Indianapolis Area ITS

EARLY DEPLOYMENT PLAN

FINAL REPORT

Prepared by:

BRW, Inc.

in association with:

Battelle Memorial Institute
DKS Associates
First Group Engineering
Planning and Development Concepts

Prepared for:

Indiana Department of Transportation

July 1996

INDIANAPOLIS AREA ITS EARLY DEPLOYMENT PLAN TEAM

The Indianapolis Area ITS Early Deployment Plan Team was lead by the Indiana Department of Transportation and consisted of a Steering Committee, Oversight Committee and Consultant Team. The Steering Committee set the strategic direction for and coordinated all activities of the Early Deployment Plan development effort. The Oversight Comrnittee participated in all major planning activities and reviewed all major work products of the Early Deployment Plan. The Consultant Team, under supervision of the Steering and Oversight Committees, prepared the Early Deployment Plan and all associated documents.

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EXECUTIVE SUMMARY

INDIANAPOLIS AREA ITS EARLY DEPLOYMENT PLAN

July 1996 marks a significant milestone for deployment of Intelligent Transportation Systems (ITS) in the Indianapolis area and represents a major step in a plan to make regional travel safer, more convenient and more friendly to the environment. The Indianapolis Area ITS Early Deployment Plan (EDP) lays out the strategy for improvement of regional transportation through the application of high-technology.

The process, which has culminated in the publication of the ITS Early Deployment Plan (EDP), began on March 9, 1993. On this date, the Federal Register published the Federal Highway Administration (FHWA) announcement of procedures for implementing the Early Deployment Program. The FHWA approved the Indiana Department of Transportation's (INDOT) proposal for ITS Early Deployment funds for the Indianapolis area in April 1994.

The Indianapolis Area ITS EDP represents over 13 months of hard work and dedication on the part of a wide range of participants with a stake in the performance of the Indianapolis area transportation system. The Indianapolis Area ITS Early Deployment Plan Team, led by the Indiana Department of Transportation (INDOT). The team included a steering committee, an oversight committee, and a consultant team. The Steering Committee set the strategic direction for and coordinated all activities of the EDP development effort. The Team also includes multi-modal local, regional, and state agencies and other interest groups throughout the area. The Steering and Oversight Committees developed the Indianapolis Area ITS EDP in a coordinated manner with full public disclosure and involvement.

The Steering Committee was composed of 11 individuals representing INDOT, the City of Indianapolis, and the Federal Highway Administration. The Oversight Committee was formed in order to assure broad jurisdictional and multi-modal support for ITS deployment in the Indianapolis area. The Oversight Committee included the members of the Steering Committee and 40 other individuals representing multi-modal local, regional, and state agencies and other interest groups.

The goals of the Early Deployment Plan include solving current problems and pursuing new developments that can improve the overall surface transportation network in the Indianapolis area. The central element of the EDP is the programs and projects that will be deployed to deliver ITS user services. Additionally, a special focused effort was undertaken to develop an Incident Management Plan for the Indianapolis area.

Implementation of the Early Deployment Plan will show INDOT's commitment to address mobility from a region-wide perspective. This commitment includes improved interagency communication and joint development of projects and procedures.

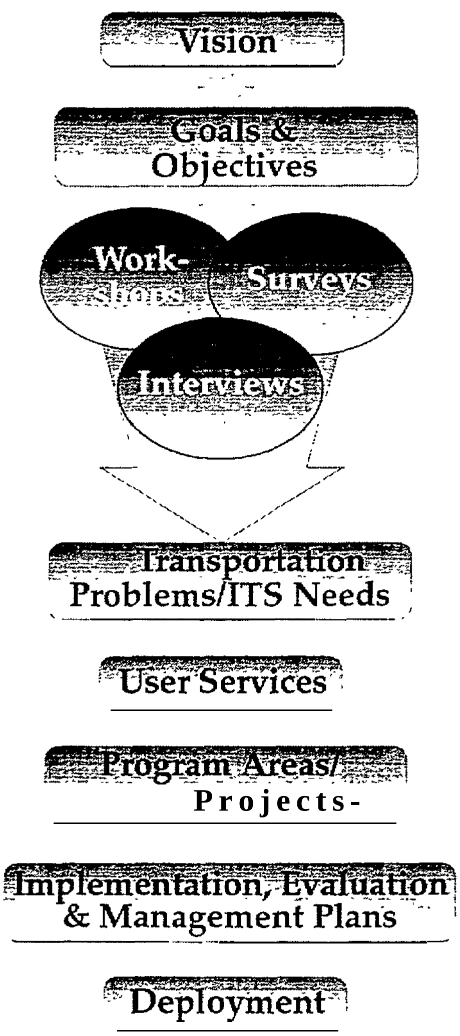
PLAN DEVELOPMENT

This document lays out a 20-year schedule for the implementation of ITS in the Indianapolis area. The report presents an integrated, multi-modal, phased strategic plan to address the surface transportation needs and problems of the Indianapolis area through the use of Intelligent Transportation Systems.

Preparation of the Indianapolis Area ITS EDP has followed the ten step ITS Planning Process developed by the Federal Highway Administration. The federal ITS planning and deployment process emphasizes the significance of a strategic approach, a user-needs perspective and a strong institutional coalition.

The vision for the Indianapolis area is one of enhanced transportation productivity, mobility, efficiency and safety within the region with a reduction in energy use and improvement in the environment through the use of cost effective ITS technologies and systems. Goals and objectives were developed to reflect the working vision statement.

In developing the EDP, the strategic plan for realizing the vision, workshops, surveys, and interviews were held with a diverse group of stakeholders to identify corridor needs and potential solutions. Using this information, desired ITS user services were identified and specific program areas and projects developed to deliver the services. The figure below summarizes the process to develop the Early Deployment Plan.



PROGRAMS AND PROJECTS: AN EARLY FOCUS IN THE NORTHEAST CORRIDOR

The ITS Early Deployment Plan includes over 70 projects organized into the following six Program Areas:

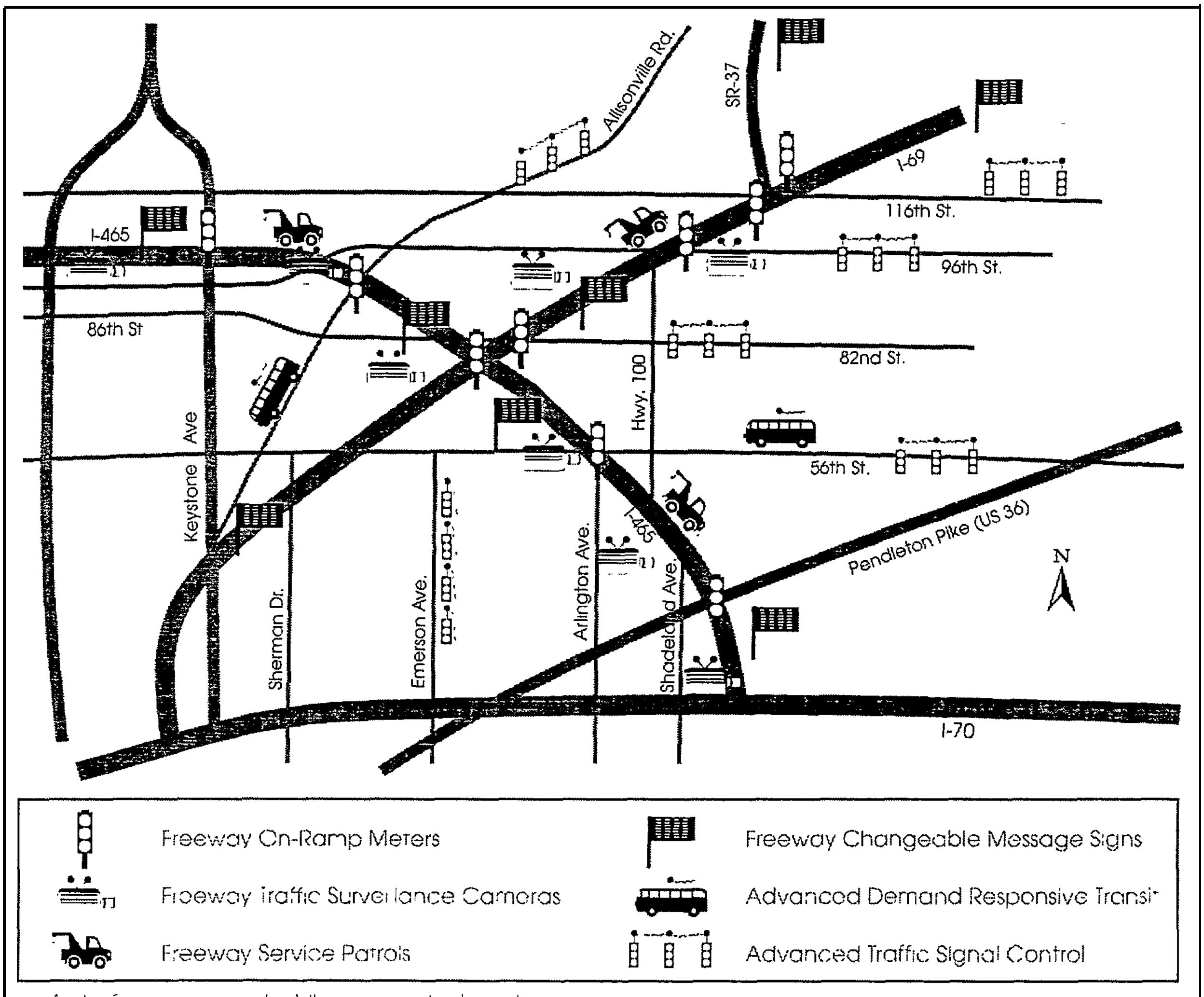
1 - Multi-Modal Traveler Information System
2 - Freeway Management System
3 - Traffic Signal Control Systems
4 - Transit Management Systems
5 - Public-Private Partnerships
6 - Technical and Planning Support

The first program area includes projects which will provide travelers information about traffic conditions and transit, such as traffic accidents and bus schedules. Program Area 2 implements a system to monitor freeway traffic conditions and to selectively control the rate of traffic merging onto the freeway in order to improve safety and increase traffic flow and travel speeds. Program Area 3 includes projects which will improve the flow of traffic on arterial streets by making traffic signals more responsive to changing traffic conditions. Program Area 4 implements systems which make transit more responsive and efficient, including technology to speed fare payment and to inform riders of expected bus arrival times. Program Area 5 identifies specific opportunities for involving the private sector in ITS deployment. Program Area 6 lays out the management and administrative structure to guide implementation and a public education and outreach program.

Although traffic congestion occurs at locations throughout the Indianapolis area, some of the most extreme, widespread and consistent congestion currently occurs in the northeast portion of the region. Forecasts indicate that congestion in this area will become more extreme and more widespread in the future. For this reason, the Northeast Corridor--defined as a pie-shaped area bounded roughly by Keystone Avenue to the west, US 36 to the south and the SR 37/I-69 junction to the north--is the focus of many of the ITS projects slated for early implementation in the EDP. The figure on the following page illustrates, in a conceptual manner, the sorts of projects planned for implementation. The locations shown on the figure are illustrative; the actual location of specific projects will be determined in subsequent phases of the projects. Proposed Northeast Corridor projects are summarized below and on following pages.

Backbone Communications Infrastructure

The EDP proposes to implement the backbone communications infrastructure first in the Northeast Corridor. This would connect the freeway management and traveler information system field elements with the Traffic Operations Center (TOC). A link would also be established between the TOC and both the Metropolitan Emergency Communication Agency (MECA) and the Indianapolis Public Transportation Corporation, known as "METRO Bus". This would form the first major step in establishing the foundation for the hub and spoke plan for the communications infrastructure which would provide comprehensive, integrated and multi-modal information.



Note This is a conceptual illustration only Locations are pre- minary

Multi-Modal Traveler Information Dissemination

One traveler information kiosk is proposed for the Northeast Corridor. A kiosk is like a comprehensive, interactive automatic teller machine (ATM) that provides frequently updated traveler information on traffic speed, road congestion, and incidents. The kiosk in the Northeast Corridor would reflect conditions along that corridor. At least four live surveillance cameras in the Northeast Corridor area are proposed. The cameras would be strategically located to be able to cover the critical congestion or problem areas, with specially located cameras to cover construction areas. The information from the cameras could then be transmitted through a video feed to the local media.

Incident Detection and Verification

The EDP proposes the implementation of a Hoosier Helper freeway service patrol program in the Northeast Corridor. The Hoosier Helper roving patrols would be used to detect incidents, minimize incident duration, restore full capacity to the freeway and reduce risks to motorists for potential secondary accidents. A vehicle detection system for freeway traffic management is also proposed for the Northeast Corridor, which would allow for the automated detection of incidents and the establishment of appropriate ramp metering rates. Finally, the installation of closed circuit television (CCTV) cameras along the Northeast Corridor would be used to detect and verify incidents, to monitor congestion and -to help determine which agencies should respond to an incident.

Traveler Information for Freeway Traffic Management

Several changeable message signs (CMS's) are proposed for implementation in the Northeast Corridor. The CMS's would be placed prior to key decision points near and within the Northeast Corridor such that motorists would have sufficient time after viewing the message to decide on a course of action and divert to an alternative route if necessary.

Incident Response

The EDP proposes the installation of ramp meters at each of the entrance ramp locations along the fifteen-mile Northeast Corridor. Ramp meters can significantly increase the vehicle handling capacity of freeway through lanes, improve the safety of the merge area and can be used to help return the roadway to normal operations faster after an incident.

Advanced Traffic Signal Control

In the Northeast Corridor, an integrated adaptive traffic signal control system for all arterial roadways is proposed. The adaptive control would allow for the real-time adjustment of signal timing in response to traffic conditions. When compared to a fully optimized fixed time system, an adaptive system can reduce stops by 40%, delays by 20%, fuel consumption by 12% and vehicle emissions by 7%. The EDP proposes the installation of emergency vehicle preemption (EVP) at each arterial street traffic signals in the Northeast Corridor. Preemption would allow emergency services vehicles to interrupt the normal traffic signal timing along the traveled route and to receive a green light on demand. This will reduce emergency response time and the likelihood for emergency vehicle crashes while responding.

Transit Management Systems

The demonstration of "smart" transit service utilizing automatic vehicle location (AVL) technology is proposed in the Northeast Corridor. The project would implement the Neighborhood Zone Service concept which aims to provide local services to get people to the core transit system, connect neighborhoods with nearby shopping, and to integrate suburban clusters with the surrounding residential areas. An AVL system allows the real-time dispatch and routing of service vehicles to achieve a high level of demand responsiveness. The proposed service would provide arranged pickup at flag bus stops near residents. Active transit station signs showing estimated waiting time for shuttle pickup at flag bus stops in the experimental area would be implemented.

ITS PROGRAM BENEFITS

Throughout the United States, the many of the ITS programs and projects similar to those included in this Early Deployment Plan have demonstrated significant improvements in transportation efficiency and safety, including the following (Intelligent Transportation Infrastructure Benefits: Expected and Experienced, FHWA, January 1996):

Freeway Management Systems

- 20 to 40 percent reductions in travel times
- 17 to 25 percent increases in freeway capacity
- 15 to 50 percent reductions in accidents
- reductions in fuel consumption and emissions

Traffic Signal Control Systems

- 8 to 15 percent reductions in travel time
- 6 to 12 percent reductions in fuel consumption
- 4 to 13 percent reductions in emissions

Incident Management Programs

- 10 to 42 percent reductions in travel time
- reductions in incident clearance times of up to 8 minutes

Traveler Information Systems

- reductions in travel times of up to 17 minutes per incident
- 6 to 12 percent reductions in fuel consumption
- reductions in emissions of up to 25 percent

Transit Management Systems

- 15 to 18 percent reductions in travel times
- 12 to 23 percent increases in service reliability

Based on the benefits observed in other ITS programs, the following cost savings are possible in the Indianapolis area if the EDP is fully implemented:

Incident Management

- $94 million savings in delay per year
- $39 million savings in fuel per year

Traffic Signal Control Systems

- $84 million savings in delay per year
- $8 million savings in fuel per year
- $490,000 savings in emissions per year

Transit Management Systems

- $156 million savings in delay per year
- $18 million savings in fuel per year

Traveler Information Systems

- $74 million savings in travel time per year
- $15 million savings in fuel per year
- $12,000 savings per incident
- $3.1 million savings in emissions per year

SHORT TERM IMPLEMENTATION COSTS

The estimated short term implementation cost of the Indianapolis Area ITS EDP is $31.45 million, phased in over 5 years. Implementation costs are the initial costs for planning / design and equipment and facilities. These costs do not reoccur on an annual basis.

The table below presents the Year 1 through 5 costs for the six Program Areas identified in the EDP. The cost to install fiber optic cable, estimated at approximately $5.5 million for the first 5 years, is not included in the totals because it is assumed to occur under a partnership with a communications provider at no cost to INDOT. No costs are provided for Program Area 5, Public-Private Partnerships, because these initiatives will be funded through other projects.

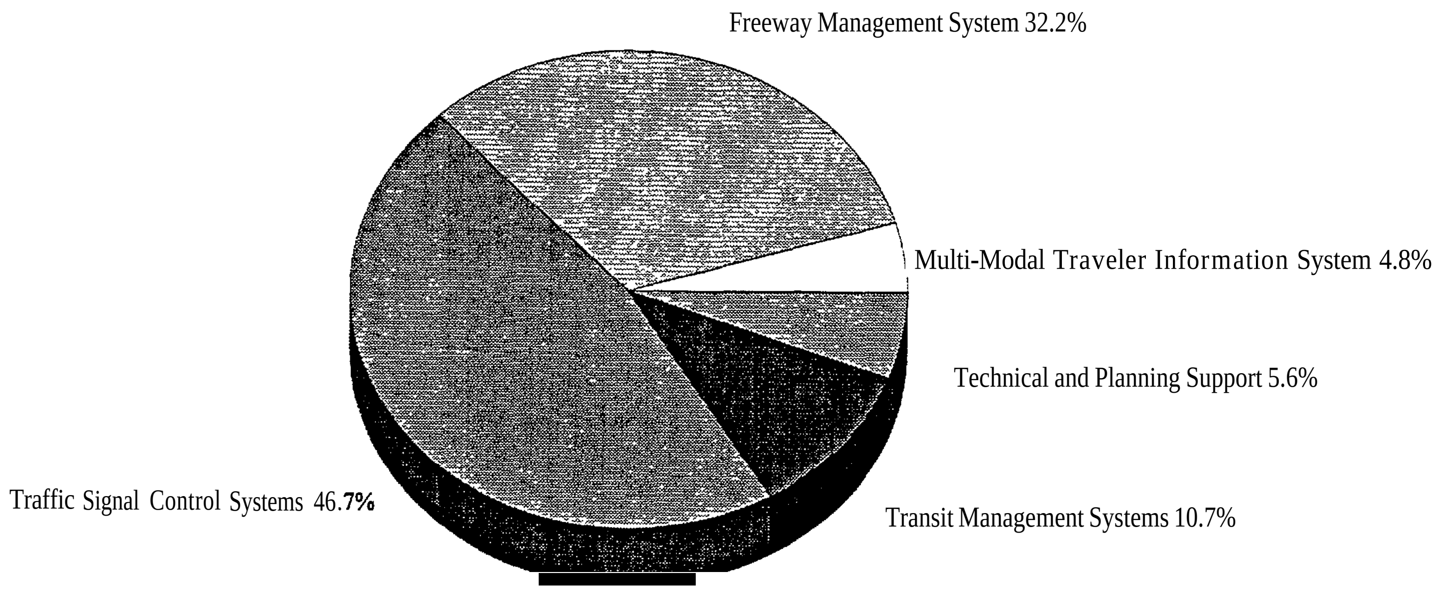
Year 1– 5 Costs by Program Area

Program Area	Year 1	Year 2	Year 3	Year 4	Year 5	Total
1. Multi-Modal Traveler Information System	$658,000	$300,000	$411,000	$54,000	$88,000	$1,511,000
2. Freeway Management System	$760,000	$1,786,000	$2,211,000	$2,101,000	$3,351,000	$10,209,000
3. Traffic Signal Control Systems	$1,748,000	$2,773,000	$3,428,000	$3,328,000	$3,538,000	$14,815,000
4. Transit Management Systems			$380,000	$1,293,000	$1,467,000	$3,140,000
5. Public-Private Partnerships’*’						
6. Technical and Planning Support	$250,000	$250,000	$350,000	$425,000	$500,000	$1,775,000
Total	$3,416,000	$5,109,000	$6,780,000	$7,201,000	$8,944,000	$31,450,000

(1) The cost to install fiber ophc cable ($5,399,000) is not included in this table. This project is assumed to occur under a partnership with a communications provider at no cost to INDOT.
(2) These initiatives are funded through other projects.

As shown, Program Areas 2 and 3, Freeway Management System and Traffic Signal Control Systems, account for roughly 80 percent of Year 1-5 costs. The costs of these programs reflect their infrastructure intensive nature.

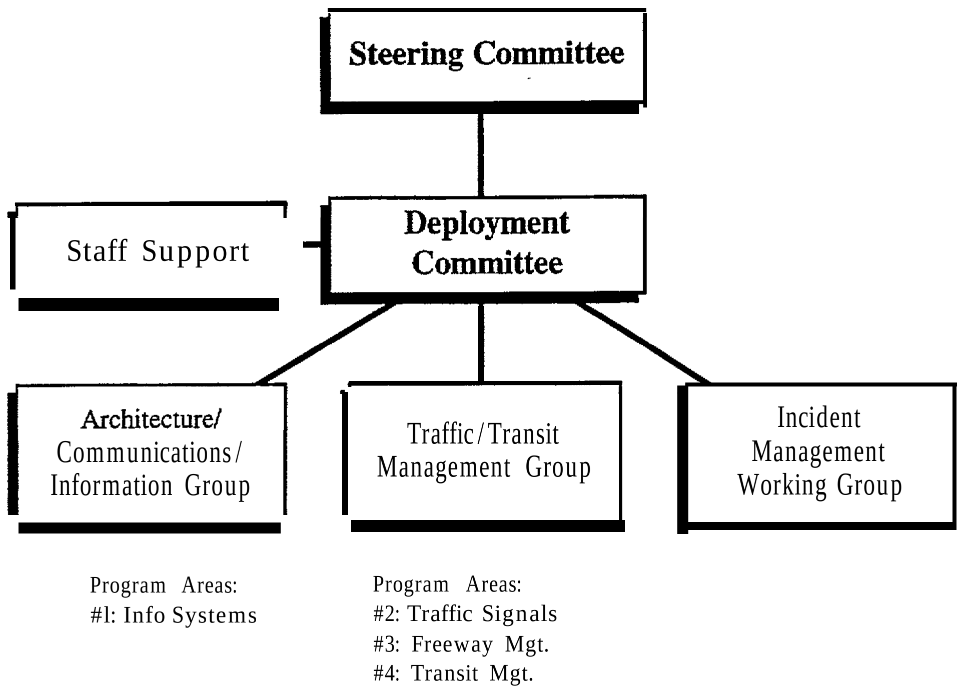
Year 1-5 Conceptual Implementation Costs: Percentages by-Program Area



MOVING TOWARD IMPLEMENTATION

Development of the Indianapolis Area ITS EDP has required significant cooperation and coordination between all agencies within the region. These strong institutional relationships will need to continue as the program plan proceeds into the deployment stage.

A major responsibility in any ITS program plan is the management of the activities within the program. The formation of a management team is recommended to guide the Indianapolis Area ITS EDP process, as shown below. This management team will manage the program activities and address the key technical issues that will arise during the deployment stages. The recommended management team consists of Steering and Deployment Committees supported by Working Groups that will focus on specific programs and projects.



There will be several program management issues that will need to be addressed by the management team. These issues include multi-jurisdictional relationships, cooperative agreements, new legislation, legal considerations, public/private partnerships, monitoring of plan process, and jurisdictional authorities.

The future success of the Indianapolis Area ITS EDP is dependent upon quality management of the implementation process and the mutual cooperation between all multimodal transportation agencies within the corridor.

1.0 INTRODUCTION

The problems of urban traffic congestion and air quality are of national concern. The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 established national goals for the development and implementation of advanced technologies to address these problems through coordinated programs. Part B of Title VI of this legislation established Intelligent Vehicle Highway Systems (IVHS) initiatives that included a focused program to address the highest priority corridors in the country. The term IVHS has since been renamed to Intelligent Transportation Systems (ITS) to reflect the multi-modal nature of the program.

This report presents an integrated, multi-modal, phased strategic plan to address the surface transportation needs and problems of the Indianapolis area through the use of Intelligent Transportation Systems.

1.1 ORIGIN AND CHRONOLOGY OF THE INDIANAPOLIS AREA ITS EARLY DEPLOYMENT PLANNING INITIATIVE

The process which has culminated in the publication of this ITS Early Deployment Plan (EDP) began March 9, 1993 with the Federal Register publication of the Federal Highway Administration (FHWA) announcement of procedures for implementing the Early Deployment Program. On May 4, 1993 the Indiana Department of Transportation (INDOT) submitted an application to the FHWA for IVHS funds under the Early Deployment Program.

In August 1993, FHWA approved the INDOT application for IVHS Early Deployment funds for the Indianapolis area in Fiscal Year 1994, subject to refinement of the proposal. Following consultation with FHWA Region 5 in December 1993, INDOT refined the proposal in conjunction with the formation of a multimodal / multijurisdictional Oversight Committee and resubmitted it to the FHWA on February 25,1994. The FHWA approved the revised proposal in April 1994.

On April 20, 1994, INDOT published a Professional Services Bulletin (PSB) soliciting statements of interest for preparation of the EDP. The deadline for submissions was May 20, 1994. On June 20, 1994, the IVHS Grant (Partnership) Agreement between FHWA and INDOT was executed.

Following the review of consultant proposals and interviewing, on October 6, 1996 INDOT selected the BRW, Inc. led consultant team to prepare the EDP. The Notice to Proceed was issued to the consultant team on May 15, 1995.

1.2 THE INDIANAPOLIS AREA EDP TEAM

The Indiana Department of Transportation (INDOT) led the Indianapolis Area ITS Early Deployment Plan Team. The team included the following groups:

1. Steering Committee
2. Oversight Committee
3. Consultant Team

The Steering Committee set the strategic direction for and coordinated all activities of the EDP development effort. The Steering Committee was composed of 11 individuals representing three agencies:

- Indiana Department of Transportation
- City of Indianapolis
- Federal Highway Administration

Indiana Department of Transportation offices represented on the committee consisted of:

- Planning Engineering and Environment
- Planning
- Executive Office
- Design
- Roadway Management
- Operations Support

The City of Indianapolis was represented by:

- Department of Capital Asset Management
- Department of Metropolitan Development (the area Metropolitan Planning Organization)

The Oversight Committee was formed in order to assure broad jurisdictional and multimodal support for ITS deployment in the Indianapolis area. The Oversight Committee participated in all major EDP planning activities and reviewed all major work products. The committee included all of the members of the Steering Committee plus 40 individuals representing:

- Cities and towns
- FHWA
- Fire departments
- Indiana Convention Center
- Indiana Motor Truck Association
- Indianapolis Airport Authority (BAA Indianapolis)
- Indianapolis Public Transportation Corporation (IPTC, or "METRO Bus")
- INDOT
- Interested private transportation planning and engineering firms
- Law enforcement (state and local police; sheriffs)
- Metro Traffic
- Purdue University
- RCA Dome

The private consulting team employed by INDOT to assist in the preparation of the EDP consisted of:

- BRW, Inc. (prime consultant)
- Battelle Memorial Institute
- DKS Associates, Inc.
- First Group Engineering
- Planning and Development Concepts

1.3 THE FEDERAL HIGHWAY ADMINISTRATION ITS DEPLOYMENT PLANNING PROCESS

Preparation of the Indianapolis Area ITS EDP has followed the ten step ITS Planning Process developed by the Federal Highway Administration. This process is illustrated in Figure l-1.

The federal ITS planning and deployment process emphasizes the significance of a strategic approach, a user-needs perspective and a strong institutional coalition. The deployment of ITS should be structured and strategic in order to protect against the inefficient allocation of resources and to ensure that ITS potential can be fully realized. Deployment should be based upon solving local user needs rather than simply looking for opportunities to utilize new technologies. Finally, successful deployment depends upon the development of an institutional framework and coalition of transportation agencies and other stakeholders. Such a coalition and the cooperation it fosters help ensure that each agency's needs, constraints, opportunities and responsibilities are addressed and that the resulting system meets the needs and expectations of each agency and the public.

1.3.1 Development of the Indianapolis Early Deployment Plan

As applied in the Indianapolis area, the ten step FHWA deployment planning process consisted of the following major areas of activity:

Agency Coordination and Public Outreach

The Steering and Oversight committees developed the Indianapolis area ITS EDP in a coordinated manner with full public disclosure and involvement. During the course of the EDP study, the Steering Committee met 12 times to develop goals and objectives, review needs and problems, discuss proposed program areas and priorities, and approve the EDP. The Oversight Committee met eleven times in conjunction with the Steering Committee meetings to provide further input and a broader representation of stakeholder interests.

The public was kept informed of and involved in the EDP developments through workshops and newsletters. Workshops were held to inform and solicit input from a diverse range of Indianapolis area transportation stakeholders such as transit agencies, trucking firms, local governments and the media. Workshop participants were provided an opportunity to review draft EDP products and identify and discuss information specific to their concerns.

Two half day outreach workshops were held, one on August 23, 1995 and one on March 21, 1996. The first workshop described the study to participants and elicited their comments on needs, problems and potential solutions. The second workshop focused on the draft projects developed by the consultant team in conjunction with the Steering and Oversight Committees and included small group discussions of each project. Both workshops were held in Indianapolis, Indiana.

Three newsletters were published during the course of the study. The first newsletter was published in August of 1995. It announced the study, a schedule of activities, and provided a brief introduction to ITS services. The second newsletter was published in May of 1996. This newsletter summarized the conclusions of the needs assessment and user service prioritization

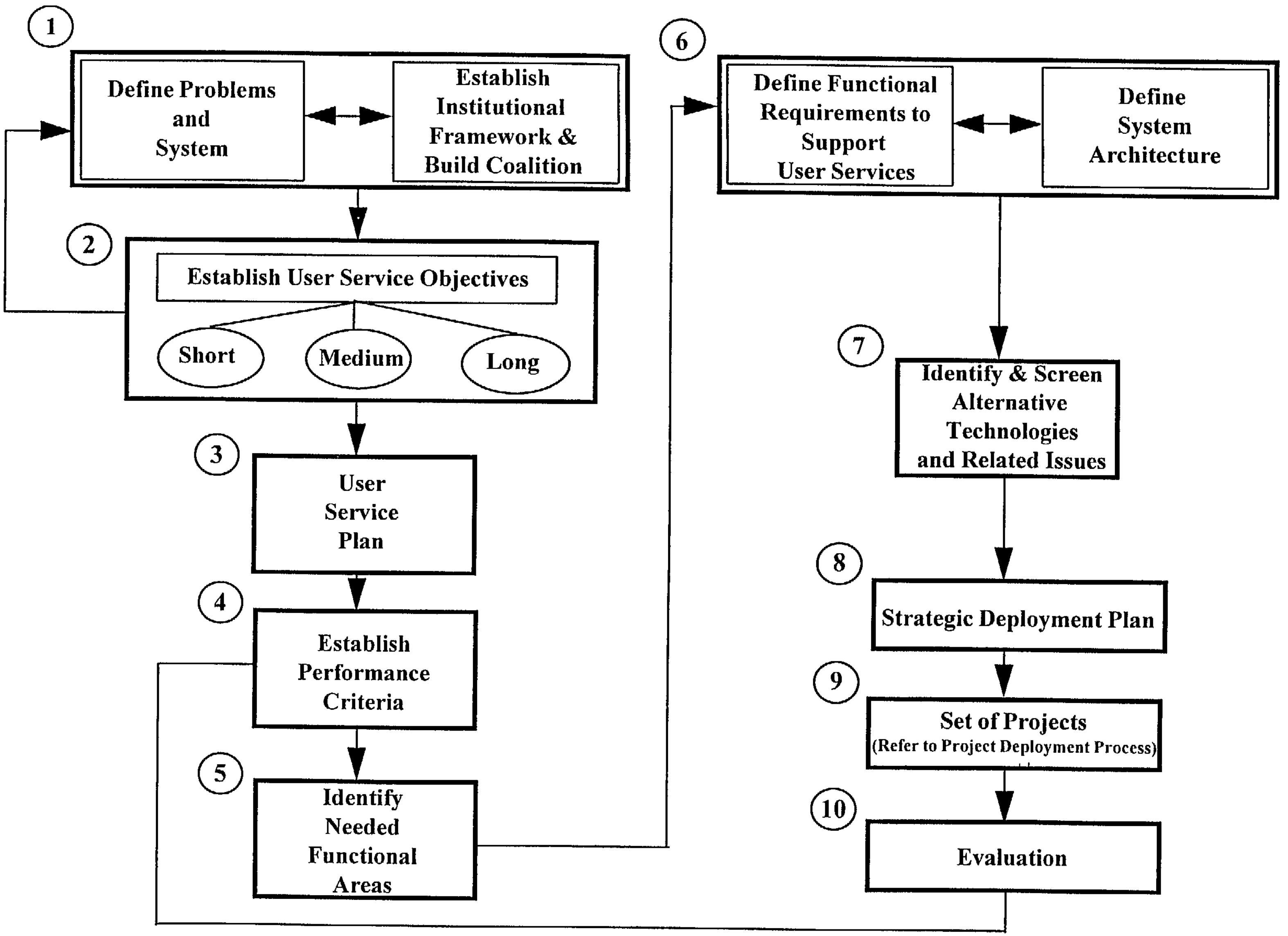


Figure 1-1

FHWA ITS Planning Process

Source: "IVHS Planning and Project Deployment Process", FHWA, April 1993 activities and presented the draft program areas which have been used to organize specific projects. The third newsletter was published in July of 1996. This newsletter provided an executive summary of the report and an outline of the next steps for Indianapolis area ITS deployment. Three hundred and fifty copies of each newsletter were printed and distributed using a list of transportation stakeholders as identified by the Steering Committee.

Define Travel Environment, User Needs, and Program Vision

The goals of the Early Deployment Plan include solving current problems and pursuing new developments that can improve the overall surface transportation network in the Indianapolis area. To achieve these goals, the current and anticipated future needs of the area needed to be identified and defined, and a vision needed to be developed of the future state of the corridor and the role for ITS. The needs of the corridor needed to be defined qualitatively by users and quantitatively from data.

The qualitative assessment of the Indianapolis area travel environment and user needs utilized three separate techniques. Interviews were conducted with 37 representatives of 29 key transportation agencies. Surveys were distributed to 162 individuals with significant transportation interests in the Indianapolis area. Responses were received from 37 individuals. Finally, over 350 people were invited to each of the outreach workshops and 68 people attended these needs definition workshops. Each of these techniques focused on the identification of needs and suggestions for ITS oriented solutions.

In addition to the qualitative needs assessment utilizing the three techniques described above, a wide range of quantitative transportation data was assembled from planning and operating agencies within the corridor. Data such as demographics, facility capacities, vehicle occupancies, travel characteristics and modal splits were gathered. The past, current and expected data for these characteristics were gathered to assess trends and/or patterns.

At the same time that the travel environment and stakeholder perspectives were evaluated in order to identify user needs, a vision statement was developed that describes the desired future state of the study area. The vision statement and accompanying goals and objectives that were developed by the Steering and Oversight Committees are presented in Section 1.4 of this Introduction.

Develop ITS Projects

The central element of the EDP is the programs and projects that will be deployed to deliver ITS user services. The BRW team used an iterative, cooperative approach to identify and develop programs and projects for the EDP.

The first step in the development of specific program areas and projects began with a special two-day workshop with the Steering Committee. The purpose of the workshop was to identify and prioritize the specific user services appropriate for early deployment in the Indianapolis area. This prioritization was based upon the results of the qualitative and quantitative needs assessment. The workshop included many presentations and interactive voting and discussion activities. These activities yielded the following:

- a prioritized list of the causes of the most significant transportation problems in the Indianapolis area;
- a prioritized ranking of the ITS user services most appropriate to address those problems;
- a list of overriding factors to guide the development of all of the specific programs and projects included in the EDP; and
- a list of potential projects to investigate.

In the months following the two-day prioritization workshop, the ITS functions associated with high priority user services were investigated, potential system architecture relationships among the functional components of these services were identified and specific technology alternatives were evaluated. Concurrent with these efforts, the process to develop specific projects and program areas was initiated. The process of project development continued through the preparation of the EDP Final Report and proceeded in an evolutionary manner in response to finalization of system architecture concepts and technology recommendations. The project development process involved repeated rounds of review and comment by the Steering and Oversight Committees.

Develop Incident Management Plan

During approximately the same time that program areas and specific projects were developed, a special focused effort was undertaken to develop an Incident Management Plan for the Indianapolis area. This effort entailed the formation of an Incident Management Task Force composed of members of the Steering and Oversight Committees and representatives of agencies involved in roadway incidents, such as law enforcement, fire departments and communications.

The establishment of a separate task force devoted to incident management and treatment of incident management in a separate plan was made in recognition of the special issues associated with this topic. These issues include the degree of coordination and cooperation required between the Indiana Department of Transportation and other incident response agencies as well as legal, liability and safety issues.

Although approached separately, the development of the incident management plan was closely integrated with the development of specific projects and programs in the EDP, especially those in the areas of freeway management and traffic signal control. Generally, the infrastructure required for ITS incident management are provided through projects identified in these program areas and the procedures for ITS incident management are addressed in the incident management plan.

The Incident Management Task Force met four times during the EDP development process, starting in January 1996. The primary purposes of the task force were to establish working relationships, commitments and consensus on objectives among INDOT and those involved with roadway incidents. During the course of the task force effort the objectives of the EDP were explained, the potential role for ITS and its benefits in the area of incident management were identified and specific potential strategies were discussed.

There were two primary products of the incident management effort:

- an institutional framework and process that will allow further development of incident management projects and processes; and

- an Incident Management Plan continuing the consultant team's recommendations for specific elements of a regional incident management plan and for a geographically limited pilot test of these elements.

Utilizing the recommendations from the Incident Management Plan and building upon the framework for cooperation established through the task force effort, the Incident Management Task Force will continue to meet as a working group to identify and implement specific measures. This effort is described in more detail in Section 8.0, Program Management Plan.

Develop Early Deployment Plan Final Report

The final step in the development of the EDP was the production of this final report and the elements necessary to move the EDP into the deployment stages. In the final stages of the study, strategies were established for the implementation of the EDP, including a recommended ITS program management structure, roles and responsibilities.

1.3.2 Accompanying Documents

Several documents were produced which support this Early Deployment Plan Final Report. These documents consist of:

- User Service Plan (January 1996)

- Technologies Working Paper (June 1996)

- System Architecture Working Paper (July 1996)

- Incident Management Plan (July 1996)

In the cases of the User Service Plan, Technologies Working Paper and System Architecture Working Paper, these documents provide detailed documentation of activities included only in a summary form in this final report. As noted in Section 1.3.1 above, the Incident Management Plan documents the recommendations for the procedural aspects of ITS incident management.

1.4 VISION, GOALS AND OBJECTIVES

As explained in Section 1.3, the development of a shared vision for the desired end state of the Indianapolis area transportation system relative to ITS deployment was an early and important activity in the development of the EDP. Goals and objectives were developed to reflect the working vision statement.

1.4.1 Vision Statement

The vision for the Indianapolis area is one of enhanced transportation productivity, mobility, efficiency and safety within the region with a reduction in energy use and improvement in the environment through the use of cost effective ITS technologies and systems.

The vision starts with mutual cooperation between agencies and jurisdictions within the region to plan and implement advanced ITS technologies. The vision is an integrated approach to solve transportation problems. The vision seeks to improve the use of existing infrastructure and the choices of users and operators. The vision approaches problems that can be effectively addressed with the resources available within the region.

The vision for the Indianapolis area applies to all single and multimodal users who travel within and those who travel through the region. The vision is also for transportation operators and agencies, and the surrounding community. The vision for the region includes the following elements:

- **Evolution**
  The implementation of ITS technologies within the Indianapolis area will occur in an evolutionary manner. They will be introduced gradually as the costs and benefits of the technologies are demonstrated and justified for the region.

- **Travel Information**
  Information regarding the transportation system within the Indianapolis area will be immediately available to users and operators through a variety of devices such as television, radio, personal computers at home and at work, public kiosks, hand held mobile devices, roadway signage and other interactive communication devices. Users and operators will be able to inquire and receive information about current and expected traffic conditions, travel times, incidents and alternative routes. Users and operators will be also able to inquire and receive information about transit status and schedules. This information will allow users to make informed decisions about when to leave, how to travel, and what route to take.

- **Traffic Management**
  The traffic on selected Indianapolis area routes will be monitored and controlled through an integrated system. Integrated systems will control arterial and freeway operations, monitor and make adjustments to lane usage, speed limits, ramp access and traffic signals. The goal of an area-wide system is to maximize the efficiency of the overall network based on actual conditions. In cooperation with travel information systems, traffic control operators can notify users of current or changing conditions and thereby redirect traffic or set drivers' expectations for safer more efficient flow. An incident management system will identify incidents, dispatch the appropriate response services, and serve to remove and mitigate the effects of incidents throughout the area.

- **Commercial Operations**
  In coordination with national and regional initiatives, commercial carriers will be able to drive through the region with minimal delays. Commercial carriers will have access to

traveler information systems that can assist with routing, scheduling and dispatching optimization.

- **Electronic Payment Services**
  Devices will allow users to electronically pay fares and fees with a minimum amount of delay. Payment systems will collect fares and fees from users and operators in an integrated manner with other collection systems.

- **Travel Demand**
  Users who wish to ride share can immediately determine potential candidates and dynamically create car pools. Devices such as smart cards, public kiosks and personal digital assistants will allow users to communicate with each other and work together to reduce the number of vehicles on the roadway. ITS technologies will allow for detailed traffic data collection and analysis. This information can support demand management techniques such as congestion pricing and large employer travel management.

- **Transit Systems**
  Public transportation will be more attractive by offering faster service resulting from traffic signal priority and control of special ramps or lanes. Service will also be improved through the use of technology to track vehicles, accurately maintain schedules, predict demand and operate fleets more efficiently with a minimum of downtime and delay. Users of transit systems can be informed immediately on the status of their chosen route using a variety of devices such as telephones with services such as audiotext, public kiosks, personal computers and personal digital assistants. Users will be encouraged to use transit systems through improved information and easier access to information. Fare collection will be made easier and more accessible through addressing policies and barriers.

- **Vehicle Tracking**
  Systems will monitor and track the status of commercial carriers, transit operators, emergency and service vehicles, and hazardous material carriers. These systems will allow operators to efficiently schedule their services, monitor on-time performance, and quickly respond to user needs.

- **Emergency Management**
  Devices will notify authorities of the need for dispatching emergency vehicles to the site of a collision or incident. Systems will coordinate the response from fire, police and medical agencies resulting in fast response in the most appropriate manner. Other systems will coordinate the removal of incidents to promote the timely return of the travel network to peak performance.

- **Navigation**
  Systems and on-board devices will assist drivers with planning and following safe and efficient routes throughout the Indianapolis area. These devices will also provide local information such as services and attractions.

- **Pollution**
  Air pollution will be reduced through improved efficiency and use of transportation systems including demand management strategies. Dynamic ride-sharing systems will encourage the use of high occupancy vehicles. Traveler information systems will decrease the number of vehicle miles traveled through better planning. Public transportation systems will improve information available to users which will increase the use of public transit services. Traffic management systems will improve the flow of vehicles and reduce the level of pollution. Detection systems will monitor vehicle emissions and support enforcement efforts.

- **Cooperation**
  The future of transportation in the Indianapolis area starts with the mutual cooperation among transportation agencies within the region. All agencies from INDOT to city traffic agencies to local fire, police and medical service providers will work together to promote and encourage the most productive and safest operation of the transportation network. These agencies will work together to plan, design, implement and operate ITS systems in a cooperative and mutual manner.

- **Institutional Issues and Barriers**
  Barriers to deploying ITS technologies and arrangements will be researched and identified. Legislative initiatives will be developed and submitted where appropriate to reduce barriers, resolve privacy concerns and encourage arrangements such as public/private partnerships.

1.4.2 Goals and Objectives

The overall goals of the Early Deployment Plan are to:

- Improve productivity.
- Improve safety.
- Reduce energy use and negative environmental impact.
- Improve mobility and accessibility.
- Increase efficiency.
- Create a state-of-the-art ITS transportation system for the region.

The objectives associated with each of these goals are as follows.

Create a State-of-the-Art ITS Transportation System

- To establish an ITS architecture that is:

  - open, receptive and adaptable to meet future area architecture and field test needs

  - consistent to the maximum degree possible with developing national standards

- To develop and integrate the following systems throughout the area as appropriate:

  - Travel and Traffic Management

  - Public Transportation Management

  - Electronic Payment Services

  - Commercial Vehicle Operations

  - Emergency Management

Enhance Productivity

- To reduce the travel delay and increase the reliability and predictability of moving people and goods for all transportation users.

- To improve the ability of users and operators to perform travel planning using real-time travel information.

- To reduce the operational costs to operators incurred from poorly operating transportation facilities.

- To reduce the scheduling and processing delays and costs to users and operators associated with the regulation of vehicles.

- To reduce the costs and improve the quality of data collection for transportation system planning, use, operations, maintenance and installations.

Improve Safety

- To reduce the number and severity of motor vehicle collisions and associated injuries and fatalities.

- To improve the average response time of emergency services.

- To improve the ability to identify, respond, remove and/or mitigate the effects of incidents.

- To improve the 'cracking of hazardous material movements, and the response to and mitigation of the effects due to loss of containment situations.

- To enhance personal security on all modes of transportation.

Reduce Energy Consumption and Improve the Environment

- To increase the use of public transit and other shared ride alternatives.

- To reduce harmful emissions per unit of travel for all transportation modes.

- To maintain and improve air quality standards.
- To reduce the energy consumption per unit of travel for all transportation modes.
- To reduce the need for new right-of-way requirements and related community disruption associated with transportation facility improvements.

Enhance Mobility and Accessibility

- To improve the accessibility and availability of travel options information to users of all transportation facilities.
- To reduce the variability and to simplify the use of public transportation.
- To improve the predictability of travel time for all transportation modes.
- To reduce the complexity of scheduling and fee collection procedures for operators and users of intermodal facilities.

Increase Efficiency

- To reduce congestion and associated costs.
- To optimize the operational efficiency of goods and people movement on existing facilities.
- To increase average vehicle occupancy.
- To reduce time lost in intermodal interchange.
- To increase capacity of existing infrastructure through ITS Deployment.

1.5 ORGANIZATION OF THE EARLY DEPLOYMENT PLAN

This document has been produced to provide the reader with a summary of the process used, the data gathered, analysis performed and conclusions reached during the development of an ITS Early Deployment Plan for the Indianapolis area. This document is divided into the following sections:

Introduction

This section introduces the overall Indianapolis area ITS deployment effort and the process leading up to and performing the development of the Early Deployment Plan.

Needs Assessment

This section summarizes the process and presents the products of the analysis of Indianapolis area user needs. This information is presented in detail in the separately bound User Service Plan (January 1996).

User Services Prioritization

This section summarizes the process and presents the results of the effort to identify and prioritize Indianapolis area transportation problems and appropriate ITS user services. This information is presented in detail in the separately bound User Service Plan (January 1996).

Technology Assessment

This section summarizes the process and presents the results of the effort to identify, evaluate and recommend ITS technologies for deployment in the Indianapolis area. This information is presented in detail in the separately bound Technologies Working Paper (June 1996).

System Architecture and Communications Concept Plan

This section summarizes the analysis and recommendations for an Indianapolis area ITS system architecture and presents a summary of the recommended backbone communications system concept. This information is presented in detail in the separately bound System Architecture Working Paper (July 1996).

Projects

This section describes the ITS programs and projects recommended for deployment in the Indianapolis area. Each of the 6 program areas is overviewed and individual projects are described in terms of objective, scope, current conditions, time frame, budget, staffing, administration and sponsor. Projects have been organized into 6 program areas based upon the components of the United States Department of Transportation's "Intelligent Transportation Infrastructure."

Implementation Plan

This chapter presents recommendations for the staged implementation of the EDP and includes a detailed deployment schedule, costs and an assessment of ITS procurement and contracting issues and options.

Benefit - Cost Analysis

This section identifies the potential benefits of the major programs included in the EDP. These estimates are based upon national experience with projects similar to those recommended for the Indianapolis area.

Program Management Plan

This chapter presents recommendation for the management of the EDP including the development of an ITS deployment committee and internal agency management.

Needs Assessment

2.0 NEEDS ASSESSMENT

The Indianapolis Area ITS User Service Plan, a plan prepared as part of the development of the Indianapolis Area ITS Early Deployment Plan (EDP), analyzed the needs of the Indianapolis area through review of area transportation plans and outreach efforts. The following information reflects a summary of the findings compiled in the User Service Plan.

2.1 TRANSPORTATION SYSTEM ASSESSMENT

The Indianapolis Metropolitan Planning Organization (MPO) (the Indianapolis Department of Metropolitan Development) updated its long range transportation plan in July 1995 to reflect the projects which are fundable into the year 2020. The Indianapolis Transportation Plan Update, along with several other transportation plans in the Indianapolis area, served as primary sources in assessing the current and future transportation system in the Indianapolis area.

2.1.1 Highway System

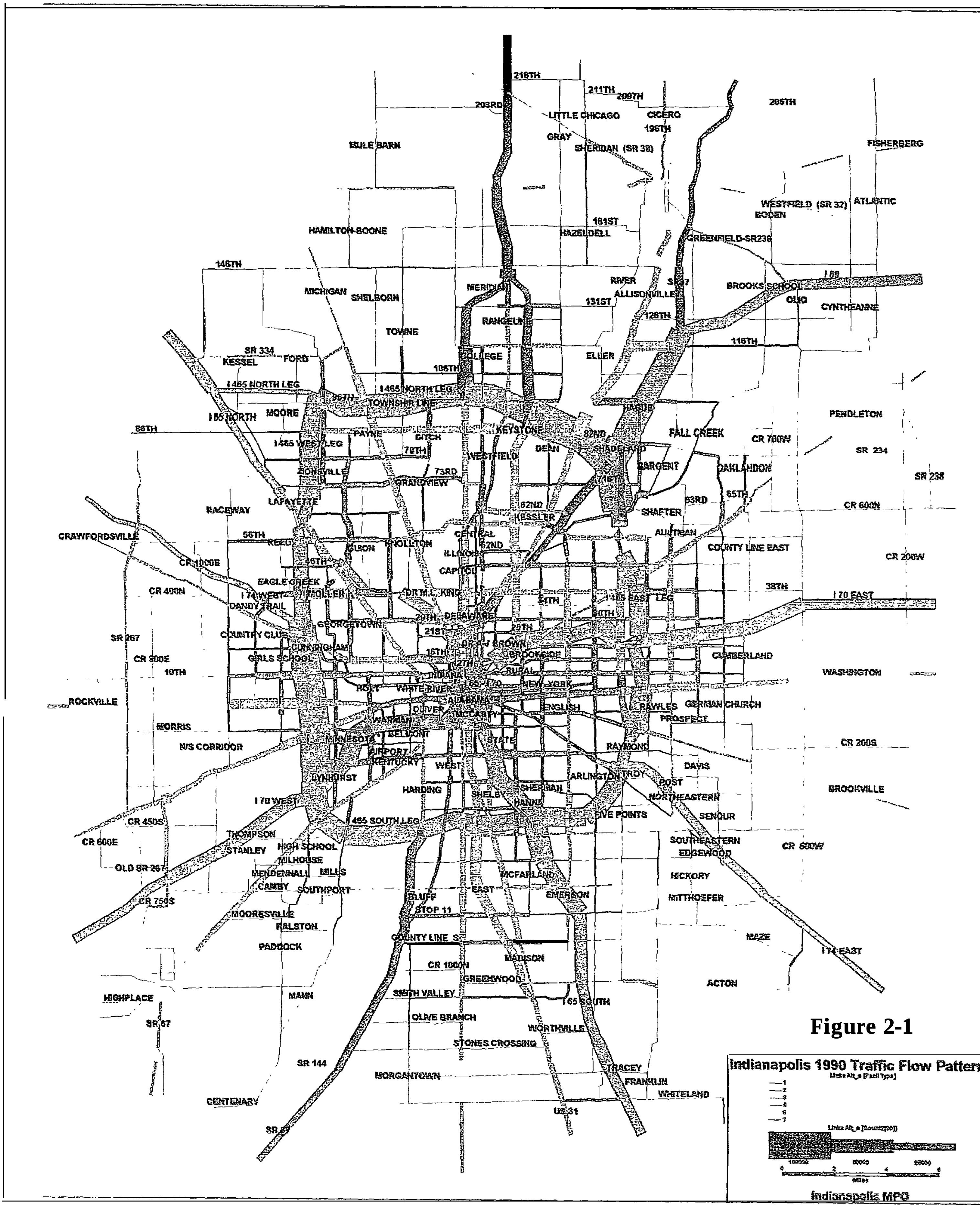
Interstate and U.S. highways are highly prominent features in the Indianapolis area roadway system. Interstates I-65, I-69, I-70, and I-74 converge in Indianapolis. I-465, a circumferential route around Indianapolis, creates a loop around the city and links the four interstate roadways together. Four-lane U.S. Routes 31 and 40 serve the Indianapolis area and also feed into the loop created by I-465. Numerous state and county roads, and city streets form the rest of the roadway system included in the ITS project study area. Given the number of intersecting major U.S. and State roadways, the Indianapolis area is appropriately nicknamed "The Crossroads of America".

Traffic Volumes

In 1990 there were 3,001,927 daily person trips within the Indianapolis Metropolitan Planning Area. This number excludes the truck and taxi trips and all the trips with one or both ends outside the MPA. Of these trips, 702,282 are home-based-work trips (23.4 percent). The occupancy for these trips was 1.11 persons.

Figure 2-l represents 1990 traffic flow patterns for the Indianapolis MPA modeling area. It is evident that state routes, U.S. routes, and interstate highways are high volume corridors in the region. The estimated daily vehicle miles traveled (VMT) for the MPA modeling area is 26,192,580. Figure 2-2 shows 1990 existing volume/capacity for roadways within the Indianapolis MPA.

Data from the *Indianapolis Transportation Plan Update* indicates the daily person trips within the Metropolitan Planning Area will increase 48 percent from the year 1990 to the year 2020. In the same period, vehicle miles traveled will increase 69 percent to over 44 million. Figure 2-3 presents the forecasted year 2020 traffic volumes on a roadway network consisting of existing roadways plus all committed roadway improvements.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CUNNINGHAM
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CUMBERLAND
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10TH
RURAL
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INDIANA
HOLT
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NEW YORK
ROCKVILLE
ALABAMA
ENGLISH
GERMAN CHURCH
RAWLES
OLIVER
WARMAN
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PROSPECT
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MINNESOTA
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SOUTHEASTERN
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CR 500W
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EDGEWOOD
OLD SR 267
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OLIVE BRANCH
WORTHVILLE
STONES CROSSING
SR 144
TRACEY
MORGANTOWN
FRANKLIN
WHITELAND
CENTENARY
US 31
SR 37
Indianapolis 1990 Traffic Flow Pattern
Miles
Indianapolis MPO

Figure 2-1

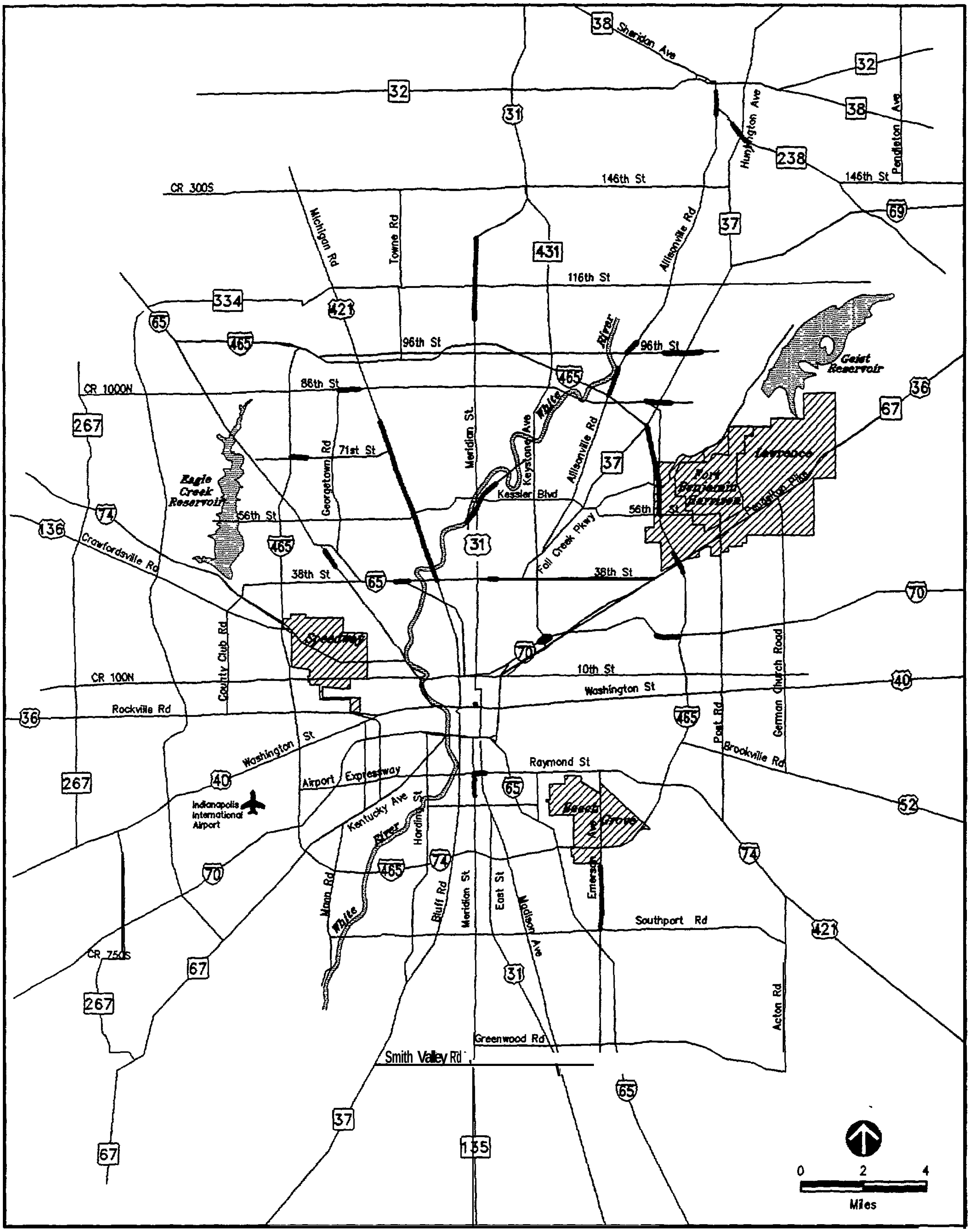

Figure 2-2

1990 Roadway Segments with Volume Capacity V/C 2 1.1

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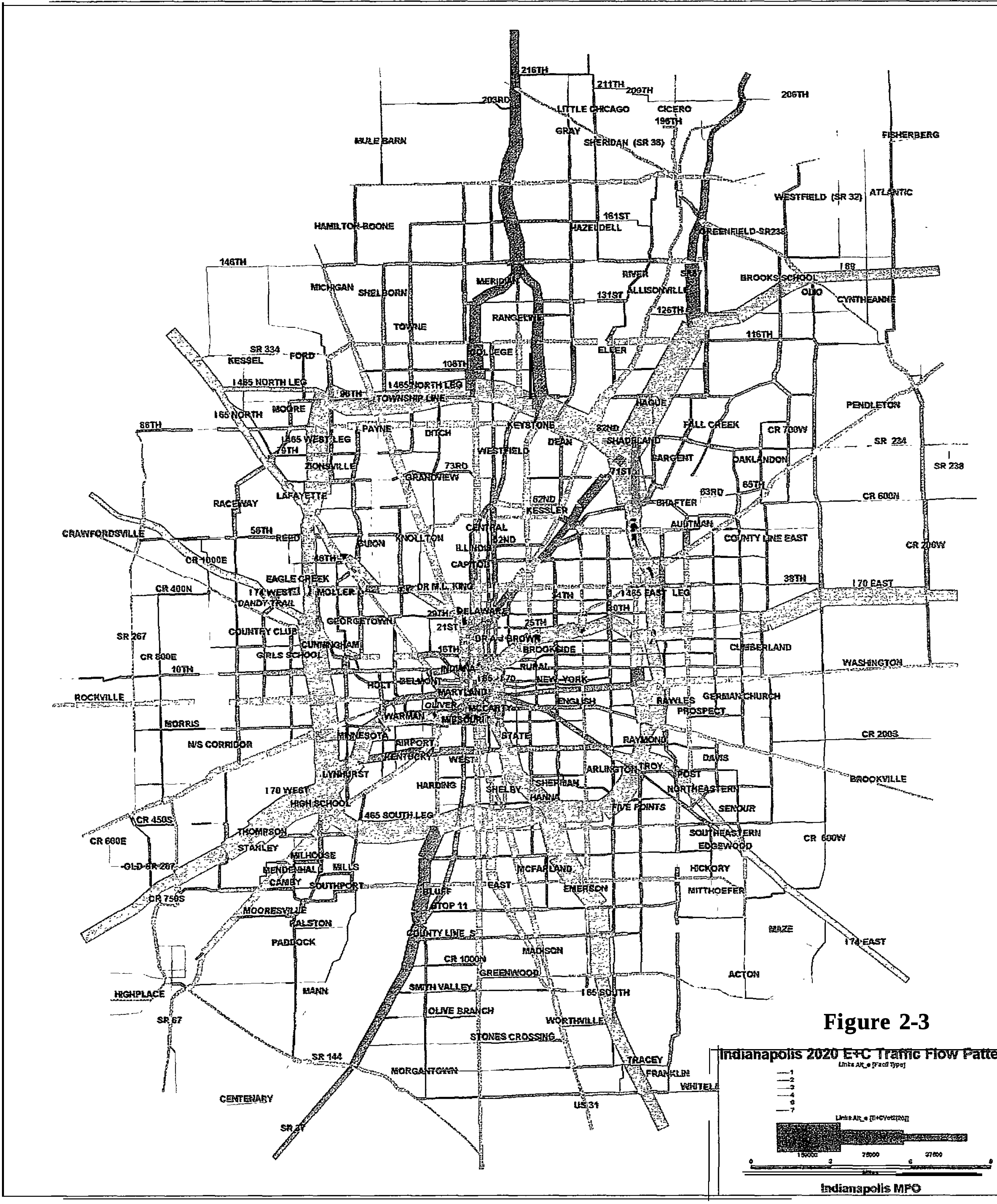
DKS Associates
First Group Engineering
Planning and Development Concepts

Ind. Reg. Trans. Plan
August, 1995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Indianapolis 2020 E+C Traffic Flow Patte
Indianapolis MPO

Figure 2-3

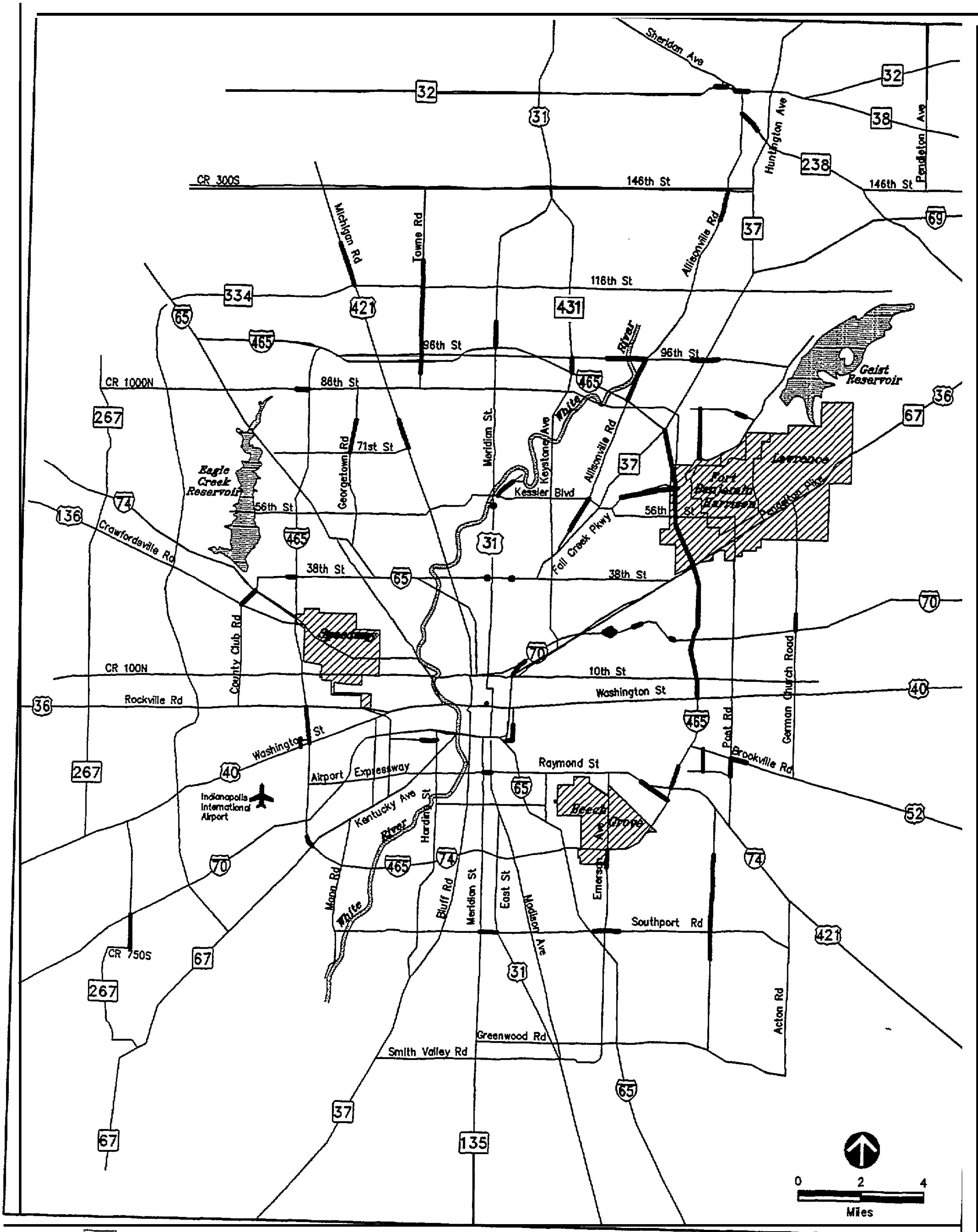

Figure 2-4
Year 2020 Cost Feasible Plan V/C > 1.1

Indianapolis Area ITS

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Planning and Development Concepts

Ind. Reg. Trans. Plan
August, 1995

The projects for which funding is available have been identified in the Indianapolis Transportation Plan Update as the 2020 Cost Feasible Plan. Figure 2-4 shows roadway segments with volume-to-capacity ratios greater than or equal to 1.1 under the 2020 Cost Feasible Plan. As shown in Figure 2-4, feasible roadway improvements are insufficient to accommodate forecasted future travel demand at acceptable congestion levels.

Congestion Levels

Many of the roadways in the northern half of the MPA modeling area within I-465 are at a Volume to Capacity (V/C) level of .8 or above, meaning that they are approaching, at, or over-capacity. Additionally, many of the arterials near the interstate interchanges are exhibiting capacity problems. Since 1990 there have been a few arterial improvement projects which have improved the capacity of these facilities. These projects include 86th Street located on the northwest side of the city and U.S. 31 and S.R. 135 located on the south side of the city.

Congested Interstate Segments:

I-465 from Keystone Avenue to Allisonville Road
I-465 from I-69 to I-70
I-65 from the southeast corner of the innerloop to Raymond Street
I-65 from Kessler Boulevard to 38th Street
I-70 from Holt Road to Harding Street
I-69 from I-465 to 82nd Street

Interstate Segments Nearing. Capacity:

I-465 from I-70 to Washington Street (east leg)
I-465 from Brookville Road to I-74
I-465 from U.S. 40 to I-74 (west leg)
I-70 from Harding Street to the southeast corner of the inner loop
I-69 from 82nd Street to 96th Street

Construction Activity

There are many construction projects that are planned within the project study area between 1995 (present) and the year 2020. These projects are being planned by the Indiana Department of Transportation and the Indianapolis Department of Capital Asset Management as well as several local agencies. The projects are spread out throughout the project study area, and include several types of projects.

The following is a list of significant projects that are either currently under construction or in the planning/design stage. This list was compiled from the Indianapolis Transportation Plan Update.

Committed Projects - 1995-1997 (Major Projects):

1. DCAM Project — I-70 at Six Points, New Interchange, cost - $18,891,000

2. INDOT Project — I-65 at Marion/Johnson County Line, New Interchange, cost - $7,200,000

3.	DCAM Project	82nd Street from I-69 to Hague Road, Roadway Widening, cost - $3,450,000
4.	INDOT Project	I-69 at 96th Street, Interchange Modification, cost $2,290,000
5.	INDOT Project	I-465 from Emerson to I-70 (east), Roadway and Interchange Reconstruction, cost - $110,000,000 (multiple phases)
6.	INDOT Project	I-70 at S.R. 267, Interchange Modification, cost - $3,326,000

1998-1999 Projects

7.	Hendricks County	N/S Corridor at 1000 East from I-70 to U.S. 40, New Roadway, cost - $11,358,075
8.	Fishers Project	96th Street from Allisonville Road to Lantern Road, Roadway Widening, cost - $10,208,000

Over the next 25 years a large proportion of proposed roadway construction projects will concentrate on the northeast side of town along the I-69 and U.S. 31 corridors and on the southwest side of town near the Indianapolis International Airport. These two areas are experiencing heavy growth and will most likely continue to grow significantly in the coming years.

Traffic Signal Technologies

Traffic signal equipment located in the project study area is controlled by a number of different agencies, As such the technology varies considerably from location to location. There are intersections that are controlled with electro-mechanical fixed time controllers operating in an isolated manner as well as solid state controllers with fiber optic interconnection controlled by a closed loop master. There is no large area computerized signal system in the area. Outside of the Central Business District, most of the signals are on arterial routes which are interconnected. Traffic signals at the interstate ramps are interconnected to one another but may not be interconnected to the other signals on the arterial. All of the agencies involved are in a continuous process of updating their signal systems and installing new systems.

Commercial Vehicle Operations/Freight Movements

As a hub for a number of Interstate, U.S., and State Routes, the Indianapolis area's major roadways serve as a transportation facility for inter-state transfer of goods and services, Approximately 63 percent of the trucks entering the project study area travel through without making any deliveries.

The truck route system in the Indianapolis area is generally comprised of all Interstate, U.S., and State Routes, with the exception of U.S. 31 (Meridian Street) south of 86th Street to Washington Street. In addition to these routes, a number of local streets are also included in the truck route system.

Most of the truck termini are located within one-half mile of the Interstate System. The only intermodal facility for container/trailer transfer between rail and truck is located in the Conrail Avon yard on the west side of the project study area.

Freeway Accidents

Accident rates (accidents per million vehicle miles traveled) for major study area freeway segments have been calculated. These rates are useful in identifying the relative accident incidence, one measure of roadway safety, of various roadways. This analysis utilized 1992,1993 and 1994 accident data provided by the Indiana Department of Transportation.

Between 1992 and 1994 the growth in the number of accidents on the analyzed segments outpaced the growth in travel. From 1992 to 1994, the total number of accidents on all segments analyzed increased by approximately 20 percent, from 1,943 to 2,342. During this same period, the total vehicle miles traveled increased only approximately 4 percent, from 208,787,625 to 217,351,284. This relationship is reflected in the increase in the overall accident rate from 0.56 accidents per million vehicle miles (MVM) to 0.66 accidents per MVM.

Accident rates on the analyzed freeway segments ranged from 0.25 accidents per MVM (I-65 from I-465 to Greenwood Road) to 1.34 accidents per MVM (I-65 from Meridian Street to Raymond Street). The highest accident rates are found on the high volume freeway segments near the Indianapolis International Airport and which pass through the Indianapolis central business district.

Accident rates increased on 15 of the 23 segments studied. The segments consisting of I-65 from I-465 to 38th Street/Guion (164 percent increase) and I-465 from I-70 to I-74 (107 percent increase) showed the greatest increases.

Emergency Response

Because of the many jurisdictional boundaries within the project study area, several emergency response agencies exist to provide local and regional emergency assistance. Local police agencies include the Indianapolis Police Department (IPD) and several smaller community police agencies (i.e. Speedway, Lawrence, Beech Grove, Greenwood, Fishers, etc.). Each county has a County Sheriffs department. The Indiana State Police is also available in the event of an accident in each county within the project study area. The fire departments and ambulance services are responsible for providing emergency medical care and emergency health care transport in the event of a serious accident within their specified jurisdictions. To reduce the impacts that an accident has on the roadway system and ensure public safety, these agencies must quickly be able to secure the scene, safely detour traffic around the incident, and clear the incident.

Currently, the IPD and the Marion County Sheriff's Department share a common communication system (Indianapolis-Marion County Communications Center). Emergency response agencies communicate with one another through hotline numbers or radio communications. Incoming emergency calls are channeled through local phone systems to the appropriate jurisdiction.

The "North" District of the Indianapolis Police Department is experimenting with a system which allows an officer to preempt traffic signals from the police vehicle, stopping cross traffic and allowing the police vehicle to proceed through the intersection. The system's range is flexible and appears to work well when utilized properly. The system has the capability to expand its present uses. The Washington Township Fire Department is also currently utilizing an emergency vehicle signal preemption system along 86th Street.

Key Issues/Deficiencies

- Reoccurring, severe traffic congestion is not currently a problem throughout most of the Indianapolis area. However, there are localized problem areas where high traffic volumes, commuter trip peaking characteristics and roadway geometrics combine to frequently produce moderate congestion during peak travel periods, including weekday morning and evening commutes, holidays and weekends. Severe localized traffic congestion is experienced in association with several Indianapolis area special events, including RCA Dome, Market Square Arena and Indianapolis Motor Speedway events. Regional travel demand forecasting modeling indicates that current localized congestion will significantly increase geographically in severity over the next 20 years.

- Roadway construction season is shortened due to sub-freezing winter temperatures, focusing major construction within a period of approximately 8 months. There are many major construction projects planned for the next 5 years that will have significant traffic control and congestion impacts, especially the reconstruction of the I-70 / 1-65 commons section of highway through downtown Indianapolis. Construction has and will continue to pose major challenges in terms of maintenance of traffic flow and protection of the safety of motorists and workers.

- There is no centralized regional control of traffic signals in the Indianapolis area. Many traffic signals throughout the Indianapolis region utilize relatively antiquated signal hardware, although these systems are continuously being upgraded as resources permit and the number of closed-loop signal systems is increasing. Arterial street traffic flow could benefit greatly through the introduction of more advanced signal hardware, software and timing strategies.

- Relative to many major urban areas, the incidence of traffic accidents on Indianapolis area freeways / interstate segments is not high. However, many accidents do occur, including those which involve fatalities and / or considerable personal or property damage and the traffic delay associated with major accidents is significant. The number of accidents will increase as traffic volumes rise in the future. One of the difficulties in reducing the numbers of accidents has been the inability to perform detailed analysis of regional accident patterns due to the unavailability of consistent, geographically precise accident data. Establishment of an improved data collection and analysis capability is needed. In both the short and long terms, ITS has the potential to significantly decrease the number of accidents and their impacts to traffic operations.

2.1.2 Transit System

The Indianapolis area within Marion County is served by the Indianapolis Public Transportation Corporation, known as METRO Bus and other public transportation companies contracted by the City of Indianapolis. The Town of Speedway has its own public transportation provider in addition to METRO Bus service. Transit service includes 39 fixed routes that operate primarily in a radial manner from the central business district of Indianapolis. Public transportation ridership is estimated at 29,700 daily linked transit trips, which account for about 1 percent of total daily person trips. Additionally, fixed-route and demand responsive transportation services are provided by taxi companies, private organizations and social service agencies. Approximately 1250 vehicles are used to provide these alternate transit services.

Key Issues-Future, Unmet Needs

- Like many urban areas, the Indianapolis area transit system does not serve a significant volume of regional trips and ridership levels have eroded over the last 20 years. Many of the remaining transit system riders, including seniors and lower income residents, depend entirely upon transit for their travel needs. Further, the majority of the growth in the Indianapolis area is occurring in relatively low density outlying areas where traditional fixed-route transit service is usually not economically viable. Demand-responsive neighborhood shuttle type "smart" transit service and other services made possible through ITS technologies can significantly improve transit responsiveness.

- In addition to the common problems of inadequate resources and a dwindling ridership base, the ability of Indianapolis area transit providers to meet riders needs has been disrupted by a significant reorganization of regional transit administration and operations, the result of which has been a fracturing of responsibilities among multiple providers. One of the promising outcomes associated with the reorganization has been the institution of a Mobility Manager office to oversee and coordinate the various components of the regional transit scene. A single source administrative coordinator focusing on overall mobility needs creates a number of opportunities for improving transit in conjunction with ITS.

2.1.3 Multi-/Intermodal Facilities

Airport / Air Travel

Sixteen (16) non-military airports serve the Indianapolis area. The Indianapolis International Airport is the only airport with scheduled commercial carrier flights and contains three runways with a maximum length of 10,000 feet. Eight of the sixteen airports listed below serve as general aviation reliever airports for Indianapolis International.

- Eagle Creek Airport
- Downtown Heliport
- Greenwood Municipal
- Hendricks County (new airport near Danville)
- Indianapolis Metropolitan Airport
- Mt. Comfort Airport
- Shelbyville Municipal
- Terry Airport

In 1994 the Indianapolis International Airport processed 6.5 million passengers, 200 daily departures (average), 241,347 operations (landings and take-offs), and approximately 596,000 tons of cargo. It is served by 18 commercial passenger airlines.

Currently, there are plans to construct a new Mid-Field Terminal Complex southwest of the existing terminal near I-70 and Bridgeport Road. Primary access to the new terminal, parking, garage, and surface parking will be via a new I-70 interchange in the vicinity of I-70 and Bridgeport Road (Six Points Interchange).

Intercity Rail

According to information from the 1995 Indianapolis Transportation Plan Update, there are two Class I (national) railways in the Indianapolis area:

1. Consolidated Rail Corporation (Conrail)
2. CSX Corporation

There are no Class II (regional) railways in the Indianapolis area. There are four Class III (short-line) railways:

1. Indiana Rail Road Company
2. Indiana Southern Railroad
3. Indianapolis Union Railway
4. Louisville and Indiana Railroad Company

AMTRAK provides passenger service from Chicago to Cincinnati over the Conrail lines.

Key Issues/Deficiencies

- Airport traffic congestion can at times be relatively heavy. Major development and construction is planned for areas around the airport. This activity will increase traffic volumes and congestion in the area.

- Indianapolis includes junctions of several major interstate highways which are heavily utilized by commercial trucking firms. This generates relatively high levels of truck traffic on some facilities and increases the significance of truck related safety issues, especially accidents involving hazardous materials.

2.2 OUTREACH PROGRAM

The Indianapolis Area ITS Outreach Program served as a basis for prioritizing ITS program areas/projects that address user needs in the Indianapolis area. The Indianapolis Area ITS Outreach Program is ongoing and consists of newsletters, surveys, interviews, and workshops. This combination of items and events helped develop a prioritization framework that will guide deployment of ITS program areas and projects. The outreach program serves not only in the user needs prioritization process, but will continue throughout the planning and deployment of Indianapolis ITS initiatives. The Outreach Program is essential in analyzing user needs as they evolve through time.

Newsletters

With a mailing list of over 350 individuals who represent a wide array of transportation issues, newsletters form an integral part of the outreach program. In August 1995, the first Indianapolis ITS newsletter was sent out to inform potential stakeholders of the ITS Early Deployment Plan development process. This newsletter invited interested individuals to the first Indianapolis Area ITS workshop held on August 23, 1995. Additional newsletters were used and future newsletters will be used to inform stakeholders on the status of planning and deployment processes of ITS programs and projects in the Indianapolis area.

User Needs Questionnaire

The Indianapolis ITS User Needs Questionnaire was the first of three preliminary steps used to assess Indianapolis ITS user needs. Agency interviews and an outreach workshop were the second and third preliminary steps. Questionnaires were distributed to private citizens and individuals affiliated with state, regional and local governments, and commercial operations. Individuals receiving the questionnaire represented motorized modes of transportation including: transit, highways, trucking, aviation, intercity rail, and intercity bus.

The questionnaire identified problem areas, problem area suggestions, user need priorities, and project ideas. Congestion, incident management/emergency response, and poor transit services were the most frequently reported problems. The questionnaire listed traffic control, incident management, and emergency vehicle management as the most needed user services. The results of the questionnaire formed a basis for discussion of problem effects and problem causes at the Prioritization Workshop discussed in chapter three.

Stakeholder Interviews

Representatives from public and private transportation agencies were interviewed to help identify agency goals and responsibilities, transportation problems in the Indianapolis area, ITS technologies already in use, ITS funded projects, and to discuss projects or suggestions that might improve the Indianapolis area transportation system. Interviews provided an opportunity to solicit detailed comments from agency representatives that might not be expressed through the other outreach efforts such as the questionnaires and workshops.

The most frequently reported problems during the interviews included congestion, regional/ agency coordination, signing and availability/ accuracy of traveler information, inadequate funding for staff/transportation improvements, and lack of adequate transportation facilities. The results of the interviews were presented at the Prioritization Workshop in October 1995.

Outreach Workshop

Forty people attended the outreach workshop held August 23, 1995. Workshop attendees included representatives from local and state governments, regional agencies, commercial operations, and consulting firms. The purpose of this workshop was three-fold. First, the workshop sought to educate stakeholders about ITS and the early deployment planning process. Secondly, tasks completed by the Oversight and Steering Committees in July 1995 were summarized. The third purpose of the workshop was to identify transportation problems and propose solutions that would address user needs.

In the breakout sessions workshop attendees, broken into five discussion groups, listed obstacles, problems, and trends interfering with the Indianapolis Area ITS vision and proposed solutions to overcome those obstacles. Responses to the breakout questions were highly varied and reflected special interest areas of each breakout group. Three groups listed lack of transit/ alternative modes and coordination as significant problems.

User Services
Prioritization

3.0 USER SERVICES PRIORITIZATION

A workshop held on October 17 and 18,1995 served to define the highest priority transportation problems of the Indianapolis area and to select the program components of an ITS strategic plan to address these problems. · The Prioritization Workshop utilized the results of the outreach workshop, local agency interviews, and the user needs questionnaire to identify and prioritize user needs and user services. The results of the prioritization workshop formed the basis for selecting appropriate program areas and projects.

Twenty Steering Committee members attended the Prioritization Workshop. Organizations represented at the workshop include the following:

- Indiana Department of Transportation (INDOT)
- The project consulting team:
  - BRW, Inc.
  - Battelle
  - DKS Associates
  - First Group Engineering
  - Planning and Development Concepts
- Federal Highway Administration (FHWA)
- Indianapolis Metropolitan Planning Organization
- City of Indianapolis

Overriding Factors

In the course of considering the relative significance of various user needs and potential ITS services, the project Steering Comrnittee identified a number of important, overriding factors. These Overriding Factors were used as a compass throughout the process of problem and service prioritization to ensure that the results of the effort adequately addressed critical underlying issues.

The Overriding Factors are:

- Region-wide Perspective
- Safety
- Funding/Sponsor
- Multi-Modal
- Serves Many
- Building Block
- High Visibility
- Creative
- Early Winner
- User Acceptance (preserve privacy)
- Low Risk/High Pay-Off
- Ease of Deployment
- Maximize Available Resources

User Needs Identification

To identify user needs, attendees of the workshop first distinguished problem causes from problem effects. A list of problems identified through the outreach program was used as a basis to distinguish problem effects such as congestion from problem causes such as incidents. Based on group discussion, the major problem effects in the Indianapolis area were identified as follows:

- Congestion
  a. Recurring
  b. Non-Recurring (construction, accidents, special events, etc.)
- Safety
- Insufficient Travel Alternatives
- Air Pollution

Workshop participants then identified and prioritized problem causes. Prioritization of problem causes indicated what user needs within the Indianapolis transportation system should be addressed.

TABLE 3.1
FINAL PROBLEM CAUSES PRIORITIZATION

Problem Cause	Problem Area	Votes
Incidents (poor management, response)	Highway	15
Maintenance/Construction Planning, Operations	Highway	11
Inadequate Capacity	Highway	7
Lack of Transit Service	Transit	7
Poor Arterial Flow/Signal Coordination	Highway	6
Poor Institutional Coordination/Jurisdictional Cooperation	Institutional	6
Travel Time Information	Highway	4
Safety (Accidents)	Highway	3

* Maximum votes = 18 (if each participant cast one of his/her four votes for the problem cause)

The above eight problems were formally acknowledged as those which would be utilized to guide prioritization of user services and development of program areas and projects. It was noted that other problem causes would not necessarily be ignored and that projects would be considered which addressed problem causes not included on this list.

User Service Prioritization

User service prioritization activities followed problem identification and prioritization at the workshop. The Steering Committee formally acknowledged the twelve user services shown below to be the most appropriate services to address user needs and therefore the most important services to be addressed in Indianapolis area. The user services shown below were used to guide the preparation of the program areas and projects within the Early Deployment Plan. It should be noted that other user services were not ignored during the preparation of the EDP, however, and that future projects will be considered which address problem causes not included in Table 3.2.

TABLE 3.2
TOP USER SERVICES

- Incident Management
- Traffic Control
- Public Transportation Management
- Pre-Trip Travel Information
- En-Route Driver Information
- Route Guidance
- Demand Management and Operations
- Emergency Vehicle Management
- Hazardous Materials Incident Response
- Emergency Notification and Personal Security
- Traveler Services Information
- En-Route Transit Information

Technology Assessment

4.0 TECHNOLOGY ASSESSMENT

This report analyzed the various technologies and strategies available to implement the twelve Intelligent Transportation System (ITS) user services identified in the Indianapolis Area ITS User Service Plan (January 1996) as high priorities in the Indianapolis area. Based upon their relative costs, implementability and effectiveness in accomplishing goals and objectives identified by Indianapolis area transportation stakeholders, specific technologies and strategies are recommended for implementation.

The technology assessment described in this report includes four main components:

1. a descriptive Evaluation of alternative technologies;
2. a Trade-Off Analysis of alternative ITS technologies and user service delivery strategies; and
3. a list of Highest Potential Technologies/Strategies for consideration in the development of Indianapolis area ITS applications.

The technology evaluation represents a primer, or sourcebook, of current and emerging ITS technologies. The various technologies available to perform required ITS functions are introduced and described in terms of their performance and cost.

The trade-off analysis compares combinations of both individual ITS technologies and user service delivery strategies. These strategies consist of alternative approaches which may be technology non-specific or which combine several technologies according to a particular service delivery philosophy. The trade-off analysis utilizes a combined quantitative/qualitative assessment methodology that generates a numeric score, similar to a benefit/cost ratio. This ratio describes the relationship between the implementability of the system configuration (in terms of cost, maturity, etc.) and its effectiveness in satisfying Indianapolis area ITS deployment goals and objectives.

Based upon the evaluation of ITS technologies and on the results of the trade-off analysis, the most promising technologies and strategies for deployment of the twelve high priority Indianapolis ITS user services are identified. These technologies and strategies are those which should be given first consideration when developing specific Indianapolis area ITS projects.

The evaluation involved review of current and emerging ITS technologies. The various technologies available to perform required ITS functions are introduced and described in terms of their performance and cost. The trade off analysis evaluates these technologies relative to their appropriateness for deployment in the Indianapolis area.

The technologies and strategies evaluated in this section are organized according to the common functions they perform, such as surveillance, communications, etc. As part of the process to develop a recommended system architecture for Indianapolis area ITS deployment, the twelve high priority user services identified in the Introduction to this report were mapped against the 17 ITS functions identified in the United States Department of Transportation/ITS America

National ITS Program Plan. These relationships are shown in Table 4.1 of the technology evaluation document.

For the purposes of this technology assessment, the 17 ITS functions have been aggregated into seven categories as shown in Table 4.1. This table summarizes the technologies evaluated for each function.

TABLE 4.1
SUMMARY OF TECHNOLOGIES

ITS FUNCTION	TECHNOLOGIES
Surveillance	Advanced Detection Systems CCTV Vehicle Positioning Systems MAY DAY Weigh-in-Motion (WIM) Electronic Tags
Communications	Cable-Based Communications Wireless Communications
Traveler Interface	Broadcast Audio Interactive Media Information Displays Passenger Information Systems
Navigation/Guidance	Satellite-Based Location Land-Based Location Inertial Navigation Toll Tag Location Map Data Matching Dead Reckoning Route Guidance Systems Teletext Video Text Video Text Variable Message Signs Automated Kiosks HAR/AHAR
In-Vehicle Sensors	Restraint Systems Collision Avoidance Lane Control Driver/Vehicle Performance Monitoring
Control Strategies	Traffic Signal Control Freeway Traffic Control Traffic Control Algorithms
Data Processings	Traffic Prediction Database Processing

The technology evaluation identified candidate ITS technologies and strategies and described their relative performance and costs. The tradeoff analysis compares alternative ITS technologies and strategies in terms of their appropriateness for deployment in the Indianapolis area. The trade-off analysis uses a quantitative/qualitative assessment methodology that generates a numeric score, similar to a benefit/cost ratio. This ratio describes the relationship between the implementability of the system configuration (in terms of cost, maturity, etc.) and its effectiveness in satisfying Indianapolis area ITS deployment goals and objectives.

Although it would be possible to implement the 12 user services with all the functions, it is also possible and very logical to implement the user services with the best configuration option in place for short- and long-term success. Alternative system configurations with less than full functionality would not be expected to be as beneficial as those that include a complete set of functions. However, a reduced level of functionality might be appropriate for the initial phases of implementation or may actually meet the pertinent needs of the users of that service. It is also possible that a given system option might be appropriate for implementation for a user service in which full deployment may require a major investment that does not correspond to an equally large benefit.

The trade-off analysis included the following steps:

- identification of technology/strategy alternatives;
- definition of technology/strategy alternatives;
- development of regional goal and implementability factors for use in the quantitative comparison of alternatives; and
- preparation of summary results.

For each of the twelve Indianapolis area high priority user services, alternative technologies/strategies were developed. These alternatives were organized around the ITS functions that are applicable to each user service, as identified in the System Architecture Working Paper.

The following is a summary of descriptions of the alternative configurations for the twelve ITS User Services in the core group.

Incident Management Services

The providing of en-route driver information service was divided into three configuration items:

- Surveillance Strategies
- Data Processing Strategies
- Information Reporting/Detour Strategies

Traffic Control Services

The providing of traffic control services was divided into three configuration items which are:

- Control Strategy
- Surveillance Methodology
- Control Algorithm

Public Transportation Management Service

The providing of en-route driver information was divided into four configuration items, which are:

- Data Collection
- Data Processing
- Dissemination Techniques
- Transit Priority

Pre-Trip Travel Information Service

The providing of en-route driver information service was divided into two configuration items which are:

- Data Processing Strategies
- Dissemination Methods

En-Route Driver Information Service

The providing of en-route driver information service was divided into four configuration items which are:

- Data Processing Strategies
- Surveillance Methodology
- Navigation Methodology
- Dissemination Methods

Route Guidance Service

The providing of en-route driver information service was divided into three configuration items which are:

- Data Processing Strategies
- Surveillance Methodologies
- Dissemination Methods

Demand Management & Operations Service

The providing of en-route driver information service was divided into two configuration items:

- HOV Control
- Congestion Pricing

Emergency Vehicle Management Service

The providing of en-route drive information to emergency vehicles was divided into two configuration items:

- Emergency Fleet Management
- Emergency Vehicle Priority

Hazardous Materials Incident Response Service

The providing of hazardous materials information was divided into three configuration items which are:

- In-Vehicle Haz-Mat
- Electronic Cargo
- Automatic Notification

Emergency Notification and Personal Security Service

The providing of en-route driver information was divided into three configuration items:

- Driver & Personal Security
- Collision Notification
- HAZMAT Notification

Traveler Services Information Service

The providing of en-route driver information was divided into two configuration items:

- Information Services
- Dissemination Methods

En-Route Transit Information Service

The providing of en-route transit information service was divided into three configuration items:

- Data Processing Strategies
- Surveillance Monitoring
- Dissemination Methods

A modified trade study analysis was performed on the alternative systems identified above. Two sets of factors were utilized in this analysis that were developed based on steering committee input into the factors members felt were pertinent to the deployment of ITS elements. The first set of factors addressed the difficulty in implementing the system alternative and is called implementability factors. The second set of factors used related to the degree which the configuration satisfied the regional goals and were simply called regional goal factors.

Evaluations were performed among the alternative configurations for a particular user service. The ratings given to the cost of alternatives for a user service were based on a qualitative assessment of the cost against one another. Weights of each evaluation factor were assigned, based on the results of a survey of key steering committee members regarding the priority of these factors. Ratings were assigned by the consultant team and revised, based on comments by the steering committee at a monthly workshop. Equal ratings given to the cost of system alternatives in two different user services do not imply that these alternatives are equal in cost. Due to the nature of this analysis procedure, it is not possible to compare the ratings that were given to alternatives in different service bundles.

A preliminary comparison of alternatives for each user service was performed by plotting the regional goal satisfaction (benefits) against the implementation difficulty (costs) in a two dimensional graph. In this analysis, the benefits are all relative assessments of the degree to which the regional goals are satisfied by each alternative and the costs are relative assessments of the difficulties that will be encountered during implementation of that strategy. Although this process is based on a qualitative assessment, the resulting graphs, provide valuable insights into the trade offs involved in selecting a particular ITS strategy for a specific user service. As a result, the following technologies are recommended as a means to implement the recommended system architecture and achieve the desired ITS user services.

Table 4.2 show the preferred technologies/strategies for implementation in the Indianapolis Region.

TABLE 4.2
PREFERRED TECHNOLOGIES/STRATEGIES

Incident Management	Traveler Reports Freeway Service Patrols Accident Investigation Database Preplanned Detour Routes
Traffic Control	Freeway Controls Arterial Traffic Management Automated Surveillance Traffic Adaptive Control
Public Transportation	Automatic Vehicle Location Automated Scheduling and Dispatch Information Dissemination via Telephone /FAX Partial Transit Priority
Pre-Trip Travel Information	Dynamic Databases Telephone/Media Dissemination
En-Route Information	Dynamic Databases Advanced Detection Devices Traveler Reports via Cellular Phone Differential GPS Radio and VMS Dissemination
Route Guidance	Dynamic Database Advanced Detection In-Vehicle Displays
Demand Management	Ramp Meters with HOV On-Ramps Real-Time Congestion Pricing
Emergency Vehicle Management	AVL Emergency Vehicle Priority at Signals
HazMat Response	Cargo Contents Databases
Emergency Notification	Manual Driver Security Rural MAY DAY
Traveler Services	Private Sector Information Hand Held Devices Information Kiosks
En-Route Transit Information	Transit Scheduling GPS/AVL Synthetic Voice Annunciators

System Architecture

5.0 SYSTEM ARCHITECTURE

As part of the EDP development process, a conceptual system architecture for the Indianapolis area ITS was identified. The conceptual architecture is intended to illustrate how the various components of the ITS relate to one another at a functional level, focusing on the flows of data between and among the various major ITS components.

The architecture development effort focused on the 12 highest priority Indianapolis area ITS user services (see Section 2.0) and began with an identification of the functional needs associated with each of the 12 services. This identification was made by mapping the user services against the 17 ITS functional needs identified in the National ITS Program Plan (March 1995). Table 5.1 illustrates the results of this exercise.

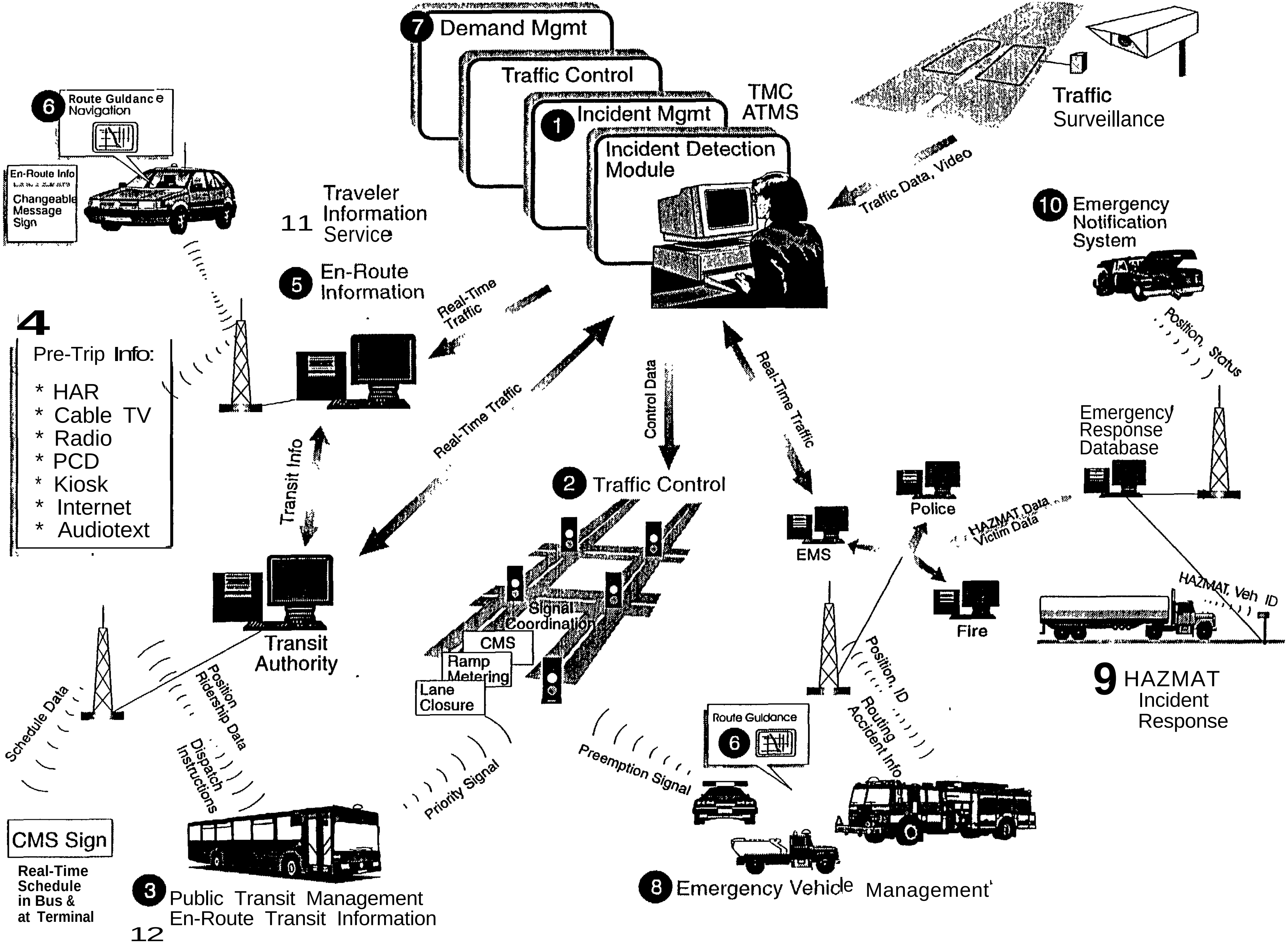
After identifying which functions apply to each of the user services, the functions themselves were analyzed, focusing on the interrelationships between and among user services. Based on this analysis, physical and logical architectures were developed for each user service. The logical architecture defines the conceptual or functional components of each user service and the tasks they perform. The physical architecture identifies the physical components associated with each user service, such as surveillance and data processing subsystems, and how they communicate with one another.

Both the physical and logical architectures of each user service were depicted graphically and described. Drawing upon the individual user service architecture diagrams, a single high-level architecture diagram was developed focusing on groupings of user services and functions and the major communication flows between ITS elements. This diagram is shown in Figure 5-1.

TABLE 5.1
INDIANAPOLIS PRIORITY USER SERVICES VS. ITS FUNCTIONS

User Services												
Incident Management	Traffic Control	Public Transportation Management	Pre-Trip Travel Information	En-Route Driver Information	Route Guidance	Demand Management and Operations	Emergency Vehicle Management	Hazardous Material Incident Response	Emergency Notification and Personal	Traveler Services Information	En-Route Transit Information	**Applicable Functions**
●	●	●	●	●	●		●				●	Traffic Surveillance
		●				●	●	●	●		●	Vehicle Surveillance
●	●	●	●	●			●				●	Inter-Agency Coordination
●		●		●	●	●	●	●	●		●	1-Way Mobile communications
●		●	●	●	●		●	●	●	●	●	2-Way Mobile Communications
●	●	●	●	●	●	●	●				●	Stationary Communications
		●	●	●	●	●			●	●	●	Individual Traveler Interface
		●				●						Payment Systems
●	●	●	●	●		●	●				●	Variable Message Displays
●	●	●				●	●					Signalized Traffic Control
			●			●						Restrictions Traffic Control
●		●	●	●	●	●	●	●	●	●	●	Navigation
●	●	●	●	●	●	●	●	●	●	●	●	Database Processing
●	●	●	●	●	●		●				●	Traffic Prediction Data Processing
●	●											Traffic Control Data Processing
		●	●	●	●		●		●			Routing Data Processing
		●						●	●			In-Vehicle Sensors/ Devices

Figure 5-1: Recommended Indianapolis Area ITS Conceptual System Architecture



Projects

6.0 PROJECTS

INTRODUCTION

This chapter details the Indianapolis ITS program areas and projects that have been developed through the survey, interview, and workshop processes described in the preceding chapters of this document. Prior to this discussion, however, is a summary of the process that was used to identify Indianapolis Area transportation system problems causes and problem areas documented by the Indianapolis Area User Service Plan (January 1996) and the framework for developing ITS solutions to these problems.

INDIANAPOLIS AREA TRANSPORTATION PROBLEMS

The process that was used to identify the highest priority problems of the Indianapolis Area transportation system was described in the Indianapolis Area ITS User Service Plan (January 1996) and included eight major problem causes and problem areas to carry forward as the subject of future workshops and in the preparation of the EDP. These major causes and problem areas were identified as follows:

Cause	Problem Area
1. Incidents (Poor management/Response)	Highway
2. Maintenance/Construction Planning, Operations	Highway
3. Inadequate Capacity	Highway
4. Lack of Transit Service	Transit
5. Poor Arterial Flow/Signal Coordination	Highway
6. Poor Institutional Coordination/ Jurisdictional Coordination	Institutional
7. Travel Time Information	Highway
8. Safety (Accidents)	Highway

DEVELOPMENT OF PROGRAM AREAS AND PROJECTS

Based on the consensus reached from discussions and workshops held by the Steering Committee, the aforementioned prioritized transportation problems were then directed toward the development of program areas and projects. The development of Indianapolis Area ITS program areas and projects were guided by and based on the Federal Highway Administration's (FHWA) core infrastructure requirements for the Advanced Traffic Management Systems (ATMS) and Advanced Traveler Information Systems (ATIS) for metropolitan areas. The core infrastructure concept was initially presented in the Indianapolis Area ITS User Service Plan (January 1996) and includes the following five elements:

1. Regional Multi-modal Traveler Information Center
2. Traffic Signal Control Systems(s)

3. Freeway Management System(s)
4. Transit Management System(s)
5. Incident Management Program

Use of these elements is a cornerstone for the early deployment of the Indianapolis ITS. Future program area and project initiatives identified by the FHWA will enable the Indianapolis system to be directly compared and coordinated with other metropolitan area systems because its architecture will be parallel to the national system architecture.

Using the national core infrastructure elements as a base, a list of program areas was derived based on the results of a prioritization workshop held by the members of the Steering Committee in October 1995. This workshop considered the results of the outreach workshop, local agency interviews, and the user needs questionnaire. The final six program areas include four of the FHWA core elements, as well as two additional areas for public-private partnerships and technical and planning support. The program areas are as follows:

1. Multi-Modal Traveler Information System
2. Freeway Management System
3. Traffic Signal Control Systems
4. Transit Management Systems
5. Public-Private Partnerships
6. Technical and Planning Support

The Steering Committee also identified a number of Overriding Factors to be used as a benchmark to assess the performance of the ITS service areas selected to address the identified transportation problems. These factors include:

1. Region-wide Perspective
2. Safety
3. Funding/Sponsor
4. Multi-Modal
5. Serves Many
6. Building Block
7. High Visibility
8. Creative
9. Early Winner
10. User Acceptance (preserve privacy)
11. Low Risk/High Pay-Off
12. Ease of Deployment
13. Maximize Available Resources

The six identified program areas are those that can have the largest impact on the highest priority transportation problems and address the largest number of overriding factors for the Indianapolis area. Within these program areas are a collection of interrelated projects that address a common set of program objectives. As the EDP matures and the results of deploying specific user services become available, it is expected that modifications and additional user services will be considered and amended into the plan. New initiatives resulting from the National ITS Program Plan will also likely require a periodic update to the plan.

INDIANAPOLIS AREA ITS PROJECTS BY PROGRAM AREA

The following sections present specific ITS projects organized by program area. Each program area sections begins with a description of the program area, its rationale and its expected program results. Following the program area description, the following information is presented for each project:

- Project Objective
- Summary of Current Conditions
- Scope
- Location
- Technology
- Administration
- Time frame
- Budget
- Staffing
- Sponsor

(Program Area 5, Public-Private Partnerships, is structured as follows: Description; Scope and Partnership Agreement; Time Frame; and, Partnership Benefits.)

PROGRAM AREA: 1 - Multi-Modal Traveler Information System

DESCRIPTION: The goal of this program area is to expand on the existing and planned ITS traveler services information architecture to provide a comprehensive, integrated, multi-modal traveler information system to serve the needs of travelers and operators in the Indianapolis area.

Traveler information services have been identified as a priority need that is targeted for early deployment in the Indianapolis area. The intent is to make traveler information accessible to travelers at home or work to support pre-trip planning and while en-route, whether using a private vehicle or public facilities such as public transit terminals or highway rest stops to help the traveler locate routes, desired points of interest, or critical local services. This user service provides a variety of traveler information including conditions on roadways, construction activities, congestion, accident or hazard information, transit information, wide area travel information, intermodal connection options, and other travel-related data.

Current information system capabilities in the Indianapolis area include 19 local radio stations that broadcast periodic traffic reports, accident and hazard information. WIBC is one of several major radio providers of traffic information, and they have established an Internet Home Page that is currently being expanded.* Data sources include the State Police, county sheriff's departments, Metro Traffic, and a link to information on the Metropolitan Emergency Communications Agency's (MECA) computer system. Three local TV stations monitor police scanners, Metro Traffic reports, and the Marion County computer, and they provide viewers with periodic traffic reports. INDOT is in the early stages of developing an Internet Home Page that will eventually be able to link travelers to a variety of traveler information services. The Annual Capital Improvement Plan provides funding for METRO Bus' Downtown Customer Information Center, and METRO Bus plans to replace its centralized computer system with a distributed network of microcomputers. The plan also provides for the installation of public information services, including kiosks, signs, and carousels at bus stops in the downtown area. In addition, METRO Bus' travel center is installing an automated public information telephone system that will provide route information directly to callers without human operators.

The three projects in this program area focus on:

1. Developing a detailed system design for the Indianapolis area multi-modal traveler information system based upon the system architecture and communications concepts established in this EDP.

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1 See discussion in Program Area #5: Public-Private Partnerships for further information on links with WIBC.

2. Creating the basic infrastructure needed to support a traveler information system, including coordination of hardware infrastructure and inter-agency communications. This Communication infrastructure, or "Data Pipe", to link traveler information services with the TOC and other transportation organizations such as METRO Bus. Early projects will implement the parts of the Data Pipe which connect the various field elements of the freeway management system (see Program Area 2), such as closed circuit television surveillance equipment, with a Traffic Operations Center (TOC) to be located in downtown Indianapolis. Linking the TOC with METRO Bus and MECA will also occur early in the deployment of the infrastructure. Over time, the infrastructure will be expanded in conjunction with the siting of additional traveler information and freeway management field elements. Expansion will also incorporate organizations in the eight counties bordering Marion County and link to neighboring regional systems including I-65 in Louisville and along the Borman Expressway (I-80/94) in Northwest Indiana.

3. Providing selected communication technologies that distribute and display traveler information from the Traffic Operations Center (TOC) in a manner appropriate to a wide audience of travelers and operators. Information dissemination methods include the following:

   - Expanded Internet information service that visually displays current traffic conditions and locations of construction, accidents, congestion, as well as multi-modal information.

   - A dedicated 24hour phone line, tied in to the ATIS, through which travelers can obtain up-to-date information on construction situations, congestion, accidents or hazards, transit information, yellow pages, and other related data.

   - Kiosks that offer similar traveler information located strategically in downtown and suburban malls, airports, business areas, and other appropriate locations.

   - Expanded media and cable TV information services. Real-time traffic information will be provided directly to TV and radio stations.

RATIONALE: The program area supports all of the Overriding Factors:

- Region-Wide Perspective
- Safety
- Funding/Sponsor
- Multi-Modal
- Serves Many

- Building Block
- Highly Visible
- Creative
- Early Winner
- User Acceptance
- Low Risk/High Payoff
- Ease of Deployment
- Maximize Available Resources

EXPECTED RESULTS: This program area will address most of the Problem Causes and User Services.

1 MULTI-MODAL TRAVELER INFORMATION SYSTEM	Implementation Timeframe: Year 1	Year 2	Year 3	Year 4	Year 5	Year 6-10	Year 11-20
1.1 Backbone Communication Infrastructure							
1.1.1 Communication Infrastructure Specification and Preliminary Design	X	X					
1.1.2 Northeast Corridor Data Pipe Elements	x	x	x				
1.1.3 Link METRO Bus and MECA Systems to the Data Pipe		x	x				
1.1.4 Regional Data Pipe Expansion					x	x	X
1.1.5 Establish Links with Regional Systems						X	X
1.2 Multi-Modal Traveler Information Dissemination							
1.2.1 Automated Telephone System			x	x			
1.2.2 Internet Site	x	x					
1.2.3 Kiosks			x	x	x	x	
1.2.4 Media, Cable TV			x	x	x		

PROJECT:	1.1 - BACKBONE COMMUNICATION INFRASTRUCTURE

Objective: This project includes the system design, development, and deployment of a multi-modal traveler information communication infrastructure for the Indianapolis metropolitan area. This infrastructure will support the collection, integration, processing, and dissemination of transportation data and related information among transportation organizations, emergency service agencies, the media, and other providers and users, including the traveling public.

The backbone of the communications infrastructure will be a regional hub and spoke configured fiber optic cable network connecting a Traffic Operations Center (see Program Area 2, Freeway Management System), other key transportation and communications agencies, and the various field elements of the freeway management and traveler information systems.

This project can be thought of as the collector, processor, and disseminator of multi-model traveler information. Multi-modal traveler information flows through the Data Pipe from its origin, through the Traffic Operations Center (TOC), and on to its final destination. The TOC schedules and manages these exchange processes in a way that is transparent to the user, providing required traveler information that is timely, accurate, reliable, and targeted to the needs of its users.

All relevant traveler data are collected and processed through the TOC, and all interested users have a single place to turn to obtain the information that they require. In this way, data throughout the Indianapolis metropolitan area can be managed and distributed in common formats under predictable schedules through a robust system. The infrastructure replaces multiple sources of traveler information, different modes and formats for disseminating these data, and conflicting data standards, schedules, and message content. The success of this system is predicated on a recognized need and willingness of all participants to share multi-modal information among themselves and with all interested end users.

The approach to establishing this infrastructure will be an evolutionary one, beginning with a few key existing organizations and linking traveler information data inputs and outputs, starting with the Northeast Corridor, into an integrated system under the control of the TOC. An underlying principle is to begin with smaller, manageable components, demonstrate system functionality and benefit, and then expand to include additional components at a pace the system can effectively handle. This infrastructure and its communications architecture are expected to support emergency service providers, METRO Bus, the City of Indianapolis, selected counties, and other support organizations in the Indianapolis area. A high-level system concept for the Data Pipe and communications backbone infrastructure is illustrated in Figure 6-1.

Traveler information is expected to include current traffic and roadway conditions, including information on congestion, accidents, construction activities, volumes and speeds, and weather as it effects roadway conditions. Information on public transportation will include transit routes and schedules, parking, real-time performance data, expected trip times, system delays, and multi-modal route planning. The system will offer route selection and trip planning support to travelers. All relevant institutions, agencies, and organizations will be included in the strategic planning process to assure access to all needed traveler information, the development of appropriate information exchange protocols, and long-term commitment and support of the system.

This project will implement common communication formats, protocols, standards, and network management strategies. Compatibility with other communication infrastructures in the region, as well as with national standards, including compliance with the National Architecture, are important objectives. The vision for the area communications system in support of this approach is a hub and spoke fiber optic network that will be developed incrementally.

Current Conditions:

As described in the summary discussion to this program area, the provision of current traveler information in the Indianapolis area is quite limited. Currently there is no publicly operated traveler information system in operation in the area. The information that is available is provided by several area radio and TV stations and includes media generated traffic reports that are based on data derived from the State Police, Sheriffs' departments and Metro Traffic reports. Thus, the media currently serve as the primary mechanism for transmitting information on traffic and roadway conditions to travelers in the Indianapolis area. In addition to the limitations of the traffic condition data, media broadcasts generally lack the timeliness and reliability needed to serve the pre-trip and en-route trip planning needs of the traveling public. They have no consistently reliable way of identifying and tracking information on incidents, congestion, speeds, or volumes, and such an unstructured approach to traveler information lacks the appropriate traffic management system within which informed operators can effectively respond to real-time conditions.

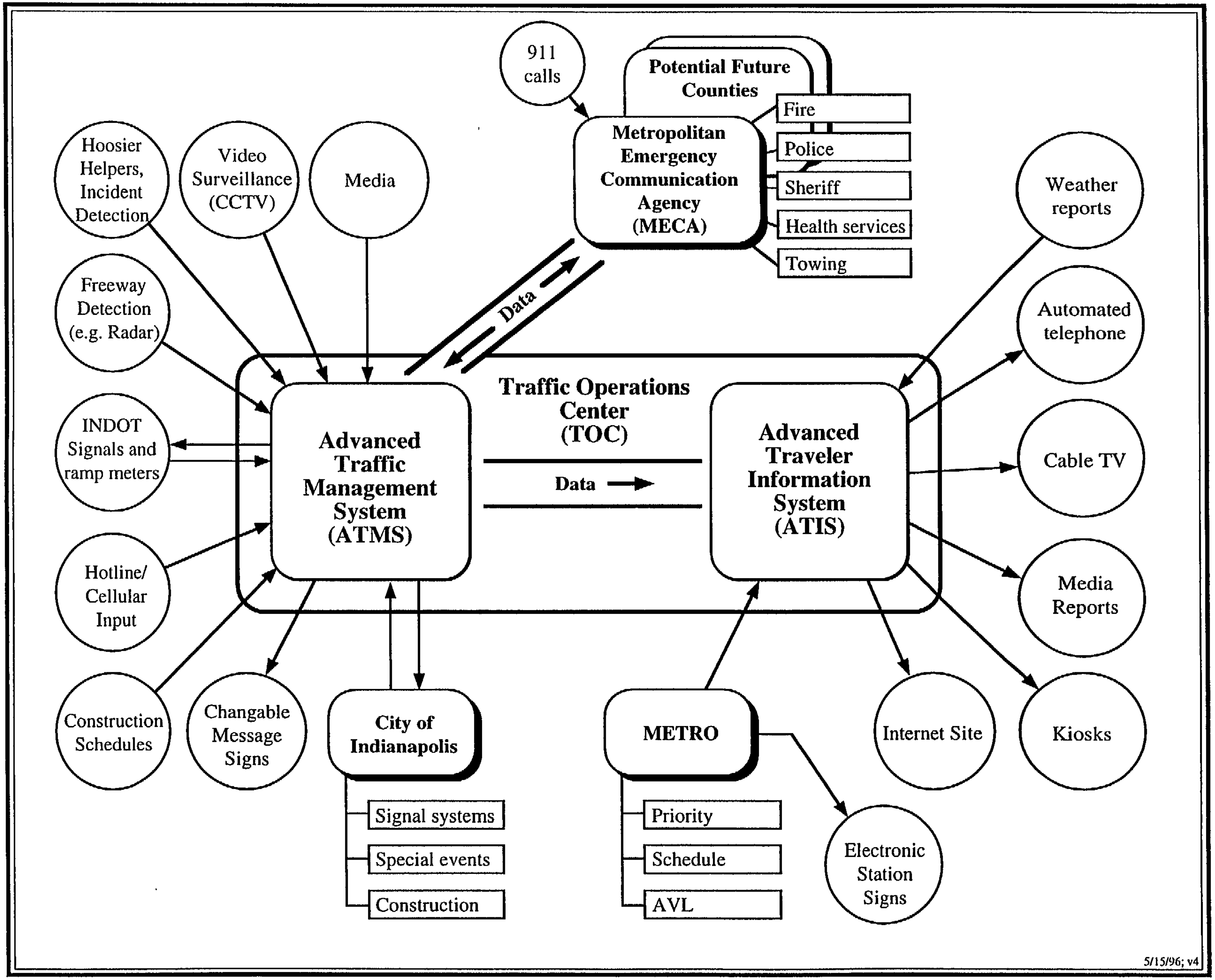


Figure 6-1: Data Pipe Conceptual Architecture

Projects in Program Area 2 of this EDP, Freeway Management System, will implement a freeway management system in the northeast section of the Indianapolis metropolitan area that could serve as a model for the rest of the area. As discussed under Program Area 2,the Indiana Department of Transportation (INDOT) has initiated the development of an Advanced Traffic Management System on the Borman Expressway in Northwest Indiana. This includes some of the elements also needed for a traveler information system, including a fiber optic backbone cable, along with data gathering and data dissemination capabilities such as CMS, spread spectrum radio, cellular communications, Internet Homepage travel information, and an electronic bulletin board service.

This includes the evolutionary deployment of a backbone communication infrastructure that can serve as a model for the Indianapolis area. INDOT also manages traffic incident data through its dedicated crew of Hoosier Helpers on the Borman Expressway and Interstate 65.

The Metropolitan Emergency Communication Agency (MECA) is a multijurisdictional cooperative communications organization with membership from most of the fire and police agencies in Marion county. MECA provides the County with a centralized communication hub for incident response, serving 32 political subdivisions in the Indianapolis area.

METRO Bus is setting up a computer network in the Indianapolis area to enhance its communications capabilities. The Early Deployment Plan for Indianapolis specifies an integrated approach to designing and deploying a traveler information system that will be tied in to and coordinated by a Traffic Operations Center. METRO Bus' communications system, based on distributed microcomputers tied together under a common network, will be connected to the TOC.

With very little linked infrastructure currently in place and multiple agencies managing traveler information as best they can, an integrated approach is needed.

Scope: This project includes five phases. The first three phases design the backbone communications infrastructure and implement it in the Northeast Corridor and links key agencies to the Traffic Operations Center. The other two phases expand the infrastructure throughout the Indianapolis region and implement links to key systems beyond the region.

1.1.1 - Communication Infrastructure Specification and Preliminary Design

The preliminary system design for the backbone communications infrastructure will build on the current transportation information distribution systems and proposed systems, based on the updated understanding of users and their requirements, coupled with an understanding of available information technologies. This information will provide a road map for developing a more fully integrated information system, creating public/private partnerships in support of the system (see Program Area 5.0), and showing where the various functions fit into the institutional structure.

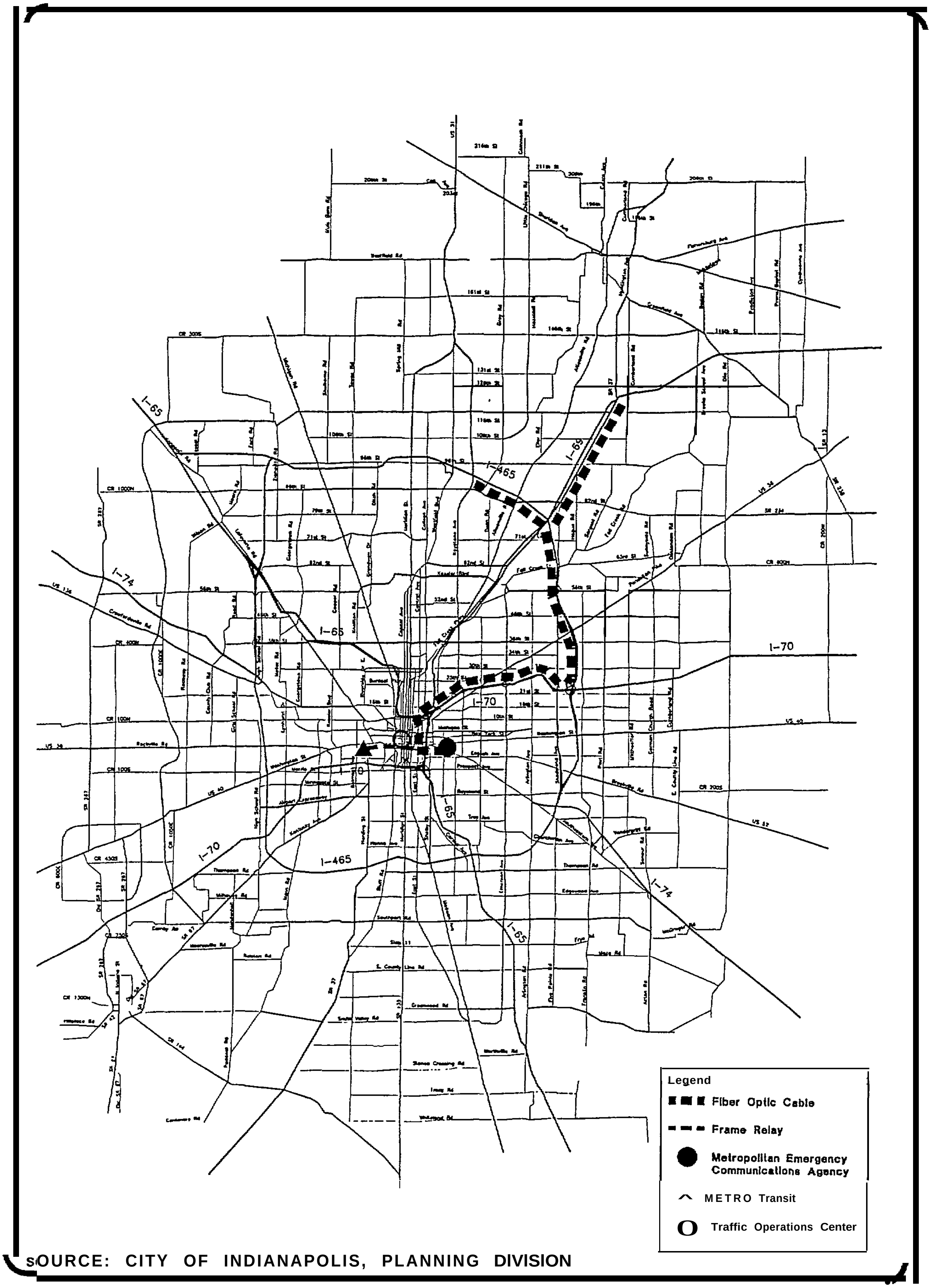
The traveler information system plan must take account of similar plans and systems in adjacent areas. As the geographic extent of the Indianapolis system extends outward and as inter-regional and inter-state traveler information becomes more useful for Indianapolis travelers, this system will need to be well coordinated with comparable external systems in order to provide for the seamless exchange of information across these boundaries. This is why a careful early approach is important to long-run success.

The system specifications that are developed through this process will provide guidance for procuring various services and identifying and guiding vendors who are experienced in these kinds of communication systems.

1.1.2 - Northeast Corridor Data Pipe Elements

This project implements the communications infrastructure connecting the freeway management and traveler information system field elements in the Northeast Corridor with the TOC, and links the TOC with MECA and METRO Bus.

It is proposed to install fiber optic cable along about 10.5 miles of I-465 between Keystone Avenue (SR 431) and Pendleton Pike (US 36/SR 67) and radially out from I-465 for about five miles along I-69/SR 37. This will provide backbone coverage for the Northeast Corridor. This line will be further linked to the TOC in downtown Indianapolis primarily along I-70 for an additional 9 miles. This will form the first major step in establishing the foundation for the hub and spoke plan for the communication infrastructure. Figure 6-2 illustrates the components of the Data Pipe, including those pieces implemented in project phases 1.1.2 and 1.1.3.



SOURCE: CITY OF INDIANAPOLIS, PLANNING DIVISION

Figure 6-2
Northeast Corridor Data Pipe Communications Infrastructure

The Traffic Operations Center (TOC) serves as a hub between transportation data inputs and outputs. The Data Pipe radiates out from this hub in a set of "spokes" that will be located along key transportation corridors, based on decisions made under 1.1.1 above. The two main components of the TOC include an Advanced Traffic Management System (ATMS) and an Advanced Traveler Information System (ATIS). The functional relationship between these two systems is illustrated in Figure 6-l. The broad functions of traffic control and systems management are contained in the ATMS. Transportation data generally flow into the ATMS where they can be processed, displayed, and used to support traffic management decisions. Operators can see current traffic conditions visually displayed, learn of accidents or other freeway incidents from several different sources, or identify changes in roadway speeds and congestion from freeway detection systems. They can respond to this information by adjusting Changeable Message Signs, ramp meters, or traffic signals, or by notifying other agencies, such as MECA, to dispatch emergency response vehicles. They also supply data to the ATIS which further processes the information and makes it available through a variety of technologies to travelers, agencies, or other end users.

The ATIS is an automated computer system that accepts data processed through the ATMS as well as directly from other sources, such as METRO Bus and national or regional weather sources. The ATIS fuses data from different sources, reformats the data as needed, and makes the data available to various devices to assist travelers in their pre-trip planning and en-route guidance. The data offer real-time information to travelers about current conditions detected through the ATMS, METRO Bus, MECA and other sources. The ATIS offers multi-modal information that can be used to facilitate mode shift as well as more efficient travel.

Thus the Data Pipe facilitates the acquisition, flow, transformation, and final disposition of transportation data. Once the detailed design and architecture for the Data Pipe have been developed and approved, a prototype system can be built and tested. The early objective will be to serve a traffic control function as well as a traffic monitoring function to aid in information dissemination on traffic conditions. The Data Pipe will need to be set up in a step-wise, evolutionary fashion, including the following components:

- **Data gathering devices and sources.** In order to be able to most effectively manage- traffic in congested urban corridors, it is helpful to acquire accurate, real-time data on transportation conditions. This would include information on volumes, speeds, accidents, construction-related congestion, and the variability in these indicators at different times of the day. Thus, an important component of the Data Pipe backbone infrastructure includes such devices and sources as the media, video surveillance cameras, Hoosier Helpers and other incident detection capabilities, freeway detection devices that measure speed and congestion, ramp meters and other signal devices, cellular input,construction schedule information, and Changeable Message Signs. Data on emergencies and incidents are communicated to the ATMS through MECA.

- **Advanced Traffic Management System.** The TOC includes an ATMS which houses computers and display devices to support the processing and management of transportation data derived from the variety of devices and sources described above. The effective management of the data includes understanding how to take data in different forms from a variety of agencies and devices, and processing those data so that they can be disseminated to end users in a user friendly form that is consistent with the intended uses of the data. Data management also includes responsibility for understanding user needs and requirements and managing the TOC in a way that is responsive to those needs. Management of these data streams requires compliance with approved access procedures and preservation of data integrity within the system.

- **Advanced Traveler Information System.** This facility will include a computer information server that can receive and further process (fuse) traffic information coming in primarily from the TOC. Relevant data also will be acquired from other sources, such as METRO Bus. What is of importance to the ATIS is a clear specification of what data will be acquired by the system and what form those data will take. Digital, audio, and video traffic surveillance data will be collected in the ATMS and transmitted over the Data Pipe to the ATIS for fusion, processing, and distribution to users.

- **Traffic Operations Center.** The TOC ties all the parts of the infrastructure together and manages the system so that the appropriate data are being- collected, processed, and disseminated to the users who need those data. The TOC acts as a nerve center that is linked with METRO Bus' transit information system,MECA, INDOT, and other agencies. The deployment of a TOC is discussed in Project 2.3.4.

- **A communication network.** Communications will be set up to connect the data collection devices with the information distribution devices. Initially, these communications can be built upon existing telephone lines, supplemented where necessary with wireless systems. A fiber optic cable will be installed in the Northeast Corridor, between that corridor and the TOC, and along selected additional corridors. Installing a backbone cable system in key corridors at the beginning stages will lay the groundwork for a system that can serve a wide variety of information and communication needs in the future and will eventually be tied in with an area-wide system.

- **Data dissemination devices.** The ATMS and the ATIS will share the capability to process and fuse the incoming data and export the formatted data over the communications backbone to a variety of end users. These include transportation agencies as well as individual travelers. The devices include roadway information aids such as CMS; information broadcasting devices that keep Internet users, Cable TV viewers, and media sources informed; and, individual vehicle route guidance devices that are now coming onto the market.

Setting up a backbone infrastructure on a prototype basis in the Indianapolis Northeast Corridor will serve two important objectives: 1) address immediate high priority needs in this sector for congestion management, and 2) showcase the benefits of this multi-modal traveler information system to the rest of the area. Eventually, many new applications for the use of this infrastructure will emerge, along with new users for these capabilities. Much of this future demand cannot be precisely quantified at this time, but evidence in other locations strongly suggests that this basic foundation will support many diverse and beneficial applications down the line.

1.1.3 - Link METRO Bus and MECA to the Data Pipe

This project links METRO Bus and MECA to the Data Pipe via connections to the TOC. The METRO Bus connection is to the ATIS component of the TOC and allows AVL-collected, real-time vehicle location information to be processed and distributed from the TOC to transit station signs, kiosks and other distribution outlets. The MECA connection is to the ATMS component of the TOC and will allow the exchange of traffic and incident response data during roadway incidents and regional special events. The METRO Bus and MECA connections will be made using telephone data lines immediately and will be replaced by fiber optic connections as Project 1.1.2 is completed.

METRO Bus currently provides transit and traffic information to local media broadcast stations. In addition, METRO Bus is receiving funding under the Capital Improvement Plan to develop its downtown Customer Information Center as well as replace their centralized computer system with a distributed network of microcomputers. METRO Bus is also planning to install public information services, including kiosks, signs, and carousels at bus stops in the downtown Indianapolis area, particularly at the downtown transit store. And finally, METRO Bus' travel center has installed an automated public information system that provides route information directly to callers without human operators.

MECA is another important manager of transportation information, particularly focusing on freeway incidents and emergency management in Marion County. MECA coordinates police, fire, the county sheriff, health services and towing services to meet county-wide needs.

This project element assures that METRO Bus and MECA are institutionally linked to the TOC, both as providers and recipients of transportation data through the Data Pipe structure. MECA will feed incident data to the ATMS, where it will be evaluated and used, for example, to adjust ramp metering or post appropriate messages on the CMS system. The data will be passed on to the ATIS where it will be further processed and fused with other relevant data to provide real-time alerts to travelers about current roadway conditions. METRO Bus will link directly to the ATIS, providing data on transit schedules and vehicle location to aid transit travelers. Buses can also serve as probe vehicles, monitoring and providing feedback on traffic conditions along their routes. Later developments can include the provision of real-time transit performance data to travelers to encourage and support mode shifts and increase overall transit ridership.

METRO Bus and MECA management will be included as central players in the backbone planning process, and the institutional mechanisms will be put in place to provide for the integration of METRO Bus and MECA into the TOC development plans. A more detailed discussion of METRO Bus can be found in Program Area 4, Transit Management Systems.

1.1.4 -Regional Data Pipe Expansion

This project phase expands the Data Pipe to support the siting of freeway management and traveler information field elements in congested corridors and other key locations throughout the Indianapolis region. This expansion will also include selective links to agencies in counties outside Marion County based on the spread of congestion and the activities, needs and capabilities of these agencies.

A long-term objective of the development of this communication infrastructure is to effectively manage traveler information throughout the Indianapolis metropolitan area and with surrounding counties. These counties provide much of the traffic flow in and out of the immediate Indianapolis area in terms of commuters, through traffic, and commercial traffic. It will be important to take a long-term view of the integrated growth of this system in the strategic planning process to include an expansion of both the geographic coverage of the system and the inclusion of a wider set of regional transportation and traveler information agencies and organizations. These issues are addressed in the systems architecture project.

1.1.5 - Establish Links With Regional Svstems

The project phase establishes selective linkages with ITS systems beyond the Indianapolis region, including the I-65 corridor in Louisville and the Borman Expressway in Northwest Indiana.

A national vision for ITS systems that is embodied in the ITS National Program Plan seeks to provide for a seamless linking across the country of local, state, and regional transportation and traveler information systems under a common architecture. While the architectural aspects of this system compatibility will be attended to at the front end of the strategic planning process (element l.l.l), this Project must address the need to eventually tie the Indianapolis infrastructure in with regional networks. Thus, data will be able to be shared among regional TOCs along communication links from adjacent systems that can be tied together. This will also include provision for institutional relationships and agreements that encourage and support data sharing and joint regional decision making.

Location: Initially, the Data Pipe will implemented within the Northeast Corridor, between the corridor and the TOC and between the TOC and METRO Bus and MECA. Later, the infrastructure will expand regionally and to selected ITS systems beyond the Indianapolis region.

Technology: The Data Pipe will be required to be operational 24 hours a day, and appropriate fail-safe technology will be needed to maintain this level of operational performance on a continuing basis.

The Data Pipe will use fiber-optic cable, microwave, spread-spectrum radio, hard-wired RF, automated telephone systems, cellular communications, the Internet, CMSs, CCTV cameras, ramp meters, or a combination of technologies appropriate to the 11.76

The intent is to use existing communication technologies where possible in the initial phase and develop new systems as necessary and as resources permit. The more advanced technologies will be implemented in the Northeast Corridor from the outset for demonstration purposes.

Data gathering technologies characterized by lower speed data requirements will be implemented first. This cost effective approach can be accomplished initially over phone lines. Later higher capacity digital communication lines can be installed that will support video data and more complex data transmission requirements. Wireless communications are another option that can be considered to supplement the current and early infrastructure, depending on available resources. Budgets permitting, the most important communication links should be based on the installation of fiber-optic cable.

Administration: It is recommended that INDOT hire and supervise qualified consultants to participate in the planning and development of this Data Pipe system. INDOT, working with a team composed of METRO Bus, the City of Indianapolis, MECA, and other key stakeholder agencies as may be appropriate, should establish facility sites, decide on the technologies to be implemented first, and conduct a study of user requirements for traveler information (as outlined in element l.l.l), to guide the design and deployment of the backbone infrastructure. It will be important to assure coordination across each of the Projects, such as 2.3, since the backbone infrastructure cross-cuts several other project areas.

Time Frame: The design and development of the Data Pipe will begin in Year 1. Setting up the initial system and incorporating METRO Bus' information network into this system will primarily occur during Year 2 to 5. Once established, the system will operate and evolve as the need dictates and the resources allow. The Project should be evaluated in Years 4 and 5 to measure performance effectiveness and to identify where improvements can be made and where further expansion and development of the system makes the most sense. Expansion of the Data Pipe throughout the Indianapolis region will occur according to the pace of the expansion of freeway management system and traveler information field infrastructure.

Budget (Years 1-5):	Design	Construction	Total
	$729,300	$497,700	$1,227,000

Staffing: During Years l-2: 0.7 person-hours
During Years 3-5: 1.15 person-hours

Sponsor: INDOT is recommended to sponsor this project.

PROJECT: 1.2 - MULTI-MODAL TRAVELER INFORMATION DISSEMINATION

Objective:

The objective of this project is to deploy advanced multi-modal traveler information dissemination devices in selected locations of the Indianapolis metropolitan area and link them to the ATIS in the Traffic Operations Center in order to provide travelers with accurate, current traveler information. The information dissemination equipment will be located in a few selected areas where the need is greatest and where the public exposure will be high. These will also be locations where communication links with the TOC can be established quickly and cost-effectively. Once these services are in place and operational, they will be tested and evaluated both for their reliability and their ability to meet the public's needs for traveler information. After that, they will be expanded as appropriate throughout the metropolitan area, and eventually to outlying areas.

Note that Program Area 2, Freeway Management Systems, also includes projects which involve motorist information along the freeway/interstate systems, specifically changeable message signs (CMS). Changeable message signs have been documented in Program Area 2 because they relate so closely to the functions of freeway traffic management and because control of the signs will be performed from the Advanced Traffic Management rather than the Advanced Traveler Information system components of the TOC.

Current Conditions:

METRO Bus currently operates an automated telephone system for transit users. They provide callers with pre-recorded taped messages on their system, similar to a regular telephone answering machine. By entering a specific METRO Bus route number, the caller can hear a static message describing that route. This is currently the only such automated phone system in place in the Indianapolis area. The information is static, as opposed to covering current, real-time events and conditions.

INDOT operates an Internet site that offers limited traveler information primarily because it is relatively early in its development and the kinds of traffic and related data that could enhance this service are not yet readily available in the Indianapolis area. The address for this site is: <http://www.ai.org/dot> There is also a commercial site that is being privately operated by a local radio station personality, Big John Gillis of WIBC, who calls himself the "radio personality and flying traffic guy." His internet address is: <http://www.hi-tech.net/bigjohn> This site provides weather information and a map for the state, and other general items of interest.

Traveler information kiosks are not yet in use in the Indianapolis area. However, a kiosk which provides weather and community information is located at the Indianapolis International Airport.

Program Area 1.0 describes the range of media capabilities and reports that include information of interest to travelers. Cable TV has not yet been used as a medium for providing traveler information to the viewing public.

Although some headway has been made in several of these areas, none of them are tied into a centralized data management system. The information that is disseminated is developed on an ad hoc basis, is not coordinated with other information sources, and is current on only a sporadic basis.

Scope:

This project includes four phases, devoted to an automated telephone system, an Internet site, kiosks and cable TV and other media outlets.

1.2.1 - Automated Telephone System

This project would design and implement an automated, multi-modal telephone system that would allow travelers to consult a computerized menu of travel information choices, including construction, congestion, special event and multi-modal information. This system will initially be devoted to roadway information and will include a rninimum of "real-time" traffic congestion information. The amount of real-time data will increase over time as this information becomes available and as the resources required to manage the data become available. It will be important to market this system carefully so as to avoid unmet expectations regarding the volume of real-time data. The system will ultimately incorporate the transit information currently provided by METRO Bus (and which will be enhanced in Program Area 4, Transit Management Systems.

An automated telephone system is one of the easier advanced traveler information systems to implement, and it requires relatively little operator attention and maintenance. It can be a more or less stand alone system, and it can be located almost anywhere convenient, though a logical location would be in the TOC to facilitate management of information sharing with the variety of data sources coming into the ATMS. This system allows a user to dial in from any touch tone telephone and select a particular topic area of interest from a tree branching type of menu structure. Static messages are stored on tape and played back on the request of the user. The system is highly reliable and does not require much maintenance or operator attention.

The more advanced telephone systems incorporate dynamic traffic information data that are frequently and automatically updated to reflect real-time, current conditions. Modern digital systems no longer use audio tape and instead directly translate text into synthesized speech. When the user punches in the appropriate key sequence on a touch tone phone, the system returns with a voice synthesized version of the message. On-line synthesized user instructions lead the caller through the steps and key sequences needed to get to the information they desire.

The advanced telephone system is typically revised and updated frequently to reflect current information on a variety of transportation topics, such as traffic speeds, travel time, and incidents. Current information can be fed to the system automatically as frequently as every five minutes. This can include information on road construction and maintenance, traffic advisories, congestion, road closures, travel time from one requested landmark to another, and other traveler information.

The kinds of traveler information to be initially provided in Indianapolis on this system will be limited by the available communications technology and type of available traffic data to static information on the wider Indianapolis area with more current data derived in the Northeast Corridor. Later implementation of this telephone system will cover more real-time traffic information, and the updating of the system itself will be automated through the TOC. Therefore, as the sophistication of the information collected and compiled in the ATMS advances, the currency and detail of traveler information made available to users through the ATIS can also expand. Full implementation of this system requires full implementation of the ATMS and ATIS systems and the communications infrastructure to collect the data.

1.2.2 - Internet Site

This project enhances the existing INDOT Internet web page to create a comprehensive, regional source for multi-modal on-line travel information. Like the automated phone system described under Project 1.3.1, the web page will evolve over time, starting with “static”- information like construction schedules and incorporating dynamic, real-time information like roadway specific travel times and speeds as this data becomes available through freeway management system detection and surveillance.

By virtue of the capabilities of the Internet, there are numerous opportunities to partner with other web page publishers, both through the placement of electronic “links” within the respective pages and through data sharing. Private sector opportunities in this area are discussed in Program Area 5, Public-Private Partnerships.

INDOT currently has a home page on the Internet as noted earlier. At this time the traveler information available on INDOT's site is fairly limited, with no real-time traffic information, and no mapped data on traffic conditions for Indianapolis. But having a start on the world wide web gives INDOT an excellent foundation from which to build for the future.

Using the existing site as a starting point, the next step is to identify what sources of existing useful traveler information data are currently available that can be incorporated into a restructuring of INDOT's site. The Internet provides a networked medium for interagency data sharing. Various agencies, such as MECA and the City of Indianapolis, can establish electronic mechanisms to automatically transfer data to the existing Internet site. Data on construction activity, roadway maintenance, and lane closures, do not require as frequent updating as speed or accidents, and they can be transmitted through the TOC to the Internet site. The Internet then becomes the central touchstone where individual travelers or other agencies that desire such information can turn to for travel data.

Another step in the process of elaborating the Internet capability is to systematically determine how much and what kind of demand exists in the region for browsing on the Internet for traveler information, as well as who is likely to be able to gain access to this technology. The Internet is still a relatively new technology, and not everyone has easy or frequent access to it. Currently access is more likely through a place of business than it is through the home. This will effect in the near term the likelihood that travelers will turn to the Internet for pre-trip planning kinds of information. Therefore, some consideration must be given to matching the kinds of data available, the kinds of data that will be most useful to travelers, and the accessibility of the Internet to those travelers. A likely early development scenario is that much of the Internet access will involve inter-agency coordination and information sharing. Using the Internet to exchange data among organizations is likely to precede individual travelers using the Internet for travel planning.

Early in the development of the Internet as a traveler information tool in Indianapolis will be the need to coordinate its development to avoid overlaps in the functions of the various agencies. Decisions will have to be made regarding whether there will be a single site with all the relevant traveler information or several more specialized sites that are linked to each other. A computer will be dedicated to the Internet site. Another issue to be resolved is the capacity of the Internet data path. INDOT currently uses a Tl line that has large capacity and bandwidth. This should be adequate for further site development.

A later phase in the development of the Internet as a traveler information tool will involve the acquisition of real-time traffic information and effective ways of displaying that information. Several state DOTs around the country have developed Internet sites that show maps of the major freeways with color coded indicators of traffic speed and the ability to update the display frequently. On these more sophisticated maps, travelers can view icons that designate construction sites, incidents, and other relevant traveler data. By clicking their computer's cursor on these icons, they gain access to additional data about the incident, for example.

For this kind of Internet system to work, appropriate communications need to be provided. The hardware and software allow web servers to manipulate graphics and other information formats that can enrich the quality of the presentation of traveler information. The web server needs to organize and prepare the data in the most useful format to best meet the needs of the end user. Each of the major agencies represented on the Internet, such as INDOT, MECA, and METRO Bus, could have their own web home page with links to each other as well as to a variety of other useful traveler information. This effort could be coordinated by INDOT.

A further advance in Internet capability might involve detailed route finding and itinerary building, based on user requests. Itinerary planning requires a separate powerful database and computer program to handle the location information (detailed street map addresses for example), route finding capability, "yellow pages" information on such destinations as banks, gas stations, restaurants, and the like, and a range of multi-modal data. As these systems increase in complexity, they begin to take on dynamic route planning which takes into account actual conditions (speed, accidents, congestion) on route segments rather than typical "average" conditions, and also true inter-modal linking that takes account of park-and-ride facilities, METRO Bus schedules, and traffic routes and current conditions.

1.2.3 - Kiosks

This project implements traveler information kiosks at key locations including major shopping and employment centers, regional transit facilities, major special event travel destinations and interstate rest areas. During the first two years of the project, kiosks are recommended at the following three locations:

- Castleton Mall
- a major Northeast Corridor employer
- at the Downtown Customer Information Center

Other future potential kiosk locations include other major METRO Bus stations and the airport.

Based in part on the operating experience of these kiosks, additional kiosks will be implemented through the Indianapolis region in conjunction with deployment of freeway management and transit data collection systems and implementation of the Data Pipe backbone communications infrastructure.

A kiosk is like a comprehensive, interactive ATM machine. They usually start out providing static traffic information, and they can be upgraded as more real-time data become available to accept a live data feed from the ATIS to the kiosk. This provides frequently updated traveler information on traffic speed, road congestion, and incidents. kiosk screens are typically touch sensitive. They use phone line communications and dial up connections like a modem. The dial up process is automated, and the kiosk may communicate and exchange data with the ATIS every five minutes or more frequently as necessary.

Each kiosk will be linked over telephone lines through the TOC with the ATIS computer. These kiosks will provide multi-modal data, including information on major highway construction throughout the metropolitan area, METRO Bus schedule and park and ride data, and, as the data allow, real time traffic data for the Northeast Corridor area.

These data will be expanded in later years as more real time data become available to the ATMS. Also, the number of kiosks can be expanded as demand and resources allow, eventually creating a network of kiosks throughout the metropolitan area.

1.2.4 - Media, Cable TV

This project develops relationships between INDOT and media providers of travel information and implements expanded/

enhanced media travel information dissemination through linkages to TOC travel data.

As with the other dissemination services discussed above, the presentation of traveler information through the local media will go through an evolutional process that is largely dictated by the data available, the communications systems in place, and the development of the capacity of the TOC to manage the data.

Initially data such as live surveillance video derived from cameras in the Northeast Corridor may be transmitted through a video feed to the local media stations. It will also make sense to focus on construction sites or other traffic “hot spots” in the Northeast Corridor or elsewhere in the metropolitan area. Information that is available in electronic form can be “dumped” to a dumb terminal and made available to the media to access and incorporate into their programming as they see fit. This information may be provided free of charge; however, the possibilities for selling this information or exchanging it for other resources should be pursued. This is one of the issues that should be considered by the Deployment Committee described in Program Area 6, Technical and Planning Support.

Later developments of this capability will include live video feed from INDOT controlled freeway surveillance cameras. This information would be made available at the discretion of INDOT. A further enhancement beyond a straight video feed will involve the TOC packaging the traveler information and, in effect, making a presentation or telling a story. After the capability and communications are in place to provide this level of service, it will be appropriate to sit down with media and cable TV representatives to explain what it is possible to do with mapped displays and real time traffic data, and then determine just what the media and their viewers want to see and in what form it should best be presented.

The unique aspect of cable TV, compared with other media outlets, may be access to a dedicated channel where extensive traveler could be presented. Alternatively, this service can be treated only as a distribution system where short (sometimes only 10 second) feeds can offer live clips of current traffic conditions, congestion, or incidents on selected roadway segments. An additional outlet could include government local (typically county) access channels that provide traveler information clips as a community service. Before traveler information can be brought to cable TV in Indianapolis, it will likely be necessary to install several to a half dozen live surveillance cameras in critical locations. This project will include at least four such cameras in the Northeast Corridor area, strategically located to be able to cover the critical congestion or problem areas, with specially located cameras to cover construction areas. Once these are in place, the information can be fed to local cable TV through the TOC.

Location: Initial deployment of these traveler information dissemination systems will be in the Northeast Corridor of Indianapolis. The automated telephone system will be centrally located, and the recommended site is at the TOC. As discussed above, INDOT already has an Internet site and there are others in the region that address some elements of traveler information. Location in not a critical issue for the Internet, and INDOT is the logical point of coordination for all sites that address traveler information. Kiosks will be initially located in busy travel locations, including the airport, key transit stations, and in the Northeast Corridor. The media is not itself location dependent, but will rely on data gathering devices that need to be strategically located. The location for these devices is discussed under the appropriate Project descriptions.

Technology: Initially most of the dissemination technologies will be linked to the TOC/ATIS by standard telephone cable or wireless. The most current technologies (hardware/software) will be acquired for kiosks, the automated telephone equipment, and the Internet.

Administration: INDOT will administer contracts to set up the automated telephone service, provide and install kiosks, and as needed to expand the Internet capability to provide for the display of real-time mapped traffic conditions. The private sector, working with INDOT, is expected to develop and expand media capabilities as discussed above.

Time Frame: Each of these information dissemination services is expected to be deployed and operational by year 5 at the latest. Over time additional kiosks will be installed and tied into the TOC/ATIS. The Internet site will undergo continuous enhancement to improve the provision of traveler information. The media are expected to do likewise.

Budget (Years l-5):

Design	Construction	Total
$98,600	**$185,400**	**$284,000**

Staffing:

During Years l-2: 0.5 person-hours
During Years 3-5: 0.77 person-hours

Sponsor: INDOT is recommended to sponsor this project.

PROGRAM AREA: 2 - Freeway Management System

DESCRIPTION: This program area consists of an integrated freeway management system capable of monitoring traffic conditions on the freeway system, identifying recurring and non-recurring flow impediments, implementing appropriate control and management strategies (such as ramp metering) and providing critical information to travelers through infrastructure-based dissemination methods, such as changeable message signs. The objective of this program area is to develop a comprehensive cost-effective freeway management system for the study area that will reduce congestion and accidents and improve incident detection, response and clearance along the freeways and provide for the integration of other program areas.

The ultimate vision for the study area includes the development and implementation of a traffic operations center (TOC). The TOC would be comprised of two separate but interconnected functional components; an Advanced Traffic Management System (ATMS) and an Advanced Traffic Information System (ATIS). The ATMS would use high technology strategies, components and communications to receive, process, analyze and distribute real-time traffic data for congestion and incident management purposes along the freeway segments within the study area. The ATMS would require regular analysis and updating of control strategies, and provision of adequate operations and maintenance resources to support the system's operational objectives. The ATMS would also provide real-time traffic data to the ATIS in a processed format such that the ATIS could further analyze and refine the data, if necessary, prior to disseminating to pre-trip and en-route travelers via kiosks located at major retail and employment centers, an Internet Homepage, an automated telephone system, cable television, other media, etc.

The implementation of ATMS for freeway management purposes have demonstrated measurable benefits over an extended period of time and across a variety of Measures of Effectiveness (MOE's), including travel time, travel speed, freeway capacity, safety, fuel consumption and emissions. Analyses of systems in several metropolitan areas, including Seattle, Minneapolis, Detroit, Chicago and locations in California, indicate the following system benefits can be achieved.

- Travel time decreases of 20% - 48%
- Travel speed increases of 16% - 62%
- Freeway capacity increases of 17% - 25%
- Accident rate decreases of 15% - 50%
- Significant reduction in fuel consumption
- Significant reductions in vehicle emissions

In addition, the benefit/cost ratio of implementing freeway traffic management is also more attractive than freeway expansion. For example, the cost associated with expanding approximately 31 miles of I-465 from three to four lanes per direction and for interchange reconstruction would be approximately $30 million per mile (Table 6-4, page 2, Task 40 Summary and Final Report, Draft, Indianapolis Transportation Plan Update, July 1995) and would result in roughly a 33 percent capacity increase. Whereas, the cost associated with implementing freeway traffic management over this same segment, which would be expected to result in a conservative 20 percent capacity increase, would be approximately $300,000 to per mile. In other words, over 60 percent of the capacity benefit would be achieved at one percent of the cost.

The freeway traffic management system in the Indianapolis area should provide an open architecture to allow for future expansion and technologies and possible links to other regional systems. The ultimate system may include CMS's Hoosier Helpers, ramp metering, CCTV surveillance cameras, an advanced detection system, HAR, HOV bypasses, HOV lanes, an express bus/park-n-ride system, cellular hotline, automated enforcement, in-vehicle detection and/or communication devices, improved communication links, computers and monitors and a fully functional TOC with an adequate number of trained personnel.

The freeway traffic management system will be needed to support other program areas, such as:

1) Multi-Modal Traveler Information System
3) Traffic Signal Control System
4) Transit Management System

RATIONALE: This program area supports the following Overriding Factors:

- Region-Wide Perspective
- Safety
- Multimodal
- Serves Many
- Building Block
- Early Winner
- High Visibility
- Low Risk/High Pay-Off

EXPECTED RESULTS: Full implementation of a freeway management system would address the following Problem Causes:

- Incidents (poor management, response)
- Inadequate Capacity
- Maintenance/Construction Planning, Operations
- Safety (Accidents)
- Travel Time Information

The program area will address the following User Services:

- Traffic Control
- Incident Management
- Emergency Vehicle Management
- Public Transportation Management
- Emergency Notification and Personal Security
- En-Route Driver Lnformation
- Route Guidance
- Pre-Trip Travel Information

2 FREEWAY MANAGEMENT SYSTEM	Implementation Timeframe						
	Year					Year 6-10	Year 11-20
	1	2	3	4	5		
2.1 Detection/Verification							
2.1.1 Implement Hoosier Helper Program On and Within I-465 Loop and Along I-69 between I-465 and SR 37	X	X	X				
2.1.2 Expand Hoosier Helper Program to Remainder of Freeway System						X	X
2.1.3 Implement Detection Systems in Northeast Corridor	X	X	X	X	X		
2.1.4 Conduct Study to Determine Mid-Term FMS Expansion Corridors and Phasing					X	X	
2.1.5 Expand Detection Systems Coincident to Construction and Congestion to Cover Remainder of Freeway System						X	X
2.1.6 Implement Cellular Hotline System			X	X			
2.1.7 Implement CCTV Cameras Along Northeast Corridor	X	X	X	X	X		
2.1.8 Expand CCTV Camera Systems Coincident to Construction and Congestion to Cover Remainder of Freeway System						X	X
2.1.9 Implement Reference Markers Along Freeway System		X	X	X	X		
2.1.10 Conduct Study to Determine Long-Term FMS Expansion Corridors and Phasing							X
2.2 Traveler Information							
2.2.1 Install Changeable Message Signs Along Major Radial Routes			X	X	X		
2.2.2 Install CMS's Along Northeast Corridor	X	X	X	X	X		
2.2.3 Expand CMS's Coincident to Construction and Congestion to Cover Remainder of Freeway System						X	X
2.3 Incident Response							
2.3.1 Install Ramp Meters Along the Northeast Corridor	x	x	x	x	x		
2.3.2 Expand Ramp Meters Coincident to Construction and Congestion to Cover Remainder of Freeway System						X	X
2.3.3 Prepare Conceptual Definition of Traffic Operations Center (TOC)	X						
2.3.4 Implement TOC		X					
2.3.5 Prepare Detailed Design of Ultimate TOC			X				
23.6 Increase Staff and Equipment of TOC				X			
2.3.7 Implement Fully Operational **TOC**					X		

5/15/96

PROJECT: 2.1 - DETECTION/VERIFICATION

Objective:

The objective of this project is to support the implementation of a freeway management detection/verification system in the Indianapolis area capable of detecting and verifying incidents, minimizing incident response and clearance times, and providing adequate data for related control functions such as ramp metering.

Current Conditions:

There are currently no publicly operated freeway management system incident detection or verification components or capabilities in operation within the Indianapolis area. Incidents are currently detected and verified by motorists with cellular phone capabilities, by other observers who phone 911 to contact an emergency dispatching system or by police personnel.

The area does have a private "Samaritania" van, sponsored by Revco Drugs, which detects incidents and helps disabled vehicles. The van currently does not operate on a set schedule or route.

Although there are no freeway management system incident detection or verification components within the Indianapolis area, INDOT has field tested and evaluated various ATMS detection/ verification components along the Borman Expressway in Northwest Indiana. These technologies or components include incident response vehicles (known as Hoosier Helpers), a variety of above-road vehicle detection devices, CCTV cameras and wireless communications.

Scope:

This project is divided into the following phases:

2.1.1 - Implement Hoosier Helper Program

This phase consists of implementing a Hoosier Helper program along the I-465 freeway loop, all freeway segments within the loop and along I-69 between I-465 and SR 37 (Figure 6-3). The Hoosier Helper roving patrols will be used to detect incidents, minimize incident duration, restore full capacity to the freeway and reduce risks to motorists for potential secondary accidents. This phase would begin implementation in Year One.

The proposed coverage of approximately 100 miles should be adequately patrolled with five vehicles and 10-12 staff personnel, assuming two shifts. This estimate is based on the current route coverage of Highway Helper vehicles along the Minneapolis freeway system. Note that a direct comparison with the Borman Expressway Hoosier Helper operations to estimate the vehicular and staff requirements would be difficult because of the vast differences in auto and truck traffic demands.

Service vehicles would be assigned a specific freeway segment to patrol. The segments would be roughly 20-25 miles in length. The patrolling of segments should be flexible and may change following initial implementation, depending upon the initial number of response vehicles, the traffic demand and the number of incidents along different segments. Initially, service patrols may only be present during the peak traffic periods on weekdays and during special events. Ultimately, the patrols may be present for 10-15 hours on weekdays, 8-10 hours on weekends and during special events or the patrols may be continuously present.

The vehicles should be equipped with two-way communication devices (cellular phones, state radio and CB radio) and other features proven to be advantageous along the Borman Expressway. These may include global positioning system (GPS) tracking, spread spectrum radio communications and truck mounted video. The wireless communications would allow the Hoosier Helper operators to monitor and operate the CMS's and possibly other management components during time periods when the TOC is down. The truck mounted video cameras would be used in the areas where overhead surveillance is obstructed or to transmit incident images to the operations center such that appropriate support services can be contacted.

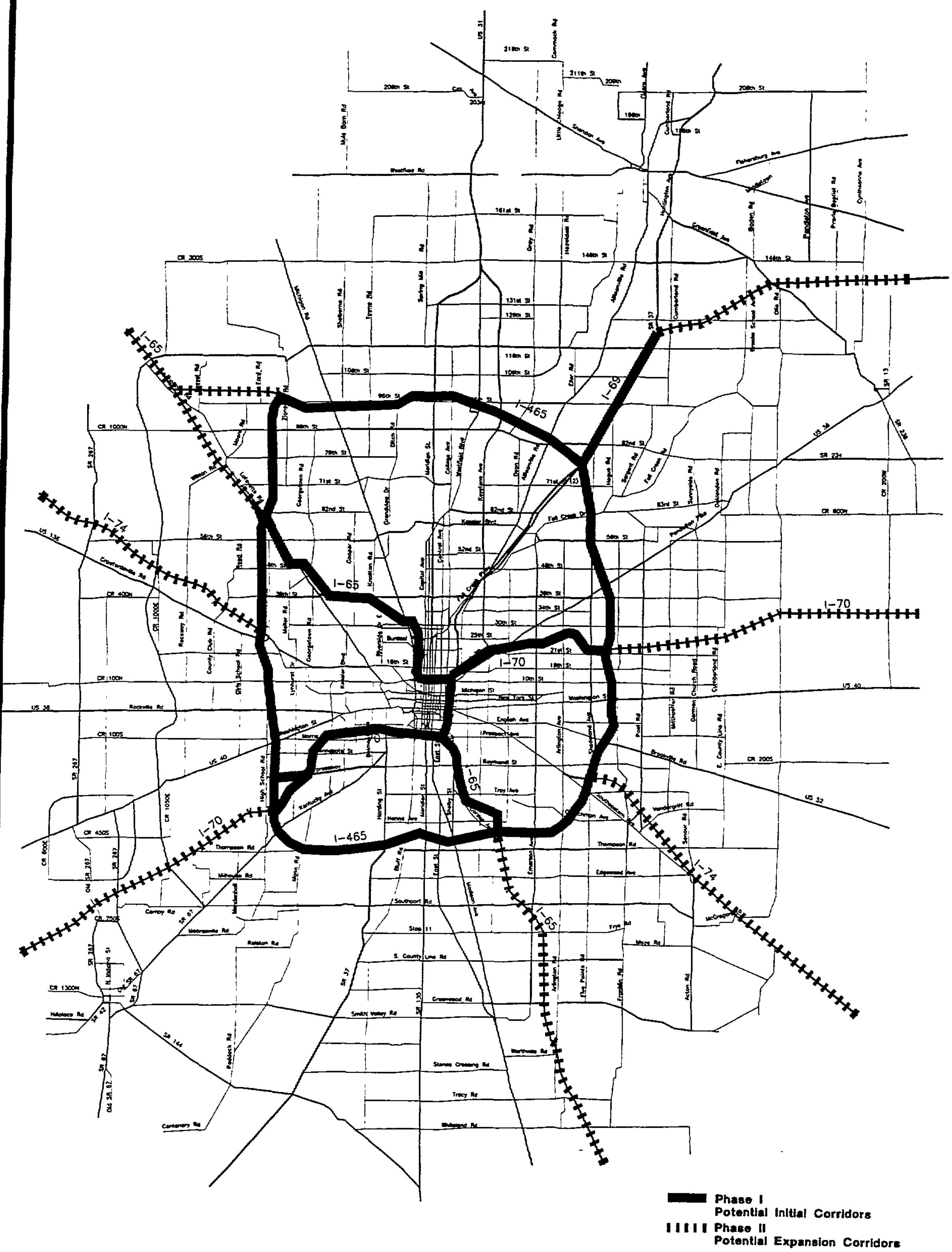
Possibilities also exist for the development of a public/private partnership with Revco Drug involving the use of "Samaritania" vans to help in the patrolling process.

2.1.2 - Expand Hoosier Helper Program

During this phase the Hoosier Helper program would be expanded to cover the remainder of the Indianapolis freeway system (i.e., the portion that was not covered in the first phase). This phase would be mid- to long-term and would occur after the first five years. The additional coverage (approximately 50 miles) would likely entail the procurement of at least three additional vehicles and six staff personnel assuming two shifts.

2.1.3 - Implement Detection Svstems Along Northeast Corridor

This phase would consist of the implementation of a vehicle detection system or systems for freeway traffic management along the Northeast Corridor beginning in Year One. Currently different types of detectors can be used to collect some or a combination of traffic count, speed, occupancy (density) and classification data. Other traffic parameters of importance for traffic management



SOURCE: CITY OF INDIANAPOLIS, PLANNING DIVISION

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FIGURE 6-3

Hoosier Helper Program

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include travel time and queue length. The detection system(s) for the Northeast Corridor would need to collect accurate data, which would be communicated to the Traffic Operations Center (TOC), the centralized facility for traffic data processing and control described in projects 2.3.3 and 2.3.4. At the TOC, detection data would allow for the automated detection of incidents (occupancy) and the establishment of appropriate ramp metering rates (traffic flow).

The Northeast Corridor should be located along a freeway segment or group of interconnected segments that is recognized by area residents as one of the most congested segments; if not the most congested segment, within the Indianapolis area and a segment that experiences recurring traffic congestion. The Northeast Corridor should be of sufficient length so as not to preclude an accurate evaluation of the ATMS components but not so long such that adequate deployment of components could not be funded.

The Northeast Corridor of the Indianapolis area was identified as having the greatest current freeway congestion. The specific limits of this congestion range from SR 431 (Keystone Avenue) to US 36/ SR 67 (Pendleton Pike) along I-465 and from I-465 to SR 37 along I-69. This encompasses a total distance of approximately 15 miles, nine miles along I-465 and six miles along I-69. The volume/ capacity ratios of these segments range from 0.8 to over 1.1, with most areas between 0.9 and 1.1. The existing average daily traffic (ADT) demands on these segments range from roughly 100,000 to 125,000 vehicles per day (vpd) along I-465 and from 95,000 to 115,000 vpd along I-69.

The existing geometrics within this segment include:

- Three lanes in each direction on I-465 with interchanges at SR 431 (Keystone Avenue), Allisonville Road, I-69, Shadeland Avenue, 56th Street and US 36/SR 67 (Pendleton Pike).

- Three lanes in each direction on I-69 with interchanges at I-465, 82nd Street, 96th Street, 116th Street/SR 37. However, there are four southbound lanes from I-465 to 82nd Street.

Typical detection would include inductance loops cut into the freeway pavement. Inductance loops are typically low cost and highly accurate and have thesapability of providing the necessary data to allow for automated incident detection and on-line ramp metering. However, the initial installation and replacement of loops can create congestion problems. Detection system(s) that are mounted above or adjacent to the roadway so as not to disrupt traffic flow would be more desirable. Possible off-road detection technologies include microwave, infrared, video imaging, microwave, and ultrasonic devices.

Although none of these alternative technologies have proven histories of performing both of the needed detector functions of incident detection and traffic flow, it is assumed that some form of overhead or side detection will be emerging within the next few years that will be able to accurately perform the desired detector functions on a cost-effective basis.

Therefore, some form of advanced overhead detection is suggested for the Northeast Corridor. The initial implementation would likely be conventional (current accident algorithm). However, the architecture of the system hardware/software should be flexible enough to allow for the future implementation of the surveillance algorithm currently being developed along the Borman Expressway. The ultimate system may include some form of pattern recognition system or in-vehicle (active) transponders or similar device.

The fifteen mile Northeast Corridor may require different numbers of detectors depending upon the chosen sensing system. Typical coverage (loops) would require detection locations at 1/2 mile spacing per direction along the segment for incident detection purposes and at each of the on and off ramps. Based on a similar coverage, detection would be needed at approximately 98 locations (total both directions), including 60 mainline sites and 38 ramp sites (Figure 6-4).

2.1.4 - Conduct Study to Determine Mid-Term Expansion Corridors

This phase will consist of conducting a detailed study to determine mid-term freeway management system expansion corridors and phasing. The study will analyze and evaluate the short-term use of the components and mid term needs for expansion of the Hoosier Helper program, vehicle detection systems, call boxes, closed circuit television (CCTV) cameras, ramp metering and changeable message signs. The study will also evaluate emerging technologies that may supplement and/or replace some of the in-place or proposed components of the detection/verification system. This phase will be conducted in Years Five and Six.

2.1.5 - Expand Detection Systems

This phase will consist of expanding the freeway management detection system of the Northeast Corridor to cover the remainder (approximately 135 miles) of the Indianapolis freeway system. The phasing of this expansion will be determined by the Mid-Term and

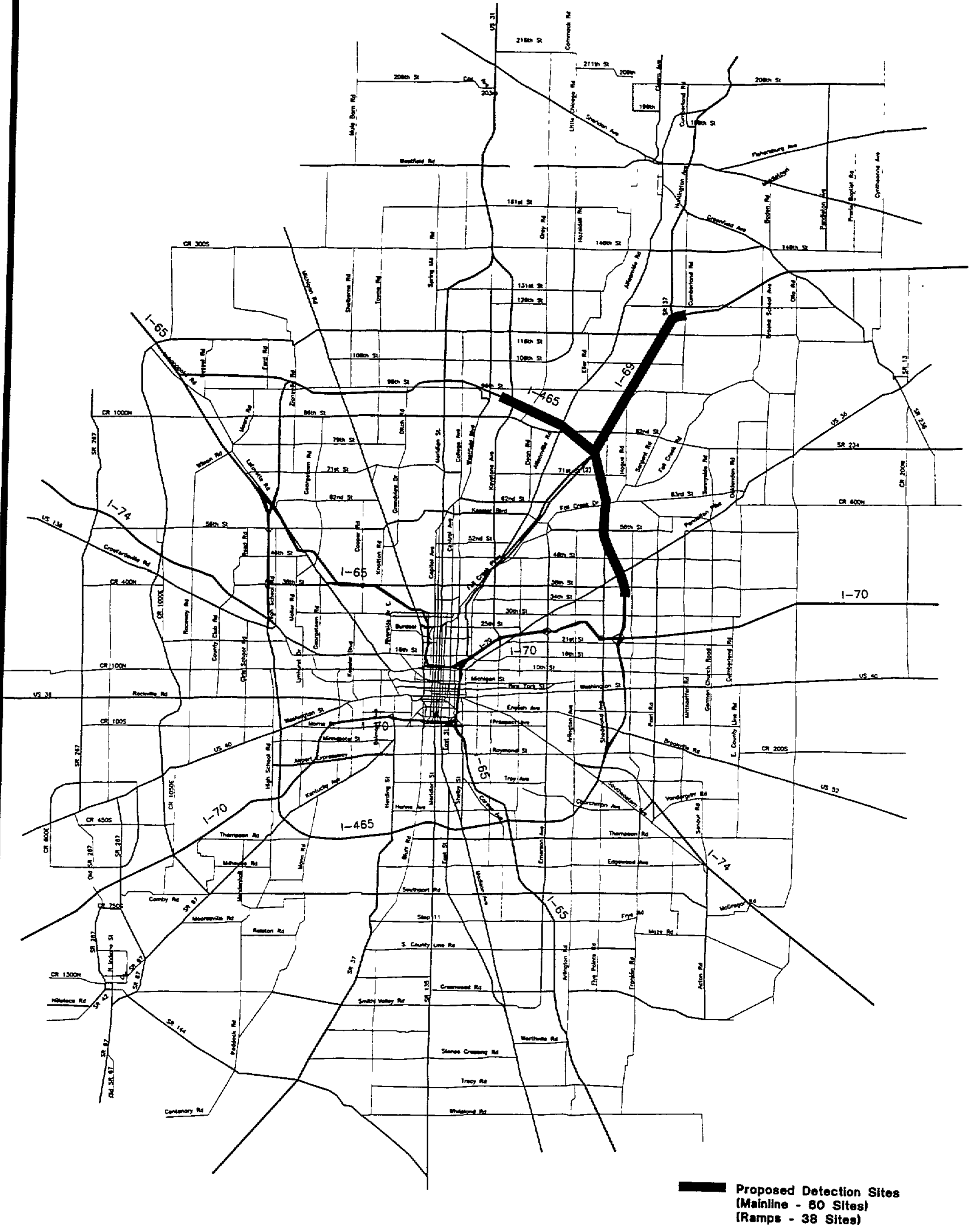

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FIGURE 6-4

Northeast Corridor Detection Systems

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Long-Term expansion studies, programmed construction projects and freeway congestion.

This phase will occur after Year Five.

2.1.6 - Implement Cellular Hotline System

This phase consists of implementing a cellular hotline system which will allow en-route motorists with cellular phones the capability of contacting the Traffic Operations Center (the centralized facility for traffic data processing and control described in projects 2.3.3 and 2.3.4) to report traffic related information. The Traffic Operations Center (TOC) dispatching system would determine an appropriate course of action, notify the appropriate responding agencies and contact MECA, if necessary. This system would be similar to the *999 cellular call-in system currently in-place in the Chicago area. Emergency services calls would still be handled by calling 911.

The hotline system would receive traffic data related to congestion, incidents, drunken drivers, malfunctioning signals, downed signs, etc. Drivers would be able to relay the locations of these occurrences via either upgraded reference marking or a new emerging technology that is currently being developed for 911 cellular calls that pinpoints cellular origination location to within a tenth of a mile. This technology is to be tested in Texas and New Jersey this summer. Future features of this technology would also tell dispatchers whether the caller is reporting from a known accident site. A recording will tell the caller that officials are aware of the accident but to remain on the line if reporting another emergency.

This system is to be implemented in Years Three and Four and will be systemwide within the Indianapolis metropolitan area.

2.1.7 - Implement CCTV Cameras Along Northeast Corridor

This phase consists of installing closed circuit television (CCTV) cameras along the Northeast Corridor beginning in Year One. The cameras will be used to detect incidents, to monitor congestion and to help determine which agencies should respond to an incident.

The CCTV surveillance cameras should be spaced at desirable one mile intervals to provide complete coverage. As a minimum (during initial installation), the cameras should be placed at all interchange locations, where added height would result in greater coverage, and adjacent to high accident locations.

Cameras will have the capability to pan, tilt and zoom and cover both directions of travel along a freeway segment. Camera operations would be controlled at the TOC where operators will be able to use a single monitor to bring up any on-line camera.

Cameras will be placed along one side of the freeway segments. Under the desirable one mile spacing, the fifteen mile Northeast Corridor will require seventeen CCTV cameras, ten on the nine mile segment of I-465 and seven on the six mile segment of I-69 (Figure 6-5). The major interchange area of I-465 and I-69 will likely require at least two cameras because of the large directional interchange area and the visibility obstructions from the ramps.

2.1.8 - Expand CCTV Coverage to Remainder of Svstem

This phase will consist of expanding the freeway management CCTV camera coverage to include the remainder (approximately 135 miles) of the Indianapolis area freeway system. The phasing of this expansion will be determined by the Mid-Term and Long-Term expansion studies, programmed construction projects and freeway congestion.

This phase will occur after Year Five.

2.1.9 - Implement Reference Markers

This phase will consist of enhancing the existing milepost reference marking system on all freeway segments within the Indianapolis area beginning in Year One. The purpose of this enhanced system would be to provide more accurate locations for incidents, construction and maintenance reporting.

INDOT currently has reference marking every mile and on major structures along interstate, US highway and state highway routes. The proposed system would provide markers every tenth of a mile and on each structure.

2.1.10 - Conduct Studv to Determine Long-Term Expansion Corridors

This phase will consist of conducting a detailed study to determine long-term freeway management system expansion corridors and phasing. The study will analyze and evaluate the mid term use of the components and long-term needs for expansion of the Hoosier Helper program, vehicle detection systems, call boxes, CCTV cameras, ramp metering and changeable message signs. The study will also evaluate other emerging technologies that may replace or supplement some of the in-place detection/verification components. This phase will be conducted in Years Nine and Ten.

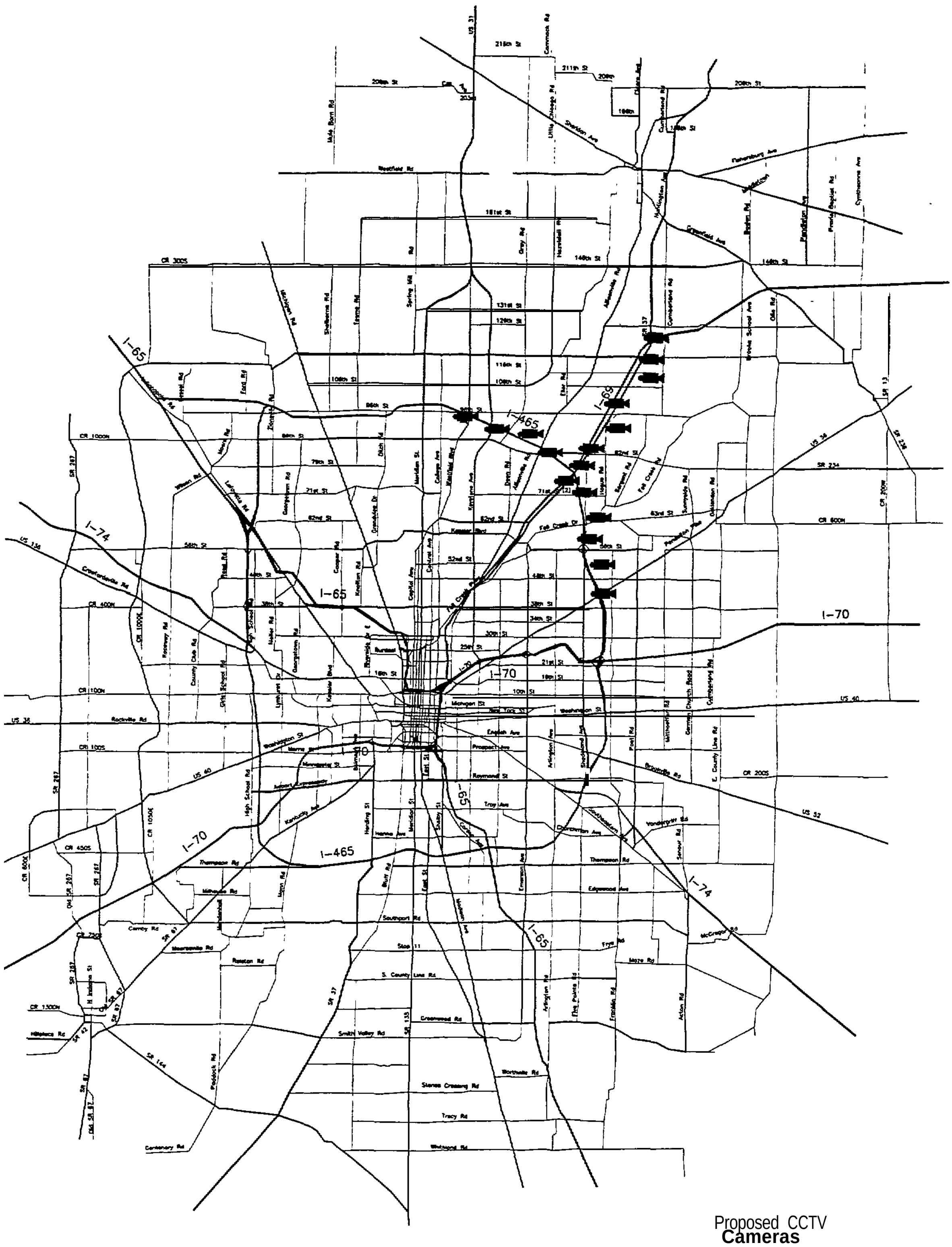

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FIGURE 6-5

Northeast Corridor CCTV Camera Locations

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Location (Years l-5): Systemwide (approximately 150 freeway miles):
Cellular Hotline and Reference Markers

Northeast Corridor (approximately 15 miles):
Detection Systems, Call Boxes, CCTV Cameras

I-465 Loop including all freeway segments within loop and I-69 from I-465 to SR 37 (approximately 100 miles):
Hoosier Helper Program

Technology:

Years l-5: Wireless communications and/or leased phone lines, GPS tracking of Hoosier Helper vehicles, truck mounted video and cellular communications.

Mid- and Long-Term: Combination of wireless communications, leased phone lines and fiber optic cable, GPS tracking of Hoosier Helper vehicles, truck mounted video and cellular communications.

Administration: INDOT will administer all contracts for outside services. The project phases should support the integrated operations plans, protocols and procedures developed in the freeway management program area and other program areas.

Time Frame:

Year l-3:	Hoosier Helper Program and Reference Marking
Year l-5:	Northeast Corridor Implementation
Year 3-4:	Cellular Hotline System
Years 5&6:	Mid-Term Study to Evaluate Years l-5 System Components and New Emerging Technologies
Years 6-10:	Expand Systems Based on Mid-Term Study, Programmed Freeway Construction and Congestion
Years 9&10:	Long-Term Study to Evaluate Years 6-10 System Components and New Emerging Technologies
Years 11-20:	Expand Systems Based on Long-Term Study, Programmed Freeway Construction and Congestion

Budget (Years 1-5):

Design	Construction	Total
$663,200	**$5,296,800**	**$5,960,000**

Note: Figures include implementation costs for Project 2.3.1.

Staffing:

During Years l-2: 5.0 person-hours
During Years 3-5: 8.25 person-hours

Note: Figures include staffing needs for Project 2.3.1.

Sponsor: INDOT is recommended to sponsor this project.

PROJECT: 2.2 - Traveler Information for Freeway Traffic Management

Objective:

The objective of this project is to support the implementation of a freeway management traveler information system in the Indianapolis area capable of providing en-route motorists with real-time congestion, incident, construction and detour information far enough in advance to allow the motorist to divert to alternate routes, if necessary.

Current Conditions:

There are currently no publicly operated freeway traffic management traveler information services, such as changeable message signs (CMS's) or highway advisory radio (HAR), provided in the Indianapolis area. However, the area does have media generated traffic reports during the peak traffic demand periods on weekdays. The media travel information is provided by several radio and television stations. The media broadcasts generally lack real-time travel information and the credibility necessary to adequately serve the pre-trip and en-route needs of the traveler in the metropolitan area.

Note that INDOT has used portable CMS's for temporary construction purposes. However, the signing messages were static.

Although there are no publicly operated traveler information services provided in the Indianapolis area, INDOT is currently implementing CMS's and HAR along the Borman Expressway in Northwestern Indiana as part of the Borman ATMS. The CMS's along the Borman will be able to have their messages changed remotely by Hoosier Helper operators to reflect real-time traffic conditions.

Scope:

This project is divided into the following phases:

<u>2.2.1 - Install Changeable Message Signs Along Major Radial Routes</u>

This phase will consist of installing CMS's along each of the major radial routes into the Indianapolis area outside of the I-465 loop to allow drivers to receive information regarding incidents, congestion, construction and detours on I-465 and downstream along their intended route. This information would be relayed to the driver far enough in advance to allow drivers adequate time to perceive the information, make a logical decision and take appropriate action. The CMS's would be placed a minimum distance (based on decision sight distance) upstream of the driver decision point. Mounting on existing bridge structures is suggested wherever possible to minimize costs. Where bridge structures are unavailable, separate signing bridges should be installed. Detailed field reviews will be necessary to determine appropriate locations due to different sign technologies, character height and line-of-sight issues.

The recommended general CMS locations on each of the twelve major radial routes are shown in Figure 6-6 and listed below. Each of these major routes has an existing traffic demand exceeding 30,000 vehicles per day.

- US 31 (north and south)
- SR 431
- SR 37 (north and south)
- I-70 (east and west)
- I-65 (north and south)
- US 36 (west)
- I-74 (north and south)

Additional CMS's may also be located further upstream, such as along US 31 north of the split with SR 431.

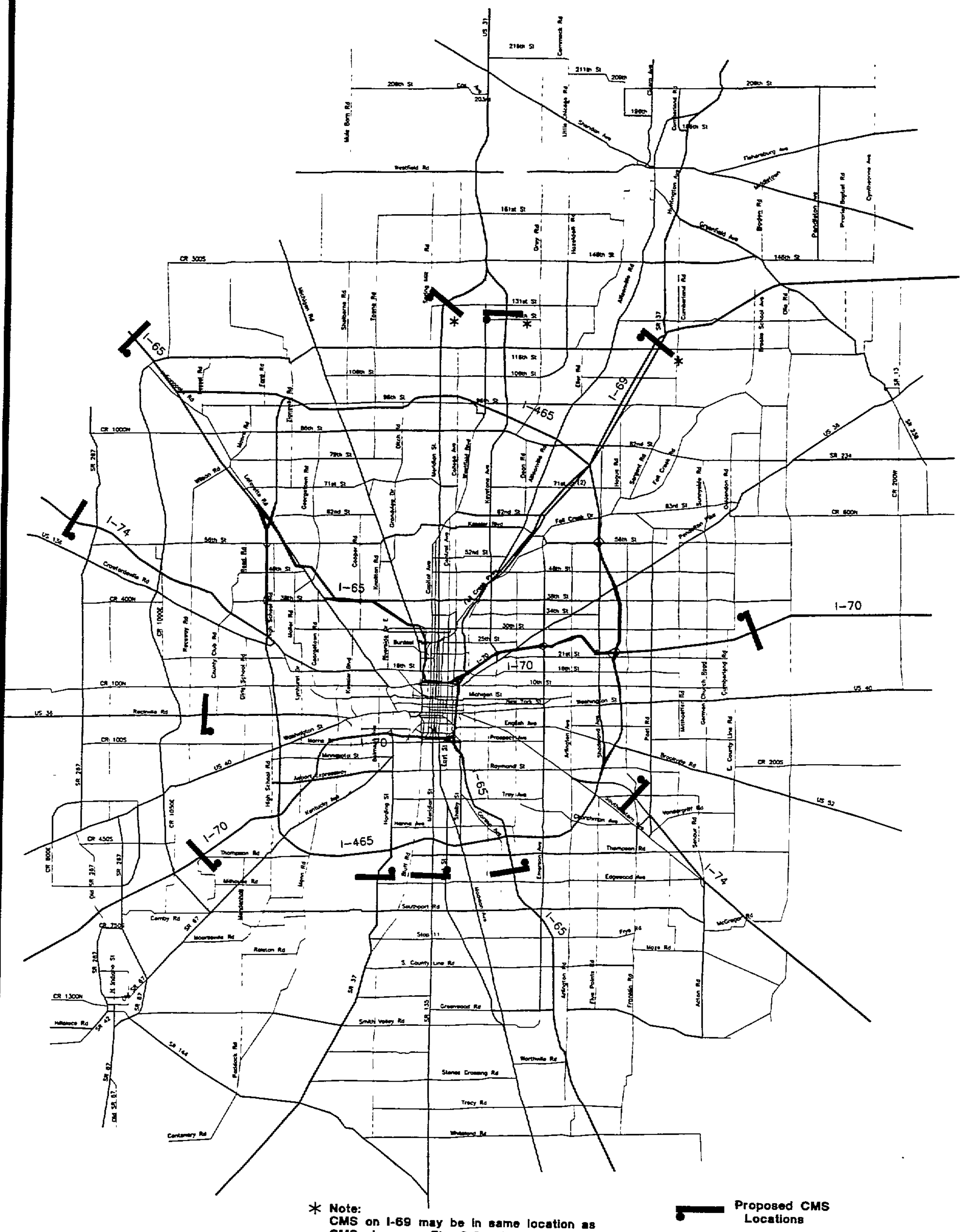
The range of available standardized messages will be pre-established by INDOT for each specific CMS location. These messages would be stored in the memory of a computer at the Traffic Operations Center (TOC), the central facility for traffic data processing and control described in projects 2.3.3 and 2.3.4. If the CMS' are operational prior to the TOC, they could be controlled through on-board Hoosier Helper vehicle computers.

Once an incident is detected, an operator will bring up the CMS location on a monitor, list out the available messages, select an appropriate message for the conditions and relay this information to the CMS which will automatically begin to transmit this message. Every 10 to 20 minutes the computer will remind the operator, via a monitored message, of the message displayed by the CMS and will ask the operator if a change is desired. If the operator does not respond, the computer will assume that no change is desired. Messages will be able to be changed very quickly and easily.

This phase is recommended to begin in Year Three.

2.2.2 - Install CMS's Along Northeast Corridor

This phase will consist of installing CMS's prior to key decision points near and within the Northeast Corridor such that en-route motorists will have sufficient time after viewing the message to decide on a course of action and divert to an alternative route if necessary.



* Note:
CMS on I-69 may be in same location as CMS shown on Fig. 6-5. Also, CMS's on US 31 and US 431 may be replaced or supplemented with upstream CMS on US 31 north of diverge.

SOURCE: CITY OF INDIANAPOLIS, PLANNING DIVISION

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FIGURE 6-6

Proposed Regional CMS Locations

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The CMS's installed as part of the Northeast Corridor would be placed along I-465, I-69 and SR 37. Some of the signs would be placed outside of the recurring congestion areas, such that en-route motorists can be forewarned of congestion in time to divert, if desirable. CMS's would also be strategically placed at other key decision points and high volume locations within the corridor, such as near the I-465/I-69 interchange area.

The minimum placement (decision sight distance), mounting procedures, standardized messages and functions and operating options of the CMS's would be the same as for the radial CMS's described in Phase 2.2.1.

The general placement of the eight recommended CMS's for the Northeast Corridor are listed below and shown in Figure 6-7:

- West of the I-465/Keystone Avenue interchange for eastbound I-465 travelers.
- South of the I-465/US 36 interchange for northbound I-465 travelers.
- Near the SR 37/62nd Avenue intersection for northbound SR 37 travelers.
- North of the SR 37/146th Street intersection for southbound SR 37 travelers.
- East of the I-69/SR 238 interchange for southbound I-69 travelers.
- At the SR 37/I-69 merge for southbound drivers.
- East and west of the I-465/1-69 interchange for westbound and eastbound travelers, respectively.

This phase should begin implementation in Year One.

2.2.3 - Expand CMS Coverage

This phase will consist of expanding the freeway management CMS coverage from the Northeast Corridor to include the remaining segments (approximately 135 miles) of the Indianapolis freeway system. The phasing of this expansion will be based on the Mid-Term and Long-Term expansion studies, programmed freeway construction projects and freeway congestion.

This phase will occur after Year Five.

Location (Years 1-5): CMS's would be installed along the twelve most heavily traveled major radial routes (US 31 north and south, SR 431, SR 37 north and south, I-70 east and west, I-65 north and south and US 36 west) at locations outside of I-465.

CMS's would also be installed at eight locations (along I-465, I-69 and SR 37) within and near the Northeast Corridor in the northeastern quadrant of the Indianapolis metropolitan area.

Technology:	Years l-5:	Wireless communications and/or leased phone lines.
	Mid- and Long-Term:	Possible combination of wireless communications, leased phone lines and fiber optic cable.

Administration: INDOT would administer all contracts for outside services. The project phases should support the integrated operations plans, protocols and procedures developed in the freeway management program area and other program areas.

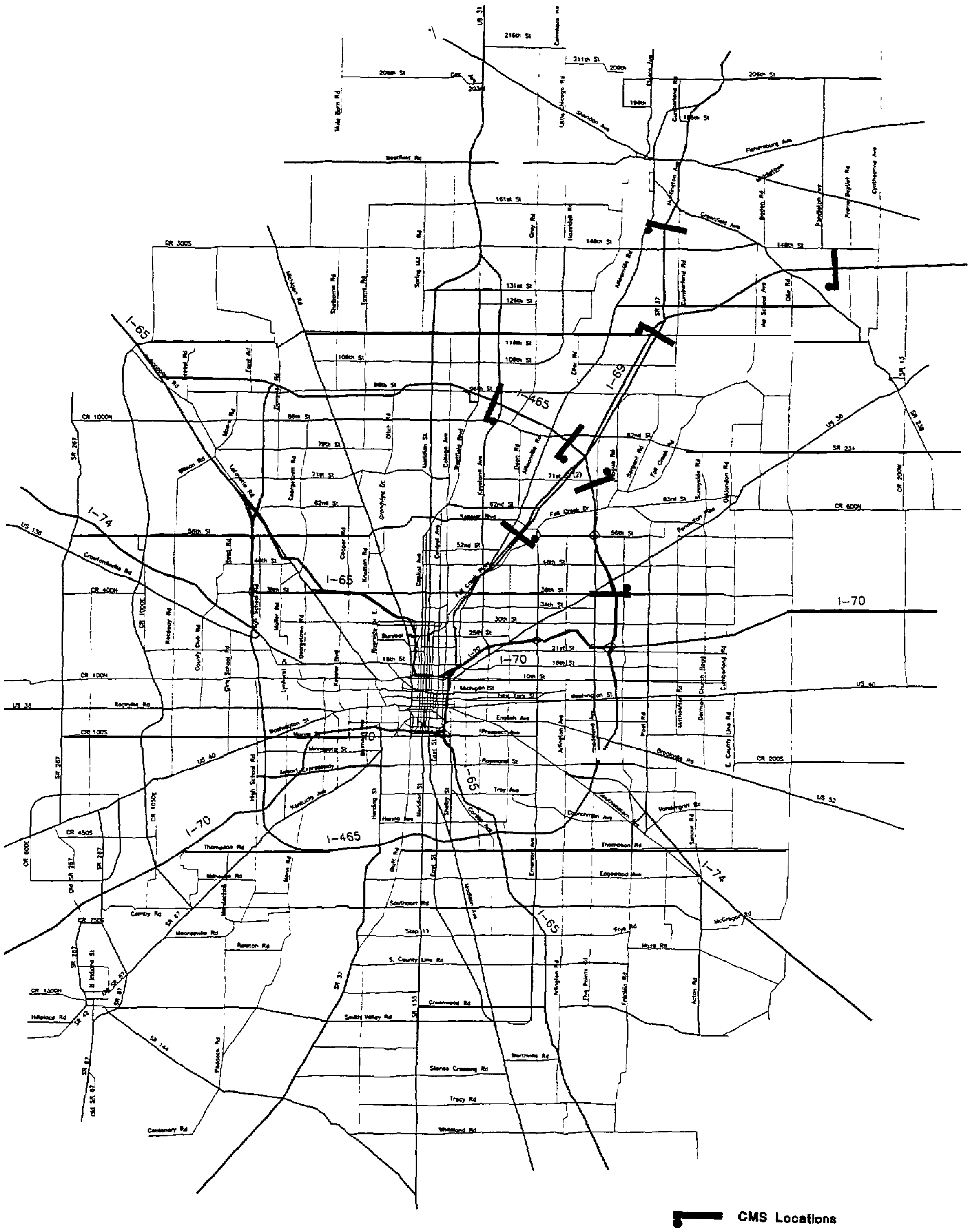
Time Frame:	Year 3-5:	CMS's along radial routes
	Year 1-5:	CMS's within and near the Northeast Corridor
	Years 6-20:	Expand system to cover remaining freeway segments

Budget (Years I-5):

Design	Construction	Total
$255,000	**$2,294,000**	**$2,549,000**

Staffing:	During Years l-2:	1.1 person-hours
	During Years 3-5:	0.6 person-hours

Sponsor: INDOT is recommended to sponsor this project.



SOURCE: CITY OF INDIANAPOLIS, PLANNING DIVISION

Indianapolis Area ITS Early Deployment Plan

FIGURE 6-7

Northeast Corridor CMS Locations

July 1996

PROJECT: 2.3 - INCIDENT RESPONSE

Objective:

The objective of this project is to support the implementation of a freeway management incident response system in the Indianapolis area capable of minimizing incident response and clearance times and changing signal control strategies to provide alternative arterial routes with acceptable levels of congestion during possible freeway diversion periods.

Current Conditions:

The current incident response and clearance systems are described in detail in the separate Incident Management Plan (July 1996) prepared in conjunction with this report.

The current conditions of the existing traffic signal control systems are documented in Program Area #3 - Advanced Traffic Signal Control.

There is currently no TOC or ATMS collecting, analyzing and distributing real-time traffic information within the Indianapolis area. However, there are agencies and components in-place that are currently providing traffic demand and incident response and clearance services and information to travelers. These agencies/ components are currently non-real time, uncoordinated, incomplete and/or technologically deficient.

Although there is no freeway traffic management system within the Indianapolis area, INDOT is currently establishing an interim traffic management center (TMC) for ATMS purposes for the Borman Expressway. The interim TMC for the Borman Expressway will receive data from Hoosier Helper vehicles, CCTV cameras and other sensing devices and distribute real-time traffic data to en-route travelers via CMS's and HAR. Data will be relayed to the interim TMC and Hoosier Helper vehicles for processing and display via spread spectrum radio and video compression technology. Information from the interim TMC and Hoosier Helper vehicles to the CMS's will be communicated via spread spectrum radio or cellular call-up.

Scope:

This project is divided into the following phases:

<u>2.3.1 - Install Ramp Meters Along the Northeast Corridor</u>

This phase consists of installing ramp meters at each of the entrance ramp locations along the fifteen mile Northeast Corridor beginning in Year One.

The ramp meters will be on-line with the Traffic Operations Center (TOC), the central facility for traffic data processing and control described in projects 2.3.3 and 2.3.4. Using TOC computers, metering rates will be determined via density (occupancy) data supplied by the vehicle detectors. Communications between the ramp meters and the TOC may initially be wireless or leased phone lines.

The ramp meters should be operational during the peak AM and PM periods on weekdays. During other periods, the meters will be turned off. The metering rates will be within the 4.5 to 18 second range, depending upon freeway demand.

The metering rates would be based on real-time traffic conditions, and adjusted every 15-30 seconds by the TOC computer. Although the metering rates will be based on real-time traffic information, system operators would have the ability to override the computer settings to help manage an incident more efficiently, if necessary.

When an incident occurs, meters upstream of the incident would be placed in the most restrictive rates and the downstream meters would be either turned off or placed into the fastest metering rates. This helps make better use of available roadway capacity following an incident, and allows the freeway to clear and return to normal operation faster.

INDOT and the local jurisdictions, including the cities of Indianapolis, Fishers, Carmel and Lawrence and Hamilton County will have to work together to coordinate and integrate the traffic signal operations of metered interchange areas with cross-street arterials and logical parallel arterial routes to accommodate possible traffic diversion during a downstream freeway incident. INDOT and the City will also monitor the diversion of freeway trips to adjacent surface streets in order to avoid queues at the meters when there is no freeway incident. Diversion of short trips from the freeway would be desirable. However, the diversion of a large amount of long distance trips to adjacent arterial roadways may not be desirable.

The effectiveness of ramp metering, like any other traffic regulation, is largely dependent upon voluntary driver compliance. Therefore, advance publicity should be positive and plentiful in order to help keep violation rates low. Police enforcement of the ramp meters should also be periodically used, especially during the initial implementation period.

All of the existing eighteen on-ramp locations along the Northeast Corridor are recommended for ramp metering installation. These sites are shown in Figure 6-8. Note that the 56th Street and Shadeland Avenue interchanges are essentially combined via a collector/distributor road and ramp meters would be installed only at the two mainline on ramps.

Ramp metering may initially start at only the land access interchanges before expanding to include the system interchange on ramps.

The ramp metering could take place without constructing specialized bus and high occupancy vehicle (HOV) bypass lanes. However, bypasses are highly desirable features that encourage transit and carpooling usage and should be considered where adequate right-of-way is available and installation costs are low and/or when other freeway interchanges are reconstructed.

2.3.2 - Expand Ramp Metering Svstem

This phase will consist of expanding ramp metering to include the remaining 135 miles of freeways in the Indianapolis area. The phasing of this expansion would be determined by the Mid-Term and Long-Term expansion studies, programmed construction projects and freeway congestion.

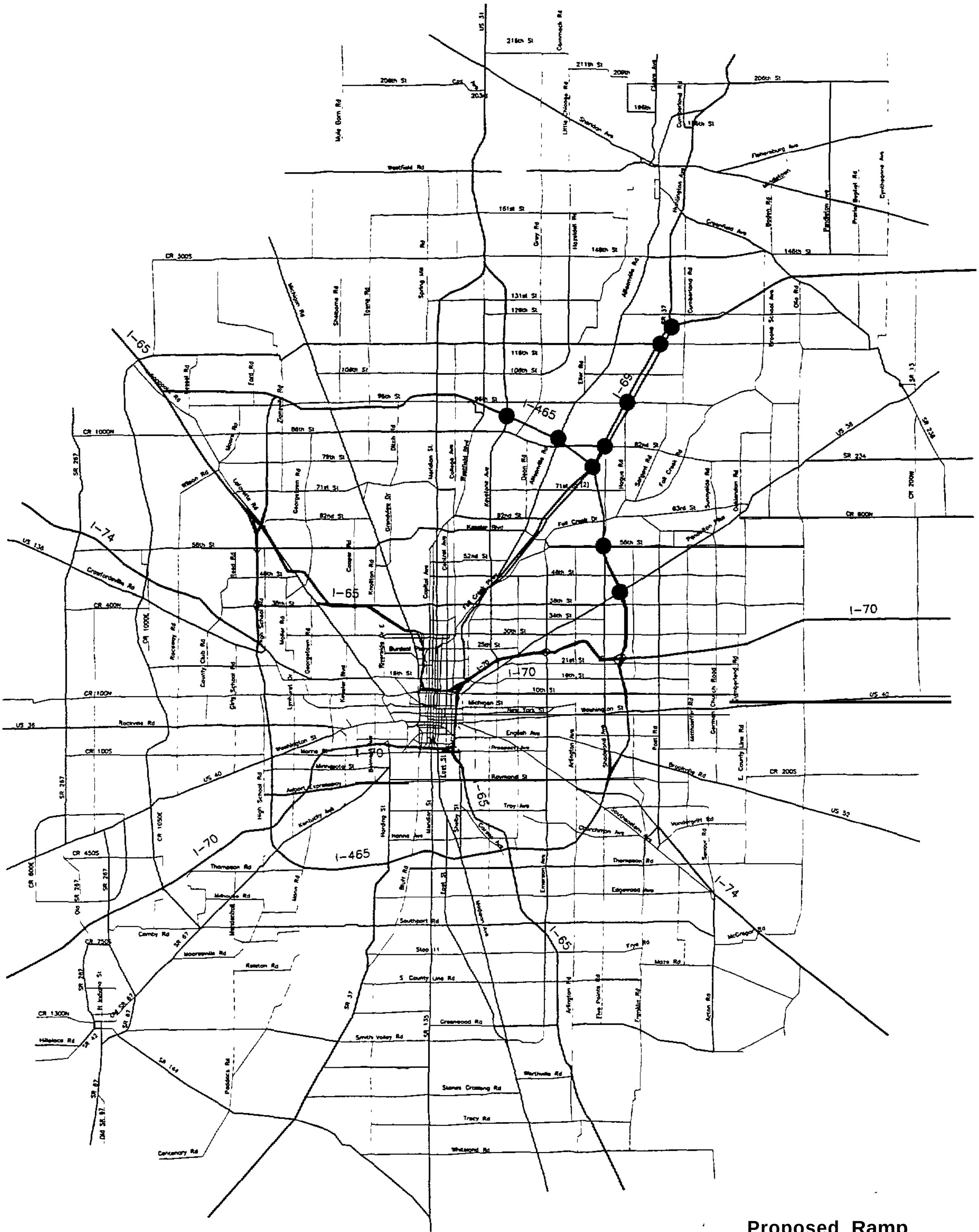
2.3.3 - Prepare Conceptual Definition of the Traffic Operations Center (TOC)

This phase will consist of the preparation of a conceptual definition of both the near-term and ultimate traffic operations centers. This conceptual planning would include analysis and evaluation of alternative TOC locations, staffing needs, operating hours, components, procedures, size requirements and communications. The recommendations of the study would be used to develop detailed plans for the TOC.

2.3.4 - Implement TOC

This phase will consist of the implementation of the near-term TOC during Year Two.

The TOC would coordinate and control the Hoosier Helper Program, the radial CMS's, the cellular hotline system and the freeway traffic management and advanced signal control components in the Northeast Corridor and quadrant, respectively. The TOC would be provided with adequate computer and monitoring capabilities (one work station on a local area network and two monitors), communications links and trained personnel.



Proposed Ramp Meter Location

SOURCE: CITY OF INDIANAPOLIS, PLANNING DIVISION

Indianapolis Area ITS **Early Deployment Plan**

FIGURE 6-8

Northeast Corridor Ramp Metering Locations

July 1996

Specific details of the TOC will be determined in the Phase 2.3.3 study. The TOC will receive sufficient data to allow for the detection, verification and rapid response/clearance of incidents and the provision of pre-trip and en-route traveler information, such that informed choices regarding mode, route, and time-of-travel can be made.

The ATMS functional component of the TOC is discussed in this section. The ATIS component is discussed under Program Area 1, Multi-Modal Traveler Information System.

The ATMS functional component of the TOC will receive the following information from these sources/components:

- Traffic volume and density (occupancy) information from vehicle detectors
- Video surveillance from CCTV cameras
- Incident detection information from Hoosier Helper vehicles, the Metropolitan Emergency Communication Agency (MECA), cellular hotline and call boxes
- Incident magnitude, type and clearance information from Hoosier Helper vehicles
- Traffic signal operations from INDOT, City of Indianapolis and other local signal systems from the ramp terminal, ramp meter and adjacent arterials within the Northeast Corridor and quadrant
- Construction, maintenance, special event and detour information from INDOT, the City of Indianapolis and area counties

The ATMS functional component of the TOC will distribute the following information to these sources/components:

- Information regarding detected incidents that may require emergency services to MECA
- Adaptive and integrated traffic signal timing information to INDOT and City of lndianapolis systems
- Processed real-time traveler information to the ATIS for further analysis and processing, if necessary, and distribution
- En-route traveler to CMS's information

The ATMS functional component of the TOC will be able to utilize the volume and density information from the inductance loop detectors to adjust ramp metering rates and to detect incidents. If an incident is detected through an abnormal occupancy, operators at the TOC will use the CCTV surveillance cameras to verify and view the incident via monitors. TOC personnel would then alert the appropriate emergency services, if necessary, and update the CMS's and real-time data flow to the ATIS.

The ATMS functional component of the TOC would also monitor and coordinate the advanced signal control system in the Northeast Corridor. This would include the integrated operations of INDOT and local signal systems, the implementation of real-time adaptive signal control along the major arterial routes and the installation/coordination of emergency/transit vehicle pre-emption. The integrated operations of the signal systems would allow for the synchronized coordination of the system as a whole and for the diversion of traffic from the freeway to adjacent parallel arterials during periods of non-recurring congestion on the freeway.

2.3.5 - Prepare Detailed Design of Ultimate TOC

This phase will consist of the preparation of detailed design plans for the expanded TOC during Years Two and Three. The detailed design plans would include specific information regarding exact TOC location and dimensions, number and capabilities of computers, number of monitors, types and numbers of graphical displays, system communications, procedures and protocol, staffing needs and operating hours. The design plans would allow the TOC to operate under an open architecture arrangement such that future expansion of the facility and implementation of new technologies would be possible.

2.3.6 - Increase Staff and Equipment of TOC

This phase would consist of increasing the staff and equipment of the TOC during Years Four and Five. These increases would allow for the management of the Northeast Corridor freeway management system, the priority quadrant advanced traffic control system, the Hoosier Helper Program, the radial CMS's and the cellular hotline systems and increasing hours of operations. The specific staffing and equipment requirements will be determined in Phase 2.3.3.

2.3.7 - Implement Fully Operational TOC

This phase would consist of changing over from near-term TOC operations to fully operational TOC operations by Year Five. This change may not actually involve a physical relocation if the TOC site is just upgraded to accommodate the ultimate TOC operations. The specific details of the fully operational TOC would be determined in Phase 2.3.5. The fully operational TOC would be able to accommodate and provide complete ATMS and ATIS functions and services for the entire Indianapolis area.

Location (Years l-5):	Northeast Corridor (approximately 15 miles): Ramp meters at the I-465/1-69 interchange; I-465 on-ramps at Keystone Avenue, Allisonville Road, 56th Street/Shadeland Avenue and US 36/ SR 37; and I-69 interchange on-ramps with 82nd Street, 96th Street 116th Street/SR 37. The TOC is recommended to be located at INDOT.
Technology:	Years 1-5: Wireless communications and/or leased phone lines, GPS tracking of Hoosier Helper vehicles, cellular communications, incident detection algorithms, ramp metering algorithms, CMS's, CCTV cameras, ramp meters, off-road detection system(s) Mid- and Long-Term: Same as Years l-5 with fiber optic cable.
Administration:	INDOT will administer all contracts for outside services. The project phases should support the integrated operations plans, protocols and procedures developed in the freeway management program area and other program areas.
Time Frame:	Years l-5: Ramp metering of Northeast Corridor Year 1: Define interim and ultimate TOC's Year 2: Implementation of TOC Year 3: Complete detailed design of ultimate TOC Year 4: Increase operations of TOC Year 5: Implement fully operational TOC

Budget (Years l-5):

Design	Construction	Total
$175,000	**$1,525,000**	**$1,700,000**

Note: Figures include implementation costs for Project 2.3.1.

Staffing:

During Years l-2: 3.0 person-hours
During Years 3-5: 4.0 person-hours

Note: Figures include staffing needs for Project 2.1.3.

Sponsor: INDOT is recommended to sponsor this project.

PROGRAM AREA: 3 - Advanced Traffic Signal Control

DESCRIPTION: This program area develops advanced traffic signal control systems to improve the flow of traffic in major regional corridors within the study area. Through the coordination of signal control systems on arterials and their integration with traffic management systems on adjacent freeways, traffic can be efficiently controlled for incidents and special events that cause non-recurring congestion. By upgrading and expanding the signal systems in major regional corridors, general traffic flow for all modes can be improved through efficient and responsive timing plans. Transit and emergency vehicle service can also be improved through the use of signal priority capabilities in the integrated system.;

Elements of the ultimate system could include:

- Incident Management
- Transit Priority
- Emergency Vehicle Preemption
- Freeway Diversion Plans
- Integrated Freeway/Arterial Traffic Adaptive Control
- Integrated Arterials/CBD Strategy
- Computerized Inventory and Timing Files
- Central/Distributed Control

The advanced traffic control system would likely be linked to other program area information systems in order to monitor/coordinate multi-jurisdictional signal operations and timing information via a centralized traffic operations center (TOC). The TOC would dynamically adjust traffic control devices such as ramp metering, traffic signals, or lane assignments. This will require networking all of the traffic controllers or the establishment of some level of centralized traffic control.

The long-range traffic control signal system may also include Transportation Demand Management (TDM) policies and strategies that can be implemented by changing the signal preferences to encourage the use of HOV systems and transit systems with signal prioritization. Preferential treatment such as signal priority can be given to high occupancy transit vehicles in the urban street network to maximize passenger throughput or to emergency vehicles to minimize response time and response accidents.

For Indianapolis, the networking and coordination of traffic signals may be the most feasible and cost effective approach for improving the overall network efficiency.

Throughout this Program Area, the term "Northeast Corridor" is used to describe an area which is the recommended early focus of many of the ITS traffic signal control projects in this section. In Program Area 2, Freeway Management System, the Northeast Corridor consists of approximately 15 miles of freeway (I-465 from SR 431 to US 36/SR 67 and I-69 from I-465 to SR 37). In this Program Area, the Northeast Corridor consists of the arterial streets within a pie-shaped area defined by I-465 to the north and east, US 36/SR 67 to the south and Keystone Avenue to the west.

RATIONALE: The program area supports the following Overriding Factors:

- Safety
- Funding/Sponsor
- Multimodal
- Serves Many
- Early Winner
- Building Block
- High Visibility
- Maximize Available Resources

EXPECTED RESULTS: The program area will address the following Problem Causes:

- Poor Arterial Flow/Signal Coordination
- Incidents (Poor Management/Response)
- Safety (Accidents)
- Poor Institutional Coordination/ Jurisdictional Cooperation

The program area will address the following User Services:

- Traffic Control
- Incident Management
- Public Transportation Management
- Emergency Vehicle Management
- Demand Management and Operations

3 ADVANCED TRAFFIC SIGNAL CONTROL	Implementation Timeframe						
	Year					Year 6-10	Year 11-20
	1	2	3	4	5		
3.1 Normal Operations							
3.1.1 Implement Program to Upload/Download and Update Timing Plans	X	X	X	X	X	X	X
3.1.2 Implement Program to Convert to Microprocessor Based Controllers and Standardize Equipment	X	X	X	X	X	X	X
3.1.3 Implement Maintenance and Malfunction Monitoring Programs		X	X	X	X	X	X
3.1.4 Implement Adaptive Traffic Control in Northeast Corridor		X	X	X	X		
31.5 Conduct Studies to Determine Mid-Term and Long-Term Adaptive Control Expansion Areas and Phasing					X	X	
3.16 Expand Adaptive Control to Remaining Major Arterials in Metro Area						X	X
3.2 Non-Recurring Conditions							
3.2.1 Install EVP on Major Emergency Services Routes in Metro Area			X	X	X		
3.2.2 Install EVP in Northeast Corridor			X	X	X		
3.2.3 Develop Diversionary Timing Plans/Procedures for Incidents **and** Special Events				X	X		
3.2.4 Conduct Studies to Determine Mid-Term and Long-Term EVP Expansion Areas and Phasing					X*	X	
3.2.5 Expand EVP to Remaining Major Arterial Routes in Metro Area						X	X
3.3 Institutional Issues							
3.3.1 Develop Interagency Coordination Committee/ Cooperation	X	X	X	X	X	X	X
3.32 Develop Procedures and Consensus for Providing Systems Integration Via Centralized TOC Computing Operations	X	X					

* Mid-Term study time period.

PROJECT: 3.1- NORMAL OPERATIONS

Objective:

The objective of this project is to outline programs, procedures and phasing for the implementation of advanced traffic signal control in the Indianapolis metropolitan area such that the arterial, ramp terminal and ramp metering signal systems will provide integrated and real-time traffic responsive operations during normal operating conditions.

Current Conditions:

Currently, traffic signal equipment located in the project study area are controlled by a number of different agencies. As such the technology varies considerably from location to location. There are intersections that are controlled with electro-mechanical fixed time controllers operating in an isolated manner as well as solid state controllers with fiber optic interconnection controlled by a closed loop master. There is no large area computerized signal system in the area. Outside of the Central Business District, most of the signals on arterial routes are interconnected. Traffic signals at the interstate ramps are interconnected to one another but may not be interconnected to the other signals on the arterial. All of the agencies involved are in a continuous process of updating their signal systems and installing new systems.

The following points outline some of the specific existing conditions.

- The City of Indianapolis operates roughly 850 signals, approximately 190-200 of these are included in 21 closed loop systems.
- INDOT operates roughly 350 signals in the study area of which approximately 120 are included in seven closed loop systems.
- There is no coordination between INDOT and City of Indianapolis signal systems.
- Of the City of Indianapolis' 850 signals, approximately 400 have electro-mechanical controllers that do not have conflict monitors.
- Approximately half of the City of Indianapolis signals are interconnected.
- All of the INDOT traffic controllers are microprocessor units.

- The City of Indianapolis traffic controllers are either electro-mechanical, solid state or microprocessor units.

- There are no ramp meter signals.

- There is a two-mile segment along SR 37 (north of 38th Street) and Fall Creek Parkway (south of 38th Street) which includes a center reversible lane.

- There is no transit priority system.

Scope: This project is divided into the following phases:

3.1.1 - Implement Program to Upload/Download and Update Timing Plans

This phase will consist of the implementation of a program to upload/download and update timing plans for all of the arterial signal systems in the metropolitan area. This phase will begin in Year One and be continuously ongoing.

Some of the INDOT and City of Indianapolis signal systems are currently able to upload and download timing information remotely from the signal maintenance and traffic engineering locations. These closed loop systems are currently capable of providing "time-of-day" signal timing patterns which optimize operations along the major arterial routes. However, there is no program for periodically updating the signal timings at these locations as this task is typically a lower priority than other signal related issues and is labor intensive. This results in the use of outdated signal timings at some locations where traffic demand conditions have changed since the last update.

The ultimate vision for the Indianapolis area would include the implementation of advanced traffic signal control technologies for normal operations that enable the real-time control of traffic signals. These technologies may include automatic traffic signal optimization, ramp metering, traffic signal prioritization, reversible lane designation and ramp or lane closure systems. The automatic traffic signal optimization component would receive real-time traffic demand information from system detectors, process and analyze this data via a TOC computing system and automatically select and relay an appropriate new timing plan for implementation to each on-line signal location based on pre-established demand thresholds and corresponding timing plans.

The phasing of this program from the current conditions to the ultimate vision of traffic responsive or adaptive control would include several years of manually updating the timing plans at the non-automated locations. However, as additional arterial closed loop segments are added or extended, more and more of this updating will be able to occur from PC's located at the signal or traffic engineering shops. Thus, as the automated system evolves to complete Long-Term implementation, the time spent uploading/ downloading and updating timing plans should decrease.

3.1.2 - Implement Program to Convert to Microprocessor Based Controllers and Standardize Equipment

This phase will consist of the implementation of programs by INDOT and the City of Indianapolis to convert to microprocessor based controllers and standardize equipment. This phase should begin in Year One and be continuously ongoing.

The conversion and standardization would allow for integrated operations between the INDOT and City of Indianapolis systems, expedite maintenance and purchasing functions and provide for implementation of traffic responsive or adaptive control.

3.1.3 - Implement Maintenance and Malfunction Monitoring Programs

This phase will consist of implementing a maintenance and malfunction monitoring program that will have the capability of automatically alerting system operators of on-street signal problems. This phase will begin in Year Two and be continuously on-going through total system conversion.

The program software will require hardware compatibility, including microprocessor based controllers with conflict monitors, and adequate communications between the central computer(s) and the on-street masters. The compatibility of the hardware components would occur coincident to the standardization of equipment in Phase 3.1.2.

The program software will allow local on-line controllers to report maintenance (bulb out, loop out, etc) and malfunction (conflicting phases, on-flash, power outages, etc) problems through corresponding on-street master controllers to a centralized location or locations (i.e. TOC, signal maintenance shop and/or traffic engineers office) where the type and magnitude of the problem would appear as an alarm message on a computer monitor. The program software would also place calls to specified E-Mail addresses and leave one of a list of standardized messages and/or activate a paging system to notify appropriate control personnel for high level alarm conditions. This feature will be especially useful during time periods when the TOC, maintenance shop or engineering office is not in operation.

The program software would also provide for the uploading and downloading of timing plans and the periodic listing of abnormal operations or occurances (preemption calls, maintenance and malfunction records, etc) at each on-line location. This would allow signal operations personnel to get on-screen or hardline copies of each signal's operations over the past day as they arrive at work each morning.

3.1.4 - Implement Adaptive Traffic Control in Northeast Corridor

This phase will consist of implementing an integrated adaptive or responsive traffic control system in the Northeast Corridor beginning in Year Two. The adaptive control would allow for the real-time operations of the signal systems in the corridor.

Throughout this Program Area, the term "Northeast Corridor" is used to describe an area which is the recommended early focus of many of the ITS traffic signal control projects in this section. In Program Area 2, Freeway Management System, the Northeast Corridor consists of approximately 15 miles of freeway (I-465 from SR 431 to US 36/SR 67 and I-69 from I-465 to SR 37). In this Program Area, the Northeast Corridor consists of the arterial streets within a pie-shaped area defined by I-465 to the north and east, US 36/SR 67 to the south and Keystone Avenue to the west. The Northeast Corridor signal system would include all of the arterial classified roadways (INDOT and City of Indianapolis) in this area and the INDOT ramp meters discussed in Phase 2.3.1.

The program software will require hardware compatibility, including microprocessor based controllers, and adequate communications between the central computer(s) and the on-street masters. The compatibility of the components would be in-line with the long-range specifications outlined in Phase 3.1.2. The central computer(s) may initially be located at INDOT and City of Indianapolis maintenance or traffic engineering shops and ultimately accommodated by an additional computer at the TOC.

The adaptive system for the Northeast Corridor would:

- Automatically measure traffic congestion, calculate optimal signal timing plans to address the congestion and implement new plans to the on-street controllers every cycle. When compared to a fully optimized- fixed time system, an adaptive system can reduce stops by 40%, delays by 20%, fuel consumption by 12% and vehicle emissions by 7%.

- Be self calibrating and simplify the implementation process by eliminating the need to manually prepare and update new signal timing plans.

- Automatically track and store vehicle counts, eliminating the need to have valuable resources performing this task.

- Allow for multiple control strategies, including adaptive, fixed time and isolated control simultaneously at different intersections within the system.

- Provide multiple security levels to allow several agencies to share the same system while retaining control over their own groups of intersections.

- Require a significant number of system detectors.

3.1.5 - Conduct Studies to Determine Mid- and Long-Term Expansion Areas and Phasing

This phase will consist of conducting detailed studies to determine the Mid-Term and Long-Term adaptive control expansion areas and phasing. The Mid-Term study will analyze and evaluate the short-term experiences with adaptive control in the Northeast Corridor and identify Mid-Term needs and phasing. The Long-Term study will analyze and evaluate the Mid-Term experiences and identify Long-Term phasing to complete the system coverage. The studies will also evaluate emerging technologies that may supplement and/or replace some of the in-place or proposed signal components. The Mid-Term study will be conducted in Years Five and Six and the Long-Term study will be conducted in Years Nine and Ten.

3.1.6 - Expand Adaptive Control to Remaining: Maior Marterials in Metro Area

This phase will consist of expanding adaptive traffic signal control to cover the remaining major arterial roadways in the metropolitan area. The phasing of the adaptive signal control expansion will be determined by the Mid-Term and Long-Term expansion studies, programmed construction projects and arterial congestion.

Location (Years l-5): Northeast Corridor defined as the area bounded by I-465 to the north and east, Keystone Avenue to the west and US 36/SR 67 to the south.

Technology: Adaptive traffic signal control, automated maintenance and malfunction monitoring

Administration: INDOT will administer all contracts for outside services. The project phases should support the integrated operations plans, protocols and procedures developed in the advanced traffic signal control program area and other program areas.

Time Frame:

Year 1:	Programs to upload/download timing plans and convert to microprocessor based controllers.
Year 2:	Programs for maintenance and malfunctions and implementation of adaptive control for Northeast Corridor.
Year 3:	Continuation of Years 1 and 2 programs
Year 5:	Mid-Term study to evaluate short term components and identify Mid-Term expansion areas and phasing and continuation of Years 1-3 programs
Years 6-10:	Expansion of adaptive control to congested arterials and Long-Term study (Years 9 & 10) and continuation of Years 1-3 programs
Years 11-20:	Expansion of adaptive control to remainder of major arterial roadways and continuation of Years l-3 programs.

Budget (Years l-5):

Design	Construction	Total
$1,335,000	**$8,965,000**	**$10,300,000**

Staffing:

During Years 1-2: 1.0 person-hours
During Years 3-5: 1.45 person-hours

Sponsor: INDOT and the City of Indianapolis are recommended to sponsor this project.

PROJECT: 3.2 - NON-RECURRING CONDITIONS

Objective:

The objective of this project is to identify procedures, protocol and phasing for providing priority treatment for emergency vehicles and the development of signal plans to handle non-recurring conditions such as incidents and special events.

Current Conditions:

The following points outline the specific current conditions relative to current traffic signal control of non-recurring conditions.

- There is one arterial segment (Keystone Avenue from 44th Street to 62nd Street, approximately 10-12 signals) currently providing emergency vehicle preemption (Opticom).

- The City of Indianapolis has programmed a second emergency vehicle preemption system for College Avenue from 16th Street to 86th Street containing roughly 23 signals.

- There are currently no procedures or plans for diverting traffic from a freeway segment to an adjacent arterial corridor during freeway incidents or periods of high congestion.

- There are currently no special event (Indianapolis 500, RCA Dome events, etc.) timing plans in-place for integrated operations between INDOT and local jurisdictions.

Scope:

<u>3.2.1 - Install EVP on Emergency Services Routes in Metro Area</u>

This phase consists of identifying the priority routes and installing emergency vehicle preemption (EVP) along the major emergency services routes in the Indianapolis Metropolitan area by Year Five. EVP would allow emergency services vehicles to interrupt the normal traffic signal timing along the traveled route to reduce emergency response time and the likelihood for emergency vehicle crashes while responding.

EVP enables authorized vehicles to activate a special phase selection sequence that would interrupt normal signal operation and provide a priority right-of-way. Civilian traffic responds appropriately because drivers react naturally to their red or green signal indications. After the emergency vehicle efficiently crosses the intersection the intersection returns quickly to its regular routine.

The EVP is enabled by the driver of the emergency vehicle by activating an emitter switch in advance of the traffic signal. The emitter device uses coded infrared transmissions to communicate the desired preemption to the signal controller. The receiving devices are typically mounted on traffic signal mastarms.

The installation of EVP within the Indianapolis metro area should occur first along routes that have a high amount of emergency vehicle traffic. Discussions with emergency services personnel and providers (police, fire, ambulatory) for the Indianapolis area indicate that there are currently some routes that are traveled more extensively for emergency vehicle response purposes. A listing of these routes is provided below.

- 86th/82nd Street from I-465 to Hague Road
- Washington Street from Girls School Road to Cumberland Road
- Pendleton Pike from Shadeland Avenue to Oaklandon Road
- 16th Street and Crawfordsville Road from I-74 to Dr. Martin Luther King, Jr. Street
- 38th Street from west of I-465 to Mitthoeffer Road
- Emerson Avenue from South County Line Road to Raymond Street
- Fall Creek Parkway from Meridian Street to 75th Street
- Meridian Street from North Street to 96th Street
- Michigan Road from 38th Street to 96th Street
- Sherman Drive from Main Street in Beechgrove to Prospect Avenue
- US 31 from Terrace Avenue to South County Line Road
- Hanna Avenue from East Street to Keystone Avenue
- Emerson Avenue from 10th Street to Kessler Boulevard
- Raymond Street from Holt Road to Southeastern Avenue
- 56th Street from Emerson Avenue to Post Road
- Post Road from Washington Street to 56th Street
- Shadeland Avenue from Washington Street to 46th Street
- Allisonville Road from 82nd Street to 96th Street
- 86th Street from Allisonville Road to Center Run Road
- Harding Street from Raymond Street to Oliver Avenue
- Morris Street from Harding Street to West Street

Other programmed traffic signal upgrades along these routes or other frequently traveled emergency services routes will also help to determine and prioritize EVP routes.

3.2.2 - Install EVP in Northeast Corridor

This phase will consist of installing EVP at each of the traffic signals suggested for adaptive signal control in the Northeast Corridor (see 3.1.4) beginning in Year Three.

3.2.3 - Develop Diversionary Timing Plans/Procedures for Incidents and Special Events

This phase will consist of the development of diversionary timing plans and procedures for incidents and special events by Years Four and Five. These plans would provide for changing the normal traffic signal settings along major arterial routes to expedite the flow of traffic diverting around an incident site or traveling to a special event (i.e. Indianapolis 500, major RCA Dome events, etc). These plans may also be used during the prolonged construction of an adjacent parallel arterial route.

Integrated traffic signal operations between INDOT and the City of Indianapolis would be necessary as incidents and special events involving freeway and arterial operations would require synchronized control of arterial, ramp terminal and ramp meter locations. These integrated operations would be provided and monitored at the TOC, which may have temporary (i.e. peak periods, special events, incidents, etc) or full-time control of both signal systems. The diversionary timing plans and procedures would be stored on the TOC signal control computer and would be able to be implemented automatically based on pre-established thresholds or via operator intervention. These settings would be able to be monitored and overridden by system operators, if necessary, to respond to unique conditions. Note that these diversionary timing plans will not be necessary for major arterial roadways following the implementation of adaptive traffic control along these routes.

3.2.4 - Conduct Studies to Determine Mid-Term and Long-Term EVP Expansion Areas and Phasing

This phase will consist of conducting detailed studies to determine the Mid-Term and Long-Term EVP expansion areas and phasing. The Mid-Term study will analyze and evaluate the short term experiences with EVP in the Northeast Corridor and identify Mid-Term needs and phasing. The Long-Term study will analyze and evaluate the Mid-Term experiences and identify Long-Term phasing to complete the system coverage. The studies will also evaluate emerging technologies that may supplement and/or replace some of the in-place or proposed signal components. The Mid-Term study will be conducted in Years Four and Five and the Long-Term study will be conducted in Years Nine and Ten.

3.2.5 - Expand EVP to Remaining Major Arterial Routes in Metro Area

This phase will consist of expanding EVP to cover the remaining arterial routes in the metropolitan area. The phasing of the EVP expansion will be determined by the Mid-Term and Long-Term expansion studies, programmed signal construction projects and arterial congestion.

Location (Years l-5): Northeast Corridor defined as the area bounded by I-465 to the north and east, Keystone Avenue to the west and US 36/SR 67 to the south.

Technology: Emergency vehicle preemption

Administration: INDOT will administer all contracts for outside services. The project phases should support the integrated operations plans, protocols and procedures developed in the advanced traffic signal control program areas and other program areas.

Time Frame:

Years 3-5:	EVP on major emergency service routes and in Northeast Corridor
Years 4-5:	Develop diversionary plans/procedures for incidents and special events
Year 5:	Mid-Term study to evaluate short term components and identify Mid-Term expansion areas and phasing
Years 6-10:	Expansion of EVP to major arterials and Long-Term Study (Years 9 & 10)
Years 11-20:	Expansion of EVP to remainder of major arterial roadways in metro area

Budget (Years l-5):

Design	Construction	Total
$1,261,500	**$3,253,500**	**$4,515,000**

Staffing:

During Years l-2: 0.50 person-hours
During Years 3-5: 1.05 person-hours

Sponsor: INDOT and the City of Indianapolis are recommended to sponsor this project.

PROTECT: 3.3 - INSTITUTIONAL ISSUES

Objective: The objective of this project is to identify programs and procedures that will result in the integration of traffic control strategies 11.25

Current Conditions: There is no coordination between the INDOT and City of Indianapolis signal systems.

Scope: This project is divided into the following phases.

3.3.1- Develop Interagency Coordination Committee/Cooperation

This phase will consist of developing a committee to help improve the coordination and cooperation between INDOT and local jurisdictions. The committee would be comprised of INDOT and local agency personnel and would meet periodically to discuss non-recurring traffic signal control issues (EVP expansion corridors, diversionary timing plans, planning signal construction activities and new technologies) relative to special events or incidents. The committee should be implemented in Year One and be ongoing.

3.3.2 - Develop Procedures and Consensus for Providing Svstems Integration Via Centralized TOC Computing Operations

This phase will consist of the development of consensus and procedures for providing integration of the INDOT and local traffic signal control systems via a centralized Traffic Operations Center (see Program Area 2, projects 2.3.3 and 2.3.4) computer. Procedural and operational issues to be resolved include:

- Control of the integrated system (INDOT, local agencies, combination).

- Operating hours and staffing of full-time or part-time Traffic Operations Center (TOC) control. Will the TOC control all signals all the time or only during peak weekday demand periods, special events and incidents?

- Extent of integration. Will all of the major on-line arterial systems be integrated or only those that may serve as a diversionary route for freeway or other arterials during special events, incidents and/or construction?

- The handling of ramp metering diversions or queuing onto arterial streets.

- The planning of diversionary routes for incidents and special events.
- Magnitude of special event to warrant additional timing plan.
- Establishment of threshold values for adaptive and/or responsive control.

The integration of the signal systems will ultimately require that all signals in the system be microprocessor based and of standardized compatible equipment to allow for the automatic uploading and downloading of timing plans, the implementation of maintenance and malfunction monitoring software and the implementation of adaptive control and EVP operations.

Location (Years l-5): Not Applicable

Technology: Not Applicable

Administration: INDOT and City of Indianapolis will administer this project.

Time Frame: Years l & 2: Develop committee to improve interagency coordination and develop procedures for providing systems integration

Budget (Years l-5): Budget included under Program Area 6, Technical and Planning Support

Staffing (Years 1-5): Staff to participate through the work groups included in Program Area 6, Technical and Planning Support

Sponsor: INDOT and the City of Indianapolis will sponsor this project.

PROGRAM AREA: 4 - Transit Management Systems

DESCRIPTION: The goals of this program area are to improve the management and operation of public transit and to promote transit ridership in Indianapolis by providing more efficient, flexible, and reliable services. The proposed ITS technologies aim to achieve these goals by the efficient use of scarce resources and through potential reductions in operating cost. This program to automate components of the transit system will be phased in over time. An ITS compatible transit system will serve as an integral part of the overall Indianapolis ITS system.

Public transit has not been a focal area in the overall transportation development program in Indianapolis in recent years. In an effort to provide good quality public transportation services to the public, METRO Bus, the Indianapolis transit agency, has been privatized and reorganized. Under the new organization, a Mobility Management Office directly reporting to City's Department of Capital Asset Management (DCAM) is overseeing the overall public transit development and operations in Indianapolis. After privatization, METRO Bus still operates 70 percent of the bus routes while ATE Management and Service Company and several other smaller operators make up the rest of the services.

In a 1994 customer survey, 22.5 percent of respondents complained about long wait for busses, 10.9 percent of respondents indicated the schedule was confusing, and 10.1 percent of respondents felt the need to serve more areas.

The challenge of public transit in Indianapolis is to maintain quality service in order to attract more riders while making the best use of limited resources. Traditionally, a higher level of service has been equated with higher service frequency. This is, however, a costly approach for a fixed-route system with inadequate demand. It is sensible for public transit to adopt demand-responsive services, and to implement selected ITS technologies to ensure a reliable connections to the fixed-route services.

Selected ITS technologies should be considered in order to increase transit system efficiency, scheduling and connection reliability, and to better coordinate operations with service providers. Examples of such technologies include computerized scheduling and dispatch, Automatic Vehicle Location (AVL) systems, electronic fare collection, wireless communications, and advanced transit information services for the public.

This program area focuses on:

- Improving the customer information service by providing useful and accurate information.

- Improving the efficiency of transit operations by adopting automation tools.

- Adopting more flexible and localized service to increase transit ridership.

This program plan is generally consistent with METRO Bus' 1995 Capital Improvement Plan and phased approach for ITS technology implementation referenced therein.

ITS project elements in support of this transit program area include the following:

- Improved customer information service using selected ITS technology.
- Automated electronic fare collection and passenger counter system to improve the operation and management efficiency.
- Demonstration AVL demand responsive shuttle service to improve the transit accessibility.

Improving customer information service can secure current transit ridership as well as to attract non-riders to use the public transit. Two areas of potential improvement in transit customer information service are proposed. The electronic display devices which provide route and schedule information should be considered at major transit terminals and transfer stations. Such devices can be easily upgraded to provide bus status information when Automatic Vehicle Location (AVL) is implemented in the future. Another opportunity is the expansion and upgrade of the current automatic telephone information system. The proposed expansion will allow the system to provide origin-destination sensitive itinerary information at users' request.

METRO Bus is in the process of moving from an aged, proprietary, central computer system to an up-to-date, flexible, networked micro-computer-based system. This move is highly beneficial to the agency in terms of increased computing power, lower maintenance costs, and compatibility with related systems. This new data network will facilitate the implementation of modern computerized scheduling and dispatch as well as information exchange with other agencies. To take advantage of the data exchange capability, two ITS technologies are identified to improve transit operations. The onboard smart card fare collection system will secure the fare collection operation and improve the boarding efficiency by utilizing electronic cash transactions. An advanced passenger counter can accurately capture ridership data for service and route performance review. The financial transaction and ridership data can be downloaded, processed, and exchanged with networked accounting and administrative system.

METRO Bus is implementing a computerized scheduling and dispatch system which will improve the personnel and facility management, as well as maintain service schedules and a re-routing capability in case of emergencies. Although costly initially, the implementation of ITS technologies such as AVL, and on-board wireless communications can achieve more efficient operation with a possibly smaller fleet size. With real-time vehicle location and communication, the dispatcher can direct individual vehicles to maintain schedules and achieve reliable connections.

Based on the "Neighborhood Zone Service" concept outlined in the Strategic Plan for Indianapolis Public Transportation (1994), an experimental transit service using AVL is proposed in this program area. The Neighborhood Zone Services aim to provide local services to get people to the core transit system, to connect neighborhoods with nearby shopping, and to integrate suburban clusters with the surrounding residential areas. The scale of these services is such that requires flexibility and small vehicles. AVL system allows the real-time dispatch and routing of service vehicles to achieve high level of demand responsiveness.

As the AVL technologies are phased in, current transit status can be disseminated to the electronic display devices and on the touch tone telephone information service system. Those information, ultimately, can be pooled with the real-time highway traffic information (from freeway management projects) to provide a true multi-modal information capability.

RATIONALE: This program area supports the following Overriding Factors:

- Region-wide Perspective
- Multi-Modal
- High Visibility
- Maximize Available Resources

EXPECTED RESULTS: This program area will address the following Problem Causes:

- Lack of Transit Service
- Travel Time Information
- Inadequate Capacity

This program area will address the following User Services:

- Public Transportation Management
- Pre-Trip Travel Information
- En-Route Transit Information

4 TRANSIT MANAGEMENT SYSTEM	Implementation Timeframe: Year 1	2	3	4	5	Year 6-10	Year 11-20
4.1 Improved Customer Information Service							
4.1.1 Study Functional Requirements and Specifications for Electronic Display			X				
4.1.2 Design and Implement Electronic Display at Major Transit Terminals			X	X	X		
4.1.3 Expand Current Automatic Telephone Information Service System				X	X		
4.1.4 Define Functional Requirements and Develop Plans for Incorporation of Dynamic Status Information						X	
4.2 Integrated **Electronic Fare Collection and Passenger Counter System**							
4.2.1 Define Functional Requirements for an Expanded System Based on Current GFI Fare Box System			X	X			
4.2.2 Design and Implement System			X	X	X		
4.2.3 Identify and Define Future Communication Requirements to Support AVL and Real-Time Ridership Data Transfer				X		X	
4.3 **Dynamic Status with Automatic Vehicle Location (AVL)**							
4.3.1 AVL Design and Specifications					X	X	
4.3.2 Neighborhood Zone AVL Demonstration					X	X	
4.3.3 Incorporate Dynamic Status Electronic Display (Active Transit Sign)					X	X	X

PROJECT: 4.1- IMPROVED TRANSIT INFORMATION SERVICE

Objective:

This project implements electronic information display devices and an automated telephone information service system to provide improved transit information service. The display devices will be placed at major transit terminals in Indianapolis. These display devices will initially provide static schedule and transfer information as well as emergency or special messages. When Automatic Vehicle Location (AVL) is implemented (Project 4.3) the display devices can also provide bus status information, including the projected arrival times of specific buses at specific stops. An automated telephone information service system provides bus fare[2], schedule and transfer information to users using a touch tone telephone. The touch tone system employs an easy to use voice menu similar to the widely adopted telephone banking system. The automated telephone system has been proven as one of the most cost effective ways of providing transit information. This system can be expanded to provide bus status information as AVL becomes available.

Current Conditions:

No electronic display devices are currently being used in Indianapolis for public transit. At a recently opened Customer Information Center in downtown Indianapolis, an automatic telephone information service system has been installed to provide information on specific bus routes. A caller who dials the number will be greeted by a recorded message to enter a bus route number for recorded information about the selected route. Information provided includes a brief description of the route, operating hours, and service frequency. If the caller does not know the route number, he or she can talk to an operator by punching a number or staying on the line. This system, however, does not provide origin or destination sensitive route information that involves connections. For someone who is not familiar with the current transit routes, this system is of little use.

Scope:

This project includes four phases. The first two phases implement electronic transit information displays at major transit facilities. The other two phases expand the current METRO Bus automated transit information service and develop the plans for incorporating dynamic, up-to-the-minute transit status information (implemented in Project 4.3).

2 Some routes servicing nearby cities charge different fares due to the local taxing scheme.

4.1.1 - Studv Functional Requirements and Specifications for Electronic Display

This stage of the project will identify the appropriate locations for the electronic displays which might include the Downtown Customer Information Center, major connection stops, and terminals. The electronic information display devices for different locations must consider the following:

- Display technology (e.g., LED matrix or video)
- Information contents
- Format of messages (e.g., overall size, character size, number of lines, time to cycle through all information)
- Audio capacity (if video)
- Communication system for distributing and updating data to display devices

The latest LED changeable message display has improved visibility and animation effects (e.g., scrolling text, graphics) and has been quickly adopted by many transit agencies. In addition to their compact size, declining costs have made LED displays a popular choice for public information. Single-line LED display is recommended for individual bus stops. Larger size multiple-line LED display is recommended for general staging areas at major transit facility such as the Downtown Customer Information Center.

For years, television monitors have been used by airlines and other transportation operators to provide schedule and other information services. The television monitor can display information from bulletin board-like textual information to video presentation with full motion video and audio. However, visibility is limited by the size of monitor. The television monitors are usually rack mounted or hidden in cabinets or walls.

Information that can be posted initially includes bus route number, start and end stops, current service frequency, last service, fare, and change of service notices. Bus status information can be provided as AVL becomes available.

The information format needs to comply with the selected display devices. The manufacturers of these display devices can usually provide basic guidelines for a specific application.

Communication is needed to update the information on the electronic display devices. The major communication options are wired and wireless systems. Wired systems use coaxial cable or twisted pair to distribute information from an information server to the electronic display devices. This option is especially feasible when an existing communication line with adequate bandwidth is in place or when the display devices and information server are in the same locale.

The alternative to a wired system is a wireless communication that distributes data over the radio spectrum. For example, an FM subcarrier that encodes textual data in the commercial FM broadcast is a relatively low cost and one-to-many wireless data communication option. Using an FM subcarrier, a small receiver in the display device will decode the textual data from the continuous FM broadcast and display the specific message on the device. In terms of coverage area, a typical FM radio station can cover an area of 30 to 50 miles radius. An even larger coverage area can be achieved by relaying the broadcast signal to an adjacent transmission facility.

Other wireless communications, such as cellular phone modem dial-in, also can be considered if continuous information updates are not required. This technology has been used to update the information on the remote changeable message sign. These electronic display devices are equipped with cellular modems. Information on the display device can be updated by placing a call to the cellular modem to upload a new message set. For transit applications, this is not a desirable option if continuous bus status updates are to be displayed.

For this project, wireless communications utilizing FM subcarrier radio broadcasts are recommended. Details of the communications system will be finalized in Projects 4.1.2 and 4.2.3.

4.1.2 - Design and Imulement Electronic Disulav at Maior Transit Terminals

The electronic display device, as stated in the time-phased table, can be implemented in the near term (3 to 5 years).

A server computer that provides information to the electronic display devices is recommended to be installed in METRO Bus' dispatch center. A LED display manufacturer, teamed up with a wireless communication service provider, must be contracted. The wireless system has the advantage of being flexible and can be relocated easily. At least one FM radio station should be contracted to provide the transmission facility. The messages are usually sent from the server computer to an FM radio station through a dedicated modem line. Depending on the intended coverage area, additional FM radio stations might be needed.

It is recommended that, initially, electronic display devices should be considered at major downtown transfers (11 locations).

4.1.3 - Expand Current Automated Teleuhone Information Service System

The primary objective of this task is to improve the existing METRO Bus automatic telephone information service system to provide origin-destination sensitive bus transit information. Eventually, this transit-only phone system will be merged with the initially highway-only automated phone system described in Program Area 1, Multi-Modal Traveler Information System. The combined system will provide comprehensive, region wide multi-modal travel information.

Based on the current system that only provides pre-recorded information on bus routes, a CAD system must be employed to provide geographic references. The improved voice menu will allow users to specify their origin and destination by either entering street address information or selecting from a list of points of interest. A software itinerary planning engine should be developed to generate response on the fly. A text-to-speech voice synthesis program will be used to provide voice response to the users. In addition, a human operator is still needed for additional assistance.

The new system consists of a computer with a text-to-speech voice synthesis card and a telephone line multiplexer that can be installed at the same location as the current system without additional modification of the facility.

4.1.4 - Define Functional Reauirements and Develop Plans for Incorporation of Dynamic Status Information

This project develops a plan to provide dynamic, up-to-the-minute bus status information to the electronic display devices and automated telephone information system described in projects 4.1.2 and 4.1.3. This information will include the expected arrival times of specific buses at specific stops. Two issues need to be investigated:

- A CAD computer system that can process real-time bus location data and provide an interface to facilitate dispatch operation as well as to distribute status information to the electronic display and automatic telephone information system.

- Information format and update frequency for electronic display devices. Transfer/connection information based on real-time bus status should also be included in the information disseminated to improve the quality and reliability of information services. Furthermore, on-board electronic display should be considered when transfer information becomes available.

The data transfer and communications issues associated with this project are addressed in Project 4.2.3. A demonstration project providing “smart” ITS-enhanced demand-responsive transit service using AVL is proposed in Project 4.4. The lessons learned should provide guidelines to this task.

Location: The electronic display devices are recommended to be deployed, initially, at major downtown transfer stations (11 locations as shown in Figure 6-11). The information server that provides the messages for electronic displays can be located at the current transit dispatch center. The new automatic telephone information system can be installed at the current downtown transit store location.

Technology: The technologies required for this project include:

- LED and/or Television electronic information display devices.
- Information server for processing and distributing information to the electronic display devices.
- Wireless communication, FM subcarrier (recommended), is used to broadcast the messages to the electronic display devices. An FM subcarrier technology firm (e.g., DCI) and local commercial FM radio station must be contracted.
- An automatic telephone information system requires CAD or GIS capability, a points of interest database, an itinerary planning software engine, and voice synthesis technologies.

Administration: It is recommended that the Mobility Management Office operate and maintain the information server for electronic display devices. A dedicated staff should be assigned to maintain the currency of the information being disseminated to the electronic display devices. The new automatic telephone information system needs to maintain the currency of route and other related information. Periodic information updates are needed. This task can be assigned to the human operator who assists the system operations.

Time Frame: The deployment of electronic display devices, including a functional requirements and specification study and actual implementation, can be accomplished in three years. The core development of an automatic telephone information system is the

CAD or GIS system and itinerary planning algorithm. The voice synthesis and touch tone interactive software are commercially available and can be customized to fit these specific purpose. An operational system can be developed in two years.

	Design	Construction	Total
Budget (Years l-5):	**$47,200**	**$298,000**	**$346,000**

Staffing: During Years 1-2: none
During Years 3-5: 1.25 person-hours

Sponsor: The recommended co-sponsors for this project are the City of Indianapolis and INDOT.

PROJECT: **4.2 - INTEGRATED ELECTRONIC FARE COLLECTION AND PASSENGER COUNTER**

Objective: This project expands the existing METRO Bus onboard fare collection system to include smart card transit fare collection and an advanced passenger counter. The smart card technology will enable cashless transactions and provide an opportunity to integrate transit with other ITS smart card applications. The advanced passenger counter will record accurate ridership data for route performance analysis. In the later stage of this project, communication requirements will be investigated to support the transmission of vehicle location information as well as real-time transit ridership data for a full fledged automatic vehicle location (AVL) transit system.

Current Conditions: Currently, all METRO Bus and ATE buses are equipped with a GFI fare box system that collects tokens and coins. These GFI fare boxes can be upgraded to support optional swipe card operations. This technology can also provide accurate ridership data, which is important information for route design and performance review. No automatic passenger counters are currently used on buses in Indianapolis. With an AVL system, real-time ridership data can be transmitted along with vehicle location to the transit dispatch center to achieve even higher operational efficiency.

Scope: This project includes three phases. The first two phases design and implement smart card and advanced passenger counter capabilities. The final phase identifies the specific data transmission design and specifications to support communication of dynamic ridership and vehicle location information (Projects 4.1.4 and 4.3) from transit vehicles to base computer systems.

4.2.1 - Define Functional Reauirements for an Expanded Fare Collection Svstem Based on Current GFI Fare Box System

This phase of the project is to identify the specific technology and vendor for smart card and advanced passenger counter system hardware and software. The selected smart card system must be compatible with most of the existing systems and must facilitate future modifications without major hardware upgrades. Preferably, the smart card fare collection system will initially operate independently from other financial transaction services. As the industry evolves, other transaction capabilities can be incorporated into the basic system. An advanced passenger counter can be integrated into the fare collection system, with fare transaction information and ridership data downloaded using the same hardware equipment. A data download procedure should be included in the daily maintenance routine. This task will select the specific technology option and will develop guidelines for the implementation of smart card and advanced passenger counter technologies.

4.2.2 - Design and Implement System

The smart card and advanced passenger counter systems should be implemented on the 15 full service routes (which include more than 70 percent of the total transit ridership in Indianapolis) currently operated by METRO Bus and ATE. A modularized system design, which would be easy to maintain and upgrade incrementally, is recommended.

Security procedures for electronic data exchange must be established for the downloading and storage of smart card transaction information. A computer accounting system networked with other smart card participating institutes is part of the implementation.

4.2.3 - Identify and Define Future Communication Requirements to Support AVL and Real-Time Ridership Data Transfer

Project 4.1.4 identifies how transit vehicle location data must interface with electronic transit status display devices. Project 4.3 implements AVL and upgrades the electronic displays to include dynamic vehicle location data. This project defines how the combined location and passenger data (Project 4.2.2) will be bundled and communicated.

Location: The proposed integrated electronic fare collection system and passenger counter will be installed on METRO Bus and ATE buses serving the 15 full service routes (out of 39 total routes). These full service routes meet traditional transit standards for fixed- route/ fixed schedule services using full-sized transit vehicles and traditional transit scheduling methods[3]. More than seventy percent of transit passengers in Indianapolis use these routes.

Technology: The technologies required for this project include:

- A smart card system that integrates transit fare collection and other financial transaction services. The financial transaction is automatically made each time a passenger swipes the smart card through the reader on the enhanced

1 "Strategic Plan for Indianapolis Public Transportation" (January 1994) classified all service routes into full service, secondary routes, and low-productivity routes.

- fare box when boarding a bus. Transaction information is stored temporarily in the fare box system until downloaded to the accounting computer system, usually on a daily basis.

- An advanced passenger counter system that can accurately record readership information at each stop. The time-stamped ridership data can be stored locally for later retrieval to a computer or can be transmitted wirelessly back to the transit dispatch center.

Administration: It is recommended that METRO Bus and ATE should operate and maintain the onboard fare box and passenger counter systems on their respective fleets. The ridership data should be made available to the Mobility Management Office for management and service performance analysis. Dedicated METRO Bus and ATE staff should be trained to download and make use of the electronic fare and ridership data as part of their daily routine. For smart card transactions, a secured computer accounting system should be networked with other participating financial institutions.

Time Frame: As indicated in the table showing project phases, the initial phase of the smart card implementation requires the technology selection and forming of alliances with other participating institutions. The first and second years of the project should focus on system design. After detailed design, the actual implementation of onboard smart card readers, passenger counters and the accounting system can be accomplished in two years. The study of communications requirements could take place during the last year of system implementation and should be extended into the first few years of operations.

Budget (Years l-5):

Design	Construction	Total
$110,900	$710,100	$821,000

Staffing:

During Years l-2: none
During Years 3-5: 0.3 person-hours

Sponsor: The recommended co-sponsors for this project are the City of Indianapolis, METRO Bus, ATE, and INDOT.

PROJECT: 4.3 - DYNAMIC STATUS WITH AUTOMATIC VEHICLE LOCATION (AVL)

Objective:

This project designs and implements a demonstration of "smart" transit service utilizing Automatic Vehicle Location (AVL) technology. This project implements the Neighborhood Zone Service concept proposed in the Strategic Plan for Indianapolis Public Transportation (January 1994). The viability of such a service is significantly enhanced with ITS technology. The Neighborhood Zone Services aim to provide local services to get people to the core transit system, to connect neighborhoods with nearby shopping, and to integrate suburban clusters with the surrounding residential areas. The scale of these services is such that flexibility and small vehicles are required. An AVL system allows the real-time dispatch and routing of service vehicles to achieve a high level of demand responsiveness.

A candidate zone in the northeast corridor is recommended for the demonstration. The proposed service will provide arranged pickup at flag bus stops and near residences. The last phase of this project intends to implement active transit signs to provide estimated waiting time for the shuttle pickup at flag bus stops in the experimental area.

Current Conditions:

Currently, the transit service in Indianapolis primarily consists of radial bus routes serving the downtown area. The development pattern that has emerged in the region suggests that additional services are needed to connect with the major outlying activity centers and the radial bus routes so that people can travel to such destinations without connecting through the downtown. This project intends to implement an experimental demand responsive service to fulfill the above service concept.

Scope:

This project includes three phases. The first two phases design and implement the Neighborhood Zone/AVL transit service demonstration project. The last phase incorporates dynamic transit station displays into the demonstration.

4.3.1 - Demonstration AVL Design and Specifications

This task identifies the specific AVL technologies to be applied in the demonstration project. The assessment of potential technologies will consider the performance of GPS receivers, the data and voice communication options for a small area operation, and future expandability. Development guidelines for the CAD/GIS dispatch computer system will be identified and the specific demonstration service area will be defined in this process.

4.3.2 - Neighborhood Zone/AVL Demonstration Service

This transit demonstration will provide transit access to those areas that are more than l/2 mile from a core radial route, cross-town route, or perimeter routes. Services should be provided on routes that intersect with the core transit routes. Riders can arrange (by placing a phone call) for pickup in advance at a location near their residence, or at flag stops along the shuttle routes. When receiving a call, the operator will provide riders with the estimated waiting time which is calculated by the CAD/GIS dispatch system based on the current shuttle bus location and on-hand demands. The demand information along with computer optimized routing directions will be automatically transmitted to the shuttle bus operator on a display. Voice communication is used only for special instructions and problem reporting.

The core of the system is the onboard AVL system and a CAD/GIS based computer dispatch system. The intelligent algorithm in the CAD/GIS system will assign pick up to a nearby shuttle and optimize the route plan. With AVL and computer assisted dispatch, this system can achieve the maximum flexibility and efficiency possible with a small number of vehicles.

The operation requires a full time call taker, a dispatcher, and shuttle bus operators. It is recommended to extend the service hours to at least cover the last regular bus in the experimental service area.

4.3.3 - Incorporate Dynamic Status Electronic Display (Active Transit Sign)

The demonstration project described in 4.3.2 is capable of estimating waiting time for the shuttle bus. The goal of this phase of the project is to provide this bus status information to the electronic display device (active transit sign). In the operations described in 4.3.2, the riders will be provided with estimated waiting time when placing a request. This waiting time, however, will change based on the actual loss time for pickup and drop-off as well as the traffic conditions. The implementation of the active transit sign will provide riders with continuously updated arrival time information.

It is recommended that the active transit signs be installed at the flag stops intersected by the principal shuttle routes. The specification and operation of active transit signs is described in project 4.1.2. Project 4.1.4 provides design guidelines for implementation.

Location: As proposed in the Strategic Plan for Indianapolis Public Transportation (January 1994), an area located in the northeast corridor between downtown Indianapolis and the perimeter which covers several core radial bus routes is a potential candidate. The advantage of this area is the possible sharing of the communication infrastructures being proposed in freeway management and traveler information projects.

Technology: The technologies required for this project include:

- An onboard Automatic Vehicle Location (AVL) system, including a GPS receiver that provides current vehicle location (latitude and longitude), and a data transponder that transmits location data back to transit dispatch center.

- A CAD/GIS based computer system that processes bus location information and optimizes routing plan as well as assists the dispatch operations.

- Electronic display devices (active transit sign) at flag stops that provide the status of the requested shuttle bus.

Administration: It is recommended that METRO Bus and ATE operate the Neighborhood Zone/AVL demonstration service in conjunction with the Mobility Management Office. Alternatively, it can be contracted to a service provider other than METRO Bus or ATE. A call taking and dispatch center for the proposed shuttle service is recommended to be located in an existing transit facility near the experimental zone. The Mobility Management Office will promote the service through its outreach efforts.

Time Frame: The demonstration service should be implemented after project 4.1 (Improved customer information service) and 4.2 (Integrated electronic fare collection and passenger counter system) so that experiences from these two projects can be incorporated. As shown in the time-phased table, the functional requirement study will start in Year 5, which coincides with the later deployment stages of Projects 4.1 and 4.2. The actual implementation of the CAD/GIS based dispatch system and onboard AVL can be comfortably achieved in two years given that the CAD/GIS system only covers a small geographic area. The active transit sign for bus status can be implemented much later after the operation of the demonstration service.

Budget (Years l-5):

Design	Construction	Total
$339,200	**$1,893,800**	**$2,233,000**

Staffing: During Years 1-2: none
During Years 3-5: 6.5 person-hours

Sponsor: Recommended co-sponsors for this project are the City of Indianapolis, METRO Bus, ATE, and INDOT.

PROGRAM AREA: 5 - Public-Private Partnership

DESCRIPTION: The successful introduction of ITS services relies on private as well as public commitments. Awareness and support of ITS services must be developed in both sectors to allow ITS initiatives to reach their full potential, and therefore, an early start to develop such relationships is necessary because of the partnering issues (described herein) that must be considered prior to reaching agreement on ITS deployment responsibilities, use of labor and financial resources, etc.

Public-private partnerships could include a range of activities, such as "design/build" project implementation, system operation and maintenance, and sharing facilities. There will be several issues that the committee should focus on in terms of legal an procurement issues to create a positive atmosphere for public-private partnerships, such as:

- Statutory Authority - the extent by which any partnerships are allowed, including data, facility, and staff sharing, should be investigated.
- Partnerships involving purchases of equipment or software relative to competitive bidding or sole source of supply.
- Developing a partnership agreement and purchase order.
- Partnerships involving procurement of services.
- Property rights and ownership of documents.
- Intellectual property indemnification.
- Patents.
- Copyright.
- Audit clause.
- Confidentiality.
- Liability.
- License agreements.

The Indianapolis Area ITS Early Deployment Plan acknowledges the innovation and ability of the private sector to develop creative, mutually benefitting approaches to meeting transportation challenges. This program area provides means for educating and actively involving the private sector in Indianapolis area ITS service initiatives.

This program area includes three components:

1. Specific project opportunities that are integral to the successful deployment of the EDP and which involve a private sector component;

2. Two open initiatives which provide forums and mechanisms through which Indianapolis area public-private ITS partnerships can be pursued and integrated with the EDP; and

3. A public-private *partnership education and outreach program.*

Several conceptual opportunities for public-private sector partnership in the implementation of the initial Indianapolis area EDP have been identified. Private sector representatives have not been included in project discussions. The potential of these projects, as well as additional partnership opportunities, will be investigated as the development of the other program areas continues.

RATIONALE: The program area has the potential to support all **Overriding Factors.**

EXPECTED RESULTS: By stimulating private sector involvement and providing the mechanism for the implementation of a wide range of possible projects throughout the Indianapolis area, **this program area will address many** of **the Problem Causes and User Services.**

5. PUBLIC -PRIVATE PARTNERSHIP	**Implementation Timeframe**						
	Year					**Year 6-10**	**Year 11-20**
	1	**2**	**3**	**4**	**5**		
5.1 Samaritania-INDOT Highway Helper Freeway Service Patrols	X						
5.2 Media Coordination/Partnerships	X						
5.3 Cellular Phone Freeway Incident Detection	X						
5.4 Fiber Optic Cable Installations	X						
5.5 Cable TV Traveler Information Channel	X						
5.6 Navigational Information for In-Vehicle Navigational Computer Manufacturers	X						
5.7 Adopt-A-Device	X						
5.8 Technology Demonstrations							
5.8.1 Transit/Intermodal ITS Services	X	X	X	X	X	X	X
5.8.2 Personal Vehicle ITS Services	X	X	X	X	X	X	X
5.9 Public-Private Partnership Outreach	X	X	X	X	X	X	X

*** Assumes initiation of partnership agreements or outreach programs to conduct activities.**

PROJECT: 5.1- SAMARITANIA - INDOT HOOSIER HELPER FREEWAY SERVICE PATROLS

Description: This project would provide for the means to supplement the services of the existing INDOT Hoosier Helper Program with a private service patrol. The Samaritania freeway service patrol, sponsored by Revco Drug Stores, is currently operating in this capacity but not in an integrated capacity. This project could include any private organization in the Indianapolis Area that would be willing to purchase or contract for patrol services to enhance the capabilities of the Hoosier Helper Program. The extent of emergency services offered will be in accordance with the Hoosier Helper Program and will not exceed the responsibilities/ liabilities authorized by INDOT.

Scope and Partnership Agreement: The location of Samaritania and other potential service patrols will coincide with corridors identified in the Incident Management Plan for the Indianapolis Area. Partnership agreement items for consideration should include such factors as operating schedules, personnel, communications, and services offered. The private service patrol should emulate the Hoosier Helper Program to the extent possible.

Time Frame: A solicitation for such a partnership(s) should be made in the first year and continue in succeeding years as needs dictate.

Partnership Benefits: Benefits to INDOT would include supplemental assistance to implement its Hoosier Helper Program at a lower cost than adding additional INDOT patrols. Benefits to the private partner/ corporate sponsor would include advertising and "good will" knowledge by the community at large.

PROJECT: 5.2 - MEDIA COORDINATION/PARTNERSHIPS

Description: This project involves the coordination and potential partnering of INDOT with media resources for traveler information. Metro Traffic, a supplier of travel condition information and many media outlets, is one of the important potential partners in this area.

Scope and Partnership Agreement: Coordination efforts will include sharing of some types of information, procedures to ensure consistency in the information provided and to avoid contradictions, and provision of electronic links between these and related world wide web sites. Partnership agreements should include means by which information will be shared, updated, stored, and continuously linked.

Time Frame: A solicitation for such a partnership(s) should be made in the first year and continue in succeeding years as needs dictate.

Partnership Benefits: Benefits for each of the providers of this project will be improved, expanded, coordinated, and more accurate traveler information.

PROJECT: **5.3 - CELLULAR TELEPHONE HOTLINE FOR FREEWAY INCIDENT DETECTION AND TRAVEL INFORMATION**

Description:

This project consists of establishing a partnership with a cellular phone company in the operation of a freeway traffic incident telephone hotline reporting system. This system would be similar to the Illinois Department of Transportation's "*999" system, a dedicated number for the reporting of freeway incidents. The benefit of such a program is that it provides an alternative to the "911" number which should be used only for emergencies but in many places is overwhelmed by multiple cellular phone calls regarding traffic incidents which either do not require emergency services or which have previously been reported.

This program would be operated by INDOT, who would screen calls and coordinate issue resolution with emergency responders and others. The role of the cellular phone company would be to provide for the phone calls free of charge to their cellular phone users. The incentive for the cellular phone company is two-fold, they receive a public relations benefit and, according to companies participating in these programs elsewhere, feel that facilitation of cellular phone usage for traffic reporting encourages the use of the phones for other, for fee, uses.

Scope and Partnership Agreement:

The initial inventory of current cellular telephone systems should be performed by a consultant. The development of a strategic plan to integrate and develop cooperative agreements between agencies would require the participation of representatives from INDOT, emergency response organizations, and the City of Indianapolis.

Time Frame:

A solicitation for such a partnership(s) should be made in the first year and continue in succeeding years as needs dictate.

Partnership Benefits:

The public benefits of this program include more plentiful traffic incident information, fuller and more informed participation by INDOT, timelier and more appropriate incident response and a reduced burden to 911 systems.

PROJECT: 5.4 - FIBER OPTIC CABLE INSTALLATIONS

Description: This project involves seeking installation opportunities and reducing costs of installing fiber optic cable by using existing highway rights-of-way for such purposes.

Scope and Partnership Agreement: An inventory of desirable fiber optic cable expansion areas (in designated ITS deployment areas) should be prepared by a consultant and then matched to potentially available roadway right-of-way. A feasibility analysis and priority installation schedule could then be developed. Partnership agreements should include such provisions for installation specifications, permitting, maintenance, compensation, and expansion review and authority.

Time Frame: A solicitation for such a partnership(s) should be made in the first year and continue in succeeding years as needs dictate.

Partnership Benefits: A reduction in installation and expansion cost will be achieved for the partnering fiber optic cable firm since no other utility easement acquisition or approval would be required. The benefit to INDOT would be monetary compensation or use of the bandwidth (for the free use of right-of-way) and hence more expedient ITS project deployment after such installations are completed.

PROJECT: 5.5 - CABLE TV TRAVELER INFORMATION CHANNEL

Description: This project involves integrating sources to provide cable TV subscribers in the Indianapolis area with real-time travel information.

Scope and Partnership Agreement: The cable TV services within the Indianapolis Area ITS -EDP should be inventoried to determine existing sources of traveler information. Much like Project No. 5.2, many media sources in the Indianapolis area maintain Internet world wide web sites which include or will include traveler information.

Coordination efforts will include sharing of some types of information, procedures to ensure consistency in the information provided and to avoid contradictions, and provision of electronic links between these and related world wide web sites. Partnership agreements should include means by which information will be shared, updated, stored, and continuously linked.

Time Frame: A solicitation for such a partnership(s) should be made in the first year and continue in succeeding years as needs dictate.

Partnership Benefits: Benefits for each of the providers of this project will be improved, expanded, coordinated, and more accurate traveler information.

PROJECT: 5.6 - NAVIGATIONAL INFORMATION FOR IN-VEHICLE NAVIGATIONAL COMPUTER MANUFACTURERS

Description: This project will streamline the provision of navigational information for in-vehicle navigational computer manufacturers.

Scope And Partnership Agreement: Navigational information sources should be standardized and be made uniform by INDOT for supply- to vendors. Partnership agreements should include such items as appropriate sources and types of information made possible by technological advancements, as well as utilization of existing private navigational information.

Time Frame: A solicitation for such a partnership(s) should be made in the first year and continue in succeeding years as needs dictate.

Partnership Benefits: Partnership benefits would include uniform sources of information to install in-vehicle navigational systems, as well as a cooperative approach to installing new and advanced technologies as they become available.

PROJECT: 5.7 - ADOPT - A- DEVICE PROGRAM

Description: This project involves the private sector "adoption" of appropriate ITS devices, including changeable message signs and kiosks.

Scope and Partnership Agreement: The adoption of these devices could occur in any INDOT-preapproved location. Partnership agreement items should include such items as responsibilities for programming operations and maintenance, staffing, information display/distribution, and appearance/placement of corporate sponsorship images.

Time Frame: A solicitation for such a partnership(s) should be made in the first year and continue in succeeding years as needs dictate.

Partnership Benefits: Partnership benefits for INDOT will include the ability to expand its existing base of ITS devices by allowing for system support from the private sector. The private sector would benefit from advertising received from the appearance of corporate logos, "good will" gesture to the community, etc.

PROJECT: 5.8 - TECHNOLOGY DEMONSTRATIONS

Description: The purpose of this project is to:

- Acquire operational experience and feedback and assess the performance of emerging ITS hardware/software;
- Provide benefits to private sector participants by product exposure and marketing potential associated with the deployment; and,
- Foster private sector involvement and an ongoing analysis will be conducted of opportunities and benefits for private sector partners.

A wide variety of funding sources currently exist for the implementation of Indianapolis Area transportation projects, including transit/intermodal-related ITS projects. This project complements existing Indianapolis area ITS funding sources and provides a means for ensuring coordination and consistency with other EDP projects.

Scope and Partnership Agreement: Two open initiatives will be considered for this project to provide for the development of ITS initiatives which are not included elsewhere in this plan. Project proposals will be accepted from private organizations, public-private partnerships, and public organizations. Initiatives will be grouped into two project phases, as follows.

5.8.1 - Transit/Intermodal-related ITS Services

This project phase will provide the means for implementing currently undefined projects which address transit/intermodal-related ITS services, reward innovation and support the overall objectives the Indianapolis Area ITS - EDP.

5.8.2 - Personal Vehicle-related ITS Services

This project phase will also provide the means for implementing currently undefined projects which address personal vehicle-related ITS services, reward innovation and support the overall objectives of the Indianapolis Area ITS - EDP.

Time Frame: This project can begin after the assembly of subcommittees for transit/intermodal ITS services and for personal-related ITS services. It should continue indefinitely thereafter.

Partnership Benefits: Partnership benefits to be derived from this project include continued development and support for ITS by the establishment of a regular proposal solicitation process during the course of the EDP. These proposals will not only encourage the participation of public-private partnerships, but will also reward innovation and recognize the success of such relationships by the introduction of new ITS services in the Indianapolis area.

Staffing: During Years l-2: 0.05 person-hours
During Years 3-5: 0.05 person-hours

PROJECT: 5.9 - PUBLIC-PRIVATE PARTNERSHIP OUTREACH

Description:

The purpose of this project is to stimulate private sector involvement in Indianapolis Area ITS service development and deployment. The project includes the establishment of a regular forum to discuss private sector involvement and ongoing analysis of opportunities and benefits for private sector partners. This project will also research techniques, procedures, agreements and legislation that support public / private partnerships, provide this information to Indianapolis Area projects and facilitate the support necessary to establish these partnerships.

Scope and Partnership Responsibilities:

It is expected that ITS Midwest chapter will play a lead role in organization and the ongoing guidance of this project. ITS Midwest will work with other groups in the corridor, such as the other City of Indianapolis / metropolitan agencies and INDOT-ITS working groups which have shown a significant amount of interest in ITS initiatives. They will be given a small amount of staff support within this project in areas such as meeting coordination and consultant resources for material development.

Time Frame:

Initially, two-year contract periods are recommended to encourage the stability of the project. After that, contracts could be awarded on an annual basis. This project will operate continuously during the deployment period.

Partnership Benefits:

Partnership benefits will include a continuous outreach effort via a regular forum to encourage and support private sector involvement. Improved communications and educational exchanges between organizations and manufacturers will also result.

Staffing:

During Years l-2: 0.25 person-hours
During Years 3-5: 0.25 person-hours

PROGRAM AREA: 6 - Technical and Planning Support

DESCRIPTION: This program area consists of support services to the Indianapolis Area ITS - EDP in the following areas:

ITS Deployment - It is recommended that an ITS Deployment Committee be formed to coordinate and facilitate the implementation of the Indianapolis Area ITS EDP. The current Indianapolis ITS Steering Committee is recommended to become the ITS Deployment Committee. This new committee should at least be represented by agencies from INDOT, the City of Indianapolis, and other governmental jurisdictions within the Indianapolis area. Services will be needed to support the formation, administration, and activities of this ITS Deployment Committee and technical sub-committees including decision support, project workshops, data collection, and meeting facilitation.

Technical Support - Services will be needed to support the ITS Deployment Committee in the development of projects and providing the technical coordination, evaluation, and management of various projects in the Indianapolis Area. Initial efforts will focus on developing detail project plans including reviews of relevant and existing plans, systems, standards, specifications, and guidelines. Guidance will also be provided in coordinating the Indianapolis ITS program with local, state, and national efforts and plans. Recommendations will be developed for joint working relationships, and private sector initiatives and responsibilities. It is expected that ITS Midwest will play an important role in this coordination and establishment of standards and guidelines.

Outreach and Public Education - Services will be provided to develop and conduct outreach and public education programs of ITS services and systems. Benefits such as increased efficiency and safety will be emphasized. Service will include workshops, meetings, public forums, and newsletters. The purpose of this program area is to build public support for ITS services.

It is expected that this program area will be supported through a combination of the ITS Midwest chapter and other groups in the Indianapolis area which have shown interest in ITS initiatives. This support will be augmented by consultant services. The need for outside services will be reviewed annually and balanced against the program and internal staff requirements.

RATIONALE: This program area supports the following Overriding Factors:

- Region-wide Perspective
- Multi-Modal
- Serves Many
- Building Block

- High Visibility
- Low Risk/High Pay-Off
- Maximize Available Resources

Expected Results:

This program area will address the **following Problem Causes:**

- Poor Institutional Coordination/ Jurisdictional Cooperation

The coordination provided through this program area will support most of the **User Services.**

6. TECHNICAL AND PLANNING SUPPORT	Implementation Timeframe						
	Year					Year 6-10	Year 11-20
	1	2	3	4	5		
6.1 ITS Deployment Committee							
6.1.1 Assist with Formation of Committee and Subcommittees. Provide Initial Organizational Support in Implementing Corridor Program Plan	X	X					
6.1.2 Committee Administration and Coordination Service	X	X	X	X	X	X	X
6.1.3 Decision Support Services	X	X	X	X	X	X	X
6.2 Technical Support							
6.2.1 Develop Project Plans, Solicitations, And Evaluations	X	X	X	X	X	X	X
6.2.2 Lead Projects at the Direction of the Deployment Committees	X	X	X	X	X	X	X
6.2.3 Coordinate Indianapolis Plan with Local, State, and National Plans	X	X	X	X	X	X	X
6.3 Outreach Education							
6.3.1 Public Information Center	X	X	X	X	X	X	X
6.3.2 Public Outreach and Education	X	X	X	X	X	X	X
6.3.3 Internal Education and Interagency Involvement	X	X	X	X	X	X	X

PROJECT: 6.1- ITS DEPLOYMENT COMMITTEE

Objective: Support the establishment of an ITS Deployment Committee and technical subcommittees and provide ongoing administrative support to these committees.

Current Conditions: The Indianapolis Area ITS EDP was developed by INDOT in cooperation with the City of Indianapolis and other regional transportation agencies. Two committees guided the EDP effort:

- Oversight Committee to provide overall direction
- Steering Committee to provide technical direction

It is anticipated that this structure will be revised to support deployment activities and coordination after the EDP is approved and funded. A copy of the Indianapolis EDP Memorandum of Understanding (MOU) and the joint operating and funding agreement are included as Appendix of this report.

Scope: This project involves the establishment of the ITS Deployment Committee and technical subcommittees, the administrative support of those committees, and the decision support for project lead agencies.

This project is divided into the following phases:

6.1.1 - Initial Committee Development

It is recommended that an ITS Deployment Committee and technical subcommittees be formed from the current EDP Steering Committee to support the deployment of the EDP. The ITS Deployment Committee will oversee deployment in a consistent and integrated manner and ensure that the plan is maintained and updated as necessary. The technical subcommittees or working groups will oversee specific projects conducted under the EDP.

This phase will support the creation of this committee structure including: developing a comprehensive plan for the operation, authority, responsibilities of each committee; identifying and securing representation on the committees by appropriate individuals and agencies; leading the development of organization goals and objectives for each committee; and identifying the initial plans for the committee operations.

6.1.2 - Administrative and Coordination Support

This phase will provide support to the general operations of the Indianapolis ITS - EDP committees. This will include coordination, facilitation and documentation of committee meetings, financial tracking of Indianapolis ITS projects, correspondence support for internal activities, and providing a central contact for Indianapolis EDP organizational information.

6.1.3 Decision Support

As the Indianapolis EDP evolves and becomes a mature program, an ongoing decision support process will be necessary to determine project priorities and funding levels. A central element of this decision support is the gathering and analysis of relevant project information. A framework is needed to analyze the costs, benefits, impacts and other issues of corridor projects in a common manner such that relative merits of projects can be viewed in an objective manner.

This phase provides support services to individual projects and lead agencies to help justify project funding. It establishes a framework to perform cost-benefit impact and other analysis needed to justify corridor projects. It also provides staff support to perform analysis functions. Included will be the collection of data from relevant sources to support the analysis process.

Location: The ITS Deployment Committee and technical subcommittees will represent transportation agencies and interests throughout the Indianapolis area.

Technology: General purpose office automation technology will be used to support the ITS Deployment Committee and technical subcommittees.

Administration: It is recommended that the contract for the outside consulting services be administered by a lead agency. The lead agency will receive proportional funds for the contract from supporting agencies. It is recommended that each supporting agency commit to a 15% participation level for at least one lead person. The lead agency should commit the resources to develop, monitor and administer the consultant contract.

Time Frame: Ongoing from project start. Annual review to determine level of support needed and use of consultant versus internal staff.

Budget:

Design	Construction	Total
$525,000	**N/A**	**$525,000**

Staffing:	During Years 1-2:	0.20 person-hours
	During Years 3-5:	0.20 person-hours

Sponsor: It is recommended that INDOT and the City of Indianapolis Department of Metropolitan Development sponsor this project.

PROJECT: 6.2 - TECHNICAL SUPPORT

Objective: Provide the ITS Deployment Committee and technical sub-committees with technical services and project management support for Indianapolis Area ITS-EDP projects.

Current Conditions: Technical support is currently being provided to the EDP Steering Committee.

Scope: This project involves providing technical project management support to the ITS Deployment Committee and technical subcommittees.

This project is divided into the following phases:

6.2.1 - Develop Project Plans, Solicitations, Evaluations

The output of the EDP will establish the core elements of projects to be funded with local, state and federal funds. From these core elements, project plans and solicitations for consultants and contractors need to be developed. The lead agencies for the projects will determine the project management needs for each project and the resources to develop and manage the projects. This phase provides ongoing support to the lead agencies for finalizing project definitions, developing project solicitations, selecting suppliers, and evaluating projects and results achieved. It is expected where consultants are involved in project development and evaluations, they will be excluded from supplying the requested project services. It is expected that project development support will be requested for between four and eight projects per year and evaluation support for between two and four projects per year.

6.2.2 - Lead Projects at the Direction of the Deplovment Committee Including; Data Pipe and System Architecture Refinement

This phase provides project management for those Indianapolis ITS - EDP projects not managed by participating agencies. Project management activities will include:

- Developing scope of work, schedule and budget with contractor
- Providing technical leadership for project activities
- Ensuring project meets objectives, budget and schedule
- Providing liaison with appropriate Indianapolis area ITS interests
- Managing administrative functions

It is expected that between one and three projects will be supported by this phase per year.

6.2.3 - Coordinate and Update Indianauolis EDP as Necessary with Subregional, Regional, and National Plans

The Indianapolis Area ITS - EDP is a living document that needs to be updated on an annual basis to reflect changes in local, regional and national ITS plans, opportunities and needs. The sub-project will monitor the Indianapolis ITS projects and other local and state ITS initiatives and track their compatibility with each other and national ITS initiatives and architectures. It will also support an annual update to the EDP including a process to review past plans, current status and needs, and a review and update of program area priorities and project funding.

Location: Areawide.

Technology: General purpose office automation technology will be used to provide technical support.

Administration: It is recommended that the contract for the outside consulting services be administered by a lead agency. The lead agency will receive proportional funds for the contract from supporting agencies. The technical support contract is initially expected to be a two-year contract and be extended in two-year increments. This will allow the support consultant to dedicate adequate resources to the project and establish a project office.

Indianapolis area agencies will request services of the technical support consultant on an as-needed basis. Each requesting agency should supply a liaison to the technical support consultant to coordinate issues. An oversight committee will also be needed.

Time Frame: Initial two-year contract and a minimum of a second two-year contract.

Budget:

Design	Construction	Total
$745,000	**N/A**	**$745,000**

Staffing:

During Years 1-2: 0.05 person-hours
During Years 3-5: 0.05 person-hours

Sponsor: It is recommended that INDOT and the City of Indianapolis Department of Metropolitan Development provide the sponsorship for this project.

PROJECT: 6.3 - OUTREACH/EDUCATION

Objective: Build private and public awareness and support for ITS services and benefits.

Current Conditions: Outreach programs have been used to educate a variety of transportation interests throughout the Indianapolis area. The Steering and Oversight Committees have held a series of individual meetings to conduct workshops and prepared newsletters to keep the public apprised- of EDP developments. Two half-day workshops were held to educate and gather stakeholder feedback, and three newsletters have been published. (Additional information regarding current outreach program activities appears in the Executive Summary and Chapters 3.0 and 4.0, respectively, of this document.)

Scope: The introduction of ITS services will be through a combination of public and private initiatives. Awareness and support of ITS services must be developed in both sectors to allow ITS initiatives to reach their full potential. In the public sector, local, state and national political representatives should be educated on ITS services and their benefits to transportation and the general public. This education will allow legislators to make educated funding decisions where proposals are presented for ITS initiatives. Public agency officials need to be educated on ITS services and plans for the Indianapolis Area ITS - EDP so that they can take these services and plans into account when they make their planning decisions. Finally, the general public needs to be made aware of the ITS initiatives so they can voice their support to their representatives and be educated on the use of ITS services to improve their traveling experience.

In the private sector, service providers, equipment manufacturers and system developers need to be brought into a full partnership with the public sector initiatives. These private sector organizations need to be made aware of potential partnerships on all Indianapolis Area projects and forums established to discuss how private sector involvement can be fostered.

This project is divided into the following phases:

<u>6.3.1 - Program Information Center</u>

The Program Information Center (PIC) will provide a centralized source of information of Indianapolis Area projects and activities. As the official “voice” of the Indianapolis Area ITS - EDP, the PIC will publish a regular newsletter and press releases. It will also develop special communications materials such as brochures, displays, and media communication pieces as necessary throughout the life of lndianapolis Area ITS initiatives. Finally, the PIC will serve as a central source for all inquiries on Indianapolis Area ITS activities. Inquiries will be handled directly or forwarded to the appropriate agency.

6.3.2 - Public Outreach and Education

This phase focuses initially on providing local and state political representatives with information on ITS services and benefits. Forums and workshops will be conducted throughout the region to inform legislators with information on issues such as Indianapolis Area ITS projects, future plans, private initiatives, benefits from existing local systems and national operational tests. The general traveling public will also be educated on these issues as projects near operation and funding requests are submitted.

6.3.3 - Internal Education and Interagency Involvement Program

This phase focuses on educating public agency officials on the use of ITS services and the status of lndianapolis projects. Classes and workshops will be held in the Indianapolis area on a regular basis to provide this education. Training would cover planners, design engineers, department leaders and others concerned with ITS services. A regular forum will also be established to discuss the use of ITS services and an exchange of ideas, practices and operating issues associated with ITS services. This training would cover technicians, system operators, and operation managers from ITS agencies throughout the corridor.

This phase will also provide a mechanism for interaction between the ITS Deployment Committee and subcommittees, ITS Midwest and environmental agencies to discuss the use of ITS services to address environmental (air quality) issues within the EDP area.

Location: Areawide.

Technology: General purpose office automation technology will be used to provide technical support.

Administration: A significant amount of interest in ITS initiatives has been shown by groups within the corridor such as the ITS Midwest chapter, City of Indianapolis, and INDOT ITS working groups. With the exception of the Program Information Center, these groups will provide the majority of initial support for this project. They will be given a small amount of staff support within this project in areas such as meeting coordination and consultant resources for material development.

Time Frame:	Initial two-year contract and a minimum of a second two-year contract.		
Contract Budget:	Design **$505,000**	Construction **N/A**	Total **$505,000**
Staffing:	During Years 1-2: During Years 3-5:	0.25 person-hours 0.50 person-hours	
Sponsor:	It is recommended that the INDOT and City of Indianapolis share the sponsorship of this project.		

Implementation Plan

7.0 IMPLEMENTATION PLAN

This chapter discusses the issues involved in implementing the Indianapolis Area Early Deployment Plan, Project costs, staffing requirements, implementation schedules and contracting and procurement issues are topics that need to be addressed during the various stages of ITS deployment.

Chapter 6 of this report provides detailed project descriptions that include project costs, staffing requirements and implementation schedules. This chapter summarizes this detailed information. Project costs and staffing requirements for projects scheduled during the first five years of deployment are presented. A 20-year implementation schedule is included that displays the preferred order of project deployment. Contract and procurement issues that relate to ITS projects in general and issues specific to the Indianapolis area are discussed.

This implementation plan can serve as guide to deploying proposed projects and understanding each project's role in developing an overall ITS system in the Indianapolis area.

7.1 COSTS

This section presents conceptual implementation costs and staffing requirements for Years 1 through 5 of the recommended Indianapolis area ITS deployment program.

7.1.1 Implementation Costs

Implementation costs are the initial costs for planning/design studies, equipment and facilities (including software) and costs for major program expansions. Implementation costs do not reoccur on an annual basis.

Table 7.1 presents implementation costs by project and year for the first five years of the Indianapolis ITS EDP program. As noted on Table 7.1, with the exception of projects which themselves are planning or design studies, the costs for all other projects include any required studies. Table 7.2 breaks down the costs in Table 7.1 into the categories of design and construction. Table 7.3 summarizes design, construction and total costs by program area.

7.1.2 Staffing; Requirements

Staffing requirements constitute the bulk of the annual operating costs of many ITS projects and programs. Required staff include the personnel to conduct planning and design studies, to run the traffic operations center, to repair and maintain computer systems, changeable message signs, ramp meters and information kiosks, to drive freeway service patrol vehicles and to manage projects.

TABLE 7.1
CONCEPTUAL IMPLEMENTATION COSTS
YEAR1 -5

Program Area/Project	Description	Implementation Costs by Year					Total Imp. Cost Years 1-5
		1	2	3	4	5	
Program Area 1 Multi-Modal Traveler Information System							
1.1.1 Communication Infrastructure Specification and Preliminary Design	Planning and Design Study	$10,000					$10,000
1.1.2 Northeast Corridor Data Pope Elements	24.5 miles of fiber optic cable at no cost (partnership with communications provider)	$5,399,000					$5,399,000
1.1.3 Link METRO and MECA to the Data pipe	Link METRO, State Police and MECA to the Data Pipe		$300,000	$253,000			$553,000
1.1.4 Regional Data Pipe Expansion	Planning and Design					$35,000	$35,000
Subtotal (Project 1.1)		**$639,000**	**$300,000**	**$253,000**		**$35,000**	**$1,227,000**
1.2.1 Automated Telephone System	Design and implement an automated, multi-modal telephone system			$45,000			$45,000
1.2.2 Internet Site	Enhance existing INDOT Internet Web Page	$19,000					$19,000
1.2.3 Kiosk	Implement Traveler Information kiosks at key locations			$54,000	$54,000	$53,000	$161,000
1.2.4 Media and Cable TV	Implement expanded/enhanced media travel information dissemination			$59,000			$59,000
Subtotal (Project 1.2)		**$19,000**		**$158,000**	**$54,000**	**$53,000**	**$284,000**
Total (All Program Areas 1)		**$658,000**	**$300,000**	**$411,000**	**$54,000**	**$88,000**	**$1,511,000**

- Only the design portion of this project ($539,000) is included in the cost totals. The installation of the cable is assumed to occur at no cost to INDOT Under a partnership with a private communications provider.

Notes:
1. **Unless identified as a separate project, cost for all implementation projects include any necessary planning/design.**
2. **All costs shown are total costs, not just INDOT costs. The majority of the cost for many projects will be borne by other ITS deployment partners, such as the City of Indianapolis.**

TABLE 7.1
CONCEPTUAL IMPLEMENTATION COSTS
YEAR1 -5

Program Area/Project	Description	Implementation Costs by Year					Total Imp. Cost Years 1-5
		1	2	3	4	5	
Program Area 2 Freeway Management System							
2.1.1 Initial Hoosier Helper Program	3-5 vehicle program	$200,000	$100,000	$100,000			$400,000
2.1.3 & 2.3.1 Detection Systems & Ramp Meters in NE Corridor	15 miles of coverage	$337,500	$760,000	$760,000	$760,000	$760,000	$3,377,500
2.1.4 Mid-Term FMS Expansion Study	Planning Study					$75,000	#75,000
2.1.6 Cellular Hotline System	Signage (150miles @2 signs/mite), Database, Computer				$40,000	$40,000	$80,000
2.1.7 CCTV in NE Corridor	Cameras and wireless communications over 15 miles	$67,000	$152,000	$152,000	$152,000	$152,000	$675,000
2.19 Supplemental Reference Marking	150 miles of coverate		$338,000	$338,000	$338,000	$338,000	$,675,500
Subtotal (Project 2.1)		**$6605,000**	**$1,350,000**	**$1,350,000**	**$1,290,000**	**$1,365,000**	**$5,960,000**
2.2.1 CMS in NE Corridor	10 signs and wireless communication			$500,000	$500,000	$500,000	$1,500,000
2.2.2 CMS in NE Corridor	5-10 signs and wireless communications	$105,000	$236,000	$236,000	$236,000	$236,000	$1,049,000
Subtotal (Project 2.2)		**$105,000**	**$236,000**	**$736,000**	**$736,000**	**$736,000**	**$2,549,000**
2.3.3 Conceptual Definition of TOC	Study	$50,000					$50,000
2.3.4 Intrim TOC	Computers, monitors & communications equipment		$200,000				$200,000
2.3.5 Detailed design of TOC	Study			$125,000			$125,000
2.3.6 Expand Intrim TOC	Add'l computers, monitors & communications equipment				$75,000		$75,000
2.3.7 Implement Permanent TOC	Physical expansion and conversion to fiber optic base communications equipment					$1,250,000	$1,250,000
Subtotal (Project 2.3)		**$50,000**	**$200,000**	**$125,000**	**$75,000**	**$1,250,000**	**$1,700,000**
Subtotal (Program Area 2)		**$760,000**	**$1,786,000**	**$2,211,000**	**$2,101,000**	**$3,351,000**	**$10,209,000**

Notes: 1. Unless identified as a separate project, cost for all implementation projects include any necessary planning/design.
2. All costs shown are total costs, not just INDOT costs. The majority of the cost for many projects will be borne by other ITS deployment partners, such as the City of Indianapolis.

TABLE 7.1
CONCEPTUAL IMPLEMENTATION COSTS
YEAR1 -5

Program Area/Project	Description	Implementation Costs by Year					Total Imp. Cost Years 1-5
		1	2	3	4	5	
Program Area 3 Traffic Signal Control System							
3.1.1 Update Timing Plans	Study and implementation at 20 signals	$48,000	$48,000	$48,000	$48,000	$48,000	$240,000
3.1.2 Microprocessor Conversion &Equipment Standardization and Upgrade	Variable, including controllers, cabinets, communications, conduit and other hardware at 240 signals	$1,200,000	$1,200,000	$1,200,00	$1,200,000	$1,200,000	$6,000,000
3.1.3 Maintenance and Malfunction Monitoring Program	Centrally located computer software and communications equipment		$50,000			$10,000	$60,000
3.1.4 Adaptive Signal control in NE Quadrant	Controllers, cabinets & communications at 70 signals		$975,000	$975,000	$975,000	$975,000	$3,900,000
3.1.5 Mid-Term Adaptive Contrl Expansion Study	Planning Study					$100,000	$100,000
Subtotal (Project 3.1)		**$1,248,000**	**$2,273,000**	**$2,223,000**	**$2,223,000**	**$2,333,000**	**$10,300,000**
3.2.1 EVP on Major Emergency Routes	Along 75 miles and on 170 vehicles			$705,000	$705,000	$705,000	$2,115,000
3.2.2 EVP in NE Quadrant	Optical detectors at 140 signals and emitters on 116 vehicles	$500,000	$500,000	$500,000			$1,500,000
3.2.3 Diversionary Timing Plans/Procedures	Studies for 4 Special Event locations and 6, B-mile corridors				$400,000	$400,000	$800,000
3.2.4 Mid-Term EVP Expansion Study						$100,000	$100,000
Subtotal (Project 3.2)		**$500,000**	**$500,000**	**$1,205,000**	**$1,105,000**	**$1,205,000**	**$4,515,000**
Subtotal (Program Area 3)		**$1,748,000**	**$2,773,000**	**$3,428,000**	**$3,328,000**	**$3,538,000**	**$14,815,000**

Notes: 1. Unless identified as a separate project, cost for all implementation projects include any necessary planning/design.

2. All costs shown are total costs, not just INDOT costs. The majority of the cost for many projects will be borne by other ITS deployment partners, such as the City of Indianapolis.

TABLE 7.1
CONCEPTUAL IMPLEMENTATION COSTS
YEAR1 -5

Program Area/Project	Description	Implementation Costs by Year					Total Imp. Cost Years 1-5
		1	2	3	4	5	
Program Area 4 Transit Management System							
4.1.1 Electronic Display requirements and Specifications	Study			$14,000			$14,000
4.1.2 Electronic Displays - Major Facilities	Design and implement electronic display at major transit information service system			$78,000	$78,000	$78,000	$234,000
4.1.3 Expand Phone System	Expand current automated telephone information service system				$49,000	$49,000	$98,000
Subtotal (Project 4.1)				**$92,000**	**$127,000**	**$127,000**	**$346,000**
4.2.1 Fare Box Requirements & Specifications	Planning and Design Study			$7,000	$7,000		$14,000
4.2.2 Design and Implement Fare Box	Implement smart card and advanced passenger counter system			$263,000	$263,000	$263,000	$789,000
4.2.3 AVL and Ridership Data Requirements	Study			$18,000			$18,000
Subtotal (Project 4.2)				$288,000	$270,000	$263,000	$821,000
4.3.1 AVL Design and Specifications						$21,000	$21,000
4.3.2 Neighborhood Zone AVL Demonstration	Provide transit access to areas more than 1/2 mile from core radical route, cross-town route, or perimeter routes					$160,000	$160,000
4.3.3 Active Transit Station Signs	Private bus status information to electronic display device				$896,000	$896,000	$1,792,000
Subtotal (Project 4.3)					**$896,000**	**$1,077,000**	**$1,792,000**
Subtotal (Program Area 4)				**$380,000**	**$1,293,000**	**$1,467,000**	**$3,140,000**

Notes: 1. Unless identified as a separate project, cost for all implementation projects include any necessary planning/design.
2. All costs shown are total costs, not just INDOT costs. The majority of the cost for many projects will be borne by other ITS deployment partners, such as the City of Indianapolis.

TABLE 7.1
CONCEPTUAL IMPLEMENTATION COSTS
YEAR1 -5

Program Area/Project	Description	Implementation Costs by Year					Total Imp. Cost Years 1-5
		1	2	3	4	5	
Program Area 6 Technical and Planning Support							
6.1 ITS Deployment Committee	Organizational support committee formation and facilitation	$75,000	$75,000	$100,000	$115,000	$160,000	$525,000
6.2 Technical Support	Project development, project management, coordination with other ITS initiatives	$100,000	$100,000	$150,000	$195,000	$200,000	$745,000
6.3 Outreach/Education	Public and internal/interagency education and support-building	$75,000	$75,000	$100,000	$115,000	$200,000	$745,000
Subtotal (Program Area 6)		**$250,000**	**$250,000**	**$350,000**	**$425,000**	**$500,000**	**$1,775,000**
Total (All Program Areas)		**$3,416,000**	**$5,109,000**	**$6,780,000**	**$7,201,000**	**$8,944,000**	**$31,450,000**

Notes: 1. Unless identified as a separate project, cost for all implementation projects include any necessa ry planning/design.
2. All costs shown are total costs, not just INDOT costs. The majority of the cost for many projects will be borne by other ITS deployment partners, such as the City of Indianapolis.

TABLE 7.2
CONCEPTUAL IMPLEMENTATION COSTS
DESIGN VS. CONSTRUCTION: YEAR I- 5

Program Area/Project	**Year 1**		**Year 2**		**Year 3**		**Year 4**		**Year 5**		**Total Year 1-5 Implementation Cost**	
	Design	Const.	Design	Const.	Design	Const.	Design	Const.	Design	Donst.	Design.	Const.
Program Area 1 MultModal Traveler Information System												
1.1.1 Communication infrastructure specification and Preliminary Design	$100,000										$100,000	
1.1.2 Northeast Corridor Data pipe Elements	$539,000	$4,860,000*									$539,000	$5,399,000*
1.1.3 Link METRO and MECA to the Data Pipe			$30,000	$270,000	$525,300	$227,700					$55,000	$497,700
1.1.3 Regional Data Pipe Elements									$35,000		$35,000	
Subtotal (Project 1.1)	**$639,000**		**$30,000**	**$270,000**	**$525,300**	**$227,700**			**$35,000**		**$729,300**	**$497,700**
1.2.1 Automated Telephone System					$4,5000	$40,500					$4,500	$40,500
1.2.2 Internet Site	$19,000										$19,000	
1.2.3 Kiosk					$5,400	$48,000	$5,400	$48,600	$5,300	$47,700	$98,600	$185,400
1.2.4 Media and Cable TV					$559,000						$559,000	
Subtotal (Project 1.2)	**$19,000**				**$68,900**	**$89,100**	**$5,400**	**$48,600**	**$5,300**	**$47,700**	**$98,600**	**$185,400**
Subtotal (Program Area 1)	**$658,000**		**$30,000**	**$270,000**	**$94,200**	**$316,800**	**$5,400**	**$48,600**	**$40,300**	**$47,700**	**$98,600**	**$683,100**

*** Not Included in total, assumed at no cost to INDOT (partnership with communications provider)**

Note: 1. All costs shown are total costs, not just INDOT costs. The majority of the cost for many projects will be borne by other ITS deployment partners, such as the City of Indianapolis.
2. Design cost = 10% of total implementation costs.

TABLE7.2
CONCEPTUAL IMPLEMENTATION COSTS
DESIGN VS.CONSTRUCTION: YEAR 1-5

Program Area/Project	Year 1		Year 2		Year 3		Year 4		Year 5		Total Year 1-5 Implementation Cost	
	Design	Cosnt.	Design	Const.	Design	Const.	Design	Const.	Design	Const.	Design	Const.
Program Area 2 Freeway Management Systems												
2.1.1 Initial Hooiser Helper Program	$20,000	$180,000	$10,000	$90,000	$10,000	$90,.000					$40,000	$360,000
2.1.2 & Detection systems 2.3.1 & Ramp Meters in NE Corridor	$337,000			$760,000		$760,000		$760,000		$760,000	$337,500	$3,040,000
2.1.4 Mid-Term FMS Expansion Study									$75,000		$75,000	
2.1.6 Cellular Hotline System							$4,000	$36,000	$4,000	$36,000	$8,000	$72,000
2.1.7 CCTV in NE Corridor	$67,500			$152,000		$152,000		$152,000		$152,000	$67,500	$608,000
2.1.9 Supplemental Reference Marking			$33,800	$304,200	$33,200	$304,200	$33,800	$304,200	$33,800	$304,200	$135,200	$1,216,800
Subtotal (Project 2.1)	**$425,000**	**$180,000**	**$43,800**	**$1,306,200**	**$43,800**	**$1,306,200**	**$37,800**	**$1,252,200**	**$112,000**	**$1,252,200**	**$663,200**	**$5,296,800**
2.2.1 CMS on Radial Routes					$50,000	$450,000	$50,000	$450,000	$50,000	$450,000	$150,000	$1,350,000
2.2.2 CMS in NE Corridor	$105,000			$236,000		$236,000		$236,000		$236,000	$105,000	$944,000
Subtotal (Project 2.2)	**$105,000**			**$236,000**	**$50,000**	**$686,000**	**$50,000**	**$686,000**	**$50,000**	**$686,000**	**$255,000**	**$2,294,000**
2.3.2 Conceptual Definition of TOC	$50,000										$50,000	
2.3.4 Interim TOC				$200,000								$200,000
2.3.5 Detailed Design of TOC					$125,000						$125,000	
2.3.6 Expand Interim TOC								$75,000				$75,000
2.3.7 Implement Permanent TOC										$1,250,000		$1,250,000
Subtotal (Project 2.3)	**$50,000**			**$200,000**	**$125,000**			**$75,000**		**$1,250,000**	**$175,000**	**$1,525,000**
Subtotal(Program Area 2)	**$580,000**	**$180,000**	**$43,800**	**$1,742,200**	**$218,800**	**$1,992,200**	**$87,800**	**$2,013,200**	**$162,800**	**$3,188,200**	**$1,093,200**	**$9,115,800**

Note: 1. **All costs shown are total costs, not just INDOT costs. The majority of the cost for many projects will be bo rne by other ITS Deployment partners, such as the City of Indianapolis.**
2. **Design cost = 10% of total Implementation costs.**

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TABLE7.2
CONCEPTUAL IMPLEMENTATION COSTS
DESIGN VS.CONSTRUCTION: YEAR 1-5

Program Area/Project	Year 1		Year 2		Year 3		Year 4		Year 5		Total Year 1-5 Implementation Cost	
	Design	Cosnt.	Design	Const.	Design	Const.	Design	Const.	Design	Const.	Design	Const.
Program Area 3 Freeway Signal Control Systems												
3.1. 1 Update Timing Plans	$48,000		$48,000		$48,000		$48,000		$48,000		$240,000	
3.1.2 Microprocessor Conversion & Equipment Standardization and Upgrade	$120,000	$1,080,000	$120,000	$1,080,000	$120,000	$1,080,000	$120,000	$1,080,000	$120,000	$1,080,000	$600,000	$5,400,000
3.1.3 Maintenance and Malfunction Monitoring Program			$5,000	$45,000						$10,000	$5,000	$55,000
3.1.4 Adaptive Signal Control in NE Quadrant			$97,500	$877,500	$97,500	$877,500	$97,500	$877,500	$97,500	$877,500	$390,000	$3,510,000
3.1.5 Mid-Term Adaptive Control Expansion Study									$100,000		$100,000	
Subtotal (Project 3.1)	**$168,000**	**$1,080,000**	**$270,000**	**$2, 002,500**	**$265,500**	**$1,957,500**	**$265,500**	**$1,957,500**	**$365,500**	**$1,967,500**	**$1,335,000**	**$8,965,000**
3.2.1 EVP on Major Emergency Routes					$70,500	$634,500	$70,500	$634,500	$70,500	$634,500	$211,500	$1,903,500
3.2.2 EVP in NE Quadrant	$50,000	$450,000	$50,000	$450,000	$50,000	$450,000					$150,000	$1,350,000
3.2.3 Diversionary Timing Plans/Procedures							$400,000		$400,000		$800,000	
3.2.4 Mid-Term EVP Expansion Study									$100,000		$100,000	
Subtotal (Project 3.2)	**$50,000**	**$450,000**	**$50,000**	**$450,000**	**$120,500**	**$1,084,500**	**$470,500**	**$634,500**	**$570,500**	**$634,500**	**$1,261,500**	**$3,253,500**
Subtotal (Program Area 3)	**$218,000**	**$1,530,000**	**$320,000**	**$2,452,500**	**$386,000**	**$3,042,000**	**$736,000**	**$2,592,000**	**$936,000**	**$2,602,000**	**$2,596,500**	**$12,218,500**

Note: 1. **All costs shown are total costs, not just INDOT costs. The majority of the cost for many projects will be borne by other ITS Deployment partners, such as the City of Indianapolis.**
2. **Design cost = 10% of total Implementation costs.**

TABLE7.2
CONCEPTUAL IMPLEMENTATION COSTS
DESIGN VS.CONSTRUCTION: YEAR 1-5

Program Area/Project	Year 1		Year 2		Year 3		Year 4		Year 5		Total Year 1-5 Implementation Cost	
	Design	Cosnt.	Design	Const.	Design	Const.	Design	Const.	Design	Const.	Design	Const.
Program Area 4 Transit Management System												
4.1.1 Electronic Display Requirements and Specifications					$14,000						$14,000	
4.1.2 Electronic Displays-Major Facilities					$7,800	$70,200	$7,800	$70,200	$7,800	$70,200	$23,400	$210,600
4.1.3 Expand Phone System							$4,900	$44,100	$4,900	$44,100	$9,800	$88,200
Subtotal (Project 4.1)					**$21,800**	**$70,200**	**$12,700**	**$114,300**	**$12,700**	**$114,300**	**$47,200**	**$298,800**
4.2.1 Fare Box Requirements & Specifications					$7,000		$7,000				$14,000	
4.2.2 Design and Implement Fare Box					$78,900	$184,100		$263,000		$263,000	$78,900	$710,100
4.2.3 AVL and Ridership Data Requirements					$18,000						$18,000	
Subtotal (Project 4.2)					**$103,000**	**$184,100**	**$7,000**	**$263,000**		**$263,000**	**$110,900**	**$710,100**
4.3.1 AVL Design and Specifications										$21,000		$21,000
4.3.2 Neighborhood Zone AVL Demonstration									$160,000		$160,000	
4.3.3 Active Transit Station Signs							$89,600	806,400	$89,600	$806,400	$179,200	$1,612,800
Subtotal (Project 4.3)							**$89,600**	**$806,400**	**$249,600**	**$827,400**	**$339,200**	**$1,633,800**
Subtotal (Program Area 4)					**$125,700**	**$254,300**	**$109,300**	**$1,183,700**	**$262,300**	**$1,204,700**	**$497,300**	**$2,642,700**

Note:
1. **All costs shown are total costs, not just INDOT costs. The majority o f the cost for many projects will be borne by other ITS Deployment partners, such as the City of Indianapolis.**
2. **Design cost = 10% of total Implementation costs.**

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TABLE 7.2
CONCEPTUAL IMPLEMENTATION COSTS
DESIGN VS.CONSTRUCTION: YEAR 1-5

Program Area/Project	Year 1		Year 2		Year 3		Year 4		Year 5		Total Year 1-5 Implementation Cost	
	Design	Cosnt.	Design	Const.	Design	Const.	Design	Const.	Design	Const.	Design	Const.
Program Area 6 Technical and Planning Support												
6.1 ITS Deployment Committee	$75,000		$75,000		$100,000		$115,000		$160,000		$525,000	
6.2 Technical Support	$100,000		$100,000		$150,000		$195,000		$200,000		$745,000	
6.3 Outreach/ Education	$75,000		$75,000		$100,000		$115,000		$140,000		$505,000	
Subtotal (Program Area 6)	**$250,000**		**$250,000**		**$350,000**		**$425,000**		**$500,000**		**$1,775,000**	
Total (All Program Areas)	**$1,706,000**	**$1,710,000**	**$644,300**	**$4,464,700**	**$1,174,700**	**$5,605,30**	**$1,363,500**	**$5,837,500**	**$1,901,400**	**$7,042,600**	**$6,789,900**	**$24,660,100**

Note:
1. **All costs shown are total costs, not just INDOT costs. The majority of the cost for many projects wil l be borne by other ITS Deployment partners, such as the City of Indianapolis.**
2. **Design cost = 10% of total Implementation costs.**

TABLE 7.3
CONCEPTUAL IMPLEMENTATION COSTS
SUMMARY OF YEAR 1-5 COSTS

Program Area	Year 1			Year 2			Year 3			Year 4			Year 5			Total Year 1-5 Implementation Cost		
	Design	Const.	Total	Design	Const.	Total	Design	Const.	Total	Design	Const.	Total	Design	Const.	Total	Design	Const.	Total
Program Area 1 Multi-Modal Traveler Information System	$658,000		$658,000	$30,000	$270,000	$300,000	$94,200	$316,800	$411,000	$5,400	$48,600	$54,000	$40,300	$47,700	$88,000	$827,900	$683,100	$1,511,000
Program Area 2 Freeway Management System	$580,000	$180,000	$760,000	$43,800	$1,742,200	$1,786,000	$218,800	$1,992,200	$2,211,000	$87,800	$2,013,200	$2,101,000	$162,800	$3,188,200	$3,351,000	$1,093,200	$9,115,800	$10,209,000
Program Area 3 Traffic Signal Control Systems	$218,000	$1,530,000	$1,748,000	$320,500	$2,452,500	$2,773,000	$386,000	$3,042,000	$3,428,000	$736,000	$2,592,000	$3,328,000	$936,000	$2,602,000	$3,538,000	$2,596,500	$12,218,500	$14,815,000
Program Area 4 Transit Management Systems							$125,700	$254,300	$380,000	$109,300	$1,183,700	$1,293,000	$262,300	$1,204,700	$1,467,000	$497,300	$2,642,700	$3,140,000
Program Area 6 Technical and Planning Support	$250,000		$250,000	$250,000		$250,000	$350,000		$350,000	$425,000		$425,000	$500,000		$500,000	$1,775,000		$1,775,000
TOTAL	**$1,706,000**	**$1,710,000**	**$3,416,000**	**$644,300**	**$4,464,700**	**$5,109,000**	**$1,174,700**	**$5,605,300**	**$6,780,000**	**$1,363,500**	**$5,837,500**	**$7,201,000**	**$1,901,400**	**$7,042,600**	**$8,944,000**	**$6,789,900**	**$24,660,100**	**$31,450,000**

Notes
1. **All costs shown are total costs, not just INDOT costs. The majority of the cost of many projects will be borne by other ITS deployment partners, such as the City of Indianapolis.**
2. **Design cost = 10% of total implementation costs.**
3. **The cost to install fiber optic cable ($4,860,000) is not included in this table. This project is assumed to occur under a partnership with a communications provider at no cost to INDOT.**

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TABLE 7.4
CONCEPTUAL ANNUAL STAFFING REQUIREMENTS
BY PROGRAM AREA AND FOR YEARS 1-2 AND YEARS 3-5

	Years 1-2		**Years 3-5**	
	Person-Years		**Person-Years**	
Program Area/Project	**Managerial**	**Technical**	**Managerial**	**Technical**
Program Area 1 Multi-Modal Traveler Information System				
1.1.1 Communication Infrastructure Specification and Preliminary Design	0.10			
1.1.2 NE Corridor Data Pipe	0.50	0.05	0.80	0.25
1.1.3 Link METRO and MECA to the Data Pipe		0.05		0.10
1.2.1 Automated Telephone System	0.05	0.30	0.05	0.30
1.2.2 Internet Site	0.05	0.10	0.05	0.10
1.2.3 Kiosks			0.05	0.10
1.2.4 Media and Cable TV			0.10	0.02
Subtotal (Program Area 1)	**0.70**	**0.50**	**1.05**	**0.87**
Program Area 2 Freeway Management System				
2.1.1 Initial Hoosier Helper Program	0.75	3.00	1.00	5.00
2.1.3 & 2.3.1 Detection Systems & Ramp Meters in NE Corridor	0.25	0.50	0.25	0.25
2.1.6 Cellular Hotline System			0.25	1.00
2.1.7 CCTV in NE Corridor	0.25	0.25	0.25	0.25
2.2.1 CMS on Radial Routes	0.25	0.50	0.25	0.25
2.2.2 CMS in NE Corridor	0.15	0.20	0.05	0.05
2.3.4 Interim TOC	0.75	1.50	1.00	1.50
2.3.6 Expand Interim TOC			0.50	0.50
Subtotal (Program Area 3)	**2.40**	**5.95**	**3.55**	**8.80**
Program Area 3 Traffic Signal Control Systems				
3.1.3 Maintenance and Malfunction Monitoring Program	0.20	0.30	0.25	0.50
3.1.4 Adaptive Signal Control in NE Quadrant	0.20	0.30	0.20	0.50
3.2.1 EVP on Major Emergency Routes			0.20	0.50
3.2.2 EVP in NE Quadrant	0.20	0.30	0.10	0.25
Subtotal (Program Area 3)	**0.60**	**0.90**	**0.75**	**1.75**
Program Area 4 Transit Management Systems				
4.1.2 Electronic Displays at Major Transit Terminals			0.25	0.75
4.1.3 Expand Automated Phone System			0.10	0.15
4.2.2 Design and Implement Fare Box System			0.05	0.25
4.3.2 Neighborhood Zone AVL Demonstration			0.33	0.10
4.3.3 Dynamic Status Electronic Display			0.50	1.00
Subtotal (Program Area 4)			**1.23**	**2.25**
Program Area 5 Public - Private Partnership				
5.8 Open Request for Proposals	0.05		0.05	
5.9 Public -Private Partnership Outreach	0.25		0.25	
Subtotal (Program Area 5)	**0.30**		**0.30**	
Program Area 6 Technical and Planning Support				
6.1 ITS Deployment Committee	0.20		0.20	
6.2 Technical Support	0.05		0.05	
6.3 Outreach/Education	0.25		0.50	
Subtotal (Program Area 6)	**0.50**		**0.75**	
Total (All Program Areas)	**4.5**	**7.35**	**7.63**	**13.67**

Note: Staff requirements shown include INDOT, City of Indianapolis (DCAM, DMD, and Metro Bus) and consultants.

7.2 IMPLEMENTATION SCHEDULE

The Indianapolis Area ITS Early Deployment Plan includes a 20-year implementation schedule for the development and deployment of ITS technology within the Indianapolis area. Table 7.5 includes a schedule for the specific projects within each program area. Refinements and updates to the 20-year implementation schedule are expected as deployment proceeds. Updates to the implementation schedule will allow the Indianapolis area to remain compatible with National ITS Program developments.

7.3 CONTRACTING AND PROCUREMENT ISSUES

Traditional procurement and contract policies used by public agencies may not always be well-suited to ITS projects due to some unique characteristics of ITS. ITS projects are often unique in that extensive interagency cooperation is required, private sector personnel need to be hired to staff public facilities, public/private partnership agreements need to be determined, and privacy issues need to be resolved. Additionally, ITS involves the acquisition and deployment of high-tech equipment which may pose special procurement considerations. Therefore, certain aspects of established INDOT contracting and procurement methods may require changes to accommodate ITS projects.

Every project will have its own unique characteristics that will need to be addressed individually. This section identifies some of the options and issues relevant to INDOT contracting and procurement of ITS products and services.

Procurement Methods

There are five procurement methods commonly used by Departments of Transportation across the country. Some procurement methods are more well-suited to ITS projects than others. Regarding procurement methods, the National ITS Program Plan states:

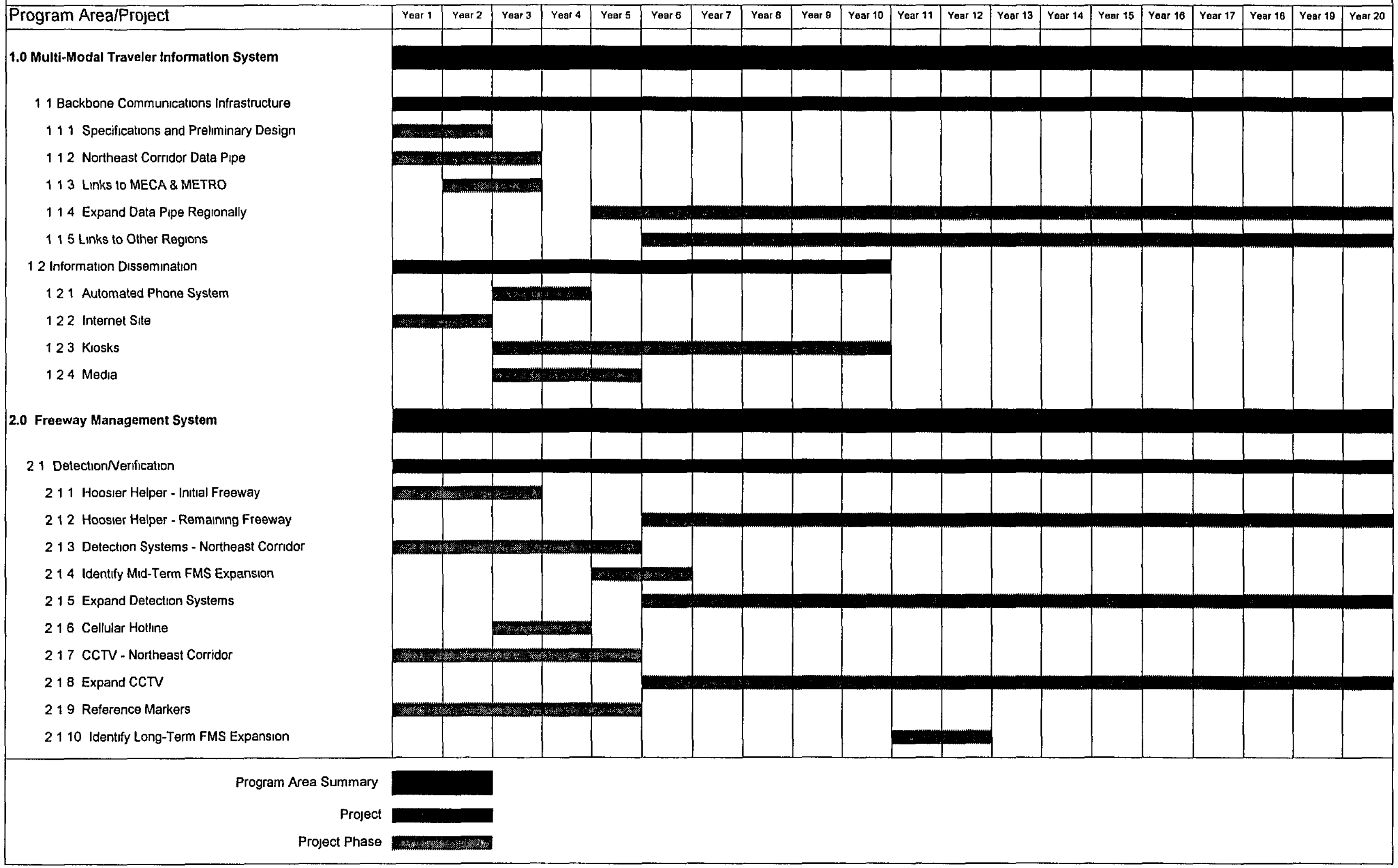
> Traditional procurement methods are not compatible with ITS procurements. ITS applications, in general, will require a systems design approach and cross-jurisdictional cooperation in order to optimize effectiveness. High technology procurements crossing jurisdictional lines pose problems for both public sector organizations and private sector providers. Public sector organizations must follow inflexible procurement regulations. Private sector providers are confronted with adhering to a complex maze of procedures changing across the boundaries of the proposed procurement. This is a mid- to long-term challenge which will impact heavily on regional deployments.

Commonly used procurement methods include the following:

Sole Source - This form of procurement is used when there is documented existence of only one technical or cost-effective solution to the requirements of a certain project. Sole Source procurement is most often used in the instances when compatibility with existing equipment is required.

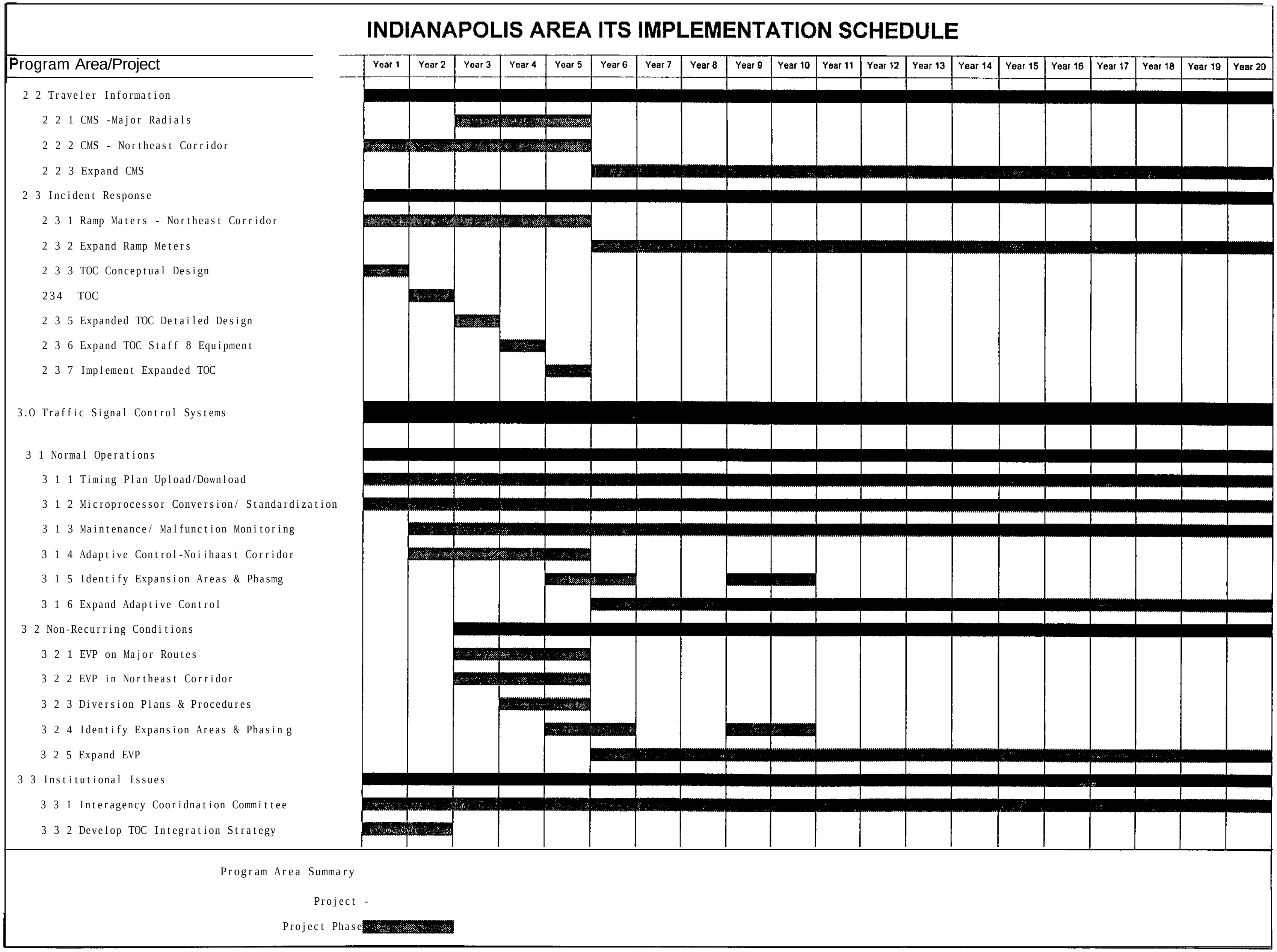
TABLE 7.5

INDIANAPOLIS AREA ITS IMPLEMENTATION SCHEDULE



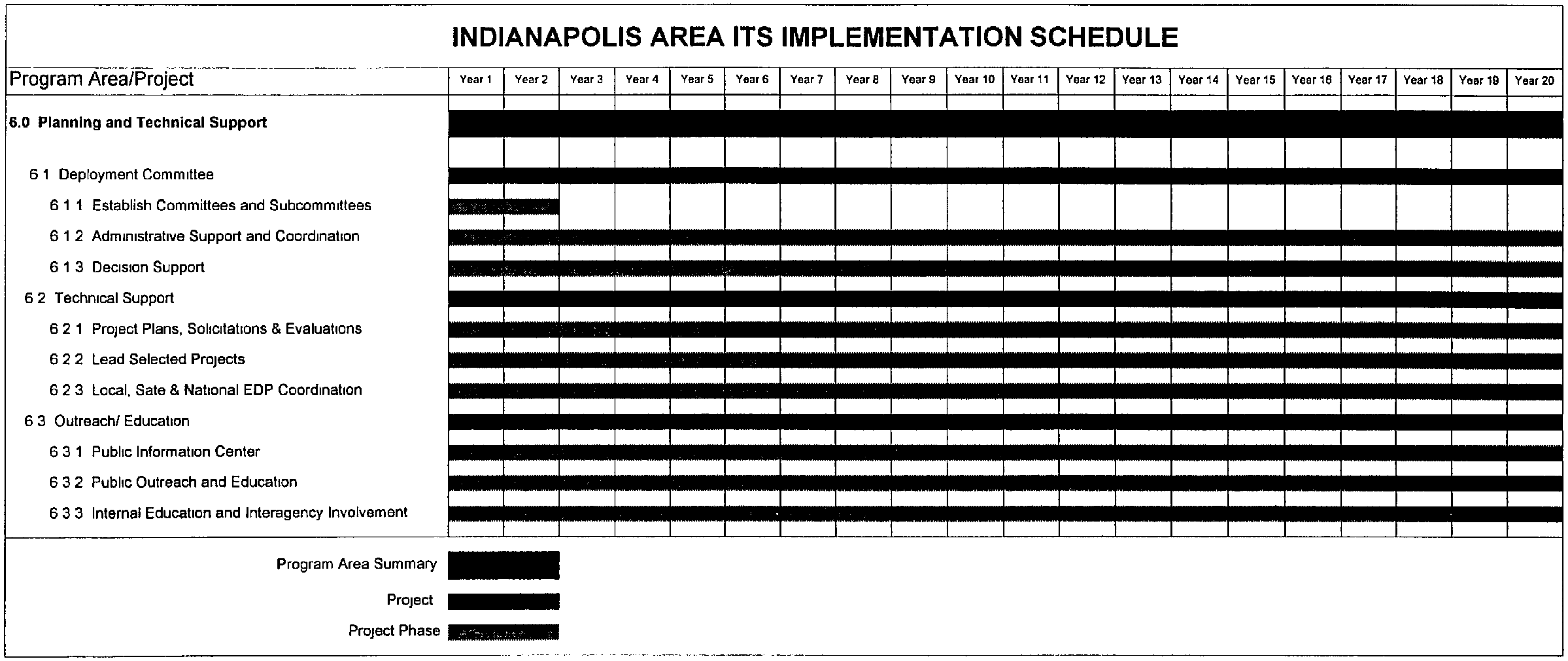
Source: BRW, Inc. 07/30/96

TABLE 7.5



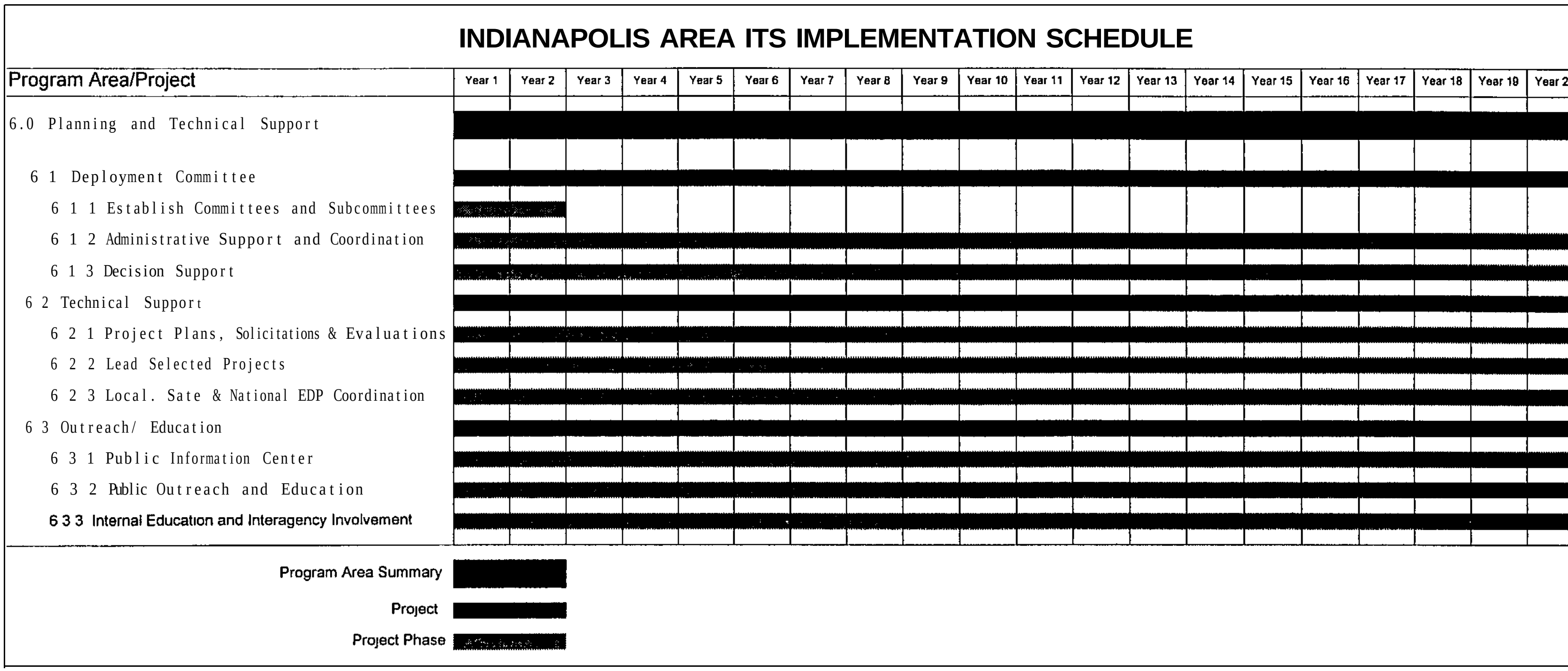
Source: BRW, Inc. 07/30/96

TABLE 7.5



Source: BRW, Inc. 07/30/96

TABLE 7.5



Source: BRW, Inc. 07/30/96

When first establishing components of an ITS system, sole source procurement should not be necessary. In later stages of development, however sole source procurement may need to be employed to ensure system-wide interoperability.

Engineer/Contractor - This is the most common procurement method used for highway projects. Plans, Specifications, and Estimates (PS & E package) are prepared by an engineer (a consultant or agency engineer) and the contracting community bids on the project. Contractors are selected based on the lowest bid for construction projects, the contractor agrees to provide a complete system, composed of hardware and software, procured, installed and integrated by the contractor's organization.

This method has been found to restrict the flexibility of system designers and implementers due to a typically standardized set of procedures and rules.

Two-Sfep Approach - This is a modified version of the Engineer/Contractor method. This approach allows prospective contractors to be rejected if they do not meet the technical criteria for the project. Technical merits of each proposal are fully considered prior to the award of a contract thus ensuring products will be of high quality with traditional highway construction contracts, technical merits are considered during the "material submittal" stage of the construction project.

Design/Build - With this method a single contractor is selected to design, construct and implement a project. This method proves to be very efficient in the cases when the design/builder fully understands the project concept because the public agency must only deal with one contractor. Fewer coordination issues to deal with on the agency's part may also allow the contractor to complete the work more quickly.

A limitation of this approach is that the agency does lose some control over the design of the project. The agency's role is reduced to oversight and monitoring of the design/builder and does not involve any of the design details that may impact operational needs of the agency.

System Manager/System Integrator - In this approach a single firm or consulting team is selected to be responsible for system design, PS & E preparation, systems integration, documentation and training. The project is divided into several sub-projects and each sub-project is contracted out using the agency's normal bidding processes and the system manager oversees all work by the various contractors. Sub-project contractors can be selected on the basis of specific sets of skills required for each sub-project. This allows experts to be used for individual steps of the system development. The system manager is responsible for integrating the sub-projects into one overall, operating system.

The agreement between an agency and system manager is typically a negotiated contract which allows contract flexibility when projects are refined. This procurement method assigns responsibility of total system success to one entity and creates an environment to more easily meet specific project requirements.

INDOT Procurement Issues

Given the current procurement and contract policies of INDOT, the following issues may be barriers to proposed or future ITS projects.

For construction projects INDOT only selects contractors based on the lowest bid. Indiana statutes (IC 8-23-2-6, IC 8-23-9, IC-23-10) state that "the lowest responsible and qualified bidder whose proposal complies with all the requirements prescribed in the proposal and this article, provided the sum is not greater than the engineer's estimate." Therefore it is very important that specifications for projects are written very carefully and accurately.

It is strongly recommended that design and integration of projects not be limited to low bid procurement. INDOT presently selects consultants based on qualifications so it is not anticipated that design and integration of ITS will pose problems.

Purchases of supplies and services using the sole source procurement method must meet INDOT department "reasonable requirements." Special documentation establishing the basis for using this method is required.

Another issue related to procurement issues with ITS projects is the establishment of public/private partnerships to develop and implement projects. INDOT has limited experience with the imitation of public/private partnerships. Each project proposed as a public/private partnership would need to be investigated individually to determine that there are not issues with conflict of interest, unfair advantage given to one competitor over another, etc.

Many projects that outwardly appear to be good candidates for public/private partnerships may be eliminated due to state and federal laws. For instance, Changeable Message Signs partially sponsored by a private company in exchange for displaying the company logo on the sign sounds like a good public/private partnership project. However, advertising is not allowed in road right-of-way so such a project could not be a candidate for a partnership unless the advertising were relocated and displayed in a different manner. Utility lines are allowed in the public right of way so a cable company could place fiber optic cable in the right of way as part of a partnership agreement for communication access. Creativity and close study of regulations will be needed to insure that public/private partnerships are viable projects that hold benefits for all involved parties.

Procurement and contract issues presented here represent a brief overview and are by no means all inclusive to proposed or future ITS projects in the Indianapolis area. ITS projects will likely cross many jurisdictional boundaries and therefore will also need to comply with many local regulations. Most procurement issues will be addressed throughout a project's deployment process. State and local policies will be addressed as they apply to individual ITS projects through the development of project operation plans and scopes of work in addition to project contracts. It is important to consider the importance of procurement and contract issues and address them as early as possible to avoid needless delay in project deployment.

Benefit-
Cost Analysis

8.0 BENEFIT-COST ANALYSIS

This section identifies the benefits associated with the recommended programs and projects of the Indianapolis area ITS Early Deployment Plan, organized according to the user services which are recommended for implementation. This analysis utilizes quantitative data to the extent possible, much of which has only recently become available through federal ITS operational tests, but necessarily relies upon qualitative measures in many areas.

Generally, the benefits of the ITS programs and projects recommended in this EDP include:

- reduction in delay;
- improved safety; and
- reduced emissions and fuel consumption

Benefits are typically presented in terms of equivalent monetary values so that comparisons can be made against costs.

To the extent feasible, benefits are identified for each of the twelve Indianapolis area highest priority user services. However, it is important to recognize that the quality of data, experience and research findings in some areas is relatively limited. As these projects proceed, it is important that their success be evaluated in quantitative terms.

The ITE Mobility Facts[1] document indicates that nationally, congestion in 2005 will be five times that of 1984. In large measure, this tremendous growth in congestion has been due to increased travel brought about by continued suburban development, increases in disposable incomes and increased labor participation rates as women increasingly move into the work force. Furthermore, the number of passengers per vehicle continues to decline. The sum of these developments has been that the number of vehicle miles of travel increased by 98.5% between 1969 and 1989 while the number of road mileage only increased by 4.5%.

In quantifying the costs associated with the benefits, certain parameters will need to be defined. These are:

- fuel consumption
- air quality
- accident costs
- delay savings

Fuel Consumption

Fuel savings is an indirect benefit resulting from the reduction of delay and stops. A major portion of fuel consumption can be attributed to stop-and-go situations.

[1] Mobility Facts, 1992.

A report prepared for the FHWA by Frederick Wagner[2] gives an equation for the total fuel consumed expressed as a function of vehicle-miles-traveled and vehicle hours of travel.

$$FTOT = 0.0425 * VMT + 0.6 * VHT$$

where: FTOT = total fuel consumed
VMT = vehicle miles traveled
VHT = vehicle hours of travel

Using traffic data collected, total fuel consumption can be collected. Assuming the average fuel cost of $1.30 per gallon, the total fuel consumption can then be determined in monetary value.

Air Quality

Three major air pollutants arising from vehicular emissions are Carbon monoxide (CO), Hydrocarbons (HC) and Nitrogen oxide (NO,). The generation of these pollutants is determined in terms of pounds per 1000 vehicle hours (due to idling of vehicles) or pounds per 1000 vehicle miles of travel.

Table 8.1 shows the quantities of emissions for every 1000 vehicle hours of stopped delay (due to idling of vehicles). The table also indicates an equivalent dollar value accounting for the impact of each pound of chemical compound released into the atmosphere. These dollar values are very approximate and are based on property damage and health costs[3].

TABLE 8.1
EMISSION QUANTITIES FROM STOPPED VEHICLES

Compound	Quantity for 1000 veh-hours of stopped delay	Unit Cost per lb	Cost per 1000 veh-hrs of delay
CO	2430 lbs	$ 0.026	$ 63.18
HC	160 lbs.	$ 0.40	$ 64.00
NO_x	50 Ibs.	$ 1.32	$ 66.00

2 Wagner, 1980.

3 Small, 1977.

Using a total stopped time delay of 6 million vehicle hours (estimated), the quantity of emissions (per year) are as follows:

TABLE 8.2
ANNUAL COST QUANTITIES FOR EMISSIONS

Compound	Total Quantity of Emissions (lbs)	Total Cost for Each Compound
CC	14,600,000	$ 379,600
HC	960,000	$ 284,000
NO_x	300,000	$ 396,000

Accidents

This assessment addresses only the cost savings associated with property damage accidents. The assumed average cost per property damage accident is $3,000 (Indiana Department of Transportation, Part V - Road Design Manual, Figure 50-2A, July 1994).

Delay Savings

ITS applications hold the potential to reduce the delays experienced by travelers. In many analyses of transportation projects, travel delay reductions are expressed as a dollar value. This analysis also equates potential Indianapolis area ITS delay reductions with dollar savings. The sorts of delay reduction savings described in this analysis are realized by individual travelers rather than by the operators of the transportation system (INDOT, for example). In the case of work travel, delays are often equated with productivity losses and are described as a "societal cost".

Delay savings are highly dependent upon the value travelers place on the time they spend traveling. Obviously, these values vary widely depending upon who is traveling, when and why. For example, delay reductions would probably be valued higher by a highly paid business person on business travel than by an unemployed adult on a pleasure trip.

This analysis uses the value of $6.66 per *vehicle* hour to estimate the dollar value of delay savings. This figure is based on the value of $6.00 per person hour used by the California Department of Transportation in their Traffic Systems Management (TSM) program. The increase in the value from $6.00 to $6.66 reflects an adjustment to convert the measure from *people* to vehicles and assumes the published Indianapolis area average work trip vehicle occupancy of 1.11 persons per vehicle (Indianapolis Transportation Plan Update, Task 40, Summary and Final Report (Draft), July 1995). An hourly delay value specific to the Indianapolis area is under development by INDOT but was unavailable for this analysis.

Indianapolis Region Travel Patterns

The Indianapolis Transportation Plan Update[4] estimated that motorists logged in 26,192,580 vehicle-miles daily. The corresponding vehicle hours of travel (VHT) are 604,254 vehicle hours daily. The increase in overall congestion levels is evident in the reduction in average speed due to congestion of about 6 miles per hour as reported by the iterative equilibrium traffic assignment model. The 1990 speed decrease due to congestion was only about 0.8 miles per hour.

Table 8.3 summarizes the auto occupancy rates. The average trip lengths are summarized in Table 8.4. Table 8.5 shows the emissions data for the Indianapolis Region.

TABLE 8.3
INDIANAPOLIS REGION DAILY PERSON TRIPS

Trip Choice	Trips	%	Occupancy
Home-based-work (HBW)	702,282	23.4%	1.11
Home-based-shopping (HBShop)	582,300	19.4%	1.67
Home-based-school (HBSchool)	173,538	5.8%	2.00
Home-based-other (HBO)	822,615	27.4%	1.50
Non-home-based (NHB)	721,192	24.0%	1.52
TOTAL	3,001,927	100.0%	

TABLE 8.4
INDIANAPOLIS REGION AVERAGE TRIP LENGTHS

Trip Choice	Trips	Trip-Hr (hr)	Ave Length (min)
HBW	702,282	201,777	17.24
HBShop	582,300	102,630	10.58
HBSchool	173,538	53,956	18.66
HBO	822,615	193,644	14.12
NHB	721,192	182,426	15.18
Total	3,001,927	734,433	14.68

4 Indianapolis Transportation Plan Update, Summary and Final Report

TABLE 8.5
INDIANAPOLIS REGION EMISSIONS

Compound	Emissions (lb/day)
HC	71,797
CO	553,434
NO_x	87,052

Table 8.6 summarizes the accident data for the Indianapolis Region for the years 1992 through 1994.

TABLE 8.6
INDIANAPOLIS REGION ACCIDENT STATISTICS

	Accident Type			
Year	**Fatality**	**Personal Injury**	**Property Damage**	**Yearly Total**
1992	10	531	1402	1943
1993	13	626	1563	1402
1994	12	637	1693	2342

User Services Bundling

Although it may be possible to deploy a system that provides a single user service, in many cases, there are combinations of user services that can be considered related. These combinations of user services have been termed ***"bundles".*** The commonality among user services in a bundle may relate to a number of different factors. In some cases, the institutional perspectives of organizations that will deploy the services provide the basis for arriving at a rationale for bundling. In other cases, the determination of bundles centers around common technical functionalities.

The bundles and user services are shown below in Table 8.7. The numbers to the left of the user service represents its rank in the initial user service prioritization. Only the top twelve user services are included in this report. These 12 user services were formally acknowledged as those which would be utilized to guide the preparation of the Early Deployment Plan. It should be noted however, that the other 17 user services defined in the ITS National Program Plan[5] will not necessarily be ignored. In the following sections, the bundled user services may be interrelatedly discussed.

5 ITS National Program Plan (First Edition, March 1995; United States Department of Transportation)

TABLE 8.7
USER SERVICES BUNDLES

BUNDLE	USER SERVICES
1. Travel and Transportation Management	1. Incident Management 2. Traffic Control 11. Traveler Service Information 5. En-Route Driver Information 6. Route Guidance
2. Travel Demand Management	4. Pre-Trip Travel Information 7. Demand Management and Operations
3. Public Transportation Operations	3. Public Transportation Management 12. En-Route Transit Information
4. Commercial Vehicle Operations	9. Hazardous Materials Incident Response
5. Emergency Management	8. Emergency Vehicle Management 10. Emergency Notification and Personal Security

8.1 INCIDENT MANAGEMENT SERVICES

The Travel and Transportation Management User Service bundle, which includes Incident Management Service, share information about the surface transportation system. These services collect and process information about the surface transportation system and provide commands to various traffic control devices. The information gathered is then disseminated to the traveler.

Aimed at quickly identifying incidents and implementing a response to minimize effects on traffic, incident management programs follow an evolutionary route to full deployment. Frequently, incident management programs become part of the mission in expanding freeway management centers. Many of the existing incident management systems such as the Highway Helper Program in Minneapolis, the Incident Management component of the CHART program in Maryland and the Emergency Traffic Patrol in Illinois began as “eyes and ears” of motorists, incorporating technology such as cellular call-in, loop detectors, video monitoring and video detectors as technology and budget constraints allowed. Incident management programs show benefits in incident clearance times and are expected to reduce fatalities.

Incident management programs show concrete promise of reducing the 50% - 60% of traffic congestion attributable to incidents. The Institute of Transportation Engineers has estimated 10%-42% decrease in travel time for incident management programs included in freeway management systems[6]. The Maryland CHART program is in the process of expanding to more automated monitoring with lane sensors and video cameras. CHART funding comes from a variety of sources including the state budget process and application for federal programs such as Congestion Management/Air Quality funding and Interstate Discretionary funding[7]. This program is expected to have about a 10:1 benefit/cost ratio[8] according to draft analyses. The Minnesota Highway Helper Program[9] reduces the duration of a stall (the most frequent type of incident, representing 84% of service calls) by 8 minutes. Using representative numbers, annual benefit through reduced delay totals $1.4 million for a program that costs $600,000 to operate. The reduction in secondary collisions attributable to the incident management program is difficult to estimate due to the coordinated freeway management program in the area.

TABLE 8.8
TYPICAL NATIONAL INCIDENT MANAGEMENT PROGRAM BENEFITS

Incident Clearance Time	Decrease 8 minutes for stalls Decrease wrecker response time 5 - 7 minutes
Travel Time	Decrease 10% - 42%

The video imaging system has several quantifiable and unquantifiable benefits associated with it. The surveillance cameras placed at critical intersections can:

- Reduce the incident response time and also help operations personnel assess the severity of the incident before implementing the appropriate response (e.g. dispatch of ambulance, tow truck, etc.)

- Evaluate signal timing characteristics such as:

  - operational performance plans,
  - progression and platoon arrival patterns, and
  - changes in the intersection performance resulting from changes in signal plans.

- Be used to investigate equipment failure like high occupancy rate recorded by a specific loop detector. This type of monitoring can augment the performance of the Traffic Control Services.

- Help analyze certain types of accidents.

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6 Meyer, M. ed., A Toolbox for alleviating Traffic Congestion, Institute of Transportation Engineers, Washington, D.C., 1989.

7 Points-du-Jour, J., Maryland State Highway Administration, telephone interview, November 1995.

8 Kuciemba, S., Maryland State Highway Administration, telephone interview, April 1995.

9 Highway Helper Summary Report - Twin Cities Metro Area, Minnesota DOT, Report # TMC 07450-0394, July 1994.

- Reduce the cost associated with traffic data collection.

Using video monitoring can also aid the clearance of an incident. The City of Richardson, Texas, tied the operator of the city's towing concession into the roadway monitoring network with an investment of roughly $200. Using the information provided by the camera, the tow truck dispatcher can position appropriate equipment near the collision site prior to the request for service from the police department. This advance notice reduces the response time for incident clearance by 5 - 7 minutes on average and greatly improves the ability to send equipment that will handle the active incident[10].

A study based on the Gardiner-Lake Shore Corridor identified that camera surveillance reduces the incident detection time on an average 5 - 7.5 minutes. This has significant impact during peak periods with high V/C ratios. Another study evaluated attributed delay savings of 10 vehicle-hours per incident to the video surveillance system.

A typical analysis was done by applying queuing theory techniques for an intersection with the following features:

V/C ratio between 0.8 - 0.9
Number of lanes in the approach: 4
Typical G/C ratio for the approach: 0.5
Number of lanes affected due to an incident: 1.4

Traffic conditions were simulated with and without the video surveillance. The presence of surveillance equipment is assumed to decrease the incident duration by about 6 minutes per incident. This information is summarized in the following table.

TABLE 8.9
DELAY SAVINGS DUE TO VIDEO SURVEILLANCE

Incident Duration ***Without Video Surveillance***	**Incident Duration With Video Surveillance**	**Delay Savings per Incident Due to Video Surveillance**
15 minutes	9 minutes	11 vehicle hours
25 minutes	19 minutes	20 vehicle hours

A study was conducted in the city of Santa Ana (CA) where accident statistics for the year 1991 indicated about 62 accidents occurred in the area of coverage of the surveillance cameras. Assuming that the actual lane blocking incidents are about 6 times more than the reported accidents, the total number of incidents would be about 372 per year. From the calculated delay range per incident, the delay savings for 372 incidents annually will be in the range of 37 vehicle hours.

10 Edwards, M., Lewis Wrecker Service, telephone interview, December 1995.

In addition to delay reduction benefits, incident management programs are expected to benefit safety and emission reduction efforts. An analysis of the accident statistics on several California arterials and expressways shows that secondary accidents represent an increase in accident risks of over 600%[11], without controlling for climatic or other conditions. According to draft analysis based on data from the Fatal Accident Reporting System, reduction of incident notification times on urban freeways from the current average of 5.2 minutes to 3 minutes would result in a fatality reduction of 10% annually, or a national total of 212 lives if all freeways nationwide were under such a program[12]. A reduction to 2 minutes would reduce fatalities by 308 annually. For comparison, the San Antonio TransGuide project has an incident detection goal of 2 minutes[13].

Benefit Savings

The Indianapolis region stands to benefit from the implementation of Incident Management Services. With the installation of lane detection and video monitoring, the region stands to benefit from the following:

- Delay Savings

  The 10% reduction results in delay savings of approximately 60,425 vehicle hours daily for the Indianapolis Region. This is equivalent to savings of $362,550 daily, or $94.3 million a year.

- Fuel Savings

  The reduction in travel time further results in fuel savings. In 1990, the estimated daily vehicle miles traveled (VMT) is 26,192,580. The estimated daily vehicle hours traveled is 604,254. Assuming a mere 10% reduction in travel time, using the Wagner approach, the savings in fuel consumption alone is approximately $148,000 daily or $38.5 million a year.

8.2 TRAFFIC CONTROL SERVICES

Included in the Travel and Transportation Management bundle, traffic control services are responsible for managing the movement of traffic on streets and highways. It provides for the integration and adaptive control of the freeway and surface street system 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.

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11 Intelligent Transportation Systems Impact Assessment Framework: Final Report, Volpe National Transportation Systems Center, September 1995.

12 Evanco, W., "The Benefits of Rapid Incident Detection on Accident Fatalities," The MITRE Corporation, unpublished paper.

13 McGowan, P., and Irwin, P., "TransGuide Transportation Guidance System: Technology in Motion." Texas DOT, November 1995.

Transportation authorities have been installing more flexible traffic signal systems since the first computerized systems were commissioned in the early 1960s. Benefits have been reported in areas including:

- travel time
- travel speed
- vehicle stops
- delay
- fuel consumption
- emissions

Among the earliest reported benefits, a 1966 project in Wichita Falls, Texas, reported a 16% reduction in stops, a 31% reduction in vehicle delay, an 8.5% reduction in accidents, and in increase in speeds of over 50%[14]. This analysis compared the computerized system to the single-dial system it replaced.

The Fuel Efficient Traffic Signal Management (FETSIM) and the Automated Traffic Surveillance and Control (ATSAC) programs in California showed benefit/cost ratios of 58:1[15] and 9.8:1[16] respectively. ATSAC, which includes computerized signal control, reported a 13% reduction in travel time, a 35% reduction in vehicle stops, 14% increase in average speed, 20% decrease in intersection delay, 12.5% decrease in fuel consumption, 10% decrease in HC, and a 10% decrease in CO.

Similar studies in other parts of the country including:

- Traffic Light Synchronization (TLC) in Abilene, Texas which provided for the installation of a closed-loop signal system with hardware interconnect and modem link back to a shop computer, showed a benefit/cost ratio of 62:1[17],

- FAST-TRAC program[18] which provided for the installation of a traffic management system and the SCATS adaptive signal control system, in Detroit, Michigan,

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14 Wilshire, R.L., "The Benefits of Computer Traffic Control," Traffic Engineering, April 1969.

15 Institute of Transportation Studies, University of California, "Fuel-efficient Traffic Signal Management Three Years of Experience, 1983 - 1985," Berkeley, CA: ITS Publications, 1986.

16 Shahrzad Amiri of LACMTA, telephone interview quoting earlier studies, April 1995.

17 Benefits of the Texas Traffic Light Synchronization Grant Program I; Volume I, TxDOT/TTI Report #0258-l, Texas DOT, Austin, Texas, October 1992.

18 "Overview of the FAST-TRAC IVHS Program: Early Results and Future Plans," Brent Bair, James Barbaresso, and Beata Lamparski in *Towards an Intelligent* Transport *System, Proceedings of the First World Congress on Applications of Transport Telematics and Intelligent Vehicle-Highway* Sysfems, December 1994.

- SCOOT signal control system, implemented on two corridors and the CBD network, totaling 75 signals, in Toronto, Canada [19],

- Katella Avenue in Anaheim, California[20],

have yielded beneficial results as well. In general, the benefits from traffic signal control systems can be summarized as shown below.

TABLE 8.10
TRAFFIC SIGNAL CONTROL SYSTEMS BENEFITS

Travel Time	**Decrease 8% - 15%**
Travel Speed	Increase 14% - 22%
Vehicle Stops	Decrease 0% - 35%
Delay	Decrease 17% - 37%
Fuel Consumption	Decrease 6% - 12%
Emissions	Decrease 5% - 13% for CO emissions Decrease 4% - 10% for HC emissions

Benefit Savings

The traffic control services, applied to the Indianapolis Region, yields a range of benefits.

- Reduction in Delay

  The signal control responds to the varying demand patterns by adopting flexible timing plans. This type of dynamic response reduces the intersection delay and number of stops by implementing optimal signal coordination for the major streets. An 8% reduction in travel time based on the 1990 value of 604,254 daily vehicle hours of travel, is equivalent to 48,340 vehicle hours saved or $322,000 (based on a $6.66 per vehicle hour) daily. This is an annual savings of $83.7 million.

  The Indianapolis Transportation Plan Update estimated the 1990 systemwide delay for the Metropolitan area as 30,903 vehicle hours daily. Assuming a 17% decrease in delay, the monetary savings would be equivalent to $35,000 daily or $9.1 million annually.

19 Siemens Automotive, USA, “SCOOT in Toronto,” Traffic Technology International, Spring 1995.

20 DKS Associates (need details on this reference)

- Fuel Savings

  According to Wagner's approach, the 8% reduction in travel time would save approximately $30,000 in fuel costs daily. This is equivalent to an annual savings of $7.8 million.

  The Indianapolis Region consumes approximately 2,272,659 gallons of fuel daily[21]. A 6% decrease in fuel consumption equal 136,360 gallons daily or 35.5 million gallons annually. This represents an annual savings of $46.1 million.

- Air Quality

  The 5% decrease in CO emissions and 4% decrease in HC emissions would correspond to 28,000 lbs and 2900 lbs respectively. The combined monetary savings is valued at approximately $1900 daily. This represents an annual savings of $491,000.

- Accident Reduction

  Efficient traffic management reduces congestion by reducing demand. Such situations avoid the formation of long queues which in turn reduce the probability of secondary accidents. An Orange County TOS Study (OCTA) indicates that the implementation of a Traffic Operations Center (TOC) reduces the accident rate by 35%. A more conservative value based on urban systems suggests a 10% decrease (property damage only) in the accident rates for the city. The 10% decrease in property damage accidents when related to the Indianapolis area accident statistics will result in a savings of roughly $508,000 a year (10% x 1693 accidents in 1994 x $3000 per property damage accident).

8.3 PUBLIC TRANSPORTATION MANAGEMENT SERVICE

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.

The Public Transportation Management Service provides computer analysis of real-time vehicle and facility status to improve transit operations and maintenance. The analysis includes deviations from schedule and provides potential solutions to dispatchers and drivers. Accurate information on bus location helps maintain transit schedules and assure transfer connections intermodal transportation.

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21 "Technical Memorandum#28 Travel Assignment and Effectiveness Evaluation for Alternative Composite Multimodal Transportation Plan - Indianapolis Regional Transportation Plan," Corradino Group, May 1995.

For nearly a decade, transit properties and emergency vehicle operators have been installing and using vehicle location systems based on signpost, triangulation, LORAN and GPS technologies? A recent study[23] found 24 US transit systems operating more than 10,000 vehicles under AVL supervision and another 31 in various stages of procurement. This represents a doubling of the number of deployed systems, with most new systems using a GPS-based location process. Five Canadian operators are using AVL on fleets totaling 3700 buses, including a 2300 vehicle fleet in Toronto. Coupled with computer-aided dispatching systems, vehicle location technologies are producing benefits in security, travel time, service reliability and cost effectiveness. Additionally, several operators have reported incidents where AVL information assisted in resolving their disputes with employees and patrons.

AVL/CAD provides precise position of the bus along its route and reports this to the central computer at the dispatch headquarters. This data is used to determine the on-time performance and provides the driver and the dispatcher with a visual indication of where the bus is (if desired) and schedule adherence (ahead of schedule or behind schedule). The systems also provide run times on routes and a covert "mayday" message capability. AVL is also the basic ingredient for providing real-time schedule information to the public to make transit easier to use and more reliable. Some benefits identified by transit agencies are listed below.

Safety and security are major factors in decisions to install transit management systems. Situations benefitting from AVL and from communication systems installed as part of transit management systems include medical emergencies as well as threats and crimes involving passengers and those observed by bus drivers. Some agencies report response time of as little as 1 to 2 minutes while others report reductions of about 40%. Agencies have reported improved cooperation with police after being able to precisely locate a bus involved in an incident and having a transit dispatcher assist in apprehending criminals using bus location information. Bus operators also report an increase sense of security with silent alarm and vehicle location capabilities[24].

TABLE 8.11
VEHICLE MANAGEMENT SYSTEM BENEFITS

Travel Time	Decrease 15% - 18%
Service Reliability	Increase 12% - 23% in on-time performance
Security	Decrease incident response time to as little as one minute
Cost Effectiveness	45% annual return on investment

22 Jones, W., ITS Technologies in Public Transit: Deployment and Benefits, USDOT ITS Joint Program Office, November, 1995.

23 Casey, R., et.al., Advanced Public Transportation Systems: The State of the Art - Update '96, USDOT FTA, January 1996.

24 Jones, W., ITS Technologies in Public Transit: Deployment and Benefits, November 1995.

AVL and dispatching systems have most directly improved schedule adherence. Some agencies that have experienced these benefits are:

- The Mass Transit Administration in Baltimore reported a 23% improvement in on-time performance by AVL-equipped buses. The Baltimore MTA initially installed the system on 50 buses in 1991 and conducted a schedule performance test on buses with and without the equipment. They are now in the process of installing AVL on the remainder of their 850 buses.

- The Kansas City Area Transportation Authority improved on-time performance by 12% in the first year of operation using AVL, compared to a 7% improvement as the result of a coordinated effort between 1986 and 1989.

- Preliminary results from Milwaukee indicate a 28% decrease in the number of buses more than one minute behind schedule[25].

- Coordination between transit systems and traffic signal systems has also demonstrated operational benefits. Allowing buses to either extend green time or shorten red time by only a few seconds reduced bus travel time on a test route in Portland[26] by 5% to 8%.

An AVL system provides a rich source of data for analyzing bus operations. Examining AVL data collected in Kansas City led to a schedule revision that reduced the 200-vehicle fleet by 7 buses while reducing scheduled travel times by up to 10%. The Kansas City Area Transportation Authority reported an annual operating expense reduction of $0.5 million based on a $1.1 million investment.

Other transit systems have reported reductions in fleet size of 2% to 5% due to efficiencies of bus utilization[27]. Toronto, Canada has had an AVL system operating for several years and has resulted in a 4% reduction in the number of buses required to serve the existing routes.

Alternatively, the efficiency gains could be used to increase frequency by the same amount. Using AVL data for analysis purposes also reduces the need for staff to perform schedule adherence and travel time surveys. Estimates of savings range from $40,000 per survey to $1.5 million annually.

Benefit Savings

The Indianapolis region is served by the Indianapolis Public Transportation Corporation, commonly known as METRO Bus. METRO Bus, which presently has 39 fixed routes and an estimated 29,700 daily linked transit trips, accounts only for about 1 percent of the total daily

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25 Jones, W., ITS Technologies in Public Transit: Deployment and Benefits, November 1995.

26 Kloos, W., et. al., Bus Priority at Traffic Signals in Portland, ITS Annual Meeting, March 1995.

27 Jones, W., ITS Technologies in Public Transit: Deployment and Benefits, November 1995.

28 USDOT, FTA, APTS Benefits, November 1995.

person trips. Additional transportation services are provided by 30 social service organizations with approximately 250 vehicles and more than 20 private providers with about 1000 vehicles. With the benefits associated with the AVL technology, METRO Bus would be able to increase its ridership.

Other factors contributing to the benefit savings including the following:

- Delay Savings

  A 15% decrease in travel time would equate to a savings of approximately 90,638 vehicle hours. This is equivalent to $600,000 daily or approximately $156 million annually.

- Fuel Savings

  Using Wagner's approach, the same 15% decrease in travel time would also result in fuel savings of approximately 54,400 gallons daily. The equivalent monetary value is approximately $70,700 daily or $18.4 million annually.

8.4 PRE-TRIP TRAVEL INFORMATION SERVICE

Part of the Travel Demand Management bundle, Pre-Trip Travel Information Service is 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.

Aimed at providing information for selecting the best transportation mode, departure time and route, Pre-Trip Traveler Information Service 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 routes, schedules, transfers, fares and ride matching services area available to encourage the use of alternatives to the single occupancy vehicle. 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 these information, the traveler can select the best route, modes of travel and departure time, or decide not to make the trip at all.

Several traveler information projects are showing popularity and usage growth. The Los Angeles Smart Traveler project deployed 78 information kiosks in locations such as office lobbies and shopping plazas[29]. The number of daily accesses ranged from 20 to 100 in a 20-hour day, with the lowest volume in offices and the greatest in busy pedestrian areas. The most frequent request (83% of users) was for a freeway map. Over half of the users requested MTA bus and train information. Users, primarily upper middle class in the test area, were overwhelmingly positive in response to a survey.

29 Giuliano, G., Golob, J., and Hall, R., "Los Angeles Smart Traveler Information Kiosks," presented at the 74th Transportation Research Board Annual Meeting, January 1995.

An automated transit information system implemented by the Rochester-Genesee Regional Transportation Authority resulted in an increase in calling volume by 80%[30], while a system installed by New Jersey Transit reduced caller wait time from an average of 85 seconds to 27 seconds and reduced caller hang-up rate from 10% to 3% while increasing the total number of callers[31]. The Boston SmarTraveler has experienced 138% increase in usage from October 1994 to October 1995 to a total of 244,182 calls monthly, partly due to a partnership with a local cellular telephone service provider[32].

The Travlink test in the Minneapolis area distributed PC and videotext terminals to 315 users and made available transit route and schedule information, including schedule adherence information as well as traffic incidents and construction information[33]. For the month of July 1995, users logged on to the system a total of 1660 times, an average of slightly more than one access per participant per week. One third of the accesses to the system requested bus schedule adherence; another 31% examined bus schedules. Additionally, three downtown kiosks offering similar information averaged a total of 71 accesses per weekday between January and July of 1995 real-time traffic data were more frequently requested than bus schedule adherence.

Surveys performed in the Seattle, Washington and the Boston, Massachusetts areas indicate that 30% - 40%[34] of travelers frequently adjust travel patterns based on travel information. Of those that change travel patterns, about 45% change route of travel and another 45% change time of travel. An additional 5% - 10% change travel mode.

Assuming that 30% of 96,000 daily callers change travel plans according to this breakdown, the impact of SmarTraveler in Boston on emissions has been estimated using a MOBILE5a model. On a daily basis, this adjustment of travel behavior nets an estimated reduction of 1100 lbs of volatile organic compounds, 55 lbs of oxides of nitrogen, and 11070 lbs of carbon monoxide representing reductions of 25%, 1.5% and 33%, respectively of these pollutants from traveler changing travel plans. While only 28,800 daily trips are expected to be affected in a metropolitan area with 2.9 million registered drivers, this represents significant reductions for participating travelers.

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30 USDOT, FTA, APTS Benefits, November 1995.

31 "NJ Transit's Customer Information Speeded Up by New System," Passenger Transport, January 24, 1994.

32 SmartRoute Systems Memorandum, "SmarTraveler Update," November 6, 1995.

33 Remer M Atherton, T., and Gardner, W., ITS Benefits, Evaluation and Costs: Results and Lessons from the Minnesota Guidestar Travlink Operational Tests, Draft, November, 1995.

34 Air Quality Benefit Study of the SmarTraveler Advanced Traveler Information Service, Tech Environmental, Inc., July 1993.

Simulations performed using an urban scenario produced more encouraging indications of potential benefits[35]. For networks with congestion causing increase of up to a factor of 3 from free flow travel time but before saturation, equipped vehicles experience a 8% - 20% advantage in travel time. As the network becomes saturated and before congestion significantly affects travel time the advantage of equipped vehicles is smaller. For experienced commuters, the simulation predicts an aggregate travel time benefit of 7% - 12%. The relative benefit to longer trips is more significant than to shorter trips, consistent with a greater opportunity for advantageous diversion. The simulations were performed using a market penetration level of 5%. A separate simulation study predicted that pretrip information on roadway conditions could result in a delay reduction of 15% when a capacity reducing incident occurs and off-road travel options are Present[36].

Studies also indicate interest in traffic information on the part of the traveler as well as willingness to react to avoid congestion and delay. In focus groups for the Atlanta Advanced Traveler Information Kiosk Project[37], 92% - 98% of participants found the current information on accidents, alternate routes, road closures and traffic congestion to be useful and desirable. A survey in Marin County, California showed that if regular commuters had been presented with alternate routes including travel time estimates, 69% would have diverted and would have saved an average of 17 minutes[38]. A pilot program in the Netherlands found a 40% increase in route diversions based on traffic information by the 300 vehicles equipped with FM sideband data receivers[39].

TABLE 8.12
Pre-Trip Traveler Information Benefits

Travel Time	Decrease 7% - 12% Decrease travel time by 17 minutes
Emissions	Decrease 33% of CO Decrease 1.5% of NO,

35 Wunderlich, K., "Congestion and Route Guidance Benefits Assessment," The MITRE Corporation, letter ITS-L-131, October 1995.

36 Wunderlich, K., "Trip Planning User Service Benefits Assessment," The MITRE Corporation, letter ITS-L-131, November 1995.

37 "Advanced Traveler Information Kiosk Project: Summary Report - Focus Groups," Catherine Ross and Associates, Inc., undated.

38 Khattak, A., Kanafani, A., and Le Colletter, E., "Stated and Reported Route Diversion Behavior: Implications on the Benefits of ATIS," University of California - Berkeley, UCB-ITS-PRR-94-13, 1994.

39 Broeders, W.P.B., "RDS/TMC as Traffic Management Tool and Commercial Products," Proceedings of the Second World Congress on Intelligent Transportation Systems, Yokohama, Japan, November 1995.

Benefit Savings

Implementation of the Pre-Trip Travel Information Service in the Indianapolis Region would result in the following potential savings:

- Delay Savings

  The 7% decrease in travel time is equivalent to 43,000 vehicle-hours saved daily. The equivalent daily monetary value is approximately $284,000 or $73.7 million annually.

- Fuel Savings

  Using Wagner's approach, the 7% decrease in travel time would result in an annual fuel cost savings of approximately 43,000 gallons daily. This represents a monetary value of $55,900 daily or $14.5 million annually.

- Emissions Savings

  The 33% reduction in CO and 1.5% reduction in NO, represents 183,000 lbs and 1,300 lbs respectively. These emission reductions would result in daily savings in the amount of about $6,500 or $1.7 million annually.

8.5 EN-ROUTE DRIVER INFORMATION SERVICE

En-Route Driver Information Service 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. Part of the Travel and Transportation Management bundle, en-route driver information conveys real-time information about traffic conditions, incidents, construction, transit schedules and weather conditions to drivers of personal, commercial and public transit vehicles. This information allows a driver to either select the best route, or shift to another mode if 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, 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 number of tourists, or in areas with unusual or hazardous roadway conditions.

Traffic and traveler information are popular with consumers. Systems that provide such information are producing data that anticipate system benefit when wider deployment occurs. Traveler information programs using variable message signs (VMS) and highway advisory radio (HAR) are funded out of highway operations budgets. Programs using kiosks and in-vehicle devices are in the pilot project stage and are funded through operational testing programs. Telephone information is making the transition from pilot to operational status. Studies have produced benefits in reducing travel delay and travel time and predict benefits in reducing emissions and fuel consumption.

INFORM (Information for Motorists) is an integrated corridor on Long Island, New York, including information via variable message signs and control using ramp meters on parallel expressways and some coordination on arterials. The program stretches back to concept studies in the early 1970s and a major feasibility study performed from 1975 to 1977. The implementation progressed in phases starting with VMSs, followed by ramp meters in 1986 and 1987, and completed implementation by early 1990.

Estimates of delay savings due to motorist information[40] reach as high as 1900 vehicle-hours for a peak period incident and 300,000 vehicle-hours in incident related delay annually. Drivers will divert from 5% - 10 % of the time when passive (no recommended action) messages are displayed and twice that when message include diversion message. Convenient alternate routes also impact diversion. Drivers will divert starting several ramps prior to the incident, with any one exit ramp carrying 3% - 4% of the total approaching volume. This higher volume represents an increase in ramp usage of 40% - 70%. Accident frequency decreased slightly during the study, but data were insufficient to claim a significant trend.

TABLE 8.13
DRIVER INFORMATION SYSTEM BENEFITS

Travel Time	Decrease 17 minutes (20%) in incident conditions Decrease 8% - 20% for equipped vehicles
Delay	Decrease up to 1900 vehicle-hours per incident
Fuel Consumption	Decrease 6% - 12%
Emissions	Decrease VOC 5% from affected vehicles Decrease HC emissions 33% from affected vehicles Decrease NO, emissions 1.5% from affected vehicles

Benefit Savings

Implementation of En-Route Driver Information Service in the Indianapolis Region would result in the following potential savings:

- Delay Savings

  A decrease of 1,900 vehicle hours per incident would result in savings of approximately $11,500 per incident.

- Fuel Savings

  A 6% decrease in fuel consumption would result in savings of -approximately 136,360 gallons or $177,270 daily. This is equivalent to an annual savings of at least $46 million.

40 Smith, S., and Perez, C., "Evaluation of INFORM - Lessons Learned and Application to Other Systems," presented at 71st Transportation Research Board Annual Meeting, January 1992.

- Emissions Savings

  The decrease in emissions would result in savings of approximately $12,000 daily or $3.1 million annually.

8.6 ROUTE GUIDANCE SERVICE

Part of the Travel and Transportation Management bundle, Route Guidance Service provides travelers with simple instructions on how to best reach their destination. The expectation here is that increasing driver navigational effectiveness will increase the capacity of the system by minimizing “wasted miles” while searching for the trip destination point. It should also reduce the overall travel time for the trip. 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.

According to the Pathfinder Evaluation Report, drivers perceived that their trip was less stressful using Pathfinder and their travel times were lower. Drivers also were 40% more likely to divert using Pathfinder. For networks with congestion causing increases of up to a factor of 3 for free flow travel time, but before saturation, equipped vehicles (with navigational aids allowing fixed and dynamic route guidance) experienced a 8% - 16% reduction in travel time for all types of trips.

Field studies performed during the TravTek project in Orlando, Florida, showed that vehicles with an active TravTek device experienced a decrease in travel time of 19% if the route is followed properly, a 20% decrease in travel times if turns are missed (i.e. when turns are missed by both TravTek and the unequipped control vehicle, TravTek provides time savings in regaining the desired route), and a decrease in probability of missing a given turn from 5.4% to 3.6%.

8.7 DEMAND MANAGEMENT & OPERATIONS SERVICE

Part of the Travel Demand Management User services bundle, the Demand Management & Operations Service supports policies and strategies that are aimed at reducing demand by developing and encouraging mode 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 transit more convenient and easier to use.

These services are also aimed at decreasing congestion by altering the timing of location of trips, or eliminating vehicle trips all together. 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. 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 increase in 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.

Some programs aimed at reducing congestion by altering the timing of location of trips[41] or eliminating trips all together are:

- compressed work week
- ridesharing/ridematching
- transit subsidies/parking restrictions
- telecommuting

Compressed Work Week

The surest way to keep employees from driving to work alone is not to have them come to work at all. This can be accomplished by implementing a compressed work week (CWW) schedule at the work site. CWW schedules are very popular with employees since it gives employees an extra 26 to 50 or more days off work per year. Common CWW schedules include the following:

- 4/10 - where employees work four lo-hour days during the week
- 3/36 - where employees work three 12-hour days during the week
- 9/80 - where employees work 80 hours in 9 working days over a two week period

Ridesharing/Ridematching

Ridesharing is one of the most effective and most popular ways of reducing single occupant vehicle trips. It encourages employees living in the same or neighboring zip codes to drive to work together. Many companies including Sun Microsystems in Mountain View, CA and Apple Computer in Cupertino organize employee zip code meetings or provide in-house ridematching to form carpools among employees who live in the same areas.

Transit Subsidies/Parking Restrictions

One highly effective incentive program is a transportation allowance linked to on-site parking charges. Employees who drive to work must pay for parking. In turn, all employees receive a monthly transportation allowance that they can apply toward the parking fee, an alternative commute mode or use as they please. The allowance can be equal to or less than the parking charge. A study based upon data from downtown Los Angeles predicted that a parking cash-out program would reduce the number of cars per 100 employees from 75 to 62, a 17% decline.

Telecommuting

Telecommuting allows employees to work at home. Home-based telecommuting is growing in popularity with an estimated 2.4 million employees nationwide in 1992, working at home during business hours as part of regular work. This program typically involves employees working at

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41 Bay Area Air Quality Management District, "BAAQMD Guide to Employer Trip Reduction Programs," November 1993 (Rewed 2/94)

home one or more days per week on a regular basis. As such it works for many types of jobs and tasks and at all levels of a company.

An estimated 45% of the labor force are potential telecommuters[42]. A nationwide survey found that 41% of telecommuters work at home one day a week and 38% work at home 2 days per week[43]. Some of the job tasks suitable for telecommuting include: writing, research, editing, data processing, phone work, data entry, data coding, etc.

Benefit Savings

The benefit savings associated with implementation of the Demand Management and Operations Services include the following:

- Delay Savings

  Compressed *Work Week* (CWW) - Implementation of a compressed work week will result in fewer trips during the peak hours. Table 8.4 identifies home-based-work trips as comprising 23.4% of all daily trips with occupancy level at 1.11 persons per trip. Hence by implementing a compressed work week, the Indianapolis Region can eliminate between 702,282 to 1,404,564 trips per week during the peak hour (depending on whether the 4/10, 3/36 or 9/80 schedule is being implemented). As such, total delay due to congestion could be reduced by as much as 7,230 vehicle-hours per week (for the 4/10 and 9/80 schedules) to 14,460 vehicle-hours per week (for 3/36 schedule). At $6.66 per vehicle hour, the delay savings range from $48,150 to $96,300 per week ($2.5 million to $5.0 million annually).

  Transit Subsidies/Parking Restrictions - The 17% decline in number of vehicles as evidenced by a study in Los Angeles implementing transit subsidies/parking restrictions would generate delay savings of approximately 900 vehicle hours daily for the Indianapolis Region. This is an equivalent monetary value of $6,000 daily or $309,100 annually.

  Telecommuting - The US Department of Transportation (DOT) estimates 45% of the work force are potential telecommuters[44]. Applying this estimate to the Indianapolis Region, and assuming that telecommuters work at home one day a week, the potential savings in delay is equivalent to 3250 vehicle hours per week or a monetary equivalent of $21,700 a week. This equals an annual savings of $1.1 million.

- Fuel Savings

  Compressed Work Week - Based on the fuel consumption of 2,272,659 gallons daily, the Indianapolis Region could potentially save between 532,000 to 1,064,000 gallons of fuel per

42 U.S. Department of Transportation (DOT), Transportation Implications of Telecommufing, April 1993.

43 RIDES, *Facts* Abouf Telecommufing, January 1992, citing *Urban Transportation Monitor.*

44 U.S. Department of Transportation (DOT), *Transportation Implications of Telecommuting,* April 1993.

week. This monetary value is equivalent to $691,600 to $1.38 million daily ($36 million to $71.8 million annually).

Transit Subsidies/Parking Restrictions - Assuming a 17% decrease in number of cars as observed in the Los Angeles study, savings for the Indianapolis Region could be in the range of 90,406 gallons per day or $117,500 daily ($30.6 million annually).

Telecommuting- The potential 45% of the labor force that are telecommuting once a week will result in fuel savings of about 239,000 gallons per week. This is a monetary value of $310,700 per week or $16.2 million annually.

8.8 EMERGENCY VEHICLE MANAGEMENT SERVICE

Police, fire and rescue operations use services in the Emergency Management Services bundle to improve their management of and response to emergency situations. Common functional elements are vehicle location, communications and response.

The Emergency Vehicle Management Service is responsible for reducing the time it takes for emergency vehicles to respond to an incident. It provides public safety agencies with fleet management capabilities, route guidance and signal priority an/or preemption for emergency vehicles. Fleet management improves the display of emergency vehicle locations and help dispatchers send the units that can most quickly reach an incident site.

Automated Vehicle Location (AVL) systems have been installed in emergency vehicles for the past decade. Of the deployed systems, the most commonly used is the GPS based location process. Other systems deployed also use the signpost, triangulation and the LORAN technologies. Coupled with computer-aided dispatching systems, vehicle location technologies are producing benefits in security, travel time service reliability and cost effectiveness.

The major factors in the decision to install these management systems are safety and security. Situations benefiting from AVL and from communications systems installed as part of transit and emergency management systems include medical emergencies.

8.9 HAZARDOUS MATERIALS INCIDENT RESPONSE SERVICE

The use of advanced computers and communications technologies to improve the safety and productivity of the motor carrier industry supports the goal of improving the efficiency and safety of commercial fleet operations. From a technical perspective, the foundation is information systems. Each service will require some set of information on the motor carrier, the vehicle, the driver and the cargo.

The Hazardous Material Incident Response Service enhances the safety of shipments of hazardous materials by providing enforcement and response teams with timely and 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 carrying hazardous materials occurs would be provided electronically to emergency responders and enforcement personnel at the scene so that the incident can be handled properly.

8.10 EMERGENCY NOTIFICATION AND PERSONAL SECURITY SERVICE

Part of the Emergency Management Services bundle, the Emergency Notification and Personal Security Service provides immediate notification of an incident and an immediate request for assistance.

The Emergency Notification and Personal Security Service includes two capabilities: driver and personal security, and automatic collision notification. Driver and personal security capabilities provide 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, and severity of the crash to emergency personnel.

8.11 TRAVELER SERVICES INFORMATION SERVICE

Included in the Travel and Transportation Management bundle, the Traveler Services Information Service provides a business directory, or "yellow pages" of service information. Traveler Services Information Service provides quick access to travel-related services and facilities. Examples of information that might be included are the location, operating hours, availability of food, lodging, parking, auto repair, hospitals and police facilities. Traveler service 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 for purchases.

Insufficient data is available to attempt to quantify the benefits of implementing a traveler services information service in the Indianapolis area. However, based on the intended function of such a program, such information could result in increased convenience to unfamiliar travelers and help to promote the attractiveness of the Indianapolis area as a tourist destination; could provide health and safety benefits by making it easier to locate emergency services; and could help reduce some of the travel and congestion associated with unfamiliar travelers attempts to locate their destinations.

8.12 EN-ROUTE TRANSIT INFORMATION SERVICE

The En-Route Transit Information Service provides information to assist travelers 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.

Future Benefits

Traffic volumes and the associated delay-and congestion can be expected to grow over the life of any system. As such, the estimate of current benefits are very conservative, representing the minimum benefits if the system features were in place at the present time. A more realistic assessment would be to accrue the benefits averaged over the life of the individual system configuration to derive annual benefit.

Program Management Plan

9.0 PROGRAM MANAGEMENT PLAN

Development of the Indianapolis Area ITS Early Deployment Plan (EDP) has required significant cooperation and coordination between all agencies within the corridor. These strong institutional relationships will need to continue as the program plan proceeds into the deployment stage. The deployment of ITS technology will require significant involvement by all stakeholders including the federal, state, regional and local government agencies; transportation operating agencies; planning organizations; transit operators; private transportation companies; public safety services; and product and service providers. Maintaining public and political awareness and support is particularly important during the deployment process to assure success of the program.

A major responsibility in any ITS program plan is the management of the activities within the program. The formation of a management team is recommended to guide the Indianapolis Area ITS EDP process. This management team will manage the program activities and address the key technical and nontechnical issues that will arise during the deployment stages. The structure of the team will include a Deployment Committee (the existing Steering Committee), a Technical Committee and several working groups that will concentrate on specific program areas within the Indianapolis Area ITS EDP. The Steering Committee has already made significant contributions to the development of the EDP and will continue to be a major force (as the Deployment Committee) in overseeing the implementation activities of the plan.

There will be several program management issues that will need to be addressed by the management team. These issues include multi-jurisdictional relationships, cooperative agreements, new legislation, legal considerations, public/private partnerships, monitoring of plan process, and jurisdictional authorities. Several of these issues will require involvement of legal departments and significant interaction between attorneys and technical staff.

The future success of the Indianapolis Area ITS EDP is dependent upon quality management of the implementation process and the mutual cooperation between all multimodal transportation agencies within the corridor.

9.1 MANAGEMENT STRUCTURE AND ROLES

The Indianapolis Area ITS Program Management Team is recommended to include the following Committees and Working Groups:

- EDP Steering Committee
- EDP Deployment Committee
- Working Groups
  - Architecture/Communications/Information Group
  - Traffic/Transit Management Group
  - Incident Management Working Group

The committees and working groups will be represented by the federal, state, regional and local agencies and all other major stakeholders included within the Indianapolis Area. This Program Management structure will allow the Indianapolis Area ITS EDP activities to be more manageable. Project direction and major program policy will be set by the Steering and Deployment Committees while the Working Groups concentrate on the technical and non-technical issues presented by specific program areas included in the plan.

9.2 RESPONSIBILITIES

Table 9.1 includes a listing of members and organizations that are currently represented or are recommended to be represented in each committee and working group. The proposed program management structure is illustrated on Figure 9-1. A summary of the responsibilities of each committee/group is as follows:

Indianapolis Area ITS EDP Steering Committee

The Indianapolis Area ITS EDP Steering Committee will continue over the course of the EDP. The responsibilities of the Steering Committee will include:

- Oversight of the ITS Deployment Committee
- Establishment of required policy
- Introduction of needed legislation to appropriate states
- Resolution of any conflicts within the Coalition
- Review and approval of the final EDP process
- Provision of overall direction for the deployment of the Indianapolis Area ITS EDP
- Monitoring of the deployment progress

Indianapolis Area ITS EDP Deployment Committee

The Indianapolis Area ITS Steering Committee has had a key role in the development of the EDP with members included from The Indiana Department of Transportation, the Federal Highway Administration, planning organizations and transportation agencies throughout the planning and deployment area. It is recommended that this committee, with its name revision as the "Deployment Committee," continue as a key player during the deployment process.

The ITS Deployment Committee, with staff support, will oversee the activities of each Working Group and the implementation of the Indianapolis Area ITS EDP. Some of the other responsibilities include:

- Managing program plan activities
- Coordinating and facilitating the implementation process
- Keeping the deployment process on schedule
- Setting or recommending required standards and policy
- Recommending the adoption of required legislation
- Securing funding
- Resolving conflicts within the Working Groups
- Providing technical support

TABLE 9.1
COMMITTEES AND WORKING GROUPS

A. Indianapolis Area ITS EDP Steering; Committee

Existing Members:

Federal Highway Administration
Indiana Department Of Transportation
City of Indianapolis

B. Indianapolis Area ITS EDP Deplovment Committee

Existing Members:
City of Carmel
City of Greenwood
Federal Highway Administration
Federal Transit Administration
Indiana Convention Center and RCA Dome
Indiana Department of Transportation
Indiana Motor Truck Association
Indiana State Police
Indianapolis Department of Capital Asset Management
Indianapolis Department of Metropolitan Development
Indianapolis Fire Department
Indianapolis Police Department
Indianapolis Public Transportation Corporation (METRO Bus)
Hamilton County
Hendricks County
Johnson County
METRO Bus Subcontractors (ATE, etc.)
Metro Traffic
Purdue University
Town of Fishers

Possible New Members:

American Automobile Association
ITS Midwest

Private Sector Representatives:

- Communication Providers
- Bus Transportation Providers
- Trucking Associations

TABLE 9.1
COMMITTEES AND WORKING GROUPS (Cont.)

Representative from each working group:

- Architecture/Communications/Information Group
- Traffic/Transit Management Group
- Incident Management Group

C. Indianapolis Area ITS EDP Architecture/Communications/Information Group

Possible Members:

- American Automobile Association
- Federal Highway Administration
- Federal Transit Administration
- Incident Management Agencies
- Indiana Department of Transportation
- ITS Midwest
- Police/Fire Agencies
- Radio Traffic Services

D. Indianapolis Area ITS EDP Traffic/Transit Management Group

Possible Members:

- City of Indianapolis
- Federal Highway Administration
- Federal Transit Administration
- Freight Rail Companies
- Incident Management Agencies
- Indiana Department of Transportation
- Private Bus Companies

E. Indianapolis Area ITS EDP Incident Management Group

Possible Members:

- Federal Highway Administration
- Indiana Department of Transportation
- Indiana State Police
- City of Indianapolis
- Indianapolis Airport Authority
- METRO Bus
- Metro Traffic
- Shelby County
- City of Beech Grove

TABLE 9.1
COMMITTEES AND WORKING GROUPS (Cont.)

City of Carmel
Town of Fishers
City of Greenwood
City of Lawrence
Towing Contractors
Town of Speedway
Town of Zionsville
Indiana Motor Truck Association
Print and Electronic Media

Indianapolis Area ITS

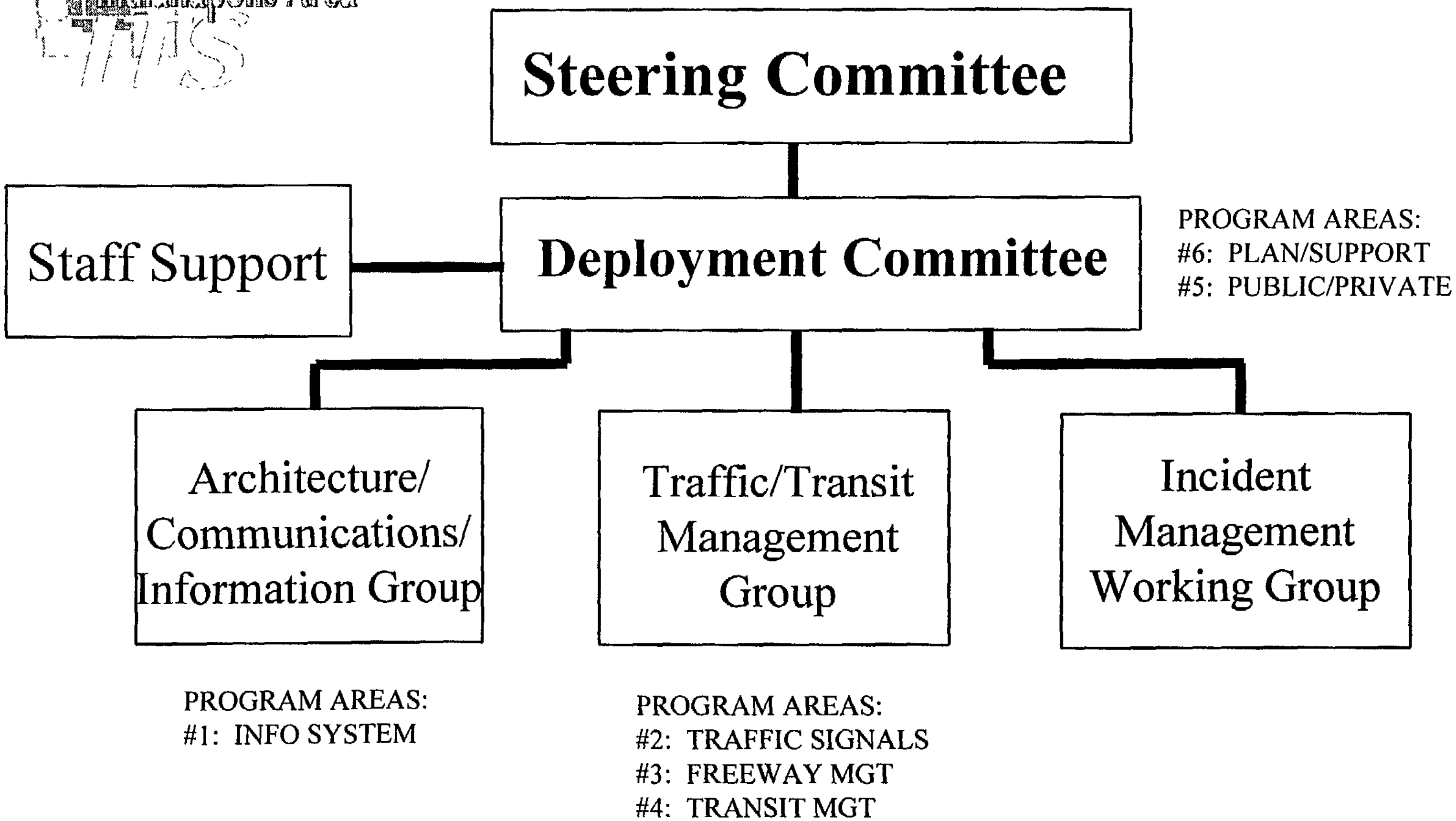


Figure 9-1

Program Management Structure

- Reviewing the Indianapolis deployment plans
- Providing guidance and administrative services to the operating agencies who are managing specific program area projects
- Developing, managing and evaluating projects not under direction of a specific operating agency
- Providing public education and outreach
- Developing and conducting awareness and support programs for ITS services to gain involvement of the public and private sectors
- Ensuring that the Indianapolis plan is maintained and updated as necessary

It is recommended that the ITS Deployment Committee meet once per month and include additional ex-officio members representing each of the Working Groups. Representatives from the Indiana State Police and American Automobile Association (AAA) should also be considered for membership.

Working Groups

Three (3) different Working Groups are recommended to provide support to the ITS Deployment Committee and oversee the details of specific program area projects included within the Indianapolis Area ITS EDP. These Working Groups will provide technical and policy expertise to the projects included within the plan. Some Working Groups will oversee groups of program areas when the different program areas are related or involve the participation of the same group of operating agencies. The Working Groups will report their activities to the ITS Deployment Committee.

The Working Groups could be considered as Subcommittees of the ITS Deployment Committee and could contain members of the ITS Deployment Committee or have members that are from the agencies represented on the ITS Committee. The Working Groups should also contain members that may represent other stakeholders in the subject projects that are not members of the ITS Deployment Committee.

Each Working Group will be responsible for specific Program Areas. A summary of the Working Groups and the associated program area(s) they will oversee is included in Table 9.2.

TABLE 9.2
INDIANAPOLIS AREA ITS EDP WORKING GROUPS

1. Architecture/Communications/Information Group

   Responsible Program Areas:

   Program Area No. 1 - Multimodal Traveler Information System

2. Traffic/Transit Management Group

   Responsible Program Areas:

   Program Area No. 2 - Traffic Signal Control Systems
   Program Area No. 3 - Freeway Management Systems
   Program Area No. 4 - Transit Management Systems

3. Incident Management Working Group

   Program Area No. 3 - Freeway Management Systems

Indianapolis Area ITS EDP Architecture/Communications/Information Group

The Architecture/Communications/Information Group will oversee Program Area No. 1 (Multimodal Traveler Information Systems).

This program area is comprised of the system architecture and communications needs for the Indianapolis Area ITS EDP. These program areas will provide an architecture and communication base that all future ITS projects will build upon. It is recommended that representation of this group include all state agencies,major transportation and transit agencies, police and emergency services.

This Working Group should coordinate its activities with ITS Midwest to assure the system architecture and communication frame work are consistent with the development of national ITS standards.

Indianapolis Area ITS EDP Traffic/Transit Management Group

The Traffic/Transit Management Group will oversee the following program areas:

- No. 2, Traffic Signal Control Systems
- No. 3, Freeway Management Systems
- No. 4, Transit Management Systems

These ITS program areas are specific to traffic signal, freeway, and transit management operations. The Indiana Department of Transportation and several transit agencies will sponsor the specific projects within the program areas. It is recommended that this group be represented by the Indianapolis Department of Capital Asset Management, major transit agencies, incident management agencies and other local traffic signal operating agencies.

Indianapolis Area ITS EDP Incident Management Group

The Incident Management Group will be closely coordinated with the management of Program Area No. 2, Freeway Management Systems. This group, originally formed as the Incident Management Task Force, would be comprised of a wide range of agencies and organizations, from the Federal Highway Administration to minor civil divisions and the electronic media and the Indiana Motor Truck Association. Initially, it is recommended that INDOT serve in the role as facilitator for this working group.

Sub-Regional Forums

An important component for acceptance and the successful implementation and operation of ITS technologies is receiving cooperation and participation from the local agencies impacted by these programs. Individual cities need to be educated and provided with an opportunity to review or express their concerns or ideas on the implementation plans for these new technologies.

An approach to assure local agency participation is by establishing sub-regional forums that would include representation of the different city and county agencies within that region. These forums would serve as a place to provide information to the local agencies on development of the program and allow the agencies to express technical and political concerns within their jurisdiction.

The Coordination Working Group would be the likely candidate to establish these forums and take a leading role of the associated activities.

9.3 NON-TECHNICAL ISSUES

As the Indianapolis Area ITS EDP is further developed, the committees and working groups will need to address many technical and nontechnical issues. Some of the nontechnical issues will include:

- Institution and jurisdictional boundaries
- Existing and required legislation
- Liability concerns
- Partnership arrangements
- Plan monitoring and review
- Authority
- Ongoing program plan updates

A preliminary assessment of some issues within each category are included below.

Institution and Jurisdictional Boundaries

The deployment of the ITS projects within the Indianapolis area will include many different public and private institutions across numerous jurisdictions. New relationships and cooperative arrangements will be required to assure the program's success. There will be a need to define individual agency roles and establish agency relationships to carry out the developed traffic, transit and incident management plans. Be aware that some jurisdictions and individuals may be resistant to change and refuse to participate in the program until they are shown that these technologies do in fact work. The issue of autonomy must also be addressed. Generally, most local agencies will not want to give up their transportation management activities to a larger agency such as the county or state. Other issues will include:

- Establishing plans for sharing information between agencies

- Assigning responsibilities for obtaining and distributing traffic/transit information and data

- Identifying and assuring dedicated funding sources for staff support to continue to operate and maintain the system after implementation

- Establishment of procedures and responsibilities for operating and maintaining the system

- Establishment of guidelines on who collects the ITS revenues and how are these revenues allocated to the various geographical locations

- Provide a means to maintaining local agencies autonomy

- Social issues such as personal privacy

Existing and Required Legislation

The committees and working groups will need to identify where new legislation will be required to assure successful implementation and operation of the ITS components. The Indianapolis Area crosses geographic and legislative boundaries and will require consistency in approach relative to the ITS EDP. Staff will need to research existing legislation and identify problem areas that may require the adoption of new legislation. It is anticipated that specific legislation may be needed to address:

- Liability in partnerships
- Standards guidelines and enforcement
- Monitoring guidelines and procedures
- Jurisdictional regulations
- Personal privacy concerns
- Maintenance procedures
- Antitrust concerns

One area where legislation is required to be adopted is regarding incident management procedures. The legislation should provide the authority to allow the Incident Management Agencies to remove or clear incidents off of the corridor's freeway system without waiting for the concurrence of the Indiana State Police.

Liability Concerns

Research, development and deployment of ITS technology opens new areas in tort liability for participating public agencies and private firms. Liability is a sensitive area that needs to be addressed in partnerships. Carefully prepared agreements between the public agencies and private industries may help to resolve some of the concerns. Agencies will need to address concerns with liability when assisting in the traffic management operations outside of their jurisdiction. Other liability issues the committees and working groups will face include:

- Identifying the liability concerns of agencies, industry, and suppliers

- Establishing the distribution of liability within a partnership or multi-jurisdictional project

- Developing methods to evaluate risk

- Identifying legislation required to address liability concerns

Partnership Arrangements

The deployment of ITS technology will require the development of some partnerships between the public and private sectors. Operational tests already completed or currently underway that have included the development of partnership arrangements can be used as a model for any partnerships required within the Indianapolis Area. FHWA and ITS Midwest will also be good sources to provide direction on the establishment of public/private partnerships.

Plan Monitoring and Review

Monitoring and reviewing the deployment of the Indianapolis Area ITS EDP will be addressed within Program Area No 6, Technical and Planning Support. The Coordination Working Group is expected to take the lead in this effort with support from the ITS Deployment Committee. The Committee/Working Group structure should provide the appropriate mechanism for monitoring the progress of the Indianapolis EDP and review details of the deployment strategies.

Authority

Issues on authority will need to be addressed. The specific projects included within the Indianapolis Area ITS EDP will encompass multiple jurisdictions within the Indianapolis metropolitan area. Clear lines of authority must be developed for each project included in the plan. The incident management plan may include the participation of all agencies. Decisions on who has the authority to implement a particular management plan and who is responsible for carrying out the plan must be addressed. Other issues to consider include:

- The distribution of authority on a regional, sub-regional and local level
- Authority for the continued operation and maintenance of the system

Ongoing Program Plan Updates

The committee/working group structure created from Program Area No. 6, Technical and Planning Support, will support any ongoing program plan updates for the Indianapolis Area ITS EDP. The ITS Deployment Committee is expected to give direction on incorporating future ITS projects within the plan. Revisions to the existing plan due to changes in the deployment of specific projects will be addressed by the Coordination Group and other Working Groups involved in the detailed program areas.

APPENDIX A

TYPICAL ITS SYSTEM FEATURES

Indianapolis Area ITS

BRW Inc.
Battelle
DKS Associates
First Group Engineering
Planning and Development Concepts

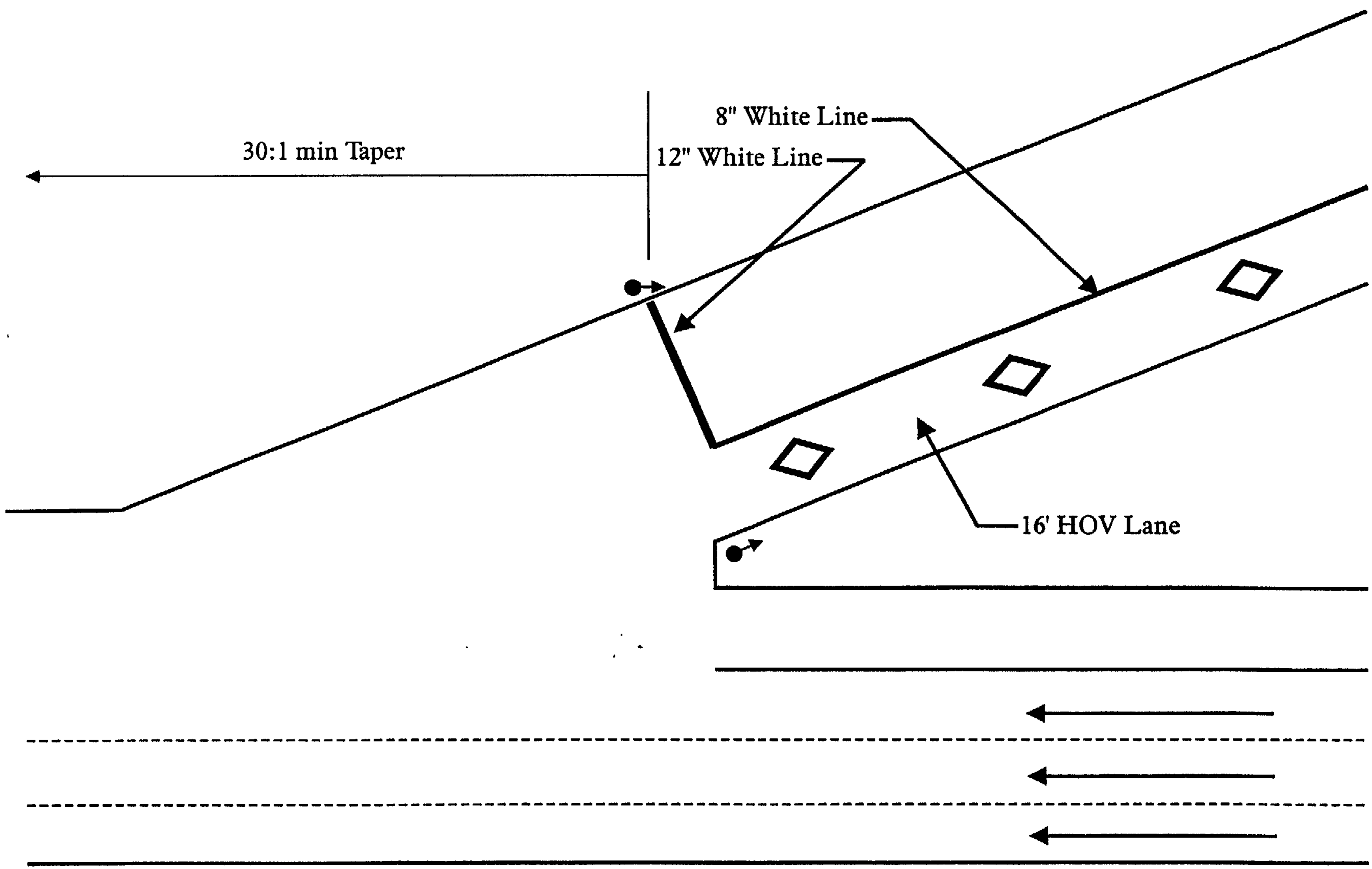
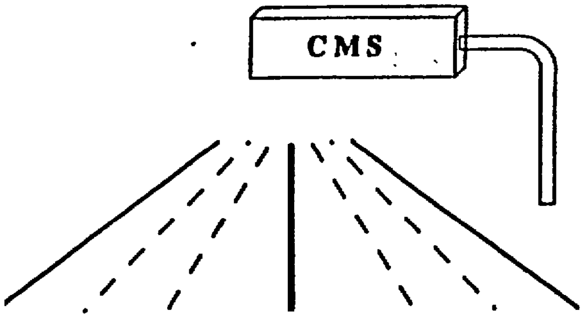
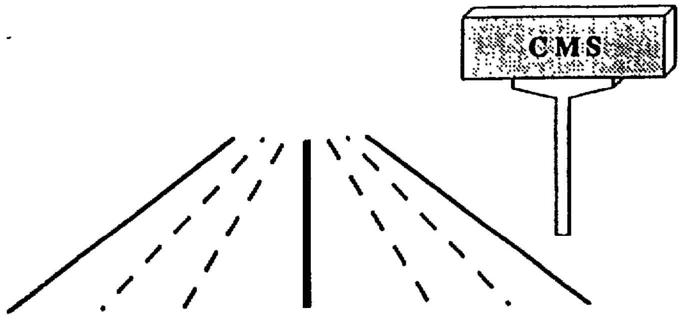


Figure
Single Lane with HOV Bypass Ramp Meter Installation

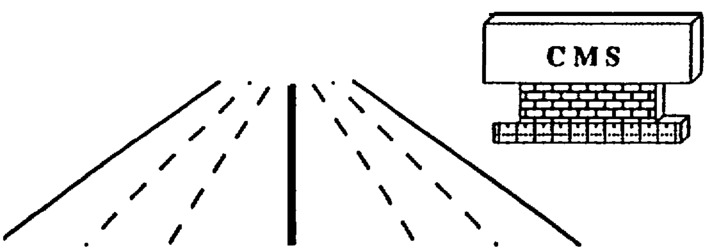
June, 96



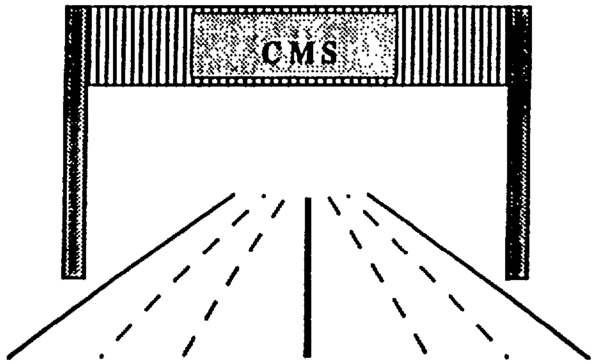
OVERHEAD MOUNT



ROADSIDE MOUNT



ROADSIDE MOUNT



GANTRY STRUCTURE

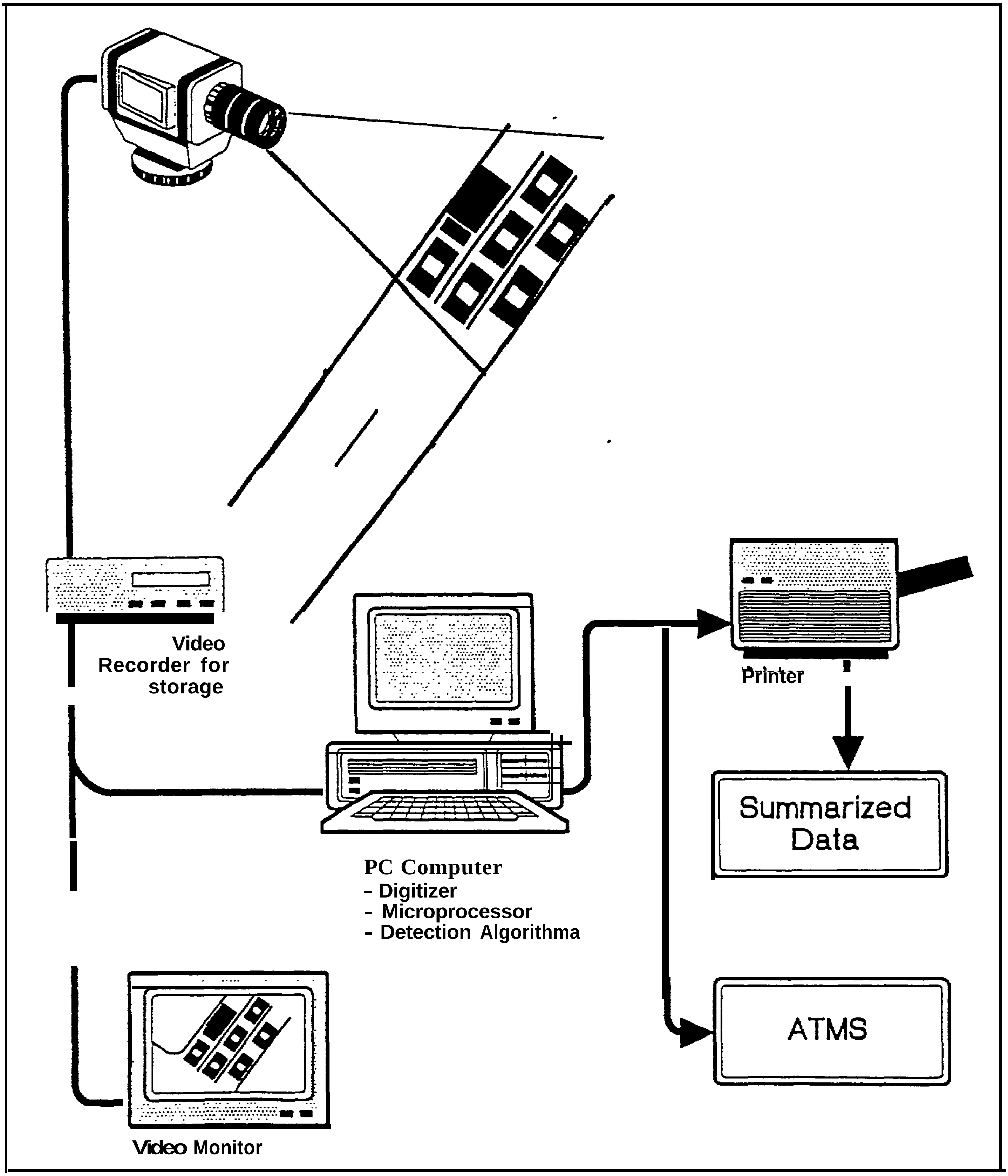
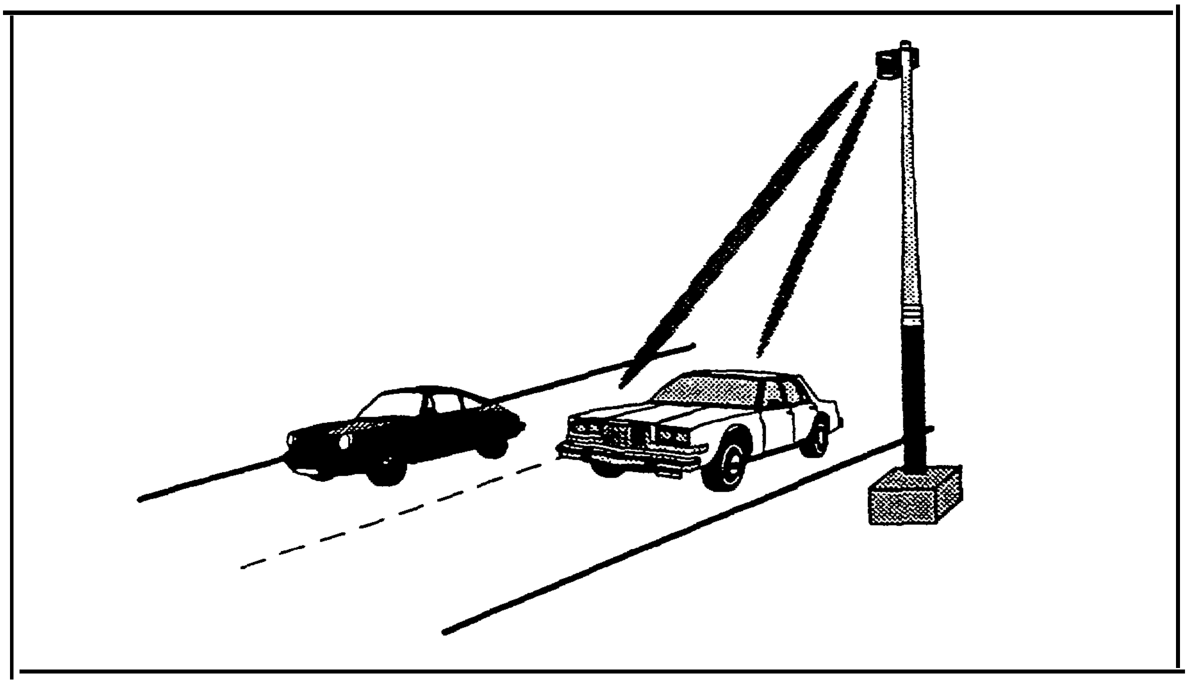


Figure
Typical CCTV/Video Detection System



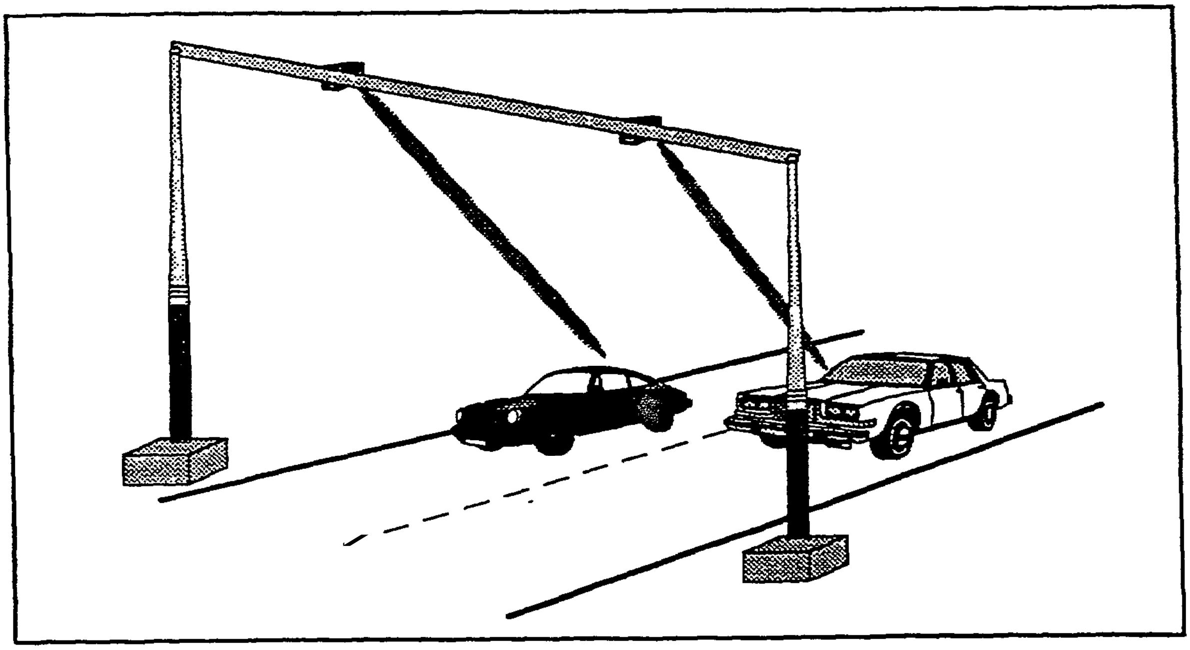
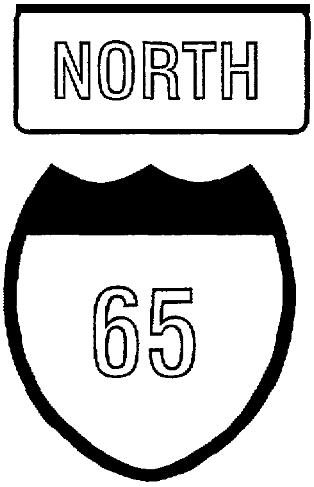


Figure ~~

Typical Advance Detection Locations

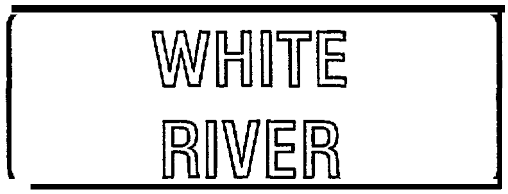
BRW Inc.
Battelle
DKS Associates
First Group Engineering
Planning and Development Concepts

June, 96



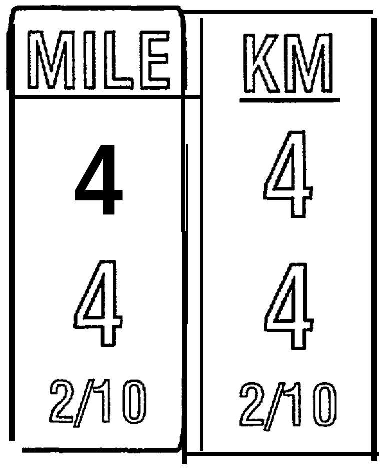
ROUTE MARKERS
WITH DIRECTION

ROADWAY
OVER PASSES/UNDERPASSES

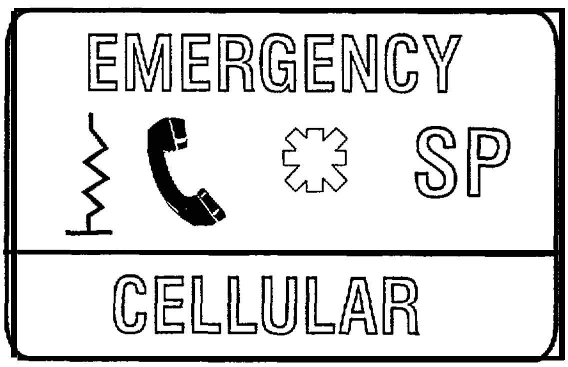


WATERCOURSES

JURISDICTIONAL
BOUNDARIES



MILEPOSTS



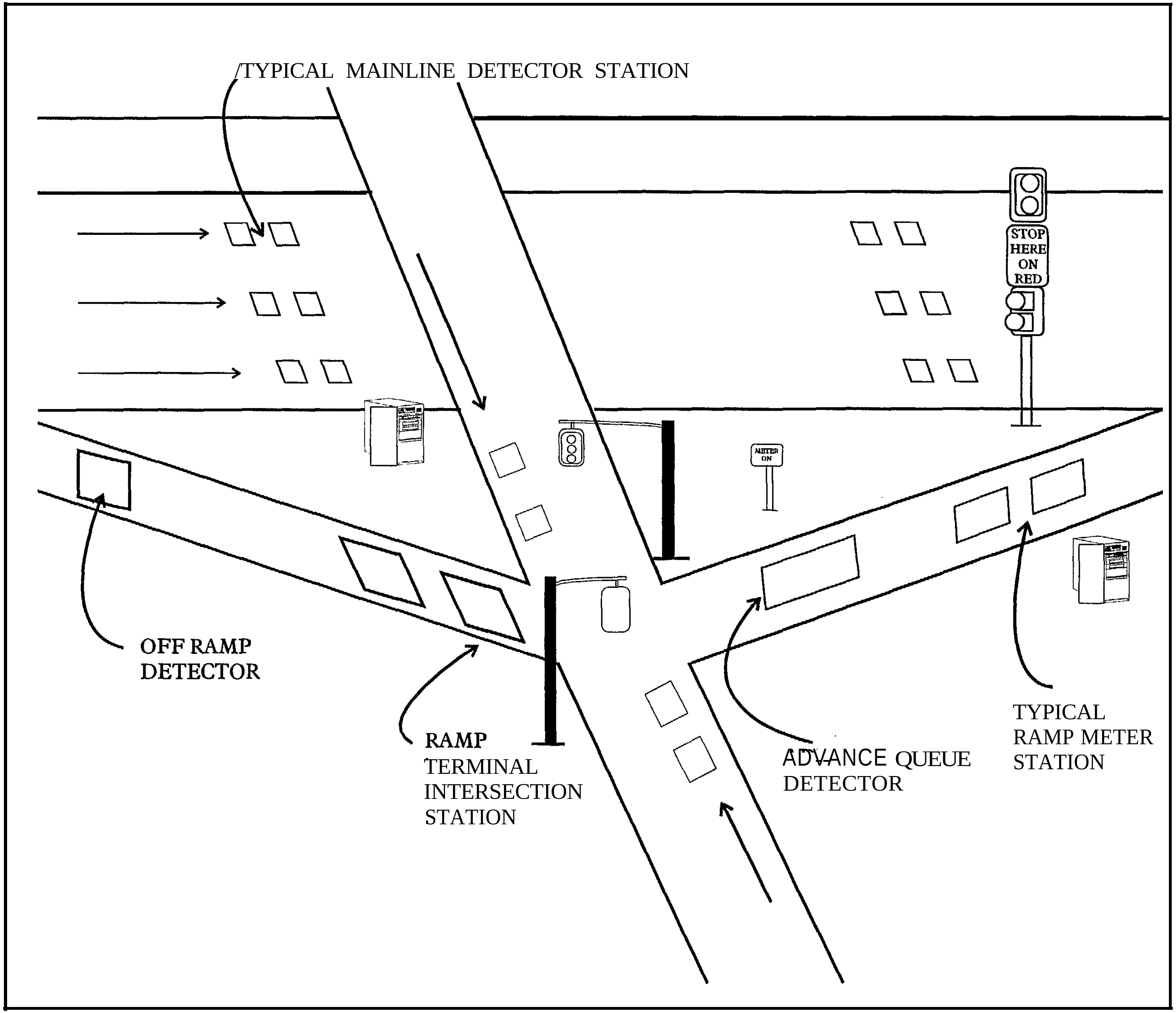
CELLULAR CALL-IN
TELEPHONE

Figure
Typical Reference Markings

Figure
Typical Detection Systems
for Freeway Interchange

June, 96

BRW Inc.
Battelle
DKS Associates
First Group Engineering
Planning and Development Concepts



APPENDIX B

EXAMPLE COMMUNICATIONS PUBLIC-PRIVATE PARTNERSHIP AGREEMENT

LONGITUDINAL FREEWAY/EXPRESSWAY OCCUPATION AGREEMENT
between
MRC TELECOMMUNICATIONS, INC.
and the
WISCONSIN DEPARTMENT OF TRANSPORTATION

May 1,1996

Table of Contents

LONGITUDINAL FREEWAY/EXPRESSWAY OCCUPATION AGREEMENT
between
MRC TELECOMMUNICATIONS, INC.
and the
WISCONSIN DEPARTMENT OF TRANSPORTATION

1. INTRODUCTION

This agreement between MIX Telecommunications, Inc. (MRC) and the Wisconsin Department of Transportation (Department) specifies the terms and conditions required by the Department enabling MRC to construct and operate a fiber optic cable longitudinally within freeway right-of-way (R/W) owned by the Department in exchange for monetary compensation or the use of bandwidth, or both. The Department's authority to enter into this agreement includes secs. 66.047, 84.08, 86.07(2), 86.16, and 182.0 17 Wis. Stats. (199596).

2. CORRIDOR LOCATIONS

The two corridor locations selected by MRC for the installation of its fiber optic limes are:

1. IH 94 westbound from USH 10 in Osseo to approximately 1/4-mile west of STH 37 in Eau Claire along the north side of the highway in Trempealeau and Eau Claire counties for a total of 22.5 miles.

2. IH 39/USH 51 northbound from Second Street (just north of Business USH 51) in Stevens Point to Business USH 5 1 in Rothschild (Wausau) along the 'east side of the highway in Portage and Marathon counties for a total of 23.425 miles.

3. PERMIT

MRC shall follow the Department's standard utility permit process to facilitate the installation of its communication lines. This agreement serves as a supplement to the actual permits that are issued to MRC by the Department.

MRC shall fill out one original plus four copies of the Department's standard EM-401 (2/95) form, "Application/Permit to Construct and Operate Utility Facilities on Highway Right-of-Way" for each of the counties where its facilities will be located [See Attachment A, EM-401 (2/95)]. Drawings depicting the location of the fiber optic lines in relation to the highway, the R/W fence, and all crossing highways shall also be submitted with each copy of the permit form.

Neither this agreement nor any permit issued grants MRC or any other person or entity an easement nor any property interest to the occupied Department R/W.

The Department's standard indemnification clause, Policy 96.03, shall be utilized on all permits.

A copy of the permit shall be at the job site during all work times.

4. PERMIT/AGREEMENT TERM LENGTH; TERMINATION

The original permits for constructing and operating the fiber optic lines shall have a 20-year term, Permits issued to MRC prior to actual construction (e.g. for tree clearing, spot location bores, etc.) or maintenance after construction (e.g. replacement of a defective fiber optic cable, etc.) shall be effective for the dates listed on the individual permits and shall not affect the terms of this agreement.

This agreement may be renewed for another 20-year period upon mutual consent of both parties. Once a renewed agreement has been achieved between MRC and the Department, new permits will be issued for the subsequent term.

This agreement may be terminated at any time by the mutual consent of both MRC and the Department.

5. PERMIT REVOCATION

The permits issued to MRC are revocable by the Department. If MRC violates the Department's Utility Accommodation Policy (Policy), as amended by the Department from time to time, or fails to take actions required by the Department to correct violations, the Department may revoke any or all of MRC's permits. In addition, MRC forfeits its original cash payment or a portion thereof as a penalty for these violations as determined by the Department.

The Department may also revoke a permit to accommodate a proposed highway improvement after giving MRC sufficient advance warning -- the type which is typically given to potentially impacted property owners as part of the Department's 6-year Improvement Program process. MRC would be eligible for a prorated refund of its original cash outlay if this type of revocation occurs.

6. FACILITY RELOCATION

MRC shall be given an opportunity to relocate their facility within the highway R/W if a proposed highway improvement project conflicts with their location. In keeping with the Department's policy on compensable and non-compensable utility facility moves, the Department shall not compensate MRC to move its facility within the R/W as part of a highway improvement project.

7. PAYMENT

MRC shall pay the Department a one-time fee of $7,000 per mile or $32 1,475 (Three Hundred Twenty One Thousand Four Hundred Seventy Five dollars and no cents) for the right to occupy the two freeway corridors listed in section II. The payment shall be made on May 15,1996.

If MRC and the Department agree to a subsequent 20-year term for R/W occupation, MRC shall pay the Department an additional fee to be negotiated by both parties at that time. That payment date shall be listed on the renewed agreement.

8. RESOURCE SHARING

The Department recognizes that MRC could become the successful bidder for the Wisconsin Department of Administration's (DOA) SONET ring project. If MRC wins the contract, the Department may refund MRC's original payment of $321,475 in a joint effort that would allow DOA to obtain telecommunications service for the Department. The Department and DOA may enter into a separate agreement with each other to specify the details of trading R/W occupancy for bandwidth.

If MRC does not win the contract or any subsequent DOA contracts to provide the state with telecommunications service, the Department may elect to refund part or all of MRC's original cash payment in exchange for telecommunications service in the future (e.g. to accommodate Intelligent Transportation Systems).

9. INSTALLATION REQUIREMENTS

All installations shall follow the guidelines set forth in the Department's Utility Accommodation Policy, as amended by the Department from time to time, except as specified in this agreement or in any special permit provisions.

A. Hours of Operation/Holiday Work Restrictions

MRC is authorized to work between normal daytime hours -- 6:00 AM to 8:OO PM -- seven days per week. No work shall take place during nighttime hours unless first authorized by the Department. MRC shall not work during the following peak holiday travel periods:

1) Memorial-Dav Weekend
From 12:00 Noon on Friday, May 24 until 6:00 AM on Tuesday, May 28,1996

2) Fourth of July Weekend
From 12:00 Noon on Wednesday, July 3 until 6:00 AM on Monday, July 8, 1996

MRC may, however, petition the district utility permit coordinators in Wisconsin Rapids and Eau Claire to work on Friday, July 5 and Saturday, July 6,1996 since peak travel times typically occur at the beginning and end of the holiday period.

B. Discovery of Unexpected Environmental Conditions

Since there is no highway improvement project associated with MRC's project, the Department will not have information pertaining to environmental conditions within the corridors. The Department suggests that MRC perform its own environmental assessments prior to construction. Any discovery of environmental conditions by MRC shall be handled in accordance with Policy 96.08.

C. Service Connections

MRC's installation is considered a transmission line. Therefore, no service connections shall be allowed to individual property owners adjacent to the two corridors without prior authorization from the Department. MRC shall have the right to exit from and enter to the R/W to make a connection to the existing fiber optic cable for the purposes of building another transmission line subject to Department permit approval.

D. Access to R/W

Access to the Department's R/W shall be from adjacent lands, frontage roads, or crossing highways, and not from the freeway itself unless specifically authorized by the Department.

MRC may temporarily remove a portion of the Department's security fence to gain access to the R/W. MRC shall be responsible for effectively restricting access by others during the period when the fence is open. Overnight, the security fence shall be restored, a locked gate installed, or some other means of securing the fence accomplished to keep people and animals out.

E. Traffic Control

For operations which occur off the shoulder and up to 45 feet from the edge of the closest traffic lane, MRC may follow Policy 96.51, sheet 4 of 6, as it may be amended by the Department from time to time. When the work operation (including all vehicles and equipment) is beyond the clear zone (45 feet from the edge of the closest lane), MRC shall not be required to place any advance waming signs on the freeway.

F. Work Area Protection During Non-Work Times

MRC may store its equipment on the R/W during non-work time provided the equipment is parked as close to the R/W fence as possible and outside of the clear zone. MRC shall ensure that any excavation left open during non-work times is well-marked.

G. R/W Restoration/Erosion Control

MRC shall restore the R/W to its original condition within one week after the installation of its cable. Although no formal erosion control plan is required, MRC shall take all steps necessary to prevent soil from getting into nearby waterways. MRC shall protect bore pits with silt fence, hay bales, or other erosion control devices to contain the soil directly at the site. Upon request from the Department, MRC shall provide an erosion control plan if it cannot effectively demonstrate proper erosion control practices during its operation.

H. Horizontal Location Within Corridor

MRC shall install its fiber optic cable parallel to and five feet away from the Department's R/W fence. Deviations from this five-foot distance may be allowed, but shall first be approved by the district utility permit coordinator.

I. Vertical Location Within Corridor

MRC shall bury all fiber optic cable that is placed in the Department's R/W. In addition to compliance with Policy 96.53(C), all cables shall be placed at a depth of 30 inches or more with a plastic "warning" tape placed above the cable to prevent accidental cutting. MRC may install its cable by means of plowing. At specific locations as directed by the Department (e.g. under culverts, crossroads, etc.), MRC shall bore or auger.

J. Tree/Shrub Removal

All trees and shrubs needed to be removed by MRC to accommodate the construction of its facilities shall first be marked out in the field by a representative of the Department. All trees, stumps and shrubs slated for removal shall be completely removed and grubbed and holes properly backfilled.

MRC may clear trees and shrubs up to five feet on either side of the proposed alignment of its fiber optic cable upon Department approval. All trees removed shall be disposed of by first giving the adjacent property owner the right to keep the trees. If the adjacent property owner does not want the trees, then MRC may dispose of the trees as they wish so long as it is off the Department's R/W and out of sight from the traveling public.

The Department may require MRC to transplant or remove and replace certain isolated trees or trees that the Department had planted for a living snow fence or for aesthetic purposes. All trees that are transplanted or new trees planted shall be maintained by MRC for a period of two years. If any of these trees die within the two year period, MRC shall replace these trees and maintain them for another two year period.

K. Structure Attachments

No part of MIX's facility shall be attached to any Department bridge, box culvert, etc., unless specifically authorized by the Department.

L. As-Built Drawings

MRC shall submit to each district utility permit coordinator a copy of its "as-built" plans approximately one month after the installation of its fiber optic Jines.

M. Above-Ground Marking: of the Facility

MRC may mark its facility with above ground markers spaced at a minimum of 900 feet. The markers should be designed to notify anyone in the vicinity of the facility as to its approximate location, but be small enough that they are not readable from the highway.

N. Pre-Construction Meetings

The Department and MRC, along with its contractors and consultants, shall meet prior to the start of construction to discuss the proposed operation.

O. <u>On-Site Project Manager/Other Contacts</u>

MRC shall provide the names of the people in charge of each of the field operations. Those persons shall have cellular phones or pagers that would enable a Department representative to contact them at any time. MRC shall also provide the names and phone numbers of additional contacts who are responsible for the overall project or individual facets such as other consultants or contractors

P. <u>Department Inspections</u>

The Department reserves the right to inspect the work in progress either with Department personnel or county highway department personnel who are under contract with the Department to provide highway maintenance services.

Q. <u>Periodic Contacts</u>

MRC should contact the district utility permit coordinator or local law enforcement authorities on a periodic (e.g. weekly) basis to inform them of the project's status and to keep the lines of communication open.

10. FUTURE ACCOMMODATIONS

This agreement does not provide for exclusive use of Department R/W by MRC. The Department may allow additional utility installations adjacent to MRC's fiber optic cable. The Departmentshall provide for a reasonable distance to be maintained from MRC's facility to minimize potential conflicts and reduce the possibility of accidental damage.

The Department may encourage other telecommunications companies interested in locating within the same corridors as MRC to talk to them about the possibility of leasing bandwidth to minimize the number of times that the Department's R/W is disrupted.

11. EMERGENCIES

MRC may respond to any emergencies related to its facility without first obtaining a permit so long it follows the guidelines in the Department's <u>Utility Accommodation Policy,</u> as amended by the Department from time to time, while handling the emergency. MRC shall submit a permit application after the emergency to document any changes to its facility.

12. FACILITY ABANDONMENT

MRC may abandon its facilities upon prior written notification to the Department. At that time, the Department will review current law and its own policies to determine whether the fiber optic cable can remain in the ground or has to be removed by MRC.

13. CHOICE OF LAW

This agreement is entered into and governed by the laws of the State of Wisconsin.

14. SEVERABILITY

If any provision of this agreement should be found to be illegal, invalid or otherwise void, it shall be considered severable. The remaining provisions shall not be impaired and the agreement shall be interpreted as far as is possible to give effect to the parties' intent.

15. ENTIRE AGREEMENT

The terms and provisions herein contained, including all attachments, constitute the entire agreement between the parties and shall supersede all previous communications, either oral or written, between the parties with respect to the subject matter hereof, and no agreements or understandings varying or extending the same shall be binding upon either party unless in writing signed by a duly authorized officer or representative of each party.

16. NO TRANSFER ALLOWED

Neither this agreement, nor any interest therein, nor claim thereunder, or any permit issued pursuant to this agreement, can or shall be assigned or transferred to any other party or parties, except the Department may approve a transfer in its sole discretion and such approval shall not be unreasonably withheld. The purpose of this limitation on transferability is to foreclose the creation of any MRC interest in property as a result of this agreement, any permit, or any activity or installation hereunder.

17. WARRANTY OF AUTHORITY

The signatories hereto warrant that they have full authority to enter into this agreement and make it binding on the parties hereto without further action or approval.

IN WITNESS WHEREOF, the parties have caused this agreement to be executed in duplicate by their duly authorized and empowered officers or representatives

WISCONSIN DEPARTMENT OF TRANSPORTATION	**MRC TELECOMMUNICATIONS, INC.**
By:____________________	By:____________________
Title:__________________	Title:__________________
Date:__________________	Date:__________________

EM401 295 ATTACHMENT A

APPLICATION/PERMIT

Wisconsin Department of Transportation

TO CONSTRUCT AND OPERATE UTILITY FACILITIES ON HIGHWAY RIGHT-OF-WAY

s.84.08, 86.07(2), 86.16, 182.017 and such other applicable Wis. Stats.

Location Description - Quarter section, section, township, range, etc.
To each copy of the application attach one copy of the sketch showing location

Proposed Work Location

☐ Town ☐ Village ☐ City

OF

County

Applicant Name and Address

Construction Starting Date

Construction Completion Date * See Note Below

Applicant Work Order - if any

Highway	Utility Facility/Work Type		Line Orientation	Trans 401 Project Designation (See policy 96.55)
☐ STH ________	☐ Electric	☐ CATV	☐ Overhead	☐ Minor
☐ USH ________	☐ Telephone/ Communications	☐ Gas/Petroleum	☐ Underground	☐ Major
☐ Interstate ________	☐ Water	☐ Chemical Treatment	☐ Bridge Attachment	☐ For Major projects only the utility shall notify the department at least 24 hours prior to the installation of erosion control and storm water management measures Trans 401.09(1)
	☐ Sanitary Sewer	☐ Tree Cutting/Removal		

*NOTE: If the work described is not completed by the "Completion Date" specified, this permit is null and void, and the work shall not be completed unless authorized through a subsequent permit or an approved time extension.

It is understood and agreed that approval is subject to the applicant's full compliance with the pertinent Statutes, as well as any rules and regulations of other jurisdictional agencies, which may be more restrictive, and with the Wisconsin Department of Transportation's Policy for the Accommodation of Utilities on Highway Right-of-Way, current edition.

Line Owner Notification Telephone Number

X ______________________
(Authorized Representative) (Date)

(Title)

(Authorized Representative Telephone Number)

Transportation District Recommendation

District Location and Telephone Number

Date Application Received by District

X ______________________
(Recommendation for District Director) (Date)

☐ The applicant shall contact the Transportation District Office at the Telephone Number given at right NOT LESS THAN 3 WORKING DAYS prior to the start of the permitted work to arrange for a District Representative to locate and mark the existing traffic signal and/or highway lighting lines. No work under this permit shall be accomplished prior to the District Representative's arrival.

Special Telephone Number

Division of Highways Permit Approval

Permit Number	Issuance Date

X ______________________
(Approval for State Highway Maintenance Director)

Date: 05/06/96
From: Tom Lorfeld — LORFET - HFRC
To: Robert Fasick — FASICR - HFRC
cc: David Vieth — VIETHD - HFRC
Subject: Elevated Expressway Fire Hazards
Reference: Note from David Vieth (VIETHD - HFRC) attached below

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Bob, please handle this directly with Johnny Gerbitz as Dave has asked.

Let both Dave and I know of your response to Johnny. Thanks.

------------------------------ ATTACHED NOTE ------------------------------

Date: 05/01/96
From: David Vieth — 267-8999 VIETHD - HFRC
To: Thomas Lorfeld — LORFET - HFRC
Subject: Elevated Expressway Fire Hazards
Reference: Note attached below

Tom, would you please request our districts to make a check of our Interstate highways which are elevated to determine whether we have any hazardous materials stored under the elevated sections.

Johnny's note attached should help you understand the objective of this request and it lays out the date they would like to hear back from us. My understanding is that we do have some parking lots under elevated sections of the interstate in D2. I'd think we should include that in our report especially if there could be a risk of damage to structures in the event one or more cars caught fire. If you disagree, we can clarify with Johnny.

Generally I wouldn't expect this to involve a significant effort by the districts. By and large they should know what is out there and what risks might exist. However, if they don't feel comfortable that they are aware of any encroachments or illegal dumping or storage, a quick look would be appropriate. It might be wise to ask bridge inspectors for info.

------------------------------ ATTACHED NOTE ------------------------------

Date: 05/01/96
From: David Vieth — 267-8999 VIETHD - HFRC
To: Johnny Gerbitz — GERBIJ - HFRC
cc: Thomas Strock — STROCT - HFRC
Thomas Fudaly — FUDALT - HFRC
Subject: Elevated Expressway Fire Hazards
Reference: Your note of 05/01/96 11:18 attached below

Sounds like a reasonable request and I appreciate you giving us a due date that provides for working this in to our workload. I'll request info from all districts to make sure we don't overlook any situations.

If we need clarification or encounter any other problems doing this scan of our system I'll be in touch.

------------------------------ ATTACHED NOTE ------------------------------

Date: 05/01/96
From: Johnny Gerbitz, FHWA (608/829-7511) GERBIJ - HFRC
To: David Vieth VIETHD - HFRC
cc: Thomas Fudaly FUDALT - HFRC
Thomas Strock STROCT - HFRC
Subject: Elevated Expressway Fire Hazards

Hello, Dave

As you may know, a section of elevated I-95 in Philadelphia, Pennsylvania was recently closed due to damage that occurred when tires illegally stored or dumped under the freeway caught fire.

Although we are not aware of any similar storage problems under elevated sections of Interstate Highways in Wisconsin, we would appreciate your District Maintenance staff's assistance to make a quick informal visual check of the elevated freeway sections in their areas to see if a more formal detailed review of illegally stored or dumped tires (or other waste products) should be initiated.

The elevated freeway sections that we could quickly think of which we suggest should be checked are those in the Milwaukee, Green Bay, and Superior areas.

If possible, we would like to get a short E-Mail response from you or the Districts summarizing their field observations by June 15.

Please give me a call if you have any questions or concerns with this request. Also, if you feel we should be requesting your assistance through more formal channels, please let me know.

Thanks in advance to you and the District staffs for your time and effort spent in response to our request.

/s/ Johnny Gerbitz

E-Mail: GERBIJ
Tel #: 608/829-7511
FAX #: 608/829-7526