDED SOLUTION
Cooperation	(1) Can improve cooperation and efficiency at incident scenes by holding regular meetings to get all incident response parties acquainted and to share information; (2) Create a coordinated policy or procedure that addresses incident response parties and their respective responsibilities in incident response.
Wrecker Services	(1) Need to develop a heavy-duty wrecker service list that includes only those providers that meet minimum standards; (2) Improve dispatch and communications to provide more accurate information about the incident to prevent erroneous requests.
Load Limits on Bridges Along Diversion Routes	Need to review bridge and road capacities to ensure that diversion routes can accommodate the trucks that get diverted from major routes.
911 Phone Line Capacity	Provide a separate cellular call number to handle all non-emergency police calls so that more capacity on the 911 line is reserved for the life threatening situations.
Secondary incidents	Clear incidents more quickly
Coordination of Resources	(1) Coordinate joint emergency response exercises; (2) Promote compatibility of equipment between jurisdictions; (3) Investigate a common communications frequency and media; (4) Develop joint operating practices and procedures
Information Sharing/Management	Develop a network for sharing incident data and other information resources.
Operational Mind Set	Develop resources and management practices that will provide a full-time 24-hour 365-day per year operations mind set.
Vehicular Carrying Capacity of Diversion Routes	(1) Coordination and incident timing plans; (2) Advanced signing; (3) Highway Advisory Radio
Incident Detection	(1) CCTV (2) Loop detectors; (3) Cellular phones

h. Inter-Agency Coordination. Inter-agency coordination is good in the Richmond/Tri-Cities area. Cooperation between jurisdictions is facilitated primarily through the Richmond Regional Planning District Commission (RRPDC) and the Crater Planning District Commission (CPDC). The participating jurisdictions and agencies in these two commissions are listed in Table 2-7 and Table 2-8.

TABLE 2-7
RICHMOND REGIONAL PLANNING DISTRICT COMMISSION

Participating Jurisdiction/Agency
Town of Ashland
Chesterfield County
Goochland County
Hanover County
Henrico County
Powhatan County
City of Richmond
Greater Richmond Transit Company
Richmond Metropolitan Authority
Richmond Regional Planning District Commission
Virginia Department of Transportation
Ridefinders

TABLE 2-8
CRATER PLANNING DISTRICT COMMISSION

Participating Jurisdiction/Agency
City of Petersburg
City of Colonial Heights
City of Hopewell
Prince George County
Dinwiddie County
Chesterfield County

In addition to coordination of jurisdictions through the Planning District Commissions (PDCs) and the Metropolitan Planning Organizations (MPOs), certain agencies coordinate efforts and exchange information to provide a common good or to serve a common interest. For example, VDOT and VSP currently coordinate resources and share information under the Construction Safety Zone program and the Statewide Interagency Radio System (SIRS). Other coordination efforts are less formal. For example, the

various incident response agencies in various areas have informal gatherings to discuss incident response issues.

There are many opportunities and new technologies for coordinating resources and sharing information amongst jurisdictions and agencies with common interests. To the extent possible, these resources can be shared through various formal or informal arrangements.

I. **Traveler Information.** One of the opportunities for reducing congestion and providing more service to the traveler is to supply information that help in making transportation decisions. A number of general comments were received concerning the need for traveler information. These comments reflect the following:

- Need to provide traveling public with information for making informed transportation decisions and perhaps educate them a little about the Richmond/Tri-Cities area.

- Need to work on implementing a variety of methods for getting traveler information to the traveling public.

- Traveler information needs to be user-specific.

Generally, comments about specific traveler information fell into two categories: Information for commuters and local travelers; and information for tourist and through-traffic. Each of these categories are discussed briefly.

Commuters and local travelers need to be informed about the alternate routes available for getting to employment and other locations. One of the problems noted was the lack of traffic reporting service in the Tri-Cities area. Richmond is served by Metro Traffic Control.

Tourists need to have information that helps them to safely and efficiently navigate to tourism locations in the Richmond/Tri-Cities area; people traveling through the Richmond/Tri-Cities area on the Interstates need to have adequate information for traversing through the area. Travelers need to have accurate information before reaching travel decision points. Comments indicated that currently, signs do not describe attractions and roads adequately for people who are unfamiliar with the Richmond/Tri-Cities area. To help address the need for getting information out to travelers, an information kiosk has been installed at the rest area on I-95 north of Richmond. Perhaps other kiosks can be installed for disseminating information.

j. **Communications.** The primary emphasis of comments concerning communications indicated the need to enhance communications at all levels, including interagency, interjurisdictional, intermodal, and interstate communications. The development of ITS requires a more mature communications network for exchanging information. Examples of comments received:

- While the Statewide Interagency Radio System (SIRS) facilitates communication between VDOT and VSP, communication with other jurisdictions is generally not possible because everyone operates on different radio frequencies.

- There is an opportunity to provide information to the public through cable TV, but several jurisdictions lack cable TV service.

- Dispatch communications need to be improved so that wrecker services are accurately informed about incident response requirements.

Finally, one of the problems with communications in general is that the current demand for bandwidth access exceeds the supply. Federal regulations parcel out the bandwidth resources, thus requiring an effort of compliance and planning on the part of state and local governments. The Ram Communications group study focuses on meeting requirements.

k. **Traffic Control.** Issues concerning traffic control related to a number of proposed improvement projects that would help to reduce congestion and improve transportation system efficiency. The following is a list of the potential improvements:

- Signal Coordination

- Video Surveillance at Key Accident Locations (Closed Circuit Television – CCTV)

- Improved At-Grade Rail Crossings

- Improved Signage

l. **Information Management.** In order to process, store, and disseminate transportation information, one or more facilities need to be located to act as the information clearinghouse(s) for the various operating agencies and the transportation system users. VDOT currently operates a Traffic Emergency Operations Center (TEOC) that may function in this capacity.

m. **Surveillance and Electronic Equipment.** Surveillance devices, if implemented wisely, present an opportunity to collect information and achieve added capabilities in the

transportation system. Note, however, that surveillance devices tend to be expensive and should be invested in cautiously and according to a strategic plan.

n. Navigation and Routing. Opportunities exist already within the private sector for deploying navigation and routing systems for use in the Richmond/Tri-Cities area. Some commercial trucking companies and other freight transport companies already employ GPS or LORAN devices to monitor the position of the vehicles in their fleets, and others may be willing to pay for the wide-scale use of such systems.

SECTION 3
ITS USER SERVICES

3.1 ITS USER SERVICES

The May 1994 Draft, of the "National Program Plan for Intelligent Vehicle-Highway Systems" established 6 "bundles" of logical groupings of 28 IVHS User Services. The March 1995 release of the "National ITS Program Plan" reorganized these user services into 7 bundles and added Emissions Testing and Mitigation, the twenty-ninth user service. Table 3-l shows the most current listing of the user service bundles and these user services. A brief explanation of these user services is shown in Table 3-2. A more complete series of definitions for these user services is contained in Appendix D.

TABLE 3-1
ITS USER SERVICES

TRAVEL AND TRANSPORTATION MANAGEMENT	**COMMERCIAL VEHICLE OPERATIONS**
- En-Route Driver Information - Route Guidance - Traveler Services Information - Traffic Control - Incident Management - Emissions Testing and Mitigation[1]	- Commercial Vehicle Electronic Clearance - Automated Roadside Safety Inspection - On-Board Safety Monitoring - Commercial Vehicle Administrative Processes - Hazardous Matetals Incident Response Freight Mobility
TRAVEL **DEMAND MANAGEMENT**	EMERGENCY MANAGEMENT
- Pretrip Travel Information - Ride Matching and Reservation - Demand Management and Operations[2]	- Emergency Notification and Personal Security - Emergency Vehicle Management
PUBLIC TRANSPORTATION OPERATIONS	**ADV. VEHICLE CONTROL AND SAFETY SYSTEMS**
- Public Transportation Management - En-Route Transit information - Personalized Public Transit - Public Travel Security	- Longitudinal Collision Avoidance - Lateral Collision Avoidance - Intersection Collision Avoidance - Vision Enhancement for Crash Avoidance - Safety Readiness - Pre-Crash Restraint Deployment - Automated Highway Systems
ELECTRONIC PAYMENT	
- Electronic Payment Services	

1 Added March 1995
2 Renamed from Travel Demand Management
3 Renamed from Commercial Fleet Management

TABLE 3-2
ITS USER SERVICES

TRAVEL AND TRANSPORTATION MANAGEMENT

1.1 **En-Route Driver Information** - Improves convenience and efficiency with driver advisories and in-vehicle signing.

1.2 **Route Guidance** - Provides travelers with instructions on how to efficiently reach their destinations.

1.3 **Traveler Services Information**- Provides a reference directory, or "yellow pages" of service information.

1.4 Traffic Control - Manages the movement of traffic on streets and highways.

1.5 Incident Management - Helps officials quickly identify incidents and implement a formalized set of procedures to minimize their effects on traffic.

1.6 Emissions Testing and Mitigation - Provides area-wide pollution information for monitoring air quality and framing air-quality improvement strategies.

TRAVEL DEMAND MANAGEMENT

2.1 Pre-Trip Travel Information - Provides information for selecting transportation modes that best suits travelers' needs.

2.2 Ride Matching and Reservation - Serves as a mechanism for increasing the attractiveness of shared-ride transportation.

2.3 Demand Management and Operations - Manages access to roadways and bridges, supporting policies and regulations like the 1990 Clean Air Act Amendment.

PUBLIC TRANSPORTATION OPERATIONS

3.1 Public Transportation Management - Automates operations, planning, and management functions of public transit systems.

3.2 En-Route Transit Information - Provides information to travelers using public transportation while on their trips.

3.3 Personalized Public Transit - Flexibly-routed transit vehicles, offering more convenient service to customers.

3.4 Public Travel Security - Creates a more secure environment for public transportation patrons and operators.

ELECTRONIC PAYMENT

4.1 Electronic Payment Services - Allows payment for transportation related transactions without cash.

COMMERCIAL VEHICLE **OPERATIONS**

5.1 Commercial Vehicle Electronic Clearance - Facilitates domestic and international border clearance, minimizing stops.

5.2 Automated Roadside Safety Inspection - Focuses on improving safety in commercial vehicle operations.

5.3 On-Board Safety Monitoring - Senses the safety status of a commercial vehicle, cargo, and driver.

5.4 Commercial Vehicle Administrative Processes - Provides electronic purchasing of credentials, and automated mileage and fuel reporting.

5.5 Hazardous Materials Incident Response : Provides immediate description of hazardous materials to emergency responders.

5.6 Freight Mobility - Provides communications between drivers and dispatchers for efficient routing.

EMERGENCY MANAGEMENT

6.1 Emergency Notification and Personal Security - Provides immediate notification of an incident and an immediate request for assistance.

6.2 Emergency Vehicle Management - Efficiently tasks available resources and directs them to incidents, reducing response time.

ADVANCED VEHICLE CONTROL AND SAFETY SYSTEMS

7.1 Longitudinal Collision Avoidance - Prevents head-on and rear-end collisions with other vehicles and pedestrians.

7.2 Lateral Collision Avoidance - Prevents collisions or vehicles leaving their own lane.

7.3 Intersection Collision Avoidance - Prevents collisions involving right-of-way violations at intersections.

7.4 'Vision Enhancement for Crash Avoidance - Improves the driver's ability to see the roadway and obstacles.

7.5 Safety Readiness - Provides warnings regarding the condition of the driver, vehicle, and roadway infrastructure.

7.6 Pre-Crash Restraint Deployment - Anticipates an imminent collision and activates passenger safety mechanisms prior to the collision.

7.7 Automated Highway Systems - Fully automates vehicles on instrumented highways, significantly improving today's safety, efficiency, and comfort standards.

3.2 ITS USER SERVICE IMPLEMENTATION LEADERSHIP

The ITS User Services listed in the preceding tables will be implemented through the leadership of many organizations. In some instances the organizations leading the implementation efforts are public agencies, in others they are private sector firms, and in a few a public-private partnerships. In several cases leadership opportunities exist for both the public and the private sector.

A preliminary screening was performed to identify the user services that require the leadership of the public sector and those that are primarily dependant upon private sector leadership. This screening, shown in Table 3-3, was also based on materials contained in the "National Program Plan for Intelligent-Vehicle Highway Systems", as well as the discussions that have taken place with VDOT staff and the other members of the Steering Committee, interviews with agency representatives, and the focus group meetings.

3.3 PRIVATE SECTOR ITS USER SERVICES

It seems clear that the Richmond/T+Cities ITS Early Deployment Project will have limited influence on ITS User Services in which the private sector must take the lead. The efforts and resources of this project will, therefore, be concentrated on the ITS User Services in which there are leadership opportunities for the public sector.

The implementation priorities for the user services whose leadership rests primarily with the private sector will be determined by the private sector's evaluation of the risks and rewards associated with these user services. However, for purposes of this project these user services will be considered as part of the long-term deployment group.

In addition, although the Automated Highway System (AHS) has some leadership opportunities in the public sector, it will also be considered as a user service with a long-term implementation time frame. Implementation of this user services will clearly be based on a public-private partnership that will be addressed as part of a national program. Moreover, the deployment time-frame for the AHS is far enough in the future that it is unlikely that any short- ormedium-term actions could be take as part of the current project to advance its implementation.

Thus, the ITS User Services that will initially be placed in a long-term implementation time frame are:

- On-Board Safety monitoring
- Freight Mobility
- Emergency Notification and Personal security
- Longitudinal Collision Avoidance
- Lateral Collision Avoidance
- Intersection Collision Avoidance
- Vision Enhancement for Crash Avoidance
- Safety Readiness
- Pre-Crash Restraint Avoidance
- Automated Highway Systems

TABLE 3-3
IMPLEMENTATION ASPECTS OF ITS USER SERVICES

BUNDLE/USER SERVICE	IMPLEMENTATION LEADER	
	PRIVATE SECTOR	PUBLIC SECTOR
Travel and Transportation Management		
En-Route Driver Information	*	*
Route Guidance	*	*
Traveler Services Information	*	*
Traffic Control		✓
Incident Management		✓
Emissions Testing and Mitagation		✓
Travel Demand Management		
Pre-Trip Travel information	*	*
Ride Matching and Reservation	*	*
Demand Management and Operations		✓
Public Transportation Operations		
Public Transportation Management		✓
En-Route Transit information		✓
Personalized Public Transit	*	*
Public Travel Security		✓
Electronic Payment		
Electronic Payment Services		✓
Commercial Vehicle Operations		
Commercial Vehicle Electronic Clearance		✓
Automated Roadside Safety Inspection		✓
On-Board Safety Monitoring	√	
Comm. Vehicle Administrative Processes		✓
Hazardous Materials Incident Response	*	*
Freight Mobility	✓	
Emergency Management		
Emergency Notification and Personal Security	✓	
Emergency Vehicle Management		√
Advanced Vehicle Control and Safety Systems		
Longitudinal Collision Avoidance	✓	
Lateral Collision Avoidance	✓	
Intersection Collision Avoidance	✓	
Vision Enhancement for Crash Avoidance	✓	
Safety Readiness	✓	
Pre-Crash Restraint Deployment	✓	
Automated Highway Systems	*	*

* Leadership opportunities in both the Public Sector and Private Sector

3 . 4 ITS USER SERVICES CONSIDERED FOR SHORT- AND MEDIUM TERM DEPLOYMENT

The remaining 19 ITS User Services that have been retained for analysis and consideration for deployment in the short- and medium-term implementation time frames are shown in Table 3-4.

TABLE 3-4
USER SERVICES TO BE CONSIDERED FOR SHORT- AND MEDIUM-TERM DEPLOYMENT

TRAVEL AND TRANSPORTATION MANAGEMENT	PUBLIC TRANSPORTATION OPERATIONS
• En-Route Driver Information • Route Guidance • Traveler Services Information • Traffic Control • Incident Management • Emissions Testing and Mitigation	• Public Transportation Management • En-Route Transit Information • Personalized Public Transit • Public Travel Security
TRAVEL DEMAND MANAGEMENT	COMMERCIAL VEHICLE OPERATIONS
• Pre-trip Travel Information • Ride Matching and Reservation • Demand Management and Operations	• Commercial Vehicle Electronic Clearance • Automated Roadside Safety Inspection • Commercial Vehicle Administrative Processes • Hazardous Materials incident Response
ELECTRONIC PAYMENT	EMERGENCY MANAGEMENT
• Electronic Payment Services	• Emergency Vehicle Management

SECTION 4
ITS USER SERVICE PRIORITIES

As indicated in the preceding section, ITS User Services whose implementation leadership rests primarily with the private sector have been assigned a long-term implementation priority.

Priorities for the remaining ITS User Services were selected in conformance with the guidelines developed by FHWA. The three major factors used to determine the short-, medium-, and long-term user service objectives are: the ability of the user services to address the goals identified for this project; the need for these user services in the community; and the ability to implement these user services. These factors were evaluated independently for each of the ITS User Services. The results of these independent analyses were then combined to produce the overall ranking for the user services shown below in Table 4-l. The material within this section explains how these factors were evaluated for each of the user services, and how the results of these evaluations were combined to produce the priorities.

TABLE 4-l
OVERALL ITS USER SERVICE IMPLEMENTATION PRIORITIES

SHORT-TERM (1-3 Year Implementation)	MEDIUM-TERM (4-7 Year Implementation)
Incident Management*	**Traveler Services information**
En-Route Driver Information*	**Public Transportation Management**
Pre-Trip Travel Information	**Demand Management and Operations**
Ride Matching and Reservation	**Personalized Public Transit**
Traffic Control	**Electronic Payment Services**
LONG-TERM PUBLIC AND PUBLIC/PRIVATE SECTOR (7-20 Year Implementation	**LONG-TERM, PRIVATE SECTOR (7-20** Year Implementation)
Route Guidance	**Longitudinal Collision Avoidance**
Emergency Vehicle Management	**Lateral Collision Avoidance**
En-Route Transit information	**Intersection Collision Avoidance**
Emissions Testing and Mitigation	**Vision Enhancement for Collision Avoidance**
Public Travel Security	**Safety Readiness**
Automated Roadside Safety Inspection	**Pre-Crash Restraint Deployment**
Commercial Vehicle Administrative Processes	**Automated Highway Systems**
Hazardous Materials Incident Response	**On-Board Safety Monitoring**
Commercial Vehicle Electronic Clearance	**Freight Mobility**
	Emergency Notification and Personal Security

*** Immediate action implementation plans should be developed for these User Services.**

4.1 ABILITY OF THE USER SERVICES TO SATISFY THE REGION'S GOALS

The ability of the user services to satisfy the region's goals was determined using a three step process. The first step in this process identified a preliminary series of goals, and developed weights for these goals based on their relative importance. The second step assigned a series of compliance ratings to each user service based on how well that user service satisfied each of the regional goals. The third and final step ranked the user services based on the sum of the products of the goal weights and the compliance ratings. These three steps are described in greater detail in the following paragraphs.

Weights for Individual Regional Goals - The individual goals for the region were taken from the National ITS Program Plan. This plan identified five major goals:

- Improve Safety
- Improve Service Level (Efficiency)
- Reduce Energy and Environmental Impact
- Enhance Productivity
- Improve Mobility

The plan also identified a series of objectives for each goal which help to clarify the meaning of the goal. A copy of these goals and their associated objectives are shown in Table 4-2. These goals and objectives were discussed with the Steering Committee to clarify the Committee's understanding of them. The Committee was also asked to identify any additional goals that they thought were relevant, but none were identified that were not already part of these initial goals.

The Steering Committee assigned weights to the individual goals in a goal weighting workshop. Prior to the workshop the members of the Committee were given a copy of the form shown in Table 4-2, and asked to submit an initial weight for each goal with the constraint that the total weights for all goals equal 100. The range of values returned from the members of the Committee are shown in Table 4-3.

TABLE 4-2
PROJECT GOALS AND OBJECTIVES

GOALS	OBJECTIVES
A. Improve Safety	
	1. Reduce the frequency of accidents
	2. Reduce the severity of accidents, including fatalities, injuries, etc.
B. Improve Service Level (Efficiency)	
	1. Increase capability of the transportation system
	2. Reduce congestion due to incidents
	3. Imorove transportation customer service
C. Reduce Energy and Environmental Impact	
	1, Reduce harmful emissions per unit of travel
	2. Reduce enerav consumption per unit of travel
	3. Reduce new right-of-way requirements
D. Enhance Productivity	
	1. Reduce operating and maintenance costs incurred by fleet operators, agencies, etc.
	2. Reduce travel time
	3. Improve transportation system management and planning
	4. Promote economic development
E. Improve Mobility	
	1. Enhance **traveler security**
	2. Reduce travel stress
	3. Improve accessibility for all transportation services
	4. Enhance traveler awareness of all transportation services

TABLE 4-3
RANGE OF INITIAL PROJECT GOAL WEIGHTS

GOALS	HIGH	LOW
A. Improve Safety	50	10
B. Improve Service Level (Efficiency)	40	15
C. Reduce Energy and Environmental Impact	25	5
D. Enhance Productivity	30	5
E. Improve Mobility	40	5

At the workshop, the Steering Committee was divided into four working groups. The range of the goal weights that had been submitted was then discussed, and each group was asked to arrive at a consensus for the ratings within their group. These discussions clarified the meanings of the goals and resulted in some substantial changes to the weights that were assigned. The consensus weightings developed by the groups are shown in Table 4-4. Although the weights' assigned to the goals retained some variability, there was reasonable conformance, and the Committee agreed to use a final set of weights based on the average of the four sets. These weights are also shown in Table 4-4.

TABLE 4-4
GROUPS' WEIGHTINGS OF PROJECT GOALS

	WEIGHTS				
GOALS	GROUP 1	GROUP 2	GROUP 3	GROUP 4	AVERAGE
A. Improve Safety	20	35	25	30	27
B. Improve Service Level (Efficiency)	20	10	5	20	14
C. Reduce Energy and Environmental Impact	10	10	10	10	10
D. Enhance Productivity	20	10	10	20	15
E. Improve Mobility	30	35	50	20	34
Total					100

Compliance Ratings - Each ITS User Service was assigned five compliance ratings, one for each goal. These compliance ratings, which ranged from one to six, reflected the degree to which the ITS User Service could satisfy the individual goals. Thus, a particular user service could be assigned a high (six) compliance rating for one goal, and a low (one) compliance rating for another goal.

This numeric rating is a subjective and qualitative assessment which is heavily dependant upon the individual performing the rating. In order to provide a reasonable degree of structure and objectivity to this process, a two-round "Delphi technique" was utilized. In the first round, three panel members assigned the ratings individually. They then presented their reasons for assigning a particular rating and discussed the differences until they could reach a consensus. In the second round, a member of the project team, not from the original panel, assigned his own compliance ratings to the ITS User Services, and noted where his ratings differed from those of the panel. These significant differences were then reviewed with the three members of the original panel, and they were again discussed until consensus was achieved. The compliance ratings that resulted from this process are shown in Table 4-5.

Rating the ITS User Services - Table 4-5 also shows the product of the individual goal weights and the compliance ratings and the sums of these products. These sums are also shown in Figure 4-1, a bar graph in which each of the ITS User Services is presented as an individual bar.

For convenience, this graph has been rearranged in order of decreasing value in Figure 4-2. As can be seen in this figure, the ITS User Services reflect a continuous range in their ability to satisfy the regional goals.

4.2 ABILITY OF THE USER SERVICES TO SATISFY THE REGION'S NEEDS

The needs of the region are reflected in the statements of problems and opportunities that were gathered during the interviews with the Steering Committee, other agency personnel, and the representatives of the local communities.

4.2.1 Relative the Problem and Opportunity statements to the User Services

The problem and opportunity statements that were gathered from conversations with representatives of the various agencies, businesses and civic organizations in the project area were previously reported in Section 2. These statements are views of problems in the area, and opportunities for introducing transportation improvements as seen from a host of different individual perspectives. They also provide valuable insight into these issues from a regional perspective. For example, numerous people from different parts of the region cited problems with signal coordination. These comments were synthesized with other statements of intersection deficiencies into a single statement indicating that there is a "need to improve intersections, signal system coordination, and timing".

This synthesis reduced multiple pages of comments from the interviews and focus group sessions to a final list of 37 problem and opportunity statements. These statements are shown in Table **4-6.**

A systematic evaluation of the relationships between these statements and the ITS User Services was performed for user services in the following six bundles:

- Travel and Transportation Management
- Travel Demand Management
- Public Transportation Operations
- Electronic Payment
- Commercial Vehicle Operations
- Emergency Management

Relationships between the problem and opportunity statements and the user services in the Advanced Vehicle Control and Safety Systems bundle were not identified. As previously discussed, with the exception of the Automated Highway Systems (which has a very long implementation time frame), all of the user services in this bundle will be implemented under the leadership of the private sector. Thus, they are not service areas in which the Richmond/Tri-Cities area will be involved in the immediate future.

TABLE 4-5
COMPLIANCE RATING AND TOTAL POINTS FOR THE USER SERVICES

	USER SERVICES	GOALS					TOTAL SCORE
		IMPROVE SAFETY	IMPROVE EFFICIENCY	REDUCE ENERGY AND ENVIRON. IMPACTS	ENHANCE PRODUCTIVITY	IMPROVE MOBILITY	
	GOAL WEIGHT	**27**	**14**	**10**	**15**	**34**	
1.1	En-Route Driver Information	2/54	4/56	2/20	4/60	2/68	258
1.2	**Route Guidance**	2/54	3/42	2/20	3/45	2/68	229
1.3	**Traveler Services Information**	1/27	2/28	2/20	2/30	1/34	139
1.4	**Traffic Control**	4/108	5/70	5/50	4/60	2/68	356
1.5	**Incident Management**	3/81	5/70	4/40	4/60	2/68	319
1.6	**Emissions Testing & Mitigation**	1/27	1/14	5/50	1/15	1/34	140
2.1	Pre-Trip Travel Information	1/27	3/42	2/20	3/45	5/170	304
2.2	Ride Matching & Reservation	1/27	4/56	4/40	1/15	4/136	274
2.3	Demand Management & Operations	2/54	6/84	4/40	3/45	1/34	257
3.1	Public Transportation Management	1/27	4/56	2/20	4/60	3/102	265
3.2	En-route Transit Information	1/27	3/42	1/10	2/30	4/136	246
3.3	Personalized Public Transit	1/27	4/56	1/10	4/60	6/204	357
3.4	Public Travel Security	1/27	3/42	1/10	4/15	6/204	298
4.1	Electronic Payment Services	1/27	4/56	3/30	4/60	1/34	207
5.1	Commercial Vehicle Electronic Clearance	2/54	2/28	1/10	2/30	1/34	156
5.2	Automatic Roadside Safety Inspection	4/108	1/14	1/10	2/30	1/34	196
5.4	Commercial Vehicle Administration Processes	1/27	3/42	2/20	4/60	1/34	183
5.5	Hazardous Materials Incident Response	3/81	3/42	2/20	2/30	1/34	207
6.2	Emergency Vehicle Management	4/108	3/42	2/20	2/30	1/34	234
		COMPLIANCE RATING/PRODUCT					

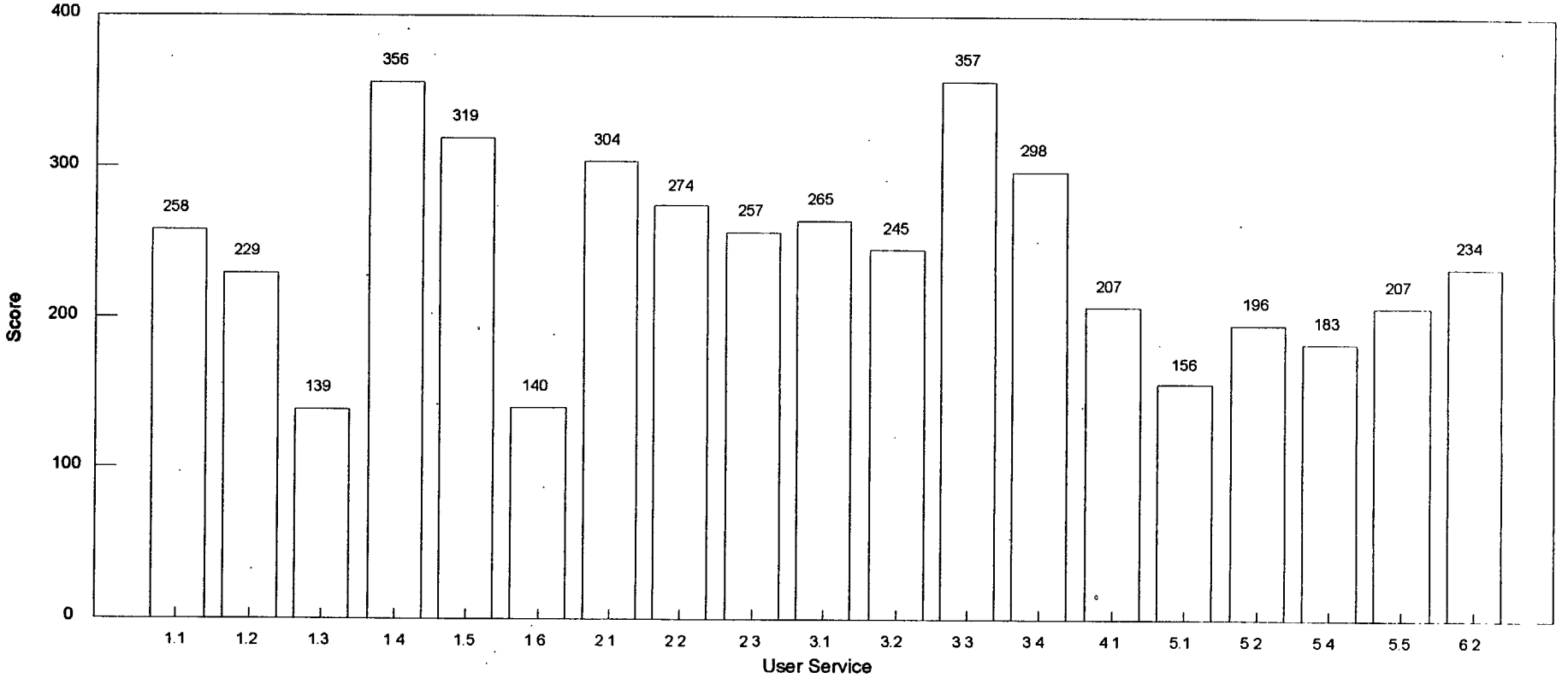

FIGURE 4-1
RATINGS OF USER SERVICES

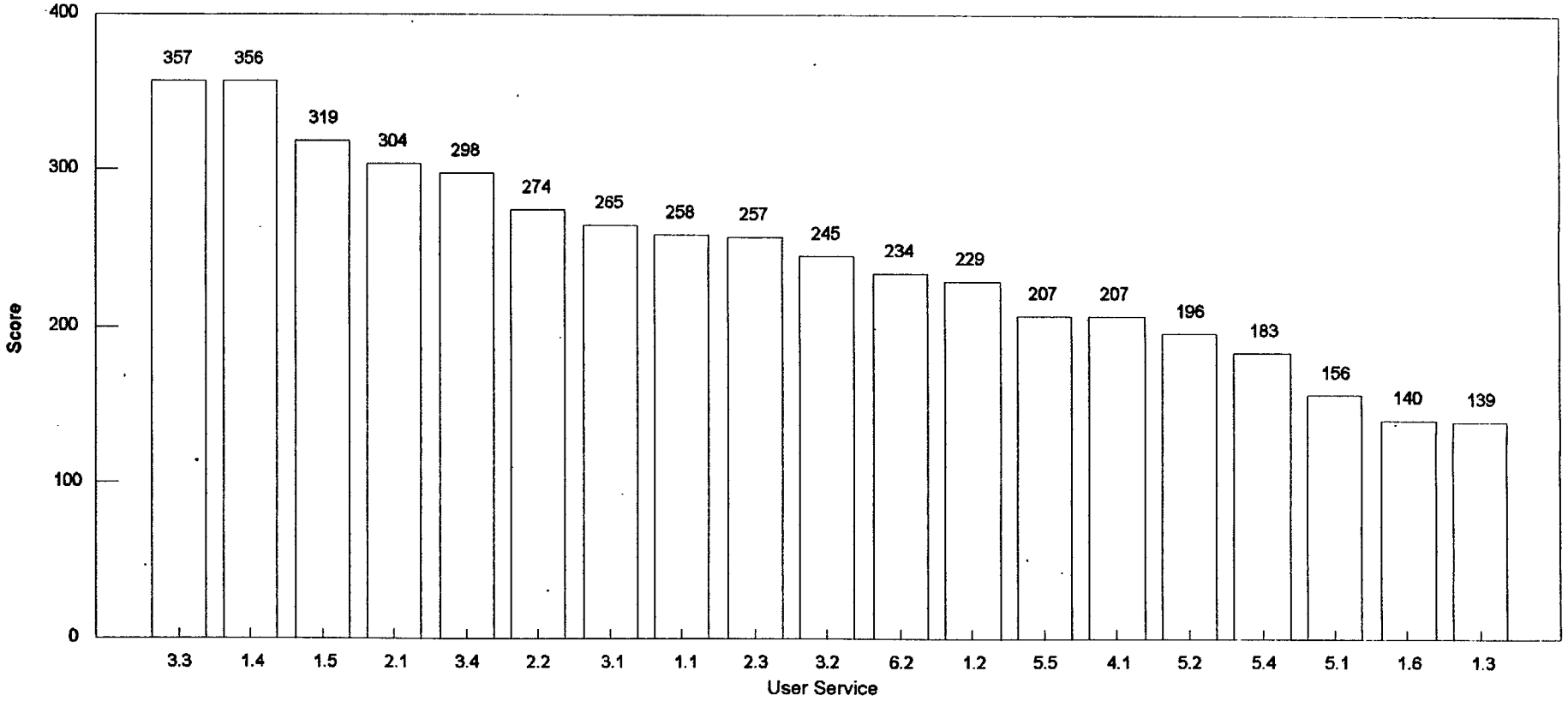

FIGURE 4-2
RANKING OF USER SERVICES

TABLE 4-6
PROBLEMS AND OPPORTUNITIES APPLIED TO USER SERVICE BUNDLES

I. Travel and Transportation Management Bundle
There is inadequate information for tourists, local residents and businesses about tourist attractions, alternate routes or planned construction activities.
There is a lack of regular traffic reports in some areas outside of the City of Richmond.
There is interest in providing real-time travel information via telephone and cable TV.
Need to improve intersections and signal system coordination and timing.
Red light running, speed enforcement, railroad crossings, obsolescence and incompatibility, maintenance and snow removal efforts are regional concerns.
We need to collect information for traffic management, and increase surveillance at the I-95/I-64 interchange.
VMS units will be constructed on I-95 N and S of the I-95/1-295 interchanges.
The region has strong mutual aid agreements, but coordination and field communication. among VDOT, VSP, fire departments and local administration should be improved.
Diversion routes with older bridges may be inadequate for some links on major interstates.
The VDOT TEOC is a resource that might be better used.
The University of Richmond and Virginia Commonwealth University present FM radio traffic broadcasting opportunities with their stations and promising educational programs.
Improvements to AM broadcasting facilities should be investigated.
II. Travel Demand Management Bundle
There should be more promotion of car pooling/ride sharing, targeting employers in addition to individual workers.
Ridefinders actively promotes ridesharing.
Additional park and ride lots should be constructed where needed.
Parking downtown is limited and expensive.
Improvements to local road networks are needed to improve accessibility to new developments, but getting appprovals from residents and jurisdictions can be difficult.

III. Public Transportation Operations Bundle
Public transit service has low ridership in some areas and is faced with declining subsidies.
Dispatchers should have the ability to call drivers in emergencies.
Bus service should be coordinated on a regional basis and should include businesses, malls, medical facilities and transportation centers.
Bus service for the disabled could be improved.
Taxi service needs to be improved.
Bus shelters should be provided and/or improved at key locations.
There are locations along the Amtrak routes that present opportunities for upgrading service.
The downtown multi-modal center will have a Greyhound bus terminal in 2003.
IV. Electronic Payment Bundle
Electronic toll systems will be installed at the airport and are being considered by the RMA.
V. Commercial Vehicle Operations Bundle
The Port has a lack of clearance for double stack trains and poor rail service connections.
CSX operates a terminal in the Richmond area, which serves as a point of distributing freight from rail to other transport modes.
VI. Emergency Management Bundle
A separate cellular non-emergency call number would be of benefit for reporting all minor incidents to the VSP.
VDOT needs to develop a heavy duty wrecker list that includes only those providers that meet minimum standards.
Some fire fighting equipment is incompatible from county to county.
VII. Other
Traffic engineering devices must be put into perspective relative to other ITS investments.
Various agencies are attempting to make their jurisdictions more attractive to tourists by promoting their historical significance and by constructing various tourist attractions.
Perhaps ITS can help dhange the public's perception of VDOT.
Bicycle pathway use is a regional concern.
Funding for ITS is seen to be a problem.
Air pollution is a regional concern.

The relationships between the synthesis statements of problems and opportunities and the user services associated with the Travel and Transportation Management bundle, Travel Demand Management bundle, Electronic Payment bundle, Public Transportation Operations bundle, Commercial Vehicle Operations bundle, and Emergency Management bundle are shown in Table 4-7. In this table, a filled-in circle is used to indicate a problem/opportunity that is directly related to the user service and an open circle identifies a problem/opportunity that is somewhat related to the user service. These relationships were determined by reviewing the complete definitions of the user services, as identified by ITS America and the Federal Highway Administration, and'then indicating the statements of problems and opportunities that had some association with each service. Problem and opportunity statements that are not directly or somewhat related to any of the user services are not included in this table.

This analysis also revealed that in several cases the statements of problems and opportunities applied to user services in more than one of the user service bundles. This it is perfectly reasonable since some of these statements have wide ranging implications.

4.2.2 Ranking of the User Services Based on the Synthesis Statements

In addition to identifying the relationships between the statements of problems and opportunities and the ITS User Services, the matrices shown in Table 4-7 were also used to produce a ranking of the user services based upon the number of synthesis statements that they are related to, and the ratings that were assigned to these statements.

The ratings for the problem and opportunity statements were assigned on a scale of 1 (low) to 4 (high) based on the conversations that the project staff had with the Committee members, agency personnel and community representatives. The rating was determined by a panel of 5 members of the project team that participated in these conversations, who individually assigned a rating based upon their recollections of the number of times the statement (or a closely related statement) was made in these conversations, and the perceived importance that was attached to the statement. Differences in these ratings made by the panel members were then discussed until a consensus was achieved.

The value of each rating was then allocated to a user service if there was a direct relationship (full circle) or an indirect relationship (open circle) with the problem and opportunity statements. The user service was allocated all of the rating points for a direct relationship and half of the rating points for those user services that were somewhat related. The total of the ratings points for the user service indicate the extent to which they address the needs of the community.

TABLE 4-7

RELATIONSHIP BETWEEN USER SERVICES AND PROBLEMS AND OPPORTUNITIES

PROBLEMS AND OPPORTUNITIES (Weighted priorities are in parentheses)	USER SERVICE																		
	En-route Driver Information	Route Guidance	Traveler Services Information	Traffic Control	Incident Management	Emissions Testing and Mitigation	Demand Management and Operations	Pre-Trip Travel Information	Ride Matching and Reservation	Public Transportation Management	En-route Transit Information	Personalized Public Transit	Public Travel Security	Commercial Vehicel Electronic Clearance	Automatd Roadside Safety Inspection	Commercial Vehicle Administrative Process	Hazardous Materials Incident Response	Electronic Payment Services	Emergency Vehicle Management
There is inadequate information for tourists, local residents and businesses about tourist attractions, alternate routes or planned construction activities. (4)	●	●	○		●			●		○	●								
There is a lack of regular traffic reports in some areas outside of the City of Richmond. (1)	●				●			●											
There is interest in providing real-time travel information via telephone and cable TV. (2)	●	●	○					●											
Need to improve intersections and signal system coordination and timing. (1)				●	●														●
Red light running, speed enforcement, railroad crossings, maintenance and snow removal are regional concerns. (2)				●															○
We need to collect information for traffic management and increase surveillance at the I-95/I-64 interchange. (4)	●				●														
VMS units will be constructed on I-95 N and S of the I-95/I-295 interchanges. (4)	●				●		●												

TABLE 4-7 (continued)
RELATIONSHIP BETWEEN USER SERVICES AND
PROBLEMS AND OPPORTUNITIES

PROBLEMS AND OPPORTUNITIES (Weighted priorities are in parentheses)	USER SERVICE																		
	En-route Driver Information	Route Guidance	Traveler Services Information	Traffic Control	Incident Management	Emissions Testing and Mitigation	Demand Management and Operations	Pre-Trip Travel Information	Ride Matching and Reservation	Public Transportation Management	En-route Transit Information	Personalized Public Transit	Public Travel Security	Commercial Vehicel Electronic Clearance	Automatd Roadside Safety Inspection	Commercial Vehicle Administrative Process	Hazardous Materials Incident Response	Electronic Payment Services	Emergency Vehicle Management
There is inadequate information for tourists, local residents and businesses about tourist attractions, alternate routes or planned construction activities. (4)	●	●	○		●			●		○	●								
There is a lack of regular traffic reports in some areas outside of the City of Richmond. (1)	●				●			●											
There is interest in providing real-time travel information via telephone and cable TV. (2)	●	●	○					●											
Need to improve intersections and signal system coordination and timing. (1)				●	●														●
Red light running, speed enforcement, railroad crossings, maintenance and snow removal are regional concerns. (2)				●															○
We need to collect information for traffic management and increase surveillance at the I-95/I-64 interchange. (4)	●				●														
VMS units will be constructed on I-95 N and S of the I-95/I-295 interchanges. (4)	●				●		●												

TABLE 4-7 (continued)
RELATIONSHIP BETWEEN USER SERVICES AND
PROBLEMS AND OPPORTUNITIES

PROBLEMS AND OPPORTUNITIES (Weighted priorities are in parentheses)	USER SERVICE																		
	En-route Driver Information	Route Guidance	Traveler Services Information	Traffic Control	Incident Management	Emissions Testing and Mitigation	Demand Management and Operations	Pre-Trip Travel Information	Ride Matching and Reservation	Public Transportation Management	En-route Transit Information	Personalized Public Transit	Public Travel Security	Commercial Vehicel Electronic Clearance	Automatd Roadside Safety Inspection	Commercial Vehicle Administrative Process	Hazardous Materials Incident Response	Electronic Payment Services	Emergency Vehicle Management
The region has strong mutual aid agreements, but coordination and field communication among VDOT, VSP, fire departments and local administration should be improved. (2)					●												○		
Diversion routes with older bridges may be inadequate for some links on major interchanges. (3)					●														
The VDOT TEOC is a resource that might be better used. (2)	●				●			●											
The University of Richmond and Virginia Commonwealth University present FM radio traffic broadcasting opportunities with their stations. (1)	●				●			●											
Improvements to AM broadcasting facilities should be investigated. (2)	●				●			●											
There should be more promotion of car pooling/ride sharing, targeting employers in addition to individual workers. (2)							●		●										

TABLE 4-7 (continued)
RELATIONSHIP BETWEEN USER SERVICES AND
PROBLEMS AND OPPORTUNITIES

	USER SERVICE																		
PROBLEMS AND OPPORTUNITIES (Weighted priorities are in parentheses)	En-route Driver Information	Route Guidance	Traveler Services Information	Traffic Control	Incident Management	Emissions Testing and Mitigation	Demand Management and Operations	Pre-Trip Travel Information	Ride Matching and Reservation	Public Transportation Management	En-route Transit Information	Personalized Public Transit	Public Travel Security	Commercial Vehicel Electronic Clearance	Automatd Roadside Safety Inspection	Commercial Vehicle Administrative Process	Hazardous Materials Incident Response	Electronic Payment Services	Emergency Vehicle Management
Ridefinders actively promotes ridesharing. (1)								●	●										
Additional park and ride lots should be constructed where needed. (2)							●		●										
Parking downtown is limited and expensive. (1)			○				●												
Public transit service has low ridership in some areas and is faced with declining subsidies. (2)							○			○	○		○						
Dispatchers should have the ability to call drivers in emergencies. (1)										●			●						
Bus service should be coordinated on a regional basis and should include businesses, malls, medical facilities and transportation centers. (2)							○												
Bus service for the disabled could be improved. (2)									●	○		○							
Taxi service needs to be improved. (2)							○		●			●							
Bus shelters should be provided and/or improved at key locations. (2)													●						

TABLE 4-7 (continued)
RELATIONSHIP BETWEEN USER SERVICES AND
PROBLEMS AND OPPORTUNITIES

PROBLEMS AND OPPORTUNITIES (Weighted priorities are in parentheses)	USER SERVICE																		
	En-route Driver Information	Route Guidance	Traveler Services Information	Traffic Control	Incident Management	Emissions Testing and Mitigation	Demand Management and Operations	Pre-Trip Travel Information	Ride Matching and Reservation	Public Transportation Management	En-route Transit Information	Personalized Public Transit	Public Travel Security	Commercial Vehicel Electronic Clearance	Automatd Roadside Safety Inspection	Commercial Vehicle Administrative Process	Hazardous Materials Incident Response	Electronic Payment Services	Emergency Vehicle Management
There are locations along the Amtrak routes that present opportunities for use and upgrading service. (1)							○												
Electronic toll systems will be installed at the airport and are being considered by the RMA. (3)	○				○			○										●	
The Port has a lack of clearance for double stack trains and poor rail service connections. (1)								○											
CSX operates a terminal in the Richmond area, which serves as a point of distributing freight from rail to other transport modes. (2)														○					
A separate cellular non-emergency call number would be of benefit for reporting all minor incidents to the VSP. (2)					●									●					
VDOT needs to develop a heavy duty wrecker list that includes only those providers that meet minimum standards. (2)					●														

TABLE 4-7 (continued)
RELATIONSHIP BETWEEN USER SERVICES AND
PROBLEMS AND OPPORTUNITIES

	USER SERVICE																		
PROBLEMS AND OPPORTUNITIES (Weighted priorities are in parentheses)	En-route Driver Information	Route Guidance	Traveler Services Information	Traffic Control	Incident Management	Emissions Testing and Mitigation	Demand Management and Operations	Pre-Trip Travel Information	Ride Matching and Reservation	Public Transportation Management	En-route Transit Information	Personalized Public Transit	Public Travel Security	Commercial Vehicel Electronic Clearance	Automatd Roadside Safety Inspection	Commercial Vehicle Administrative Process	Hazardous Materials Incident Response	Electronic Payment Services	Emergency Vehicle Management
Some fire fighting equipment is incompatible from county to county. (1)					●														
Various agencies are attempting to make their jurisdictions more attractive to tourists by promoting their historical significance and by constructing various tourist attractions. (3)		○	○																
Air pollution is a regional concern. (1)						●													
Total points based on priorities	20.5	6.5	4.5	3.0	31.5	1.0	12.5	13.5	9.0	5.0	5.0	3.0	4.0	2.5	0.0	0.0	0.0	3.0	2.0

A reorganized listing of the user services, in order of their total weightings. is shown in Table 4-8. This list has been divided into four groups based upon these weightings. These groups represent an overall prioritization of the user services based on the needs of the Richmond/Tri-Cities area.

As can be seen in Table 4-8, Incident Management and En-Route Driver Information are the most highly ranked ITS User Services and received noticeably higher ratings than the others. The two remaining ITS User Services in the high priority group are closely ranked with only a small separation between them. The medium priority group are all clustered rather closely together with a relatively small spread of values, as are the user services in the low priority group. Although the separation of user services into this medium and low priority group was somewhat arbitrary, this division did divide these user services into two groups that minimized the spread of the ranking values within these groups.

TABLE 4-8
RANKING OF ITS USER SERVICES
BASED ON PROBLEM AND OPPORTUNITY STATEMENTS

NEED FOR USER SERVICE	USER SERVICE (and relative score)
Very High	Incident Management (31.5) En-Route Driver Information (20.5)
High	Pre-Trip Travel Information (13.5) Demand Management and Operations (12.5)
Medium	Ride Matching and Reservation (9.0) Route Guidance (6.5) Public Transportation Management (5.0) En-Route Transit Information (5.0) Traveler Services Information (4.5) Public Travel Security (4.0)
Low	Traffic Control (3.0) Personalized Public Transit (3.0) Electronic Payment Services (3.0) Commercial Vehicle Electronic Clearance (2.5) Emergency Vehicle Management (2.0) Emissions Testing and Mitigation (1 .O) Hazardous Materials Incident Response (1 .O) Automated Roadside Safety Inspection (0.0) Commercial Vehicle Administrative Processes (0.0)

(Rating points are shown in parenthesis)

4.3 RANKING OF THE USER SERVICES BASED ON THE ABILITY TO IMPLEMENT THEM

The user services were also ranked on their ability to be implemented, also referred to as their implementability.

This qualitative implementation ranking reflected a variety of factors related to the implementability of the user service. These factors included: the relative cost of the program, the degree to which the service can be disaggregated into a series of projects, efforts that are already underway to implement various aspects of the user service, the degree of change required in the ways that the agencies currently perform activities related to the user service, and the dependance of some of these user services on others.

It must be remembered that this is an evaluation of the implementability of a user service and not of a particular project that has a specific scope or cost. Thus, costs can only be included in very general terms. The effect of their cost is further reduced because these costs may be allocated among several organizations which reap the benefits of their implementation, and because they can be divided among a series of projects, which are implemented over several years.

Table 4-9 shows the implementability ratings that were assigned to the various user services. Several columns have been included in this table to clarify the rational behind the ratings that were assigned. These columns show the objectives for implementing the user service in terms of the problem and opportunity statements, the typical improvement programs that could be implemented, and a series of comments that contain other factors that were considered in assigning the implementability ranking. Table 4-10 summarizes the implementability of the user services.

As is seen in Table 4-10, only four of the user services were given high implementability ratings, they are: Traffic Control, Incident Management, Centralized Information Management, and Ride Matching and Reservations. The remaining user services were fairly evenly divided between the medium and low implementability ratings.

TABLE 4-9
USER SERVICE IMPLEMENTABILITY

ITS USER SERVICE	SPECIFIC OBJECTIVES	TYPICAL IMPROVEMENT PROGRAMS	IMPLEMENTABILITY	
			RATING†	COMMENTS
En-Route Driver Information	Warn drivers of road hazards and delays	HAR & VMS In-vehicle systems	M	Richmond currently uses a number of portable VMS units and there are plans to install some fixed VMS units on I-95. HAR has not yet been implemented in the Richmond or Tri-Cities area. These systems are expensive.
Route Guidance	Provide drivers with directions to destination	In-vehicle devices	L	In-vehicle route guidance devices will become available commercially and may be included by car manufacturers in the future. The commercial sector is the most likely candidate for bringing route guidance to users in the Richmond/Tri-Cities area.
Traveler Services Information	Provide a business directory of traveler services	Kiosks at rest areas; advertising through dissemination devices; telephone-based system	M	The most likely method for providing traveler services information is by installing Travel Boards" or kiosks or some telephone-based system in the RichmondlTri-Cities area.
Traffic Control	Manage movement of traffic on streets and highways	Traffic signal systems; timing improvements; coordination	H	Upgrading traffic signal systems to include coordination is relatively inexpensive.
incident Management	Improve timeliness and efficiency of incident response	Inter-agency cooperation and improved communications	H	Coordination on incident response is generally good in the Richmond/Tri-Cities area; however, there are a number of cooperation and information sharing issues that need to be addressed.
Emissions Testing & Mitigation	Provide information for monitoring air quality	In-vehicle sensors; air quality information system	L	Implementation of this service would require: (1) Cost-effective equipment for detecting individual polluting vehicles; and (2) Legislation for violation enforcement.
Pre-Trip Travel Information	Provides information for selecting the best transportation mode, departure time, and route	Cable TV channel; automated phone service; Internet Home Page for intermodal transportation information	M	Information for different transportation modes and services can be provided to the users. Most areas in the Richmond/Tri-Cities region are serviced by cable TV -- this would serve as another way to get multimodal travel information out; another option is to have the various transit operators provide automated phone information services in which users can call in to get the latest schedules or other information.

TABLE 4-9 (Continued).
USER SERVICE IMPLEMENTABILITY

ITS USER SERVICE	SPECIFIC OBJECTIVES	TYPICAL IMPROVEMENT PROGRAMS	IMPLEMENTABILITY	
			RATING†	COMMENTS
Ride Matching & Reservation	Makes ride sharing easier and more convenient	Park & Ride lots; ride sharing bulletin board (BBS); Ridefinders	H	Park & Ride lots have been established at a number of locations in the RichmondlTri-Cities area, with a number of others planned for the near future. These lots have been successful in promoting ride sharing to downtown Richmond; another way to promote the ease and convenience of ride sharing may be to implement a BBS where potential ride sharers can share information and reserve rides; Ridefinders is currently working with employers in the Richmond area to organize employer-based car pool matching.
Demand Management & Operations	Promotes policies and regulations for reducing congestion	HOV lanes; flexible work schedules; congestion pricing; other options	L	HOV lanes are expensive and politically unpopular. Applicability of congestion pricing as a demand management mechanism is limited by the lack of toll facilities in the area. The most promising approach to demand management for the Richmond/Tri-cities area might be ride matching and working with employers to even demand during peak hours.
Public Transportation Management	Automate operations, planning, and management of public transit systems	Automatic Vehicle Location (AVL) systems; in-vehicle monitoring devices	M	AVL systems can be expensive in terms of initial purchase price and in maintenance.
En-Route Transit Information	Provide information to transit users after they begin their trips	Schedule and arrival information at bus stops, on-board announcements	L	Can be implemented with static information at bus-stops as an interim measure, and recorded announcements activated by an AVL system.
Personalized Public Transit	Provide flexibly-routed transit vehicles with real-time dispatching	Small buses; shared-ride taxis	L	Extremely expensive to operate. Comparable to a shared ride taxi.
Public Travel Security	Create secure environment for patrons of public transportation	Surveillance and alarms at transit stops and on vehicles	L	Can be expensive to install and monitor depending on the extent of deployment.
Electronic Payment Services	Allows travelers to , pay for services electronically	Electronic toll collection on roads, parking lots, and other facilities	H	The Richmond International Airport is already beginning to install electronic payment systems which may serve as the mechanism for more widespread use.

TABLE 4-9 (Continued)
USER SERVICE IMPLEMENTABILITY

ITS USER SERVICE	SPECIFIC OBJECTIVES	TYPICAL IMPROVEMENT PROGRAMS	IMPLEMENTABILITY	
			RATING†	COMMENTS
Commercial Vehicle Electronic Clearance	Eliminates stpos at weigh stations by approved trucks	Electronic tags with vehicle credentials and weight information. Inter-weigh station data systems. Weigh-in-motion systems.	L	Advantage I-75 and the Help/Crescent projects are implementations of this User Service. In both cases these programs were instituted on a multi-state basis. The Oregon ITS/CVO Green Light project is implementing a system for pre-screening vehicles based on weigh-in-motion data and other information.
Automated Roadside Safety Inspection	Improves truck safety by facilitating roadside inspections	Better equipment for brake and steering inspections. Computer notebooks to directly record data. Communications to quickly identify out-of-service vehicles.	M	Congress has mandated a project to upgrade 200 MCSAP (Motor Carrier Safety Assistance Program) sites to allow electronic access to carrier safety datat and driver license status.
Commercial Vehicle Administrative Processes	Facilitates the electronic purchase of credentials and automated mileage and fuel reporting	Electronic filing of credentials. Co-locating offices from different agencies that license truck operations. Revisions to achieve multi-state uniformity of credentials.	L	Several southwestern and Midwest states are testing different approaches to one-stop, multi-state electronic purchase of credentials from locations such as motor carrier facilities, permitting services, truck stops and state agencies.
Hazardous Materials Incident Response	Provides immediate description of Hazardous materials to emergency responders	Hazmat cargo information on electronic tags on the vehicle and easily accessible databases.	L	International boarder crossing locations in Texas, California and New York are establishing computerized information systems for emergency responders.
Emergency Vehicle Management	Reduce the time required for responding to incidents	Pre-emptive signal systems; route guidance; computer aided dispatch (CAD)	M	The Virginia State Police is in the process of implementing a CAD system for more efficient dispatching. Other projects for reducing response time may involve use of video surveillance at the I-95/I-64 interchange and/or other incident "hot spots" -- these other projects will have to be coordinated for implementation.

† Implementability Ratings are based on the relative ease of building, financing, and administering the corresponding ITS user service: L = Low Implementability; M = Moderate Implementability; and H = High Implementability

TABLE 4-10
IMPLEMENTABILITY SUMMARY

ITS USER SERVICE	IMPLEMENTABILITY RATING
En-Route Driver Information	M
Route Guidance	L
Traveler Services Information	M
Traffic Control	H
Incident Management	H
Emissions Testing & Mitigation	L
Pre-Trip Travel Information	M
Ride Matching & Reservation	H
Demand Management & Operations	L
Public Transportation Management	M
Personalized Public Transit	L
Public Travel Security	L
Electronic Payment Services	M
En-Route Transit Information	L
Commercial Vehicle Electronic Clearance	L
Automated Roadside Safety Inspection	M
Commercial Vehicle Administrative Processes	L
Hazardous Materials Incident Response	L
Emergency Vehicle Management	M

4.4 PRIORITIZED USER SERVICE OBJECTIVES

A matrix was produced based on the needs and implementability rankings of the user services. For purposes of this matrix, the two user services in the very high needs category were combined with the other user services ranked as having high needs. This matrix is shown in Table 4-l 1. The degree of goal satisfaction is also shown in this matrix within the parentheses that follow the user service name. (It will be noted that this degree of goal satisfaction has been divided by 100 and rounded to the nearest tenth.)

TABLE 4-11
COMPOSITE RANKING FOR ITS USER SERVICES

RANKING BASED ON NEEDS	RANKINGS BASED ON IMPLEMENTABILITY: HIGH	MEDIUM	LOW
HIGH	Incident Management (3.2)*	En-Route Driver Info (2.6)* Pre-Trip Travel Info (3.0)	Demand Mgmt & Ops (2.6)
MEDIUM	Ride Match & Resv (2.7)	Traveler Services Info (1.4) Public Transp Mgmt (2.7)	Route Guidance (2.3) Public Travel Security (3.0) En-Route Transit Info (2.5)
LOW	**Traffic Control (3.6)** Electronic Paym't Svc (2.1)	Emergency Veh Mgmt (2.3) Automated Roadside Safety Inspection	Emissions Testing & Mitigation (1.4) **Personalized Public Transit (3.6)** Commercial Vehicle Electronic Clearance Commercial Vehicle Administrative Processes Hazmat Incident Response

* These ITS User Services were ranked as having very high needs.
Bold indicates higher goal satisfaction rankings than other user services in this level of needs priority.

Initial assignments of implementation priorities to the ITS User Services were then made on the basis of their position within this matrix. The user services assigned a short-term implementation priority were those in the three cells on the upper left hand side of this matrix. Medium-term implementation priorities were given to the user services in the three cells along the diagonal from lower left to upper right. The remaining three cells in the lower right hand corner of the matrix contained the user service that was assigned a long-term implementation priority.

One additional adjustment was made to the user service priorities based on the degree to which the user services can satisfy the regional goals. The goal satisfaction rankings for Traffic Control and Personalized Public Transit are clearly higher than the goal satisfaction rankings of the user services in that cell or the surrounding cells. For this reason, we have raised the implementation priority for these two user services one level each.

The result of this composite ranking is presented in Table 4-12 which shows the overall short-term, medium-term and long-term implementation priorities for ITS User Services in the Richmond/Tri-Cities Area.

It should be further noted that the "need" rankings for Incident Management and En-Route Driver Information user services were both very high. Improvement plans should be developed for both of these user services, as soon as possible.

TABLE 4-12
OVERALL ITS USER SERVICE IMPLEMENTATION PRIORITIES

SHORT-TERM (1-3 Year Implementation)	MEDIUM-TERM (4-7 Year Implementation)
Incident Management*	Traveler Services Information
En-Route Driver Information*	Public Transportation Management
Pre-Trip Travel Information	Demand Management and Operations
Ride Matching and Reservation	Personalized Public Transit
Traffic Control	Electronic Payment Services
LONG-TERM, PUBLIC AND PUBLIC/PRIVATE SECTOR (7-20 Year Implementation)	**LONG-TERM, PRIVATE SECTOR (7-20 Year Implementation)**
Route Guidance	Longitudinal Collision Avoidance
Emergency Vehicle Management	Lateral Collision Avoidance
En-Route Transit Information	Intersection Collision Avoidance
Emissions Testing and Mitigation	Vision Enhancement for Collision Avoidance
Public Travel Security	Safety Readiness
Automated Roadside Safety Inspection	Pre-Crash Restraint Deployment
Commercial Vehicle Administrative Processes	Automated Highway Systems
Hazardous Materials Incident Response	On-Board Safety Monitoring
Commercial Vehicle Electronic Clearance	Freight Mobility
	Emergency Notification and Personal Security

*** Immediate action implementation plans should be developed for these User Services.**

The user services whose implementation rests primarily with the private sector were previously identified in Section 3, and are also included in Table 4-12. For purposes of this table they have been identified as having long-term implementation priorities. However it must be recognized that their actual deployment may be advanced if the private sector's evaluation of their rewards and risks indicates that it is advantages to implement them soon.

APPENDIX A
TRANSPORTATION PROVIDER INTERVIEW FORMAT

Define Transportation Problem and System/Establish Institutional Framework

Interview Objectives:

- To establish the existence and extent of an inventory of existing and proposed transportation systems and transportation management systems for which the interviewee has responsibility;
- To identify specific plans for significant enhancements to systems;
- To identify a list of problems and assessment of their magnitude; and
- To define the institutional organization with respect to ITS.

Opening question or point of departure for the interview.

Individuals each have their own ideas of what ITS is about. It would be beneficial to have the interviewee describe his/her views of ITS and what this project means to his/her organization. This may be followed with a description of our project and a succinct explanation of what ITS is, at least with respect to this assignment.

Topics to address in "generic" interviews

Transportation systems for which interviewee is responsible:

- planning, operation and maintenance (including snow removal), funding of streets and highways including signals and other traffic control devices (obtain maps and relevant statistics)
- licensing of taxis
- planning, operation, funding, and governance of bus systems (obtain route maps, schedules, fleet characteristics)
- planning, operation, funding, and governance of school bus systems and local para-transit systems for local social service agencies
- emergency service (police, fire, EMS, contract or public tow service)
- planning, operation, funding, and governance of intermodal facilities (e.g., AMTRAK station, bus terminals, etc.)
- planning, operation, funding, and governance of parking facilities

Communications systems

- describe the communications infrastructure (if there is one)
- assessment of how well the communications system meets the needs of the organization
- name of contact responsible for the organization's communications systems

Transportation management systems (existing and planned)

- traffic signal systems (including proposals for future coordinated systems)
- incident response systems (both alone and in cooperation with other agencies)

Transportation Plans

- Six-Year Plan and equivalent or supporting documentation
- County Comprehensive Plan and local Transportation Component
- Capital Outlay Plan
- ideas and concepts under consideration but not yet formalized in a plan (e.g., studies, topics of discussion, etc.)

Area Deficiencies

- major commuter routes (locate on a map)
- recurring congestion locations
- high accident locations (summary accident data that would assist in identifying and supporting the designation of such locations)
- seasonal or event-affected congestion problems
- ADT, LOS, V/C ratios or other congestion indicator maps
- parking problems for employees of the organization and employees in general (particularly in downtown areas)
- subjective assessment of transportation problems and needs

Institutional Framework

- agency table of organization (note ITS-related personnel or offices)
- functional table of organization with respect to other public and private agencies (agencies with which the interviewee communicates both formally and informally for : ATMS, ATIS, O&M, incident management)
- problems with getting data and/or support from other organizations (specify problems and agencies)
- relationship with radio traffic reporters and other information services
- recommendations for other organizations to include in this program

APPENDIX B
FOCUS GROUP PARTICIPANT INFORMATION

Richmond Area ITS Early Deployment Study
Focus Group Participant Information

The following information will help us to provide some basic statistical information to the project's steering committee for consideration in formulating regional transportation solutions.

1. **Name** _____

2. Address _____

_____

_____

3. Representing: _____
(Group or organization)

4. Location of workplace (if outside of home) _____

5. What mode of transportation do you use to get to work? _____

6. How long does it take you to get to work? _____

7. What type of work do you do? _____

8. Do you drive as a part of your job (other than commuting)? _____

9. When was the last time you (please check one for each mode of transportation):

	Last Week	Last Month	Last Year	Last 5 Years	Never
A. Were in a car pool					
B. Took a bus					
C. Took a taxi or limo					
D. Took a train					
E. Took an airplane					

10. Do you own a (check all that apply):
_____ cellular phone _____ pager _____ computer _____ CB radio
_____ other communication device _____

11. How do you currently receive information about traffic?
_____ **am/fm radio** _____ **TV** _____ word of mouth _____ other _____

12. Is this information useful to you? _____ What additional information would you like to receive?
_____

13. Where and how would you like to receive this travel information?

Where
_____ home
_____ work
_____ in vehicle
_____ public location
_____ other

How
_____ am/fin radio
_____ TV
_____ computer, via modem
_____ variable message sign
_____ other (please explain)

APPENDIX C
RECURRING CONGESTION AREAS

Prepared by the Richmond M
and VDOT

CONGESTION AREAS
RICHMOND AREA MPO
(1994)

Table 5.1

9/15/9-

Jurisdiction	Route	Segment From	Segment To	Congestion Level
ASHLAND	Rt. 54	Rt. 1	Taylor St.	E
	Rt. 54	Taylor St.	Center St.	D
	Rt. 1	Pleasant St. S	Quarles Rd.	D
CHESTERFIELD	I-95	Richmond City Line	Rt. 10	E
	Rt. 1/Rt. 301	Willis Rd.	Chippenham Pkwy.	E
	Rt. 10 (West Hundred Rd.)	Old Burmuda/Meadowville	Rt. 1/Rt. 301	E
	Rt. 60	Winterfield Rd.	Rt. 150	E
	Rt. 144 (Harrowgate Rd.)	North St.	Rt. 10	E
	Rt. 144 (Chester Rd.)	Rt. 10	Centralia Rd.	E
	Rt. 145 (Chester Rd.)	Centralia Rd.	Kingsdale Rd.	E
	Rt. 145 (Centralia Rd.)	Rt. 10	Salem Church Rd.	E
		Chalkley Rd.	Hopkins Rd.	E
	Rt. 147	Richmond City Line	Rt. 60	E
	Rt. 150	Rt. 10	Rt. 60	E
	Rt. 360	Winterpock Rd.	Rt. 288	E
		Courthouse Rd.	Walmsely Rd.	E
		Turner Rd.	Rt. 150	E
	Rt. 604 (Courthouse Rd.)	Belmont Rd.	Genito Rd.	E
	Rt. 604 (Genito Rd.)	Courthouse Rd.	Brandermill Pkwy.	E
	Rt. 624 (Walton Park Rd.)	Rt. 60	Glengate Rd.	E
	Rt. 637 (Hopkins Rd.)	Old Lane	Kingsland Rd.	E
	Rt. 647 (Ream's Rd.)	Courthouse Rd.	Providence Rd	E
	Rt. 647 (Hick's Rd.)	Providence Rd.	Rt. 360	E
	Rt. 647 (Walmsely Blvd.)	Rt. 360	Turner Rd.	E
	Rt. 649 (Newby's Bridge)	Dortonway Dr.	Walmsely Blvd.	E
	Rt. 650 (Turner Rd.)	Belmont Rd.	Walmsely Blvd.	E
	Rt. 653 (Courthouse Rd.)	Genito Rd.	Hull Street Rd.	E
		Luck's La.	Rt. 60	E
	Rt. 655 (Beach Rd.)	Rt. 10	Woodland Pond Pkwy.	E
	Rt. 663 (Elkhardt Rd.)	Providence Rd.	Turner Rd.	E
	Rt. 672 (Arch Rd.)	Reams Rd.	Rt. 60	E
	Rt. 675 (Robious Rd.)	Rt. 60	Huguenot Rd.	E
	Rt. 678 (Buford Rd.)	Rt. 60	Huguenot Rd.	E
	Rt. 678 (Providence Rd.)	Adkins Rd.	Rt. 60	E
	Rt. 683 (Forest Hill Ave.)	Huguenot Rd.	County Line	E
	Rt. 686 (Jahnke Rd.)	Buford Rd.	Rt. 76	E
	Rt. 711 (Robious Rd.)	Old Gun Rd..	County Line	E
	Rt. 718 (Old Bon Air Rd.)	Robious Rd.	Rockaway Rd.	E
	Rt. 718 (Rockaway Rd.)	Old Bon Air Rd.	Buford Rd.	E
	Rt. 754 (Coalfield Rd.)	Rt. 60	Powhite Pkwy.	E
	Rt. 755 (Pinetta Dr.)	Buford Rd.	Rt. 60	E
	Rt. 1/Rt. 301	Old Burmuda Hundred Rd.	Willis Rd.	D
	Rt. 10 (East Hundred Rd.)	Kingston Ave.	Old Burmuda/Meadowville Rd.	D
	Rt. 10 (West Hundred Rd.)	Rt. 1/Rt. 301	Buckingham St.	D
	Rt. 10 (Iron Bridge Rd.)	Buckingham St.	Rt. 150	D

CONGESTION AREAS
RICHMOND AREA MPO
(1994)

Table 5.1

9/15/94

Jurisdiction	Route	Segment From	Segment To	Congestion Level
	Rt. 60	County Line W	Winterfield Rd.	D
	Rt. 76	Rt. 150	Rt. 60	D
	Rt. 145 (Chester Rd.)	Kingsdale Rd.	Kingsland Rd.	D
	Rt. 145 (Centralia Rd.)	Salem Church Rd.	Chalkley Rd.	D
		Hopkins Rd.	Chester Rd.	D
	Rt. 150	I-95	Rt. 10	D
		Rt. 60	Richmond City Line	D
	Rt. 360	Rt. 288	Courthouse Rd.	D
		Walmsely Blvd.	Turner Rd.	D
	Rt. 604 (Genito Rd.)	Brandermill Pkwy.	Woolridge Rd.	D
	Rt. 625 (Brander's Bridge)	Happy Hill Rd.	Rt. 10	D
	Rt. 637 (Hopkins Rd.)	Kingsland Rd.	Beulah Rd.	D
		Little Creek La	Rt. 150	D
	Rt. 653 (Courthouse Rd.)	Rt. 360	Luck's Lane	D
	Rt. 653 (Qualla Rd.)	Spring Run Rd.	Newby's Bridge Rd.	D
	Rt. 674 (Cranbeck Rd.)	Robious Rd.	Huguenot Rd.	D
	Rt. 677 (Old Buckingham)	Rt. 60	Huguenot Rd.	D
	Rt. 678 (Providence Rd.)	Courthouse Rd.	Adkins Rd.	D
	Rt. 711 (Robious Rd.)	Huguenot Rd.	Old Gun Rd. (Rt. 673)	D
	Rt. 714 (Winterfield Rd.)	Rt. 60	Westfield Rd.	D
	Rt. 720 (Lucks Lane)	Spirea Rd.	Water Willow Dr.	D
HANOVER	I-95	Rt. 54	Lewistown Rd.	E
		Sliding Hill Rd.	Henrico County Line	E
	Rt. 360	Rt. 643 (Lee-Davis Rd.)	I-295	E
	I-95	Lewistown Rd.	Sliding Hill Rd.	D
	Rt. 656 (Sliding Hill Rd.)	Rt. 1	Rt. 637 (Atlee Station Rd.)	D
HENRICO	I-95	Hanover County Line	I-295	E
		Chamberlayne Ave.	Richmond City Line N	E
	I-64	Richmond City Line W	Rt. 33	E
	Rt. 250	Three Chopt Rd.	I-64	E
		Pump Rd.	Three Chopt Rd.	E
	Bethlehem Rd.	At Rt. 33		E
	Cox Rd.	Broad St. W	Three Chopt Rd.	E
	Mayland Dr.	At Parham Rd.		E
	Parham Rd.	Quioccasin Rd.	Patterson Ave.	E
		I-64	Mayland Dr.	E
		At Rt. 6		E
	Quioccasin Rd.	Pemberton Rd.	Blue Jay La.	E
	River Rd.	Bridgeway Rd.	Richmond City Line	E
	Three Chopt Rd.	Church Rd.	Fort King Rd.	E
	Williamsburg Rd.	Richmond City Line	Eanes La.	E
		Eanes La.	Charles City Rd.	E
	Rt. 1	Hilliard Rd.	Lakeside Blvd.	D
	Huguenot Rd.	Richmond City Line	Westham Station Rd.	D

Table 5.1

CONGESTION AREAS
RICHMOND AREA MPO
(1994)

9/15/94

Jurisdiction	Route	Segment From	Segment To	Congestion Level
	Mayland Dr.	Parham Rd.	Tuckernuck Dr.	D
	Nine Mile Rd.	Laburnum Ave. S	Cedar Fork Rd.	D
		Airport Dr.	Bank St.	D
	Old Osborne Tnpk.	Richmond City Line	Indian Tr.	D
	Parham Rd.	Quioccasin Rd.	Fargo Rd.	D
	Quioccasin Rd.	Gaskins Rd.	Pemberton Rd.	D
	Three Chopt Rd.	Forest Ave.	Glenside Dr.	D
	Westwood Ave.	Broad St.	Tomlynne St.	D
RICHMOND	I-95	I-64/I-195	I-64 E	E
		Rt. 195	Maury St. Exit	E
		Walmsely Blvd. Exit	Chesterfield Co. Line	E
	Rt. 1/301	Hull St.	Decatur St.	E
	3rd St.	I-64	Jackson St.	E
	8th St.	Leigh St.	Cary St.	E
	14th St.	Franklin St.	Canal St.	E
	21st St.	Hull St.	Decatur St.	E
	25th St.	Venable St.	Fairmount Ave.	E
	Bainbridge St.	Rt. 1/301	Broad Rock Rd.	E
	Belvidere St.	Leigh St.	Cumberland St.	E
	Broad Rock Rd.	Forest Hill Ave.	Holly Spring Ave.	E
	Broad St.	Hermitage Rd.	2nd St.	E
		14th St.	18th St.	E
	Brookland Park Blvd.	Chamberlayne Ave.	Edgewood Ave.	E
		North Ave.	Woodrow Ave.	E
	Cary St.	Henrico County Line	Libbie Ave.	E
		9th St.	12th St.	E
	Franklin St.	Belvidere St.	Shafer St.	E
	Huguenot Rd.	Henrico County Line	Cherokee Rd.	E
	Lombardy St.	Broad St.	Monument Ave.	E
	Hull St.	Commerce Rd.	Rt. 1/301	E
		Broad Rock Rd.	Belt Blvd.	E
		Warwick Rd.	Rt. 150	E
	Main St.	14th St.	Henrico County Line E	E
	Meadow St.	Broad St.	Monument Ave.	E
	Monument Ave.	Roseneath Rd.	Thompson St.	E
	Mechanicsville Tnpk.	Fairmount Ave.	Fairfield Ave.	E
		I-64	Magnolia St.	E
	Mosby St.	O St.	Fairmount Ave.	E
	Nine Mile Rd.	Fairmount Ave.	Henrico County Line	E
	RMA/Boulevard Bridge	Lakeview Ave.	New Kent Ave.	E
	Roanoke St.	Forest Hill Ave.	Rt. 60	E
	Roseneath Rd.	Broad St.	Monument Ave.	E
	Semmes Ave.	Rt. 1/301	Commerce Rd.	E
	W. Laburnum Ave.	Teakwood Ave.	Hermitage Rd.	E

CONGESTION AREAS
RICHMOND AREA MPO
(1994)

Table 5.1

9/15/94

Jurisdiction	Route	Segment From	Segment To	Congestion Level
	Westwood Ave.	Rosedale Ave.	Hermitage Rd.	E
	Williamsburg Rd.	Hatcher St.	Darbytown Rd.	E
		Lockhaven Ave.	Henrico County Line	E
	I-95	Henico County Line N	I-64/I-195	D
		Maury St. Exit	Walmsely Blvd. Exit	D
	I-64	Henrico County Line W	I-95	D
	Rt. 1/301	2nd St.	Semmes Ave.	D
		Maury St.	Hopkins Rd.	D
	2nd St.	Cary St.	Canal St.	D
		Byrd St.	Rt. 1/301	D
	4th St.	Willow St.	Hospital St.	D
	14th St.	Broad St.	Franklin St.	D
		Canal St.	Manchester St.	D
	21st St.	Marshall St.	Broad St.	D
	25th St.	Venable St.	Jefferson Ave.	D
		Broad St.	Main St.	D
	Bainbridge St.	Commerce St.	Rt. 1/301	D
	Boulevard	Rt. 195	Hanover Ave.	D
		Monument Ave.	Park Ave.	D
		Robin Hood Rd.	I-95	D
	Broad St.	Roseneath Rd.	DMV Dr.	D
		Allison St.	Hermitage Rd.	D
		18th St.	21st St.	D
		25th St.	32nd St.	D
	Broad Rock Rd.	Holly Spring Ave.	Belt Blvd.	D
	Brookland Park Blvd.	Edgewood Ave.	North Ave.	D
		Woodrow Ave.	Richmond-Henrico Tnpk.	D
		Meadow Bridge Rd.	Dill Ave.	D
	Cary St.	Libbie Ave.	Tuckahoe Blvd.	D
		Banbury Rd.	I-195	D
		3rd St.	4th St.	D
	Darbytown Rd.	Williamsburg Rd.	Blue Ridge Ave.	D
	Decatur St.	Rt. 1/301	20th St.	D
	Fairfield Ave.	20th St.	Cool La.	D
	Forest Hill Ave.	Roanoke St.	Semmes Ave.	D
	German School Rd.	German School Cres	Wheaton Rd.	D
	Government Rd.	Glenwood Ave.	Carlisle Ave.	D
	Grace St.	Ryand St.	Harrison St.	D
	Harrison St.	Broad St.	Marshall St.	D
	Hermitage Rd.	Westwood Ave.	Confederate Ave.	D
	Holly Spring Ave.	Broad Rock Rd.	Maury St.	D
	Hospital St.	7th St.	17th St.	D
	Hopkins Rd.	Belt Blvd.	Warwick Rd.	D
	Hull St.	Manchester St.	Commerce St.	D
		20th St.	Midlothian Tnpk.	D
	Jefferson Ave.	Marshall St.	Leigh St.	D
	Kensington Ave.	Boulevard	Sheppard St.	D

CONGESTION AREAS
RICHMOND AREA MPO
(1994)

9/15/94

Jurisdiction	Route	Segment From	Segment To	Congestion Level
	Leigh St.	3rd St.	4th St.	D
		Belvidere St.	Gilmer St.	D
	Libbie Ave.	Grove Ave.	Guthrie Ave.	D
	Lombardy St.	Main St.	Monument Ave.	D
		Broad St.	Brook Rd.	D
	Magnolia St.	Rady St.	Magnolia Ct.	D
	Main St.	Harrison St.	Cherry St.	D
		4th St.	11th St.	D
	Maury St.	4th St.	Rt. 1/301	D
	Meadow St.	Monument Ave.	Winder St.	D
	Midlothian Tnpk.	29th St. W	Roanoke St.	D
		Belt Blvd.	School Rd.	D
		Jefferson Village Dr.	Warwick Rd.	D
	Monument Ave.	Willow Lawn Dr.	Sauer Ave.	D
		Malvern Ave.	Thompson St.	D
		Lombardy St.	Harrison St.	D
	Mosby St.	O St.	Venable St.	D
	North Ave.	Chamberlayne Ave.	Corbin St.	D
	Three Chopt Rd.	Cary St.	Grove Ave.	D
	Venable St.	Mosby St.	25th St.	D
		17th St.	18th St.	D
	Warwick Rd.	Rt. 60	Powell Rd.	D
	W. Laburnum Ave.	Hermitage Rd.	North Ave.	D
	Westbrook Ave.	I-95 Exit	Hermitage Rd.	D
	Williamsburg Rd.	Darbytown Rd.	Creedmore St.	D

NOTE:

E: Existing Congestion.
D: Potential Congestion.

SOURCES:

1. VDOT's Map: Richmond 1994 Congestion on 1994, 7/27/94.
2. Local Jurisdictions' Records. August 1994.

ATTACHMENT I

Congestion Management System Database for the Tri-Cities Area Transportation Study Area

ID	FIPS	RTE	FUNC	ROADNAME	FROM	TO	MILES	KM	LANES	FEET	METERS	MED	PYEAR	PADT	2016 ADT	LOS	PSV	PV/SV	FSV	FV/SV	SPD
510530011	53	1	UMA	BOYDTN PLANK	RT 613N	RT 460	3.09	4.97	3	30	9	C	1987	8,912	11,882	D	11,013	0.81	9,113	1.3	55
510530012	53	1	UMA	BOYDTN PLANK	RT 460	RT 670	0.81	1.3	2	30	9	C	1987	9,665	12,072	D	11,412	0.85	9,194	1.31	55
510530013	53	1	UMA	BOYDTN PLANK	RT 670	.28MS RT 142	0.34	0.55	2	30	9	C	1987	9,665	12,072	D	10,092	0.96	10,967	1.1	45
510530014	53	1	UMA	BOYDTN PLANK	.28MS RT 142	RT 142	0.28	0.45	3	36	11	C	1987	9,665	12,072	D	16,470	0.59	16,470	0.73	45
510530015	53	1	UMA	BOYDTN PLANK	RT 142	RTE 85	0.27	0.43	4	48	15	D	1987	9,665	12,072	D	50,400	0.19	50,400	0.24	45
510530016	53	1	UPA	BOYDTN PLANK	RTE 85	RT 1303	0.35	0.56	4	48	15	D	1987	11,765	12,396	D	50,400	0.23	50,400	0.25	45
510530017	53	1	UPA	BOYDTN PLANK	RT 1303	RT 226	0.87	1.4	2	36	11	C	1987	11,765	12,396	D	11,799	1	11,799	1.05	45
510530018	53	1	UPA	WASHINGTON ST	RT 226	RT 319	0.29	0.47	2	30	9	C	1987	14,404	19,475	D	9,873	1.46	9,873	1.97	45
510530019	53	1	UPA	WASHINGTON ST	RT 319	WCL PETERSBRG	0.16	0.26	2	30	9	C	1987	14,404	19,475	D	8,721	1.65	8,721	2.23	45
510530851	53	85	I		RTE 703	HATCHER RUN	5.58	8.98	4	48	15	D	1987	11,755	48,300	D	42,840	0.27	42,840	1.13	65
510530852	53	85	UI		HATCHER RUN	RTE 460	2.31	3.72	4	48	15	D	1987	11,755	48,300	D	42,840	0.27	42,840	1.13	55
510530853	53	85	UI		RTE 460	RTE 603 OP	1.62	2.61	4	48	15	D	1987	26,105	57,645	D	43,350	0.6	43,350	1.33	55
510530854	53	85	UI		RTE 603 OP	NB RT 1	0.73	1.17	4	48	15	D	1987	26,105	57,645	D	43,350	0.6	43,350	1.33	55
510530855	53	85	UI		NB RT 1	SCL PETERSBRG	0.98	1.58	4	48	15	D	1987	23,854	42,460	D	43,350	0.55	43,350	0.98	55
510534601	53	460	UPA	COX RD	RT 708	RT 226	3.04	4.89	4	48	15	D	1987	9,531	18,247	D	51,100	0.19	51,100	0.36	55
510534602	53	460	UPA	AIRPORT ST	RT 226	I-85	1.16	1.87	4	48	15	D	1987	12,874	25,295	D	51,100	0.25	51,100	0.5	55
510534603	53	460	UMA	AIRPORT ST	I-85	RT 1	0.33	0.53	4	48	15	D				D	51,100		51,100		55
510530001	53	9000	UPA	N/S CONNECTOR	RT 85	CHESTERFLD CL	2.8	4.51	4	48	15					D	45,960		45,960		55
511490101	149	10	MA		S RT 10	N RT 10	1.25	2.01	4	48	15					D	52,933		52,933		
511490102	149	10	MA	JAMES RIVR DR	RT 609	RT 156	4.78	7.69	2	21	6	N	1987	3,036	4,946	D	5,877	0.52	5,877	0.84	55
511490103	149	10	MA	JAMES RIVR DR	RT 156	RT 156 BYP (OLD	0.73	1.17	4	48	15	R	1987	10,429	20,747	D	56,767	0.18	56,767	0.37	55
511490104	149	10	UPA	JAMES RIVR DR	RT 156 BTP (OLD	ECL HOPEWELL	1.17	1.88	4	48	15	R	1987	13,752	25,000	D	58,733	0.23	58,733	0.43	55
511490105	149	10	UPA	E HUNDRED RD	WCL HOPEWELL	CHESTERFLD CL	0.42	0.68	2	24	7	N	1987	13,752	34,000	D	8,694	1.58	8,694	3.91	55
511490361	149	36	UPA	OAKLAWN BLVD	ECL PETERSBRG	LEE AVE	0.76	1.22	4	48	15	D	1987	31,992	56,973	D	25,673	1.25	25,852	2.2	45
511490362	149	36	UPA	OAKLAWN BLVD	LEE AVE	WCL HOPEWELL	1.45	2.33	4	48	15	D	1987	21,926	39,162	D	17,349	1.26	19,147	2.05	45
511490951	149	95	I		WARWICK SWAMP	S RT 301	2.32	3.73	4	48	15	D	1987	22,545	59,067	D	43,845	0.51	43,845	1.35	55
511490952	149	95	I		S RT 301	RT 626	0.84	1.35	4	48	15	D	1987	22,545	59,067	D	44,850	0.5	44,850	1.32	
511490953	149	95	UI		RT 626	SCL PETERSBRG	1.34	2.16	4	48	15	D	1987	28,354	53,174	D	44,850	0.63	44,850	1.19	
511491441	149	144	UPA	TEMPLE AVE	CHESTERFLD CL	RT 36	2.58	4.15	4	48	15	D	1993	23,691	34,687	D	58,733	0.4	58,733	0.59	55
511491561	149	156	MC	PRINCE GEO DR	RT 301	S RT 626	3.94	6.34	2	22	7	N	1987	2,849	5,986	D	9,540	0.3	9,540	0.63	55
511491562	149	156	MC	PRINCE GEO DR	S RT 626	RT 460	3.21	5.16	2	22	7	N	1987	2,849	5,986	D	9,378	0.3	9,378	0.64	55
511491563	149	156	MA	PRINCE GEO DR	RT 460	S RT 616	3.34	5.37	2	22	7	N	1987	5,662	16,981	D	7,992	0.71	7,992	2.12	55
511491564	149	156	MA	PRINCE GEO DR	S RT 616	RT 106	2.39	3.85	2	22	7	N	1987	5,662	16,981	D	8,910	0.64	8,910	1.91	45

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511491565	149	156	UMA	PRINCE GEO DR	RT 106	SCL HOPEWELL	3.13	5.04	2	22	7	N	1987	7,422	11,388	D	7,335	1.01	7,335	1.55	55
511491566	149	156	UMA	JORDAN PT RD	RT 10	CHARLES CITY CL	2.69	4.33	2	24	7	N	1987	6,750	17,473	D	10,710	0.63	10,710	1.63	55
511491567	149	156	UMA	RUFFIN RD (OLD 644)	RT 156	RT 609	1.09	1.75	2	22	7	N	1987	6,483	28,111	D	9,909	0.65	9,909	2.84	55
511491568	149	156	UMA	RUFFIN RD (OLD 644)	RT 609	RT 10	3.42	5.5	2	22	7	N	1987	6,483	28,111	D	9,747	0.67	9,747	2.88	55
511491569	149	156	MA	RT 156 EXT	RT 156BYP&646	RTS 106 & 10	2.65	4.26	4	48	15	N			0	D	52,933		52,933	0	
511492951	149	295	UI		I-95 SOUTH	RT 460	3.5	5.63	4	48	15	D	1994	15,470	27,000	D	44,400	0.35	44,400	0.61	65
511492952	149	295	UI		RT 460	1ST SCL HOPEWEL	5.8	9.33	4	48	15	D	1994	20,480	55,000	D	44,400	0.46	44,400	1.24	65
511492953	149	295	UI		1ST NCL HOPEWEL	2ND SCL HOPEWEL	0.53	0.85	6	72	22	D	1994	27,100	80,000	D	67,290	0.4	67,290	1.19	65
511492954	149	295	UI		2ND NCL HOPEWEL	3RD SCL HOPEWEL	1.27	2.04	6	72	22	D	1994	27,100	80,000	D	67,290	0.4	67,290	1.19	65
511494601	149	460	PA	COUNTY DR	RT 618	RT 156	3.27	5.26	4	48	15	N	1987	10,885	15,474	D	51,100	0.21	51,100	0.3	55
511494602	149	460	PA	COUNTY DR	RT 156	RT 630	3.1	4.99	4	48	15	N	1987	10,885	15,474	D	51,100	0.21	51,100	0.3	55
511494603	149	460	UPA	COUNTY DR	RT 630	I-295	0.8	1.29	4	48	15	C	1987	9,260	26,350	D	52,867	0.18	52,867	0.5	55
511494604	149	460	UPA	COUNTY DR	I-295	ECL PETERSBURG	0.3	0.48	4	48	15	C	1987	9,260	16,121	D	52,867	0.18	52,867	0.3	55
515700011	570	1	UPA	BOULEVARD	SCL COL HGTS	WASHINGTON AV	0.19	0.31	4	40	12	N	1993	13,136	20,360	D	12,849	1.02	14,631	1.39	35 30
515700012	570	1	UPA	BOULEVARD	WASHINGTON AV	DUPUY AVE	0.32	0.51	4	54	16	N	1993	11,918	18,473	D	12,048	0.99	13,794	1.34	35 30
515700013	570	1	UPA	BOULEVARD	DUPUY AVE	LYNCHBURG AVE	0.19	0.31	4	40	12	N	1993	21,821	33,822	D	17,276	1.26	19,167	1.76	35 30
515700014	570	1	UPA	BOULEVARD	LYNCHBURG AVE	E WESTOVER AV	0.23	0.37	4	44	13	N	1993	23,655	43,510	D	18,004	1.31	21,401	2.03	35 30
515700015	570	1	UPA	BOULEVARD	E WESTOVER AV	PIEDMONT AVE	0.04	0.06	4	44	13	N	1993	21,782	33,762	D	17,256	1.26	19,149	1.76	35 30
515700016	570	1	UPA	BOULEVARD	PIEDMONT AVE	BRANDRS BR RD	0.29	0.47	4	60	18	C	1993	23,580	26,353	D	22,085	1.07	19,214	1.37	35 30
515700017	570	1	UPA	BOULEVARD	BRANDRS BR RD	TEMPLE AVE	0.26	0.42	4	63	19	C	1993	25,354	28,559	D	18,674	1.36	14,577	1.96	40 40
515700018	570	1	UPA	BOULEVARD	TEMPLE AVE	LAKEVIEW AVE	0.74	1.19	4	63	19	C	1993	26,495	31,427	D	19,061	1.39	15,411	2.04	40 40
515700019	570	1	UPA	BOULEVARD	LAKEVIEW AVE	E ELLERSLIE	0.17	0.27	5	69	21	C	1993	21,829	26,681	D	16,712	1.31	14,374	1.86	40 40
5157000110	570	1	UPA	BOULEVARD	E ELLERSLIE	SHERWOOD AVE	0.19	0.31	4	52	16	C	1993	26,009	35,513	D	18,286	1.42	16,905	2.1	40 40

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5157000111	570	1	UPA	BOULEVARD	SHERWOOD AVE	NCL COL HGTS	0.62	1	4	53	16	C	1993	21,720	31,362	D	16,668	1.3	15,796	1.99	40 40
515700951	570	95	I	I-95	NCL PETERSBRG	TEMPLE AVE	1.57	2.53	6	72	22	J	1991	60,000	103,345	D	70,305	0.85	70,305	1.47	65 55
515700952	570	95	I	I-95	TEMPLE AVE	NCL COL HGTS	2.19	3.52	6	72	22	J	1991	67,000	109,650	D	70,305	0.95	70,305	1.56	65 55
515701441	570	144	UMA	TEMPLE AVE	BOULEVARD	I-95	0.7	1.13	4	54	16	R	1993	23,691	42,196	D	17,044	1.39	20,692	2.04	40 35
515701442	570	144	UPA	TEMPLE AVE	I-95	CONDUIT RD	0.22	0.35	4	48	15	D	1993	24,426	42,531	D	21,029	1.16	20,935	2.03	40 35
515701443	570	144	UPA	TEMPLE AVE	CONDUIT RD	ECL COL HGHTS	0.93	1.5	4	48	15	D	1993	22,339	28,774	D	20,252	1.1	17,431	1.65	45 45
516700101	670	10	UPA	RANDOLPH RD	WCL HOPEWELL	N 6TH AVE	0.12	0.19	4	48	15	N	1993	20,276	33,567	D	25,566	0.79	26,099	1.29	35
516700102	670	10	UPA	RANDOLPH RD	N 6TH AVE	MAIN ST	0.4	0.64	4	48	15	D	1993	12,692	16,470	D	21,796	0.58	20,256	0.81	35
516700103	670	10	UPA	RANDOLPH RD	MAIN ST	CITY POINT RD	0.2	0.32	3	48	15	N	1993	12,155	16,730	D	14,083	0.86	13,359	1.25	35
516700104	670	10	UPA	RANDOLPH RD	CITY POINT RD	WINSTON CH DR	0.54	0.87	2	36	11	N	1993	12,155	19,663	D	14,083	0.86	14,030	1.4	35
516700105	670	10	UPA	RANDOLPH RD	WINSTON CH DR	ECL HOPEWELL	1.26	2.03	4	50	15	D	1993	14,816	24,049	D	22,580	0.66	22,492	1.07	55
516700361	670	36	UPA	OAKLAWN BLVD	WCL HOPEWELL	JEFFSN PK RD	0.46	0.74	4	48	15	D	1993	16,381	25,323	D	22,800	0.72	23,216	1.09	35
516700362	670	36	UPA	OAKLAWN BLVD	JEFFSN PK RD	I-295	0.32	0.51	3	36	11	D	1993	16,381	25,323	D	14,944	1.1	15,122	1.67	35
516700363	670	36	UPA	OAKLAWN BLVD	I-295	CEDAR LEVL RD	0.41	0.66	3	36	11	D	1993	16,381	25,323	D	13,402	1.22	13,409	1.89	35
516700364	670	36	UPA	OAKLAWN BLVD	CEDAR LEVL RD	ASHLAND AVE	0.18	0.29	3	36	11	N	1993	9,455	14,616	D	17,584	0.54	17,577	0.83	35
516700365	670	36	UPA	OAKLAWN BLVD	ASHLAND AVE	WOODLAWN ST	0.64	1.03	3	36	11	R	1993	9,455	14,616	D	15,539	0.61	9,953	1.47	35
516700366	670	36	UPA	WINSTON CH DR	WOODLAWN ST	MILES AVE	0.19	0.31	6	72	22	R	1993	18,962	18,947	D	24,626	0.77	25,134	0.75	35
516700367	670	36	UPA	WINSTON CH DR	MILES AVE	HIGH AVE	0.39	0.63	4	48	15	D	1993	18,962	17,223	D	30,135	0.63	27,008	0.64	35
516700368	670	36	UPA	WINSTON CH DR	HIGH AVE	ARLINGTON RD	0.25	0.4	4	48	15	D	1993	13,320	15,474	D	28,156	0.47	26,261	0.59	35
516700369	670	36	UC	ARLINGTON RD	WINSTON CH DR	S 15TH AVE	0.12	0.19	2	24	7	N	1993	13,320	15,082	D	10,386	1.28	10,386	1.45	35
5167003610	670	36	UMA	S 15TH AV	ARLINGTON RD	LYNCHBURG ST	0.45	0.72	2	32	10	N	1993	11,660	17,609	D	9,192	1.27	10,603	1.66	35
5167003611	670	36	UMA	S 15TH AV	LYNCHBURG ST	CITY POINT RD	0.32	0.51	2	32	10	N	1993	2,904	4,489	D	5,109	0.57	6,221	0.72	35
5167003612	670	36	UMA	N 15TH AV	CITY POINT RD	W BROADWAY ST	0.22	0.35	2	32	10	N	1993	10,986	6,917	D	11,706	0.94	7,772	0.89	35
5167003613	670	36	UMA	W BROADWAY ST	S 15TH AVE	N 6TH AVE	0.44	0.71	2	34	10	N	1993	9,388	11,707	D	12,120	0.77	9,584	1.22	35

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5167003614	670	36	UPA	N 6TH AVE	W BROADWAY ST	RANDOLPH RD	0.31	0.5	4	48	15	N	1993	10,762	22,645	D	12,503	0.86	14,545	1.56	35
5167003615	670	36	UPA	WOODLAWN ST	N OAKLAWN BLV	SURRY AVE	0.35	0.56	3	36	11	N	1993	8,786	29,435	D	16,411	0.54	21,705	1.36	35
5167003616	670	36	UPA	WOODLAWN ST	SURRY AVE	DINWIDDIE ST	0.15	0.24	3	36	11	N	1993	11,425	17,661	D	18,945	0.6	18,928	0.93	35
5167003617	670	36	UPA	WOODLAWN ST	DINWIDDIE ST	SYCAMORE ST	0.11	0.18	3	36	11	N	1993	11,425	17,661	D	18,945	0.6	18,928	0.93	35
5167003618	670	36	UPA	WOODLAWN ST	SYCAMORE ST	CEDAR LEVEL	0.18	0.29	3	36	11	N	1993	11,425	17,661	D	18,945	0.6	18,928	0.93	35
5167003619	670	36	UPA	WOODLAWN ST	CEDAR LEVEL	S OAKLAWN BLV	0.1	0.16	3	36	11	N	1993	11,425	17,661	D	18,945	0.6	18,928	0.93	35
516702951	670	295	UI	I 295	SCL HOPEWELL	WCL HOPEWELL	0.42	0.68	6	72	22	D	1994	27,100	80,000	D	70,305	0.39	70,305	1.14	65
516702952	670	295	UI	I 295	SCL HOPEWELL	NCL HOPEWELL	0.3	0.48	6	72	22	D	1994	27,100	80,000	D	70,305	0.39	70,305	1.14	65
516702953	670	295	UI	I 295	SCL HOPEWELL	CHEST. CL	0.8	1.29	6	72	22	D	1994	27,100	80,000	D	70,305	0.39	70,305	1.14	65
517300011	730	1	UPA	W WASHINGTON	WCL PETERSBRG	SUMMIT ST	0.4	0.64	4	64	20	C	1993	13,973	21,601	D	37,733	0.37	37,733	0.57	35
517300012	730	1	UPA	W WASHINGTON	SUMMIT ST	ELM ST	0.18	0.29	4	64	20	C	1993	13,973	21,601	D	37,733	0.37	37,733	0.57	35
517300013	730	1	UPA	W WASHINGTON	ELM ST	.25MS ATLNTIC	0.32	0.51	4	64	20	C	1993	13,973	21,601	D	37,733	0.37	37,733	0.57	35
517300014	730	1	UPA	W WASHINGTON	.25MS ATLNTIC	ATLANTIC ST	0.25	0.4	4	56	17	R	1993	17,963	27,770	D	37,733	0.48	37,733	0.74	35
517300015	730	1	UPA	W WYTHE ST	ATLANTIC ST	.52MW SOUTHST	0.2	0.32	3	41	12	N	1993	8,992	13,901	D	10,305	0.87	10,305	1.35	25
517300016	730	1	UPA	W WYTHE ST	.52MW SOUTHST	.21ME SOUTHST	0.73	1.17	3	41	12	N	1993	9,207	14,233	D	20,287	0.45	20,288	0.7	25
517300017	730	1	UPA	W WYTHE ST	.21ME SOUTHST	PERRY ST	0.15	0.24	4	49	15	N	1993	9,207	14,233	D	23,332	0.39	23,303	0.61	25
517300018	730	1	UPA	W WYTHE ST	PERRY ST	MARKET ST	0.15	0.24	4	49	15	N	1993	10,499	16,231	D	22,302	0.47	22,328	0.73	25
517300019	730	1	UPA	W WYTHE ST	MARKET ST	SYCAMORE ST	0.2	0.32	4	49	15	N	1993	15,449	23,883	D	16,080	0.96	16,070	1.49	25
5173000110	730	1	UPA	E WYTHE ST	SYCAMORE ST	ADAMS ST	0.08	0.13	3	51	16	N	1993	13,986	20,524	D	13,837	1.01	13,441	1.53	25
5173000111	730	1	UPA	E WYTHE ST	ADAMS ST	JEFFERSON ST	0.12	0.19	3	51	16	N	1993	19,898	59,828	D	22,280	0.89	25,459	2.35	25
5173000112	730	1	UC	JEFFERSON ST	E WYTHE ST	E WASHINGTON	0.09	0.14	2	27	8	N	1993	4,195	6,485	D	4,788	0.88	2,792	2.32	25
5173000113	730	1	UC	JEFFERSON ST	E WASHINGTON	HENRY ST	0.21	0.34	2	30	9	N	1993	1,579	2,441	D	2,908	0.54	2,909	0.84	25
5173000114	730	1	UC	HENRY ST	JEFFERSON ST	3RD ST	0.05	0.08	1	27	8	N	1991	1,784	2,869	D	4,914	0.36	2,019	1.42	25
5173000115	730	1	UC	3RD ST	HENRY ST	BOLLINGBROOK	0.1	0.16	2	26	8	N	1993	4,586	25,508	D	9,726	0.47	16,152	1.58	25
5173000116	730	1	UPA	2ND ST	NCL PETERSBRG	BOLLINGBROOK	0.35	0.56	3	38	12	N	1993	12,540	19,386	D	12,463	1.01	12,458	1.56	25
5173000117	730	1	UMA	BOLLINGBROOK	2ND ST	N SYCAMORE ST	0.1	0.16	2	38	12	N	1993	3,987	6,163	D	10,429	0.38	7,601	0.81	25
5173000118	730	1	UMA	SYCAMORE ST	BOLLINGBROOK	OLD ST	0.04	0.06	2	41	12	N	1993	3,903	10,371	D	10,704	0.36	13,577	0.76	25

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5173000119	730	1	UMA	OLD ST	N SYCAMORE ST	N MARKET ST	0.13	0.21	1	43	13	N	1993	3,702	5,723	D	7,248	0.51	5,666	1.01	25
5173000120	730	1	UC	N MARKET ST	OLD ST	W WASHINGTON	0.38	0.61	2	40	12	N	1993	5,386	8,326	D	5,221	1.03	5,216	1.6	25
5173000121	730	1	UPA	W WASHINGTON	N MARKET ST	GUARANTEE ST	0.24	0.39	2	53	16	N	1993	16,443	25,420	D	16,317	1.01	16,319	1.56	25
5173000122	730	1	UPA	W WASHINGTON	GUARANTEE ST	SOUTH ST	0.27	0.43	2	36	11	N	1993	10,680	16,511	D	13,135	0.81	13,128	1.26	25
5173000123	730	1	UPA	W WASHINGTON	SOUTH ST	ATLANTIC ST	0.71	1.14	2	40	12	N	1993	10,179	11,448	D	12,885	0.79	11,173	1.02	25
517300361	730	36	UMA	FLEET ST	WCL PETERSBRG	GROVE AVE	0.12	0.19	2	27	8	N	1993	11,993	14,388	D	8,982	1.34	8,982	1.6	25
517300362	730	36	UMA	GROVE AVE	FLEET ST	N MARKET ST	0.54	0.87	2	33	10	N	1993	4,383	6,776	D	8,982	0.49	8,982	0.75	25
517300363	730	36	UC	S MARKET ST	W WASHINGTON	W WYTHE ST	0.11	0.18	2	38	12	N	1993	5,386	8,326	D	7,788	0.69	7,793	1.07	25
517300364	730	36	UPA	E WYTHE ST	S CRATER RD	OLD WYTHE ST	0.26	0.42	3	41	12	N	1993	10,861	16,790	D	15,297	0.71	15,317	1.1	25
517300365	730	36	UPA	E WYTHE ST	OLD WYTHE ST	AMELIA ST	0.16	0.26	3	35	11	N	1993	10,861	16,790	D	11,556	0.94	11,556	1.45	25
517300366	730	36	UPA	E WASHINGTON	AMELIA ST	PUDDLEDOCK RD	0.88	1.42	4	55	17	D	1993	24,630	38,077	D	26,375	0.93	26,372	1.44	25
517300367	730	36	UPA	E WASHINGTON	PUDDLEDOCK RD	ECL PETERSBRG	0.57	0.92	4	55	17	D	1993	24,630	38,077	D	26,375	0.93	26,372	1.44	25
517300368	730	36	UPA	E WASHINGTON	AMELIA ST	.31ME CRATER	0.12	0.19	3	57	17	N	1993	20,363	31,480	D	14,400	1.41	14,400	2.19	25
517300369	730	36	UPA	E WASHINGTON	.31ME CRATER	N CRATER RD	0.31	0.5	4	77	23	N	1993	11,805	18,250	D	25,117	0.47	25,079	0.73	25
517300851	730	85	UI		SCL PETERSBRG	RT 142 UP	0.89	1.43	4	48	15	D	1987	18,835	44,857	D	46,875	0.4	46,875	0.96	55
517300852	730	85	UI		RT 142 UP	SQUIRRELLEVEL	0.12	0.19	4	48	15	D	1987	18,835	44,857	D	46,875	0.4	46,875	0.96	55
517300853	730	85	UI		SQUIRRELLEVEL	I-95	2.65	4.26	4	48	15	D	1987	18,835	44,857	D	46,875	0.4	46,875	0.96	55
517300951	730	95	UI		SCL PETERSBRG	RIVES RD	0.19	0.31	4	48	15	J				D	46,875		46,875		55
517300952	730	95	UI		RIVES RD	WAGNER RD	1.1	1.77	4	48	15	J				D	46,875		46,875		55
517300953	730	95	UI		WAGNER RD	COUNTY DR	1.91	3.07	4	48	15	J				D	46,875		46,875		55
517300954	730	95	UI		COUNTY DR	S CRATER RD	0.45	0.72	4	48	15	J				D	46,875		46,875		55
517300955	730	95	UI		S CRATER RD	I-85 NB OP	0.37	0.6	4	48	15	J				D	46,875		46,875		55
517300956	730	95	UI		I-85 NB OP	.25MN I-85	0.25	0.4	4	48	15	J				D	46,875		46,875		55
517300957	730	95	UI		.25MN I-85	MINGEA ST OP	0.16	0.26	5	60	18	J				D	58,590		58,590		55
517300958	730	95	UI		MINGEA ST OP	E WYTHE ST OP	0.31	0.5	6	72	22	J				D	70,305		70,305		55
517300959	730	95	UI		E WYTHE ST OP	E BANK ST OP	0.32	0.51	6	72	22	J				D	70,305		70,305		55
5173009510	730	95	UI		E BANK ST OP	NCL PETERSBRG	0.26	0.42	6	72	22	J				D	70,305		70,305		55
517304601	730	460	UPA	E WASHINGTON	N CRATER RD	I-95 OP	0.24	0.39	4	55	17	N	1993	13,053	20,179	D	18,668	0.7	18,684	1.08	25
517304602	730	460	UPA	E WASHINGTON	I-95 OP	SYCAMORE ST	0.43	0.69	4	55	17	N	1993	17,453	26,981	D	17,202	1.01	17,185	1.57	25

ATTACHMENT I

Congestion Management System Database for the Tri-Cities Area Transportation Study Area

ID	FIPS	RTE	FUNC	ROADNAME	FROM	TO	MILES	KM	LANES	FEET	METERS	MED	PYEAR	PADT	2018 ADT	LOS	PSV	PV/SV	FSV	FV/SV	SPD
517304603	730	460	UPA	W WASHINGTON	SYCAMORE ST	N MARKET ST	0.19	0.31	4	59	18	N	1993	16,443	25,405	D	16,661	0.99	16,638	1.53	25
517304604	730	460	UPA	E WYTHE ST	JEFFERSON ST	I-95 SBL	0.22	0.35	2	41	12	N	1993	19,898	34,865	D	17,326	1.15	17,733	1.97	25
517304605	730	460	UPA	E WYTHE ST	I-95 SBL	S CRATER RD	0.3	0.48	2	41	12	N	1993	11,322	17,082	D	13,014	0.87	12,888	1.33	25
517304606	730	460	UPA	COUNTY DR	I-95 CONN	ECL PETERSBRG	2.84	4.57	4	42	13	N	1993	14,362	19,500	D	31,067	0.46	31,067	0.63	40

APPENDIX D
ITS USER SERVICES AND USER SERVICE BUNDLING

The National Program Plan (NPP) has identified the seven user service bundles shown in Table D-l of this appendix. The twenty nine user services recognized in the NPP were sorted into bundles according to several criteria. In some cases, services were bundled together based on the institutional perspectives of the organizations that will deploy the services. Other services were bundled based on common technical functionalities.

The following are detailed descriptions of each user service bundle and the associated user services as presented in the NPP. An additional user service, Centralized Information Management has been recommended for inclusion in the Travel and Transportation Management bundle, and is described as the last user service within this bundle.

1.0 TRAVEL AND TRANSPORTATION MANAGEMENT

The Travel and Transportation Management user services were grouped in a single bundle because of the information they share about the surface transportation system. These services collect and process information about the surface transportation system, and provide commands to various traffic control devices. Travel management services disseminate this information to the traveler. When used in concert, these services can provide a comprehensive travel and transportation management system. These services also provide information to support the Travel Demand Management and the Public Transportation Operations bundles. Thus, the Travel and Transportation Management 'bundle will be of interest to transportation policy makers, public and private sector operators of transportation management centers, those involved in incident response or travel demand management, and private sector vendors supplying travel information products and services.

1.1 EN-ROUTE DRIVER INFORMATION

Provides driver advisories and in-vehicle signing for convenience and safety.

Driver advisories are similar to pre-trip planning information, but they are provided once travel begins. Driver advisories convey real-time information about traffic conditions; incidents, construction, transit schedules, and weather conditions to drivers of personal, commercial and publictransit vehicles. This information allows a driver to either select the best route, or shift to another mode in mid-trip if desired.

In-vehicle signing, the second component of en-route driver information, provides the same types of information found on physical road signs today, directly in the vehicle. The service could be extended to include warnings of road conditions and safe speeds for specific types of vehicles, such as autos, buses, and large trucks, but potential users include drivers of all types of vehicles. This service might be especially useful to elderly drivers, in rural areas with large numbers of tourists, or in areas with unusual or hazardous roadway conditions.

1.2 ROUTE GUIDANCE

Provides travelers with simple instructions on how to best reach their destinations.

The route guidance service provides a suggested route to reach a specified destination. Early route guidance systems are based on static information about the roadway network or transit schedules. When fully deployed, route guidance systems will provide travelers with directions to their destinations based on real-time information about the transportation system. The route guidance service will consider traffic conditions, status and schedule of transit systems, and road closures in developing the best route. Directions will generally consist of simple instructions on turns or other upcoming maneuvers. Users of the service include not only drivers of all types of vehicles, but also non-vehicular travelers, such as pedestrians or bicyclists, who could get specialized route guidance from a hand-held device.

1.3 TRAVELER SERVICES INFORMATION

Provides a business directory, or "yellow pages, " of service information.

Traveler services information provides quick access to travel-related services and facilities. Examples of information that might be included are the location, operating hours, and availability of food, lodging, parking, auto repair, hospitals, and police facilities. Traveler services information would be accessible in the home, office or other public locations to plan trips, and would also be available en-route. When fully deployed, this service will connect users and providers interactively to request and provide needed information. A comprehensive, integrated service could support financial transactions, such as automatic billing purchases.

1.4 TRAFFIC CONTROL

Manages the movement of traffic on streets and highways.

The traffic control user service provides for the integration and adaptive control of the freeway and surface street systems to improve the flow of traffic, give preference to public safety, transit or other high occupancy vehicles, and minimize congestion while maximizing the movement of people and goods. Through appropriate traffic controls, the service also promotes the safety of non-vehicular travelers, such as pedestrians and bicyclists. It requires advanced surveillance of traffic flows, analysis techniques for determining appropriate traffic signal and ramp metering controls, and communication of these controls to the roadside infrastructure. This service gathers data from the transportation system and organizes it into usable information to determine the optimum assignment of right-of-way to vehicles and pedestrians. The real-time traffic information collected by the Traffic Control service also provides the foundation for many other user services.

1.5 INCIDENT MANAGEMENT

Helps public and private organizations quickly identify incidents and implement a response to minimize their effects on traffic.

The Incident Management service uses advanced sensors, data processing, and communications to improve the incident management and response capabilities of transportation and public safety officials, the towing and recovery industry, and others involved in incident response. The service will enhance existing incident detection and verification capabilities to help these groups quickly and accurately identify a variety of incidents and implement a response. The improved response time will minimize the effects of these incidents on the movement of people and goods. This service will also help transportation officials predict traffic or highway conditions so that they can take action in advance to prevent potential incidents or minimize their impacts. While the direct users of this service are the public and private entities responsible for incident detection and response, the ultimate beneficiaries are commercial and transit operators, and the traveling public.

1.6 EMISSIONS TESTING AND MITIGATION

Provides information for monitoring air quality and developing air quality improvement strategies.

The Emissions Testing and Mitigation service uses advanced vehicle emissions testing systems to provide information to identify environmental "hot spots" and implement strategies to either reroute traffic around sensitive air quality areas or control access to such areas. Other technologies provide identification of vehicles that are emitting levels of pollutants that exceed state, local or regional standards, and provides information to drivers or fleet operators to enable them to take corrective action. The service also provides transportation planning and operating agencies with information that can be used to facilitate implementation and evaluation of various pollution control strategies.

1.7 CENTRALIZED INFORMATION MANAGEMENT

Provides the voice and data communication backbone required for sharing information with the various operating agencies.

The Centralized Information Management user service provides all of the centralized voice and data communication infrastructure and operations necessary to allow the various operating agencies to communicate and share information. This type of information exchange requires a communication backbone and some type of wide area network (WAN) configuration. Furthermore, the need for rapid information exchange between disparate operating agencies warrants the use of an approach in which different data types and formats are easily "communicated to a central management center regardless of hardware or software platform.

This user service is not directly accessible by the traveler; however, it is vital to the quality and efficiency of operation for the entire Intelligent Transportation System. The Centralized Information Management service provides all of the operational support required for data collection, processing, and storage; as well as the information that will be disseminated to travelers as part of other user services. This service is provided mainly at a central control facility for the transportation system.

2.0 TRAVEL DEMAND MANAGEMENT

The Travel Demand Management user services support policies and strategies that are aimed at reducing vehicle demand by developing and encouraging modes of travel other than the single occupant vehicle. The services in this bundle are designed to increase the use of high occupancy vehicles and transit by providing intermodal information to travelers prior to the beginning of a trip, and by making ride sharing and transit more convenient and easier to use. These services are also aimed at decreasing congestion by altering the timing or location of trips, or eliminating vehicle trips all together.

From a technical perspective, these services rely on information collected and processed by the Travel and Transportation Management services and the Public Transportation Operations services. Travel Demand Management services also interact with the Travel and Transportation Management services in terms of implementing control strategies that can provide incentives, or disincentives, to change travel behavior.

2.1 DEMAND MANAGEMENT AND OPERATIONS

Supports policies and regulations designed to mitigate the environmental and social impacts of traffic congestion.

The Demand Management and Operations service generates and communicates management and control strategies that support the implementation of programs to reduce the number of individuals who choose to drive alone, especially to work; increase the use of high occupancy vehicles, transit, and commuter rail; and provide a variety of mobility options for those who wish to travel in a more efficient manner, for example in non-peak periods. Demand management strategies could ultimately be applied dynamically, when congestion or pollution conditions warrant. For example, disincentives such as increased tolls and parking fees could be applied during pollution alerts or peak travel periods, while transit fares would be lowered to accommodate the increased number of travelers changing modes from driving alone. Such strategies will reduce the negative impacts of traffic congestion on the environment and improve overall quality of life.

2.2 PRE-TRIP TRAVEL INFORMATION

Provides information for selecting the best transportation mode, departure time, and mute.

Pre-trip travel information allows travelers to access a complete range of intermodal transportation information at home, work, and other major sites where trips originate. Real-time information on transit and commuter rail routes, schedules, transfers, fares, and ride matching services are available to encourage the use of alternatives to the single occupancy vehicle. Information needed for long, inter-urban or vacation trips would also be available. Real-time information on accidents, road construction, alternate routes, traffic speeds along given routes, parking conditions, event schedules, and weather information is also included. Based on this information, the traveler can select the best route, modes of travel and departure time, or decide not to make the trip at all.

2.3 RIDE MATCHING AND **RESERVATION**

Makes ride sharing easier and more convenient

The Ride Matching and Reservation service provides real-time ride matching information and reservations to users in their homes, offices or other locations, and assist transportation providers, as well as van/carpoolers, with vehicle assignments and scheduling. This will expand the market for ridesharing as an alternative to single occupant vehicle travel and will provide for enhanced alternatives for special population groups, such as the elderly or the handicapped.

3.0 PUBLIC TRANSPORTATION **OPERATIONS**

The Public Transportation Operations bundle reflects the commonality of the transit authority as the most probable provider of these services. The transit authority is responsible for implementing systems that are capable of better managing the public transportation system and providing improved transit and mode choice information.

From a technical perspective, all of these user services will share a common public transit database. The data will be available for all of the services to customize for their specific function. This data will also support services in the Travel and Transportation Management and the Travel Demand Management. bundles.

3.1 PUBLIC TRANSPORTATION MANAGEMENT

Automates operations, planning and management functions of public transit systems.

The Public Transportation Management service provides computer analysis of real-time vehicle and facility status to improve transit operations and maintenance. The analysis identifies deviations from schedule and provides potential solutions to dispatchers and drivers. Integrating this capability with traffic control services can help maintain transportation schedules and assure

transfer connections in intermodal transportation. Information regarding passenger loading, bus running times, and mileage accumulated will help improve service and facilitate administrative reporting. Transit personnel management is enhanced by automatically recording and verifying tasks performed by transit personnel.

3.2 EN-ROUTE TRANSIT INFORMATION

Provides information to travelers using public transportation after they begin their trips.

The En-Route Transit Information service provides information to assist the traveler once public transportation travel begins. Real-time, accurate transit service information on board the vehicle helps travelers make effective transfer decisions and itinerary modifications as needed while a trip is underway.

3.3 PERSONALIZED PUBLIC TRANSIT

Provides flexibly-routed transit vehicles to offer more convenient customer service.

Small publicly or privately-operated vehicles provide on-demand routing to pick up passengers who have requested service and deliver them to their destinations. Route deviation schemes, in which vehicles leave a fixed route for a short distance to pick up or discharge passengers, is another way of improving service. Vehicles can include small buses, taxicabs, or other small, shared ride vehicles. This service can provide almost door-to-door service, expanding transit coverage to lesser populated locations and neighborhoods. Potentially, this services can provide transportation at lower cost and with greater convenience than conventional fixed route transit.

3.4 PUBLIC TRAVEL SECURITY

Creates a secure environment for public transportation patrons and operation

This service provides systems that monitor the environment in transportation stations, parking lots, bus stops, and on-board transit vehicles, and generate alarms, either automatically or manually, when necessary. This improves security for both transit riders and operators. Transportation agencies and authorities can integrate this user service with other anti-crime activities.

4.0 ELECTRONIC PAYMENT

While this bundle contains only one user service, it supports deployment of many other services, both within and outside the transportation arena. This service will be developed, deployed, and operated by both public and private organizations.

4.1 ELECTRONIC PAYMENT SERVICES

Allows travelers to pay for transportation services electronically

Electronic payment services will foster intermodal travel by providing a common electronic payment medium for all transportation modes and functions, including tolls, transit fares, and parking. The service provides for a common service fee and payment structure using "smart cards" or other technologies. Such systems could be expanded to become truly multi-use, accommodating personal financial transactions that are made with today's credit/bank cards. The flexibility that electronic payment services offer will also facilitate travel demand management, if conditions warrant. They could, if local authorities so choose, enable application of road pricing policies which could influence departure times and mode selection.

5.0 COMMERCIAL VEHICLE OPERATIONS

These user services support the goals of improving the efficiency and safety of commercial fleet operations, and will benefit both the States and the motor carrier industry. Thus the CVO bundle reflects the commonality of using advanced computer and communications technologies to improve the safety and productivity of the motor carrier industry throughout North America.

From a technical perspective, the foundation for-all of the CVO user services is information systems. Each service will require some set of information on the motor carrier, the vehicle, the driver, and, in some cases, the cargo. The services are interrelated in terms of the specific types and functionality of information and data required. This network of information will be accessible by States and motor carriers nationwide.

5.1 COMMERCIAL VEHICLE ELECTRONIC CLEARANCE

Facilitates domestic and international border clearance, minimizing stops.

This service will enable transponder-equipped trucks and buses to have their safety status, credentials, and weight checked at mainline speeds. Vehicles that are safe and legal and have no outstanding out-of-service citations will be allowed to pass the inspection/weigh facility without delay.

By working with Mexico and Canada, a more efficient traffic flow would be provided at border crossings. The deployment of technologies in these countries could ultimately prevent overweight, unsafe, or improperly registered vehicles from entering the United States.

5.2 AUTOMATED ROADSIDE SAFETY INSPECTION

Facilitates roadside inspections.

Automated roadside inspections would allow real-time access at the roadside to the safety performance record of carriers, vehicles, and drivers. Such access will help determine which vehicle or driver should be stopped for an inspection, as well as ensuring timely correction of previously identified problems.

This service would also automate as many items as possible of the manual inspection process. It would, for example, allow for more rapid and accurate inspection of brake performance at the roadside. Through the use of sensors and diagnostics, it would efficiently check vehicle systems and driver requirements and ultimately driver alertness and fitness for duty.

5.3 ON-BOARD SAFETY MONITORING

Senses the safety status of a commercial vehicle, cargo, and driver.

On-board systems would monitor the safety status of a vehicle, cargo, and driver at mainline speeds. Vehicle monitoring would include sensing and collecting data on the condition of critical vehicle components such as brakes, tires, and lights, and determining thresholds for warnings and countermeasures. Cargo monitoring would involve sensing unsafe conditions relating to vehicle cargo, such as shifts in cargo while the vehicle is in operation. Driver monitoring is envisioned to include the monitoring of driving time and alertness using non-intrusive technology and the development of warning systems for the driver, the carrier, and the enforcement official. A warning of unsafe condition would first be provided to the driver and then to the carrier and roadside enforcement officials. This warning notification would possibly prevent an accident from happening. This service would minimize driver-and equipment-related accidents for participating carriers.

5.4 COMMERCIAL VEHICLE ADMINISTRATIVE PROCESSES

Provides electronic purchasing of credentials, and automated mileage and fuel reporting and auditing.

The Commercial Vehicle Administrative Processes service provides the commercial carrier with the capability to electronically purchase annual and temporary credentials via computer link. It will reduce burdensome paperwork and processing time for both the State agencies and the motor carriers.

For automated mileage and fuel reporting and auditing, this service enables participating interstate carriers to electronically capture mileage, fuel purchased, trip, and vehicle data according to state. It would also automatically determine mileage traveled and fuel purchased in each state, for use by the carrier in preparing fuel tax and registration reports to the State

agencies. This service would reduce the significant administrative burden on commercial carriers to collect and report mileage and fuel purchased within each State.

5.5 HAZARDOUS MATERIALS INCIDENT RESPONSE

Provides immediate description of hazardous materials to emergency responders.

The Hazardous Materials Incident Response service enhances the safety of shipments of hazardous materials by providing enforcement and response teams with timely, accurate information on cargo contents to enable them to react properly in emergency situations. The materials or combinations of materials involved when an incident involving a truck or railcar carrying hazardous material occurs would be provided electronically to emergency responders and enforcement personnel at the scene so that the incident can be handled properly.

5.6 FREIGHT MOBILITY

Provides communication between drivers, dispatchers, and intermodal transportation providers.

The Freight Mobility service provides real-time traffic information and vehicle location for commercial vehicles. This service significantly enhances fleet operations management by helping drivers to avoid congested areas and improving the reliability and efficiency of pickups and deliveries. These benefits are particularly important for operators of intermodal and time-sensitive fleets who can use this ITS service to make their operations more efficient and reliable.

6.0 EMERGENCY MANAGEMENT

Police, fire and rescue operations can use emergency management services to improve their management of, and response to, emergency situations. These user services have common functional elements such as vehicle location, communications, and response.

6.1 EMERGENCY NOTIFICATION AND PERSONAL SECURITY

Provides immediate notification of an incident and an immediate request assistance.

The Emergency Notification and Personal Security service includes two capabilities: driver and personal security, and automatic collision notification. Driver and personal security capabilities provides for user-initiated distress signals for incidents such as mechanical breakdowns or car-jackings. When activated by an incident, automatic collision notification transmits information regarding location, nature, and severity of the crash to emergency personnel.

6.2 EMERGENCY VEHICLE MANAGEMENT

Reduces the time it takes for emergency vehicles to respond to an incident.

The Emergency Vehicle Management service provides public safety agencies with fleet management capabilities, route guidance, and signal priority and/or preemption for emergency vehicles. Fleet management improves the display of emergency vehicle locations and helps dispatchers send the units that can most quickly reach an incident site. Route guidance directs emergency vehicles to an incident location, and signal priority optimizes the traffic signal timing in an emergency vehicle's route. Primary users of this service include police, fire, and medical units.

7.0 ADVANCED VEHICLE CONTROL AND SAFETY SYSTEMS

Although each of these services addresses a separate function, they all contribute to the common goal of improving vehicle safety. With the exception of Automated Highway Systems (AHS), all of these user services are characterized by near-term reliance on self-contained systems within the vehicle. The functionality of these user services, however, can be enhanced by supplementing the on-board capabilities with additional sensors deployed in the infrastructure. Within the vehicle, common functional elements, such as data storage, processing units, sensors, or actuators, could be shared among the user services in this bundle, including AHS.

7.1 LONGITUDINAL COLLISION AVOIDANCE

Helps prevent head-on, rear-end or backing collisions between vehicles, or between vehicles and other objects or pedestrians.

The Longitudinal Collision Avoidance service helps reduce the number and severity of longitudinal collisions, such as head-on, rear-end or backing. It includes the sensing of potential or impending collisions, prompting a driver's avoidance actions, and controlling the vehicle temporarily.

7.2 LATERAL COLLISION AVOIDANCE

Helps prevent collisions when vehicles leave their lane of travel.

The Lateral Collision Avoidance service provides crash warnings and controls for lane changes and road departures. It will reduce the number of lateral collisions involving two or more vehicles, as well as, crashes involving a single vehicle leaving the roadway. For changing lanes, a situation display can monitor the vehicle's blind spot continuously, and drivers can be actively warned of an impending collision. If needed, automatic control can provide rapid response to a situation. Warning systems can also alert a driver to an impending road departure, provide help in keeping the vehicle in the lane, and ultimately provide automatic control of steering and throttle.

7.3 INTERSECTION COLLISION AVOIDANCE

Helps prevent collisions at intersections.

The Intersection Collision Avoidance service warns drivers of imminent collisions when approaching or crossing an intersection or railroad grade crossing that has traffic control (e.g:, stop signs or a signal). This service also alerts the driver when the proper right-of-way at the intersection or grade crossing is unclear or ambiguous.

7.4 VISION ENHANCEMENT FOR CRASH AVOIDANCE

Improves the driver's ability to see the roadway objects that are on or along the roadway.

The Vision Enhancement service provides drivers with improved visibility to allow them to avoid collisions with other vehicles, obstacles in the roadway, or parked or moving trains, as well as help them comply with traffic signs and signals. This service requires in-vehicle equipment for sensing potential hazards, processing this information, and displaying it in a way that is useful to a driver.

7.5 SAFETY READINESS

Provides warnings about the condition of the driver, the vehicle, and the roadway.

Safety Readiness services provide in-vehicle equipment that unobtrusively monitors a driver's condition and provides a warning if the driver is becoming drowsy or otherwise impaired. This service could also monitor critical components of the automobile internally and alert the driver to impending malfunctions. Equipment within the vehicle could also detect unsafe road conditions, such as bridge icing or standing water on the roadway, and provide a warning to the driver.

7.6 PRE-CRASH RESTRAINT DEPLOYMENT

Anticipates an imminent collision and activates passenger safety systems before the collision occurs, or much earlier in the crash event than is currently feasible.

The Pre-Crash Restraint Deployment service anticipates an imminent collision by determining the velocity, mass, and direction of the vehicles or objects involved in a potential crash. The service activates safety systems in the vehicle prior to a collision, such as tightening lap-shoulder belts, arming and deploying air bags at the optimal pressure, and deploying roll bars. The response is based on the number, location, and major physical characteristics of any occupants.

7.7 AUTOMATED HIGHWAY SYSTEMS

Provides a fully automated, "hands-off " operating environment.

AHS is a long-term goal of ITS which would provide vast improvements in safety by creating a nearly accident-free driving environment. In AHS, the vehicle is guided automatically rather than by the driver. Driver error is reduced or possibly eliminated with full implementation. Drivers could buy vehicles with the necessary instrumentation or retrofit an existing vehicle. AHS benefits include increased roadway capacity, enhanced safety, reduced fuel consumption, and reduced emissions.

TABLE D-l
USER SERVICE BUNDLES

BUNDLE	USER SERVICES
1. Travel and Transportation Management	1. En-Route Driver Information 2. Route Guidance 3. Traveler Services Information 4. Traffic Control 5. incident Management 6. Emissions Testing and Mitigation
2. Travel Demand Management	1. Demand Management and Operations 2. Pre-Trip Travel Information 3. Ride Matching and Reservation
3. Public Transportation Operations	1. Public Transportation Management 2. En-Route Transit Information 3. Personalized Public Transit 4. Public Travel Security
4. Electronic Payment	1. Electronic Payment Services
5. Commercial Vehicle Operations	1. Commercial Vehicle Electronic Clearance 2. Automated Roadside Safety Inspection 3. On-board Safety Monitoring 4. Commercial Vehicle Administrative Processes 5. Hazardous Materials Incident Response 6. Freight Mobility
6. Emergency Management	1. Emergency Notification and Personal Security 2. Emergency Vehicle Management
7. Advanced Vehicle Control and Safety Systems	1. Longitudinal Collision Avoidance 2. Lateral Collision Avoidance 3. Intersection Collision Avoidance 4. Vision Enhancement for Crash Avoidance 5. Safety Readiness 6. Pre-Crash Restraint Deployment 7. Automated Highway Systems