Transportation Planning for Small and Medium Sized Communities

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The Sixth National Conference on
Transportation Planning for Small and Medium-Sized Communities
September 16-18, 1998, at Cavanaugh's Inn at the Park in Spokane, Washington.

This Conference was sponsored by the Transportation Research Board Committee on Transportation Planning Needs and Requirements for Small and Medium-Sized Communities—A1D05 and hosted by the Washington State Department of Transportation. The Conference was co-sponsored by the Federal Highway Administration, the Federal Transit Authority, the Institute of Transportation Engineers, the Oregon Department of Transportation, and the Idaho Department of Transportation.

The Small and Medium-Sized Communities Conference was a symposium for transportation managers, planners, engineers, and elected officials from urban areas of less than 250,000 people; representatives from regional planning agencies, metropolitan planning organizations (MPOs), federal, state, and local transportation agencies and T-2 centers; consultants; and citizens who had active interest in transportation

The theme was "Tools of the Trade." The conference that provided ready-to-use, economical and practical techniques for planners and decision-makers in urban areas of under 250,000 people. The conference provided transportation planners a forum for the exchange of useful information, practical techniques, and low-cost methodologies particularly tailored to the needs of small and medium-sized urban communities.

Thanks for your interest in the proceedings of the Sixth National Conference in Spokane

Sincerely,

KATHERYN BRISCOE
Committee Chair
Transportation Research Board Committee on
Transportation Planning Needs and Requirements
for Small and Medium Sized Communities, A1D05

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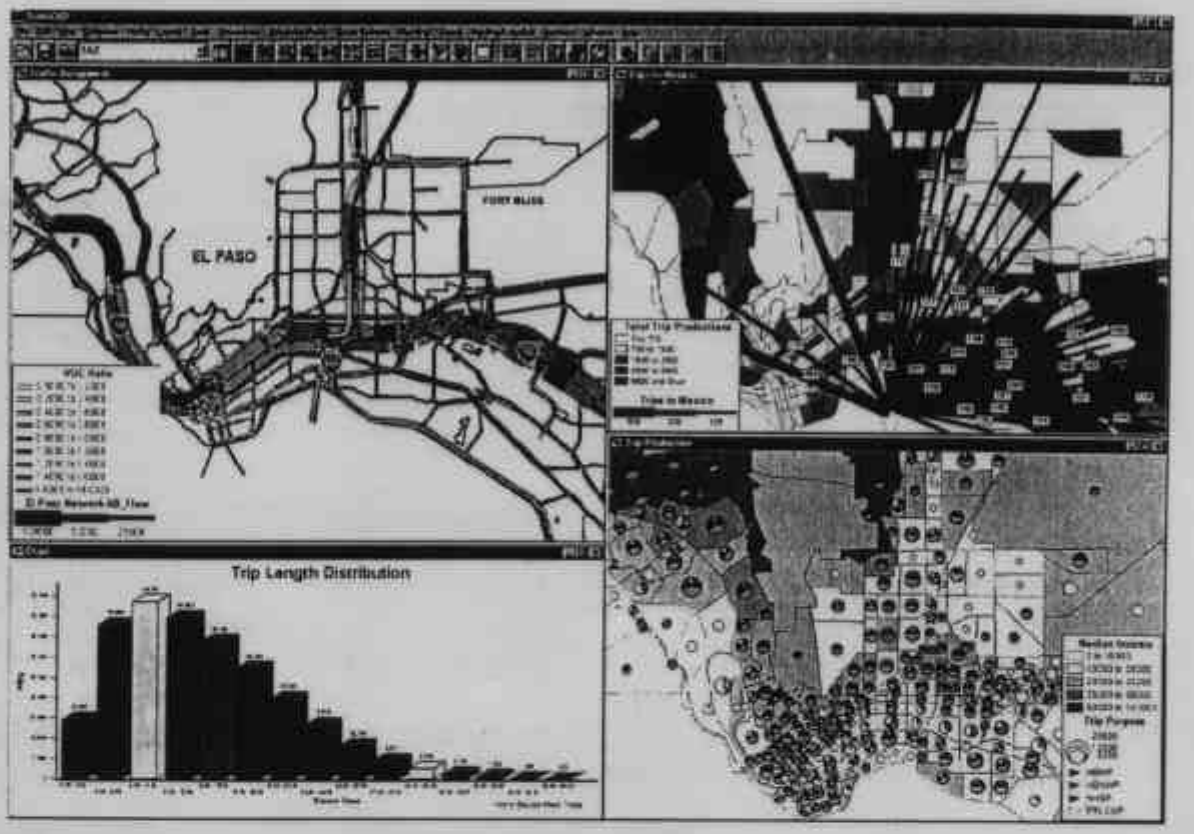

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SESSION 1 - MAKING TOUGH TRANSPORTATION DECISIONS EASIER

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Panelists: Jill Kruse, Surface Transportation Policy Project
Cass Brotherton, Washington Department of Transportation
Patrick DeCorla-Souza and James Hunt, Federal Highway Administration
Martin Weiss, Federal Highway Administration

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Session #1

Remove It and They Will Disappear

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Abstract

Remove It And They Will Disappear: New Evidence Why Building New Roads Isn't Always the Answer

While induced travel has countered the notion that cities can build themselves out of congestion, reduced travel has emerged to further challenge the way local officials think about road building.

Flying in the face of conventional wisdom, new evidence shows that closing roads can eliminate traffic. A British study, released in March, 1998, is creating a buzz in transportation circles. The study found that closing roads actually cuts driving trips. The research team, led by Phil Goodwin of University College London, one of the Blair government's key transport advisors, analyzed 60 cases worldwide where roads were closed, or their ability to carry traffic was reduced. On average, researchers found that 25 percent of the traffic vanished when a road was closed. And in some cases, the researchers found that an astonishing 60 percent of the driving trips disappeared. The question is, will it convince stalwart road supporters to curb the road building fervor and plan cities that serve its citizens?

Evidence of reduced travel has surfaced in the U.S., but it has been met with skepticism, or ignored entirely. The main lessons from these studies, however, lend support to any city that desires a healthy transportation system. Accommodating a major change in traffic patterns like a road closure, the study shows, appears to be the system's flexibility. Commuters in the British study had a variety of travel options to choose from, including public transit, walking, or working from home. This adaptability allowed for a smooth transition, demonstrating that a balanced approach to transportation planning not only better serves its citizens, but allows for improved traffic management.

Many local officials have found that decreasing road capacity and expanding options for public transit, walking, and biking are rejuvenating their cities. New evidence from the UK supports these decisions, creating fresh opportunities for traffic management. By demonstrating that road closures can eliminate traffic and boost the economy, reduced travel further debunks the notion that building more roads will solve traffic problems. And as cities around the world wrestle with rising traffic congestion, evidence of reduced travel helps show that a balanced, equitable system is the most effective solution.

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Remove It And They Will Disappear: New Evidence Why Building New Roads isn't Always the Answer

While induced travel has countered the notion that cities can build themselves out of congestion, reduced travel has emerged to further challenge the way local officials think about road building. Whereas induced travel is characterized as "build it and they will come," reduced travel takes this one step further with "remove it and they will disappear."

Flying in the face of conventional wisdom, new evidence shows that closing roads can eliminate traffic. A British study released in March, 1998, entitled the *Traffic Impact of Highway Capacity Reductions*, is creating a buzz in transportation circles. The study found that closing roads actually cuts driving trips. The research team, led by Phil Goodwin of University College London, one of the Blair government's key transport advisors, analyzed 60 cases worldwide where roads were closed, or their ability to carry traffic was reduced. On average, researchers found that 25 percent of the traffic vanished when a road was closed. And in some cases, the researchers found that an astonishing 60 percent of the driving trips disappeared.

But where does the traffic go? While transportation planning models would assume that traffic will shift onto other roads and cause congestion elsewhere, experts now posit that in many cases, it actually disappears.

Background

Increasingly, suggestions have arisen that predictions of traffic chaos following road closures are overly simplistic and, as the authors discovered, may not be well founded. One of the foundations for this conclusion is the 1994 British Standing Advisory Committee on Trunk Road Assessment (SACTRA) study which concluded that "induced traffic does occur, probably quite extensively."

The phenomenon of induced travel has been studied for years, but the strength of these findings have led today's researchers to be less concerned with whether induced traffic exists, and more focused on determining the magnitude of its impacts. Typically, when drivers perceive an increase in either travel time or travel cost, they usually cope by altering their route, travelling at a different time of day, switching to a different mode, or traveling less. When road capacity is expanded, studies on induced travel found, the opposite happens.

The Federal Highway Administration (FHWA) found evidence of induced travel in a study of Milwaukee, where researchers concluded that induced traffic accounted for 11 to 12 percent of the area's traffic growth between 1963 and 1991 (Kevin Heanue, TRB 1997). Mark Hansen's pivotal study at UC Berkeley examined 30 urban counties in California from 1973 to 1990 and found that at the metropolitan level, every one percent increase in new lane miles generates a 0.9 percent increase in traffic over four years.

The study on reduced travel set out to determine whether the findings of induced traffic would lead researchers to conclude that, similarly, a reduction in capacity would result in an overall reduction in traffic volume. If this were true, the researchers posited, the displaced traffic would

cause less severe congestion than expected. The study examined traffic reduction under three different conditions: as a side effect of maintenance or repairs, in cases of natural disaster, or as a direct result of policy.

Findings

Due to structural problems, Tower Bridge in London was closed in 1994 and became a prime example of "reduced travel." According to London's chief engineer, "[t]hree years later the traffic had still not returned to its original level." Researchers also found that when part of London's notorious ring road, the "ring of steel," was closed in 1993, traffic fell 40 percent, and air pollution dropped 15 percent. London's Hammersmith Bridge provided further evidence when it was determined incapable of carrying its load of 30,000 vehicles a day. The bridge was closed to all traffic except buses and cyclists since last February. London's Transport department surveyed people who used the bridge a few days before it closed, and then contacted the same people in the weeks following the closure. Of the commuters who used the bridge to get to work, some switched to public transit and others chose to walk or bike. Overall, 21 percent no longer drove to work. And remarkably, congestion in the surrounding areas has not markedly increased.

The researchers found similar patterns worldwide. In Japan, in the wake of the 1995 Kobe earthquake, the entire Hanshin Expressway network was impacted, resulting in a dramatic decline in traffic in the Osaka-Kobe area. Once the network was restored patterns of mode use re-established themselves, but with a 27 percent decline in car travel. The results of these studies led researchers to assert, "we conclude that measures which reduce or reallocate road capacity, when well-designed and favored by strong reasons of policy, need not automatically be rejected for fear that they must inevitably cause unacceptable congestion."

Cities that have consciously changed their road allocation policies dispel the myth of traffic chaos. In Nürnberg, Germany (population 480,000) city policy called for the pedestrianization of the city center beginning in the 1970s, and closed the last through street in 1988. As local officials reported, "Nearly 80 percent of the car traffic simply disappeared and could not be accounted for in parallel streets." Overall, the study which was conducted from 1988 to 1992, found a traffic reduction of seven percent. In the city of Hamm, Germany, population 183,000, traffic calming measures reduced a major road from four to two lanes. Local officials reported a 16 percent reduction on most of the road, with the added benefit of a 54 percent reduction in traffic accidents.

Here in the U.S., evidence of reduced travel has surfaced, but it has been met with skepticism, or ignored entirely. In fact, the U.S. equivalent of SACTRA, a committee of the Transportation Research Board, made the decision to exclude empirical evidence of road closures and traffic calming in their influential 1995 report, *Expanding Metropolitan Highways*. If they had considered such evidence they would have found stories such as the West Side Highway in New York City. In 1973, one section of the highway collapsed, resulting in the closure of most of the route. NYDOT did a study in 1976 of the remaining portion of highway, in which traffic counts taken three years before the closure and two years after revealed that, overall, 53 percent of the trips disappeared, and of those trips, 93 percent did not reappear elsewhere–only seven percent of

the lost traffic was diverted onto parallel roads. The West Side Highway was included in the British report, which found an overall traffic reduction of eight percent.

Implications for Small and Medium-Sized Cities

The findings of the British study are significant for any city, suburb or rural area. Having travel options not only affords citizens choices in how they get to work or go to the store, but ensures that the transportation system can absorb sudden changes in traffic flow and mode choice. However, as small and medium-sized cities continue to struggle with growth and increasing traffic, preserving quality of life becomes an important part of decision making. The study's findings, therefore, may be most useful for smaller areas that are faced with difficult economic decisions about whether or not to build roads, particularly bypass projects.

Bypasses are often touted as a catalyst for regional economies, offering advantages such as construction jobs, facility planning and operations, as well as indirect benefits from less delays and inter-industry effects. Actual research shows that mostly these projects mostly shift economic activity from one place to another. A study by Professor Marlon Boarnet of the University of California at Irvine showed that in counties where highway spending accelerated, they experienced increased economic activity, but also found that adjacent counties experienced reduced economic output (Boarnet, 1995). Other research echoes these findings: "By design, beltways and bypasses create large areas of highly accessible land outside the city, particularly at interchange sites, which are traditional magnets for development such as office parks or shopping areas."

The new land availability attracts businesses to the suburbs where zoning is less restrictive, allowing large parking lots and subdivision lots. This feature of the beltway system has been a powerful force for moving people and jobs out of the central city, resulting in a shift in the business activity away from downtown (Anderson, et al., 1980). In 1980, a comprehensive study carried out by a consulting group for the U.S. Department of Transportation (DOT) and the U.S. Department of Urban Development (HUD) concluded, "because any net gains are likely to be small, potential adverse impacts of beltway construction probably cannot be balanced by beltway-induced regional economic growth." These findings agree with studies of rural bypasses. One study looked at bypasses in Minnesota and Iowa and found that economic benefits of highways were merely shifted from one location to another.

Echoing these conclusions, an interim report by SACTRA that was released along with the reduced travel study, suggests that new roads can lead to job losses, and that closing roads in city centers can boost the local economy. SACTRA set out to investigate the age-old argument that new roads help to revitalize neglected areas. In rural areas, the study found that new highways expose local companies to outside competition, ultimately leading to job loss. The report's overall findings suggest that roads designed to bring jobs into areas of high unemployment can instead result in fewer employment opportunities because of increased congestion. Furthermore, the study offers that closing roads can create downtown jobs because reduced congestion results in benefits to the overall economy.

Lessons

The key to accommodating a major change in traffic patterns, like a road closure, appears to be the flexibility of the transportation system. The effects of projects to reduce capacity, the researchers assert, will be reinforced or undermined by the network conditions, policy incentives, and influenced by home, work and social activities. Commuters in the British study had a variety of travel options to choose from, including public transit, walking or working from home. This adaptability allowed for a smooth transition. The study demonstrates that a balanced approach to transportation planning not only better serves its citizens, but allows for improved traffic management and a healthy network. And many cities have found that while reducing capacity may not have a measurable traffic reduction, by reducing barriers, they have discovered a new life beyond roads.

In 1989, the Loma Prieta earthquake toppled San Francisco's Embarcadero Freeway, and the citizens and local officials decided not to rebuild it–despite the cries of impending doom. Although engineers around the Bay Area predicted a traffic disaster, the chaos never materialized, and ridership on the Bay Area Rapid Transit (BART) system went up 30,000 new passengers. Seven years later, when the upper deck of San Francisco's unstable Central Freeway was torn down, local officials again predicted a grim picture for Bay Area traffic. But once more, gridlock never materialized, prompting citizens and local officials to call for its complete removal. A stark lesson emerged from both incidents, namely the exaggeration of the freeway's importance in the transportation system.

In the case of the Embarcadero Freeway, people also underestimated how the city would transform once it was liberated from the concrete barrier. Once shrouded in darkness and noise, downtown San Francisco's now-exposed waterfront has enjoyed a revival ever since the concrete structure came down. Instead of the hostile, dead-end environment, the bayside now boasts an inviting promenade, bathed in light. Many improvements followed the freeway's demise, including the placement of historical markers along the waterfront, an overhaul of the Ferry Building Depot to serve as an intermodal hub, installation of a light rail line, and a boom in residential and commercial activity.

In Portland, Oregon, the citizens did not wait for a natural disaster to intervene, but made a conscious decision to reclaim the riverfront from Harbor Drive, a six-lane freeway abutting the river. The impact to the city was tremendous, sparking the revitalization of the downtown area. In place of the freeway, a 37-acre waterfront park was built and now hosts events throughout the year, attracting citizens and tourists to what is proudly referred to as "Portland's backyard." Because of the hard work of the citizens and projects like Pioneer Square, a former parking lot-turned-public space in the middle of the city, downtown is a destination. The light rail system is a testament to the success of downtown's attractions, as it serves a higher ridership on the weekends than during the weekday rush. Walking is also a celebrated mode of transportation. Portland's thriving downtown proves that there are solutions other than building new roads, and in the process has attracted the praise of tourists and local officials worldwide.

British officials, spanning the John Major and Tony Blair governments, are increasingly disenchanted by the idea of building more roads. Goodwin's study played a significant role in the

British government's White Paper on transport, along with the debate over the proposed 1999 Road Traffic Reduction Bill. The bill will require the Government to cut traffic levels up to 10 percent by 2010, get trucks off the roads, and boost public transport, cycling and walking. The findings also support the large-scale changes that many citizens and local officials are calling for, including the pedestrianization of Parliament Square and Trafalgar Square, and expanded public transit. The British government is poised to change its transport policy, as new studies continue to shake up transportation planning models. The question is, will it convince stalwart road supporters to curb the road building fervor and plan cities that serve its citizens?

Opportunities with TEA-21

The newly-reauthorized transportation bill, the Transportation Equity Act for the 21st Century (TEA-21) offers many tools for local officials to put some of these ideas into action. The findings of the British study reinforce the need for an integrated transportation policy which recognizes the interaction between transportation and other activities, including different elements of the transportation system itself. TEA-21 retains the structure of its predecessor, ISTEA, offering opportunities to fund more integrated transportation systems and provide more options for travelers. Some of these programs are:

- The Congestion Mitigation and Air Quality Program (CMAQ) provides funding to areas that are designated by the U.S. Environmental Protection Agency (EPA) as non-attainment or maintenance for ozone or carbon monoxide. CMAQ funds must be spent on projects that help reduce ozone, carbon monoxide or particulate matter pollution.

- The enhancements program makes the critical link between communities and transportation. Enhancements funding encourages diverse modes of travel, fosters local economic development, and brings direct benefits to communities from transportation spending. Projects eligible for enhancements funding include improvements to bicycle and pedestrian infrastructure, and scenic and historic preservation.

- The planning requirements in ISTEA have been consolidated in TEA-21 into a list of seven planning considerations for states and local Metropolitan Planning Organizations MPOs that encompass local control, fiscal constraint, and accountability.

- TEA-21 also continues the commitment to system preservation. Too often the temptation is for states and localities to focus on building new roads without ensuring enough money to adequately maintain the current infrastructure. This "fix it first" strategy is funded through the Interstate Maintenance program, and the Highway Bridge Replacement and Rehabilitation program.

TEA-21 also includes some promising additions such as:

- Explicit language that recommends a better role for local officials in small metropolitan and rural planning, although it is not a requirement.

- The Transportation and Community and System Preservation (TCSP) pilot program provides funds for projects that integrate transportation and land use.

- The Job Access and Reverse Commute Program is designed to connect unemployed people with jobs and ease the transition from welfare to work.

Many local officials have found that decreasing road capacity and expanding options for public transit, walking, and biking are rejuvenating their cities. New evidence from the UK supports these decisions, creating new opportunities for traffic management. By demonstrating that road closures can eliminate traffic and boost the economy, reduced travel further debunks the notion that building more roads will solve traffic problems. As the British transport minister proclaimed, "the fact of the matter is that we cannot tackle our traffic problems by building new roads." And as cities around the world wrestle with rising traffic congestion, evidence of reduced travel helps demonstrate that a balanced, equitable system is not only the most effective solution to current traffic problems, but a sensible policy for the future.

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Session #1
Making Tough Transportation Decisions Easier

STREAMLINING THE TRANSPORTATION DECISION-MAKING PROCESS

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ABSTRACT

Washington State has entered into an agreement with Federal Highway Administration (FHWA) in Washington, D.C., to demonstrate a new way of doing business by starting the National Environmental Policy Act (NEPA) process in the earliest planning stage of a transportation strategy. The Washington State Department of Transportation's (WSDOT) Olympic Region proposes to use the State Route (SR) 104 corridor for a demonstration project to test the new model that was developed by a state-wide process improvement team.

This explanation of the process to be used includes information on how the state transportation department will work to develop the long-range vision for a corridor using the NEPA process, so that the decisions made will "stick" for the many years it will take to implement all of the recommended strategies for the corridor.

The process includes formation of a Steering Committee of the affected jurisdictions, permit agencies, interested groups and affected citizens to determine the issues that will be addressed. There will be an extensive public outreach and involvement process to make sure that the vision is shared by the community. A Project Management Team (PMT) will manage the project, as well as coordinate the Steering Committee. The PMT will facilitate the gathering of information about the area, and the needs and wishes for the area, into a unified vision that may impact future zoning and development in the area as well as the actual transportation solutions identified for the corridor.

The SR 104 corridor to be studied is approximately 25 miles of rural two-lane road through two counties. The roadway connects an urban area (metropolitan Seattle) and a currently rural area experiencing pressure to develop in order to support the urban area. The corridor is the major transportation link between these two areas, and its future design will be critical in establishing the way in which the rural area will develop. The route has a state scenic designation, ends at a ferry terminal, includes a bridge in need of major repair, passes near tribal land and has groups in favor

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of development as well as those that want to remain rural. Given this, the corridor study will offer challenges that many jurisdictions must face as they try to plan for the future.

Currently, the perception is that decisions are made, and then the NEPA process is started and manipulated in order to come to the decisions that have already been made. This new process will bring the right people in at the right time to make the right decisions that will then guide the development of a corridor in the future. The process has the potential to become a nation-wide model for using the NEPA process in multi-modal transportation corridor planning.

STREAMLINING THE TRANSPORTATION DECISION-MAKING PROCESS

Process Development:

WSDOT chartered a Process Improvement Team (PIT) to improve the inclusion of the National Environmental Policy Act (NEPA) into long range planning for transportation projects. The PIT consisted of representatives from various expertise areas within WSDOT and FHWA. It met for over a year and outlined an improved process. This process was then presented to a group of experts from the area and around the country at a three day conference. The PIT incorporated the comments gathered at the conference and continued to refine the process. Representatives from local resource agencies were added to the PIT, and its title was changed to the Joint Process Improvement Team (JPIT).

The New Process Goals:

- Provide for the best environmental decisions for transportation strategies by integrating planning and the NEPA process
- Move NEPA decision-making into the planning process where many decisions are made (previously those decisions were made without benefit of application of NEPA principles)
- Reduce duplication of effort by WSDOT and resource agencies
- Reduce project cost
- Reduce project time
- Improve agency coordination
- Improve public involvement
- Improve the public's perception of WSDOT's efforts

In summary: *Make the right decisions the first time with the right people involved so that the decisions "stick"*.

Fundamental Changes to the Process:

1. TIMING

Timing Traditional Way:

In the past the Planning Office of WSDOT has done planning studies by working with local jurisdictions to develop strategies to identify deficiencies. Additionally, planning offices have worked with local communities, governments, residents, and users of a roadway to develop long-range visions for a roadway. Project specific strategies might be suggested from these studies. These "projects" would then be listed in the 20 year plan—the Highway System Plan (HSP)—to await funding. After a major project was funded for environmental work, the NEPA process would be started and the "official decisions" would be made. This way of doing business has several potential disadvantages:

- Perception that decisions were already made: "Something" was already written down as the strategy.

- Perception that decisions were made prior to starting NEPA.
- Duplication of work: Often the studies done by the planning office were repeated.
- Waste of resources: The replication of work takes staff time, both at WSDOT and other agencies.
- Confusion of the public: Repeated requests for input give the impression that WSDOT is not listening.
- Consideration of environmental factors too late: The perception is that decisions were made before the NEPA process was started.
- Too much focus on the details in the document and not enough on recording the decision-making process.

This process can result in some serious consequences:

- Delays in project delivery: Often resource agencies would not be involved in the planning studies, so they could not express their concerns about the decisions made and the process used.
- Inadequate decisions: Because not all of the right interests were involved from the beginning, important issues might be overlooked.
- Damaged relationships: The public and or resource agencies might decide that WSDOT was not considering issues of concern to them due to the process. This feeling might carry over to other projects and damage working relationships.
- Agency resources stressed: Due to duplication or non-involvement at the critical time, too much staff time might be required.
- Poor public perception: The public will be frustrated if they think they are ignored or asked to be involved in a process where the outcome is predetermined.
- Impacts to natural resources: The natural resources might not be protected in the best possible way if some groups and interests, and therefore some information, are left out of the early decision-making process.
- Increased costs: Duplication and re-evaluation add extra time and therefore extra money to the process.

Timing New Way:

NEPA will be applied during the corridor-level planning. By making the official decisions during planning, with input from all the involved agencies and with additional community involvement, WSDOT anticipates that problems will be greatly reduced. We anticipate that this process will deliver good decisions that can stick all the way through construction unless new regulations are passed or new information is discovered.

2. PROJECT MANAGEMENT

Project Management Traditional Way:

Historically, the planning study would be managed by a planning office. The project would then be transferred to an environmental office for development of the environmental impact statement (EIS). Then the project would be transferred to a project development office for design. Occasionally, communication between these offices fails and some critical bit of information is not passed on. Commitments could be forgotten with staff changes. There could be duplication of efforts in re-evaluating an alternative that initially appeared to be viable, but on investigation proved to be unworkable. While traditionally there was an effort to involve all disciplines in each stage, most of them never felt ownership. Sometimes, the project lead might not even be aware that a question needed to be asked of another expertise at a particular time.

Project Management New Way:

A multi-discipline team will be established for each study to provide day-to-day management of the project throughout the design. This will be called the Project Management Team (PMT), and it will oversee the development of the study. Each team will have representatives selected for the specific corridor to be studied. Generally, from WSDOT there will be people with expertise in planning, environmental and design. There will be a representative from FHWA and/or Federal Transit Administration. Other representatives could be on the team as needed for the specific project area. These could include other WSDOT expertise such as traffic or maintenance. Local agencies or resource agencies could also have representatives on the PMT as appropriate. The PMT will not be the decision-making body but will make sure that the decision makers have all of the information they need at the correct time to make the decisions in a timely manner. The team will gather or supervise the gathering of all the information.

A major function of the PMT will be to foster open communication between all the involved stakeholders including the Steering Committee, the public, transportation officials, local agencies, resource agencies, communities, traveling public, etc.

3. WORK PLANNING

Work Planning Traditional Way:

Each manager would manage the project in his or her own style.

Work Planning New Way:

A requirement of this new process is that the PMT draft a work plan that will outline the appropriate decision steps for the particular corridor under study. A public and community involvement plan will be included. This plan will make sure that key points are taken into consideration and that the right people are involved. A schedule will also be developed and updated. The work plan and schedule will both go through an iterative process as the study continues. The Steering Committee will have input into the work plan.

4. VALUE ANALYSIS

Value Analysis Traditional Way:

Value Analysis (VA) or Value Engineering (VE) has been a week-long look at the major points of a project by a team made up of experts in the fields who are not familiar with the project. Additionally, there has been a team member familiar with the project who can provide background and continuity. The VA team looks for less expensive alternatives and more effective ways to meet the functional needs of a design project. These can include reducing environmental impacts.

Traditionally, WSDOT conducted VE studies shortly before the design was completed on major projects. None were done during planning studies or for EISs.

Value Analysis New Way:

A new element of the planning study is to include this week-long cross-check look by "new eyes" at the decisions being made for the corridor. It will be included after the alternatives have been narrowed down to those most likely to be carried forward in the EIS, but before a preferred alternative has been selected. Changes made at the planning stage can have the most significant impacts on cost and effectiveness of the resulting projects.

5. AGENCY INVOLVEMENT

Agency Involvement Traditional Way:

The planning office has traditionally worked closely with the local agencies during planning studies. Often only a cursory environmental review was done by WSDOT in planning studies. The environmental office has worked with permit agencies during EIS preparation, although those agencies have often been in a review mode and not involved in the decisions being made. Local agencies have been sent the EIS for review, but are not generally involved in the development of strategies. WSDOT has worked very closely with the permit agencies during construction, since that is when the permits are acquired.

Agency Involvement New Way:

All of the affected local agencies and resource agencies will be invited to sit on the Steering Committee. They will be exposed to the views, issues and constraints of the others. All will be vested with the task of finding the "best" strategies for the study area. They will have the opportunity to influence the strategies developed at the earliest planning stages while working to find the best transportation strategy in the view of all the stakeholders.

6. PUBLIC INVOLVEMENT

Public Involvement Traditional Way:

During planning studies, there have generally been public open houses, newsletters and notices. The public is invited to give input to the decision makers.

During the EIS process the public is given the same public involvement opportunities. However, the process is more formalized under the NEPA principles. The public also has the recourse of asking for hearings, and there are legal obligations for comments to be considered in the decision making process.

The public may become confused or frustrated with the duplicative nature of the planning-to-project-construction process. They may be asked the same questions by different people several times, years apart. They may feel the process is too long or that they were not heard the first time they gave input.

Public Involvement New Way:

The public will be involved in the **one time** decision-making process for the corridor. There will be representatives of the public on the Steering Committee. Additionally, there will be even greater outreach to the public for greater involvement in the data gathering and decision making for the corridor. This will be a challenge for the PMT and Steering Committee, since the plans developed will be for 20 or more years and the public is traditionally more interested when they "see the bulldozers coming." Therefore, the importance of the study will be emphasized. Outreach will be made to the various groups in the affected locations. Information about the study will be taken to homeowner groups, civic groups, seniors, or whatever groups can be contacted in the study area. The process for giving input will be customized to the area and made as customer-friendly as possible. There will be workshops, small meetings in local neighborhoods, etc., to get the affected population involved in the decision making.

7. DECISION MAKING

Decision Making the Traditional Way:

The WSDOT regional administration has given the final approval on planning studies. When WSDOT did a Route Development Plan (a specific type of planning study), there was also approval by the WSDOT State Design Engineer and the Olympic Service Center (OSC) Planning Manager. They generally acted on the advice given by the planning office which would inform the decision makers of the recommendations and issues of the steering committee or stakeholders.

EISs have been approved by the Regional Administrator and the OSC Environmental Manager prior to going to FHWA for final approval and issuance of the Record of Decision (ROD). There generally has been an interdisciplinary team (IDT) and a technical advisory committee (TAC), each of which provided input into the decisions.

Decision Making New Way:

The Steering Committee will have representation from all stakeholder groups and will be the decision making body. There will be nine consensus points throughout the process. At each point the Steering Committee will give approval or not to move forward with the study. Consensus has been defined to *"Be the process by which a group develops substantial agreement (not necessarily unanimity) about a decision. The agreement should be strong enough that the group will be willing to implement the decision. Minority opinions will be recorded and reported in the documentation."* The Steering Committee will have to decide if the minority opinion warrants reevaluation back to the last consensus point.

In addition to these nine consensus points which are recorded in the minutes of the meetings, there will be three formal points on concurrence by the agencies with jurisdiction. Each of the agencies will have been invited to have representation on the Steering Committee, and it is anticipated that in most cases each will serve on the committee. If staffing concerns preclude this, they still will be kept informed with meeting minutes and contacts as needed. The formal concurrence points will require letters stating that the project may continue. Usually this will be a simple step, since the consensus point will have preceded the concurrence and issues will have been resolved through that process.

Any conflicts will be escalated to the Transportation Policy Group which consists of management from WSDOT, FHWA and FTA.

8. PROCESS:

Process Traditional Way:

The process of decision making has been much the same in planning studies and EISs: statement of purpose and need; development of screening criteria; existing condition data gathering; gathering of alternatives; reducing alternatives to practicable ones; data gathering about the alternatives; screening of alternatives; and selection of the preferred alternative. These steps are followed to different levels depending on the type of study.

Process New Way:

The process will remain the same. The timing, players and level of detail will differ. It is anticipated that considerable time will be spent on developing consensus on the purpose and need. However, it is essential that the Steering Committee does agree on the purpose and need, and once consensus is reached, the rest of the process should follow logically.

WSDOT is re-focusing the way it approaches purpose and need development and moving away from statements like "Add a lane in each direction..." to "Moving people and goods from ...." It is anticipated that this evolutionary process will continue through this new process, since there are likely to be Steering Committee members who will question the need to move people and goods,

and instead support strategies that discourage increased growth. Discussions about issues of land use and growth management will likely be very intense in the first few meetings while developing the purpose and need. This single forum for all the stakeholders to discuss the issues for a corridor is a challenging opportunity, but one that is long overdue.

WHAT IS NEXT?

The JPIT is continuing to meet to refine the new process. Two pilot projects have been selected and given the go ahead to start preliminary work, train the PMTs on the new process, select a Steering Committee and do the background data gathering.

SR 104 is one of the pilots. The SR 104 corridor to be studied is approximately 25 miles of rural two lane road through two counties—Kitsap and Jefferson. The roadway connects an urban area (metropolitan Seattle) and a currently rural area that is experiencing pressure to develop in order to support the urban area. The corridor is the major transportation link between these two areas, and its future design will be critical in establishing the way in which the rural area will develop.

The route has a state scenic designation, ends at a ferry terminal, includes a bridge in need of major repair, passes near tribal land and has groups in favor of development as well as those that want to remain rural, so the corridor study will offer challenges as we work with stakeholders to develop a long term vision for the roadway.

Some issues that may be identified by the stakeholders as needing study include:

Kingston Ferry Terminal:
Currently, overflow ferry traffic waits on the main street through town which disrupts local traffic. Some studies have been done in this area and will have to be incorporated into this study. A Kingston circulation plan will have to be developed that is compatible with the total corridor vision.

SR 104 and SR 307:
SR 104 makes a sharp right where SR 307 ends. Traffic impacts of this may need to be studied.

Port Gamble:
This is a small historic town located on the section of the roadway with the lowest average daily traffic (ADT). There is no way to widen the roadway in the future since the it runs between the historic buildings and a bluff that drops off to the ocean and there is physically no room. There are several sharp turns approaching town. These issues may contribute to a need to study the appropriateness of a by-pass in order to preserve the town while providing for through traffic.

SR 104 and SR 3 intersection:
This “T” intersection may not function effectively in the future.

Hood Canal Bridge:

The east half will need to be replaced in 2004. A major issue in this study may be what should the bridge look like in 50 years. How many lanes, bike lanes, HOV lanes etc. may all be issues to the local residents. Currently, there were almost 20,000 trips on the bridge per weekend day, recorded in June, 1998.

Intersection with SR 19:
Jefferson and Clallam counties would like to see a "gateway" developed at this intersection. A large timber company owns the property and would be willing to donate 20 acres for the project. Currently WSDOT has no money for this project. A gateway might serve the whole Olympic Peninsula by encouraging and informing area visitors. This could have economic impacts in an area that is seeking ways to replace lost timber revenue.

Intersection with SR 101:
This intersection can be confusing and may need to be studied to maximize the functioning.

Corridor Wide Issues:
This roadway is an important link between the two peninsulas--Kitsap and Olympic--and the Seattle metropolitan area. The capacity vision for the roadway will need to reflect the areas' vision for growth. The roadway has a scenic designation and is used by freight carriers and tourists as well as for local work and pleasure related trips. There are several high accident corridor locations on the route as well as areas that will fall below the county's level of service by 2020.

Other issues that may affect the vision for the roadway include the existence of aquifer recharge areas, endangered species, areas with geological concern, prime agriculture soils, forest land, well head protect zones, landslide hazard areas, streams as well as proximity to the Hood Canal.

The study is anticipated to take two years. If the reader would like to receive periodic updates, he or she should contact the author to be put on our mailing list.

Session #1

EVALUATION OF ALTERNATIVES USING THE SURFACE TRANSPORTATION EFFICIENCY ANALYSIS MODEL (*STEAM*)

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ABSTRACT

The Intermodal Surface Transportation Efficiency Act (ISTEA) and its successor the Transportation Equity Act for the 21st Century (TEA-21) both emphasize assessment of multimodal alternatives and demand management strategies. This emphasis has increased the need for planners to provide good comparative information to decisionmakers. Benefit-cost analysis is a useful tool to compare the economic worth of alternatives and evaluate trade-offs between economic benefits and non-monetizable social and environmental impacts. FHWA has developed a new tool for benefit-cost analysis called the Surface Transportation Efficiency Analysis Model (STEAM), available at: *www.ota.fhwa.dot.gov/steam.* The software allows development of impact estimates for a wide range of transportation investments and policies, including major capital projects, pricing and travel demand management (TDM). Impact measures are monetized to the extent feasible, but quantitative estimates of natural resource usage (i.e.,energy consumption) and environmental impact (e.g., emissions) are also provided. Net monetary benefits (or costs) of alternatives can then be used to evaluate trade-offs against non-monetizable benefits. This paper demonstrates a case study application of the software for a hypothetical medium-sized urban area in the U.S., called Any City.

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EVALUATION OF ALTERNATIVES USING THE SURFACE TRANSPORTATION EFFICIENCY ANALYSIS MODEL (*STEAM*)

1.0 INTRODUCTION

The Intermodal Surface Transportation Efficiency Act (ISTEA) and its successor the Transportation Equity Act for the 21st Century (TEA-21) both emphasize assessment of multimodal alternatives and demand management strategies. This emphasis has increased the need for planners to provide useful comparative information to decision makers with regard to proposed alternative transportation solutions. Benefit-cost analysis (also termed "economic efficiency analysis") is a useful tool to compare the economic worth of alternatives and evaluate trade-offs between economic benefits and non-monetizable social and environmental impacts. In January 1998, the Federal Highway Administration (FHWA) released the Surface Transportation Efficiency Analysis Model (STEAM) to assist in multi-modal benefit-cost analysis in metropolitan areas. STEAM is available at: *www.ota.fhwa.dot.gov/tech/traffic/steam/steam.html*.

A real-world test of the software was performed using case study data from a medium-sized urban area in the U.S., called Any City in this paper to maintain its anonymity. An evaluation of transportation alternatives was performed for the Central Freeway corridor in Any City. Section 2 provides an overview of STEAM. In Section 3, the alternatives and procedures used to develop the needed input data for STEAM are described. In section 4, impact analysis procedures embedded in the software are discussed, and results of STEAM's impact analysis are presented. Section 5 presents STEAM's economic efficiency analysis procedures and results from the case study.

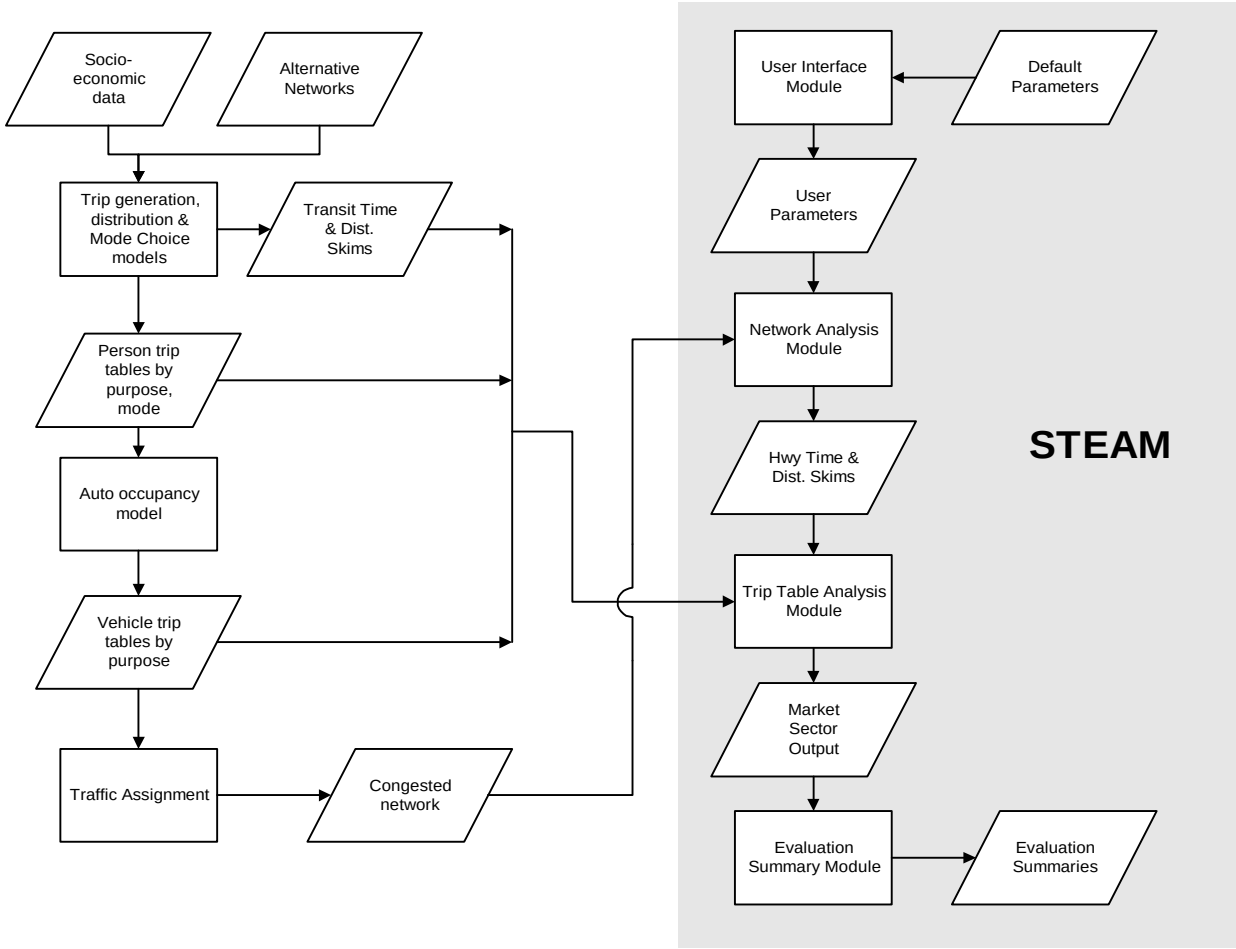
2.0 OVERVIEW OF STEAM

STEAM accepts input directly from the four-step travel demand modeling process or from off-model software such as FHWA's Travel Demand Management (TDM) software (1). It post-processes traffic assignment outputs from conventional four-step travel demand models in order to more accurately estimate highway travel speeds under congested conditions. STEAM then produces estimates of *systemwide* impact; i.e, impact estimation is not limited to the improvement corridor. STEAM is highly flexible in terms of the transportation modes, trip purposes, and time periods analyzed. It provides default analysis parameters for seven modes (auto, truck, carpool, local bus, express bus, light rail, and heavy rail) and allows the user to accomodate special circumstances or new modes by modifying these parameters.

The software develops impact estimates for a wide range of transportation investments and policies, including major capital projects, pricing, and travel demand management (TDM). Impact measures are monetized to the extent feasible, and quantitative estimates of natural resource usage (e.g., energy consumption) and environmental impacts (e.g., pollutant emissions) are also provided. Decision makers can then use net monetary benefits (or costs) of alternatives as computed by STEAM to evaluate trade-offs against non-monetizable impacts.

As shown on the right side of Figure 1, STEAM consists of four modules:

Figure 1. Overview of Analysis Procedures



1. A *User Interface Module*, which includes on-line help files.

2. A *Network Analysis Module*, which reads a file containing highway link data and produces zone-to-zone travel times and distances based on minimum time paths.

3. A *Trip Table Analysis Module*, which produces estimates of user benefits based on a comparison of Base Case and Improvement Case travel times and out-of-pocket costs for each zone-to-zone trip interchange for a given forecast year. It also produces estimates of pollutant emissions, noise costs, accident costs, energy consumption, and other external costs associated with highway use.

4. An *Evaluation Summary Module*, which calculates net present worth and a benefit-cost ratio for the improvement under consideration. It also provides summary information on individual benefit and cost items, and probability distributions of several performance measures based on a risk analysis.

3.0 CASE STUDY ALTERNATIVES AND *STEAM* INPUTS

3.1 Corridor Alternatives

The Central Freeway in Any City is a north-south 6-lane facility. The limits of the case study corridor were defined by the interchanges of Central Freeway with the beltway loop north and south of the city. The corridor is about 12 miles in length. Currently, traffic in the corridor exceeds capacities in many locations, causing significant peak period delays. Significant growth is expected in the Any City region, and in the corridor in particular. Population in the corridor is anticipated to increase by more than 100% while employment is estimated to increase by more than 140% over the next 20 years. Traffic on Central Freeway in the southern portion of the corridor is expected to double.

For the purpose of demonstrating the application of the software, three corridor alternatives were analyzed:

- *"No-Build" alternative*: This alternative included all new capacity projects in the region's Long Range Transportation Plan, except for Central Freeway improvements. A planned light rail line in the Central Freeway corridor was included.
- *"Build" alternative*: This alternative involved the widening of Central Freeway to include two additional mixed-flow travel lanes in each direction.

- *"TDM/Tolls" alternative*: This alternative primarily involved introduction of a $1.00 toll to be collected on Central Freeway through automated collection techniques at both ends of the corridor (i.e., at each of the two beltway interchanges), and at all entrance ramps within the corridor. No highway capacity improvements were included. A 25% increase in both bus and light rail service was included, to handle increases in transit demand due to auto users "tolled off" the freeway.

3.2 Developing STEAM Inputs from Demand Models

STEAM accepts as input the following output from the four-step travel demand modeling process: (1) person trip tables for passenger travel and vehicle trip tables for truck travel; (2) travel time and cost matrices skimmed from transit networks and (optionally) from highway networks; and (3) loaded highway network output from traffic assignment. Note that urban areas that do not model transit networks can still estimate benefits to transit riders using procedures described in the participant notebook for FHWA's multi-modal evaluation course (2). STEAM can then be used to estimate the highway impacts using loaded highway networks.

For the case study, travel demand model outputs for the two action alternatives and the No-Build alternative were obtained from runs of the four-step travel demand models. The models were run using Any City's 2015 Transportation Plan and its 2015 socio-economic forecasts for the region. For the TDM alternative, the No-Build highway network was re-coded to reflect an in-vehicle time penalty equivalent to the toll. The demand modeling procedures are presented graphically on the left side of Figure 1. Both trip table and loaded highway network outputs were obtained for a 24-hour time period. The transit time and cost skims reflected peak period service.

3.3 Defining Market Sectors

Market sectors for use in STEAM analysis may be defined by trip mode, purpose, and time of day. Since the Any City models produced daily demand estimates, market sectors were defined only by trip mode and purpose. The travel demand models provided *person trip tables by mode* (auto, bus, walk-accessed light rail and drive-accessed light rail) for the following four internal trip purposes: Home-based (HB) work, HB non-work, HB college, and Non-HB. For HB work person trips, an additional mode, i.e. "Carpool" was estimated by the models. Additionally, *vehicle trip tables* were provided by the models for the following three trip purposes: internal truck, internal-external, and through. Since internal-external and through trips include both passenger and truck travel, the first step would be to break down trip tables for each of these two purposes into auto and truck modes. For Any City, the truck share of these trips was unknown, so all trips were assumed to be auto mode trips.

Executing STEAM using Any City trip tables could potentially require running (for the "daily" time period) each of 22 purpose/mode market sectors identified by an "X" in Table 1-A. To reduce the number of market sectors to be analyzed, the seven trip purposes (shown in the first column of the table) were collapsed into two: (1) a passenger travel purpose and (2) a commercial (truck) purpose; i.e., all non-truck trip purposes were combined into a single "passenger travel" category, for which the same values of time and other STEAM parameters could be applied irrespective of the actual trip purpose. The resulting market sectors are indicated by an "X" in Table 1-B.

TABLE 1-A Potential Market Sectors for Any City

Trip Purpose	Auto mode	Carpool	Bus	Walk-to-Light Rail	Drive-to-Light Rail	Truck
HB work	X	X	X	X	X	
HB college	X		X	X	X	
HB non-work	X		X	X	X	
NHB	X		X	X	X	
Internal truck						X
Internal-external	X					potential
Through	X					potential

TABLE 1-B Combined Market Sectors

Trip Category	Auto mode	Carpool	Bus	Walk-to-Light Rail	Drive-to-Light Rail	Truck
Personal travel	X	X	X	X	X	
Internal truck						X

3.4 Developing Market Sector Inputs

Highway Mode Inputs: Auto-occupancies needed as input into STEAM for the passenger travel auto and carpool modes were obtained by dividing the sum of regionwide person trips by the sum of vehicle trips for each mode (using output from the four-step demand models). While STEAM can estimate vehicle operating costs based on internally generated zone-to-zone highway distance skims, the user must provide "out-of-pocket cost" skims reflecting tolls for zone-to-zone travel. For the TDM alternative, toll skims were obtained using the demand modeling software. First, a select-link analysis was done to identify zone-to-zone vehicle trip interchanges subjected to tolls, and the number of vehicle trips for each zone-to-zone interchange actually choosing the toll route. For each trip interchange, these trips were divided by trips from the total vehicle trip table to get the proportion of zone-to-zone vehicle trips actually paying tolls. Average out-of-pocket cost per vehicle for each zone-to-zone interchange was obtained by multiplying the vehicle toll by the proportion of vehicle trips paying the toll. The average out-of-pocket cost per vehicle was then divided by auto-occupancy in order to generate a skim table of average out-of-pocket cost per person for input into STEAM.

Non-Highway Mode Inputs: For the non-highway passenger travel modes (bus and rail), STEAM inputs for average occupancies were estimated from passenger count data. STEAM cannot generate travel time skims for non-highway modes. Travel time “skim” tables as well as out-of-pocket cost tables must be obtained for input into STEAM using output from the demand models. For Any City, the in-vehicle travel time skims generated by the demand models were used directly as input into STEAM. The Any City models also generated walk time skims and wait time skims. These were summed by origin-destination pair to get "out-of-vehicle" travel time skims needed for input into STEAM. Additionally, the Any City models generated out-of-pocket cost skims (in cents) based on transit fares. These were directly input into STEAM.

4.0 CASE STUDY IMPACT ANALYSIS

4.1 *STEAM* Procedures for Estimating Travel Speed, Emissions and Energy Use

Speed: Users can format input network files to include "congested" link speeds which STEAM can use directly. As an option, STEAM can estimate travel speeds based on procedures which relate average weekday traffic-to-capacity ratios (AWDT/C) to average hourly delay and speed (3). The procedures incorporate the dynamic effects of queuing and peak-spreading which are not considered when conventional Highway Capacity Manual procedures are used with assigned traffic volumes. Additionally, the procedures account for day-to-day variations in traffic and incident delays.

Emissions: The conventional link-based emissions analysis approach cannot easily be used to estimate the changes in cold start emissions that may result from demand management actions. STEAM therefore uses a trip based approach to estimate emissions (4). In STEAM, emissions for autos, trucks and carpools are calculated as the sum of: (1) emissions due to vehicle miles of travel (VMT), calculated under the assumption that vehicles are already warmed up, i.e., in either the hot-start mode or hot-stabilized mode; and (2) added emissions due to cold starts. Non-cold start emissions are calculated using emission rates as a function of speed. The added emissions due to cold starts are calculated on a per vehicle trip basis. STEAM allows the user to specify the fraction of vehicle trips starting cold; national defaults are provided from recent research (5).
Fuel Consumption and Greenhouse Gas Emissions: Increases or decreases in use of motor fuel are estimated by STEAM by vehicle type (auto and truck) as a function of average speed for each

trip interchange, using fleet average fuel consumption rates (6). STEAM calculates changes in greenhouse gas emissions using carbon dioxide (CO_2) emission rates per gallon of motor fuel consumed (7).

4.2 Impacts of Case Study Alternatives

Table 2 summarizes travel demand estimates by mode for the entire region, obtained from Any City travel demand models. Auto person trips include both solo-driver and carpool trips; and transit person trips include both bus and light rail trips. The analysis used STEAM-estimated speeds rather than travel model output speeds. Table 2 provides estimates from STEAM of resulting average regionwide vehicular travel speeds, and total regionwide emissions and fuel consumption. Note that average speeds estimated by STEAM are lower than those typically estimated by travel demand models or even by HCM procedures. This is because, as discussed in Section 4.1, STEAM's speed relationships take into account delays due to queues carried over from one hour to the next, as well as delays due to incidents and the effects of day-to-day variations in traffic when volume-to-capacity ratios are close to 1.0.

TABLE 2 Impacts Of Alternatives: Year 2015

	No-Build	Build	TDM/Tolls
Weekday Person Trips (in millions)			
Auto	5.719	5.721	5.708
Transit	0.091	0.090	0.102
Truck	0.018	0.018	0.018
Total	**5.828**	**5.828**	**5.828**
Weekday Vehicle Trips (in millions)			
Auto	4.231	4.231	4.224
Truck	0.018	0.018	0.018
Total	**4.249**	**4.248**	**4.242**
Weekday Vehicle Miles (in millions)			
Total	**27.767**	**27.958**	**27.452**
Avg. Auto Speed (mph)	18.24	18.98	18.32
Annual Emissions (tons)			
Hydrocarbons (HC)	7,723	7,622	7,578
Carbon Monoxide (CO)	166,075	162,417	162,662
Nitrogen Oxides (NOx)	8,853	8,913	8,743
PM 10	310.0	312.0	305.6
Annual Fuel Use (million gallons)	246.06	241.72	241.29
CO2 Emissions (million tons)	2.11	2.07	2.07

5.0 CASE STUDY ECONOMIC EFFICIENCY ANALYSIS

5.1 *STEAM* Procedures to Estimate Benefits and Costs

All benefits are computed by STEAM's Trip Table Analysis Module based on weekday travel estimates by market sector for a specific analysis year. Weekday benefits for each market sector are annualized assuming a default value of 250 working days per year. This annualization factor may be modified by the user. The analysis year may be selected by the user to be representative of benefits over the analysis period, which is normally the life of the investment. Alternatively, the user may run STEAM separately with data for several different analysis years, and estimate the stream of benefits over the analysis period.

User Benefits: User benefits are calculated for each zone-to-zone trip interchange. Benefits include savings in user costs such as travel time costs, vehicle operating costs and out-of-pocket costs for fares, parking (if paid by the user), fuel taxes, and tolls. User benefits also include the portion of accident costs that are perceived by the traveler and taken into account in travel decisions. STEAM uses defaults for variable vehicle operating cost (excluding fuel costs) amounting to 3.4 cents per mile for autos (8) and 10 cents per mile for trucks. It is assumed that fixed costs such as vehicle depreciation or garaging costs will not vary by alternative, but if they do, the differences with respect to the No-Build can be provided as an input to STEAM in the "non-mileage costs" category discussed later. The defaults for fuel cost are $1.21 per gallon of auto fuel and $1.15 per gallon of truck fuel *inclusive of fuel taxes*. Travel time savings for personal travel (i.e., autos, HOV and transit) are monetized by STEAM using a default value of $8.90 per person hour for in-vehicle time (9). The default value for out-of-vehicle travel time is $17.00 (7). For commercial truck traffic, STEAM's default is $16.50 per hour for in-vehicle time (9), and $17.00 for out-of-vehicle travel time. For *new* users of a mode (for each trip interchange), savings are valued by STEAM at one-half the rate used for former users, as suggested by consumer surplus theory (2).

Revenue Transfers: Fares, tolls and taxes are transfers from users to the government, and are not normally relevant in evaluation of economic costs and benefits for society as a whole, even though they are extremely important in demand estimation. However, since the imposition of fares, tolls and taxes causes a reduction in the user-perceived benefit estimates computed by STEAM, any changes in these revenues to public agencies must be added back into the computation of total benefits to society. For fuel taxes, STEAM calculates the amount of revenue transfer based on an average combined State and Federal fuel tax rate of 37.48 cents/gallon for gasoline and 42.6 cents/gallon for diesel. STEAM also calculates changes in revenues occurring as a result of *changes* in faresand tolls paid by transportation system users. The transfers are calculated at the zonal interchange level. Revenue increases due to increased transit ridership or revenue losses due to a decrease in ridership must be computed by the user off-line, and combined appropriately with estimates of changes in revenues estimated by STEAM.

*External Cost Changes***:** Many social and environmental impacts (i.e., both benefits and costs) cannot be monetized or even quantified, and must be described qualitatively for consideration by decision makers. Four types of external costs which *can* be quantified by STEAM are: accident costs, noise damage, pollution, and greenhouse gas emissions. For accidents, STEAM provides default estimates of the breakdown between "internal" (i.e., user-perceived) and "external" accident costs per accident (10), based on the assumption that all costs *borne* by the highway user are taken into consideration in the decision to drive. STEAM permits the user to specify emission costs per ton of pollutant and per ton of CO_2, and noise costs per VMT. STEAM provides default

monetary values for HC, NOx and CO emission costs per ton based on Denver (11), PM 10 costs per ton based on nationwide estimates (12), and noise damage cost per VMT and global warming cost per ton of CO_2 based on an FHWA study (13). The user may provide STEAM with estimates of other external costs which are not *specifically* computed by STEAM. The user may provide estimates of these costs per VMT by facility class and mode for mileage-based external costs (e.g., indirectly borne highway patrol and safety costs). Annual non-mileage based external costs (e.g., indirectly borne parking cost changes) can be provided by mode as a lump-sum user input. Any changes in vehicle fixed costs may be included here. External costs during construction (such as travel delay and environmental impacts) may also be provided separately as a user input.

Public Agency Costs: Included in this category are all costs borne by highway and transit agencies. Capital costs and annual highway operation and maintenance (O&M) costs must be input directly by the user. For construction costs, STEAM projects out to the year of opening of the facility the value of capital costs assumed to be incurred at the mid-point of construction, and then annualizes this cost based on the facility life. A default discount rate of 7%, as recommended by the Federal Office of Management & Budget (OMB) is used to annualize capital costs (14). STEAM permits the use of alternative discount rates. Transit operating costs are calculated by STEAM by applying cost per vehicle mile, cost per vehicle hour and cost per peak vehicle (input by the user) to the changes in transit vehicle miles, vehicle hours and peak vehicles, which the user provides as input to STEAM.

Net Annual Worth: Net annual worth is calculated by STEAM by subtracting annualized costs to public agencies from the total annual benefits (i.e., the sum of user benefits, revenue transfers, and changes in external costs). Benefit/cost ratios are also calculated. The numerator of this ratio is the total benefits. The denominator is annualized costs to public agencies. Net worth and benefit-cost ratios are indicators of the economic efficiency of the alternatives.

5.2 Case Study Benefits and Costs

User Benefits: Table 3 summarizes the annualized costs and benefits of the two action alternatives. User cost savings of $191 million make up most of the benefits for the Build alternative. For the TDM alternative, the large user disbenefits perceived -- $31 million -- reflect a combination of the monetary "losses" to users who continue to use Central Freeway and pay tolls, travel time benefits to these users due to reduced congestion, the consumer surplus losses of former Central Freeway users who are disinduced from using Central Freeway, and the travel time disbenefits to other travelers who are faced with increased congestion when former Central Freeway users who are disinduced from using Central Freeway divert to other facilities.

TABLE 3 Annualized Benefits And Costs

	Build	TDM
Annual Benefits		
User Benefits:	191.40	(30.92)
Revenues to Public Agency (change):		
Fuel taxes	(1.64)	(1.80)
Fares	(0.25)	2.75
Tolls	0.00	75.50
Sub-total	(1.89)	76.45
External Benefits/Disbenefits:		
Accidents	(0.22)	(0.58)
Noise	(0.06)	0.06
Emissions	14.16	13.85
Global warming	0.15	0.01
Other non-mileage	(0.16)	2.01
Sub-total	13.87	15.35
TOTAL ANNUAL BENEFITS	203.38	60.88
Total Annual Public Agency Costs		
Capital	73.74	0.04
Operating	0.89	14.53
TOTAL ANNUALIZED COSTS	74.63	14.57
Economic Efficiency Measures		
Net Annual Worth	128.76	46.31
Benefit/Cost Ratio	2.73	4.18

Transfers: STEAM estimated the fuel tax revenue reductions (due to reduced fuel consumption as a result of average speed improvements) at $1.6 million for the Build and $1.8 million for the TDM alternative. STEAM does not currently estimate fare revenue changes due to changes in transit ridership. Fare revenue changes were estimated "off-line" as a $0.25 million loss for the Build and a $2.75 million gain for the TDM alternative, based on transit ridership changes. Toll revenues for the TDM alternative were estimated at $75.5 million by STEAM based on input out-of-pocket cost changes for auto, carpool and truck trips as discussed in Section 3.4. The tolls paid are more than total losses suffered by users because of the monetary value of travel time savings due to faster speeds on Central Freeway.

External costs and benefits: The increase in VMT in the Build alternative causes external accident and noise disbenefits. In the case of the TDM alternative, reductions in VMT reduce noise costs, but not accident costs, because a significant amount of VMT shifts to arterials, which have higher

accident rates. For the Build alternative, higher speeds result in net cost reductions of $14 million in emissions costs and $0.15 million in global warming costs. For the TDM alternative, cost reductions are similar, but result from both speed improvements as well as VMT reductions. For the Build alternative, an increase in other non-mileage based external costs amounting to $0.16 was estimated (off-line) and was provided as an input to STEAM. The cost changes were based on parking cost increases as a result of the higher number of vehicle trips. For the TDM alternative, there are parking cost savings (i.e., non-mileage based cost savings) due to reductions in vehicle trips.

Public agency costs: Agency cost estimates are presented in Table 3 as differences with respect to the No-Build alternative. Capital costs include costs borne by transportation agencies for construction, engineering and rights-of-way (R-O-W). A discount rate of 7% was used to annualize capital costs. Costs for operation and maintenance of added freeway mixed-flow lanes were estimated based on national data (8). Transit operating cost increases (above the No-Build) were also estimated based on average costs per vehicle mile from national data (10).

Economic Efficiency: Table 3 also presents estimates of net annual worth (i.e., benefits minus costs) and benefit/cost (B/C) ratios. The Build alternative shows a net annual worth of $129 million, while the TDM alternative shows a net annual worth of only $46 million. The Build alternative is therefore superior when only monetized benefits are considered. These net worth estimates provide the decision maker with useful measures for comparative evaluation of alternatives, *along with measures or clear descriptions of non-monetized social and environmental impacts,*such as community livability and pride, neighborhood cohesion, aesthetics, energy security, social equity and environmental justice. The net worth of an alternative can be used by decision makers to assess whether other non-monetized disbenefits (or benefits) are worth the estimated net *monetized* gain (or loss) to society for the alternative under consideration. If net worth is negative, it provides "scale" as to how large non-monetized benefits should be in order to move a project alternative into the acceptable range.

6.0 CONCLUSIONS

This paper has demonstrated a benefit-cost assessment at a detailed level of analysis for two action alternatives in a major travel corridor of a case study urban area, using FHWA's new software STEAM. The case study demonstration shows that STEAM can be a useful tool for system planning and corridor planning in metropolitan areas.

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Session #1

Economic Growth from Transportation Improvements
Does it or Doesn't it

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Ironic - An Introduction

In antiquity, commerce thrived along the royal roads of the great Empires. In our own day, technology growth corridors are identified by the highway that provides them access. Strange then, that there would be controversy on the proposition that transportation improvement has potential for economic growth. Yet controversy exists. Indeed, the controversy is so extensive that the 'transportation improvement brings economic growth' proposition, especially where 'transportation improvement' means 'highway improvement' has been contested on many different, sometimes mutually incompatible, grounds. These challenges are sometimes stated as fact, sometimes as conjecture, sometimes as stories and to some extent have been the basis of statute (e.g., physical capacity increases not being eligible for CMAQ funding). A sample of such challenges, which have been taken from 'anti build' themes of newsletters, seminars and conferences of various groups, follows:

> *Sure transportation improvement brings economic growth, but if it is highway improvements, it is the fast food job growth, suburban sprawl growth, bad growth* *Highway improvements make it easier to have economic growth in Mexico and cost jobs in this country* *Highway improvements near business centers destroy property values and thus destroy business centers* *Highway improvements connecting business just induce travel while destroying business centers* * Highway improvements just induce businesses to move and shop for low labor cost thus leaving unemployed workers behind* *Highway improvements just induce more travel and ultimately cost jobs*

Along with this, another trend is underway. Many economic development policy interests are finding that other prospective economic development tools, such as preferential taxation mechanisms and regional education initiatives are becoming more problematical. These interests are turning to transportation, usually highway, improvements as a tool to bring commerce to depressed or low job growth regions. One manifestation of this latter trend is the number of highway corridor advocacy groups, some of whom use the interstate shield in their group name as a symbol of their vision for a corridor. To some extent, these visions have also been given a basis in statute (e.g. future Interstate status to certain high priority corridors).

A little too ironic, don't you think.

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Jagged Little Pill- A Brief History of Methodology

Since the Interstate era, considerable research has been done to try to understand the relationship between transportation improvements and economic growth. In the 60s, an HRB publication addressed this issue as, "Will Model Building and the Computer Solve Our Economic Forecasting Problems"[1]. Through the 70s, it was partly model development and partly empirical analysis of a regional nature. From the 80s on, the use of econometrics and other economic modeling, especially on a national scale has been increasing, sometimes supplemented with interviews to establish cost and utility functions within the modeling. Regional empirical studies became less common.

During this later period, individual research efforts, with various degrees of clarity and success, tackled the problems of data availability and accuracy, defining 'economic growth', defining 'transportation improvement', identifying hidden or deeply buried analysis assumptions and data interpretation conventions, separating causes from coincidences and explaining results in an understandable way. Along the way, some of these efforts attracted considerable attention by seeming to predict: counter intuitive results; inexplicable outcomes; or, outcomes, which while using seemingly reasonable assumptions, were inconsistent with other outcomes. Substantial numbers of conferences, seminars and so forth resulted. Researchers and policy practitioners sometimes supported, sometimes criticized each other over data, analysis techniques, interpretation and so on. Of course, one crucial group of issues is inherently difficult in such modeling, namely job growth, job quality and related matters.

You Oughta Know - The Need

At this point we don't know enough to make quick and confident judgements regarding economic development outcomes for use in developing TIPs, STIPs, Transportation Plans or environmental documents. Completing these documents requires decision brokering trade offs between improvements in different jurisdictions, between different types of transportation improvements, between maintenance type projects and increased capacity type projects and between projects that support different, sometimes contradictory regional goals.

Not the Doctor - Some Old Factoids and Their Applicability

In an effort to, at the very least, ground ourselves in information that is broadly understandable and closer to the 'taste, touch and smell', FHWA has made some efforts to renew the regional empirical element. To begin with, it will be instructive to review some of the work of the 70s.

In 1970, FHWA submitted a report to Congress[2] in which a wide variety of impacts were discussed. Two are worth reviewing at this time.

One significant effect of the Interstate System was on employment. During a five year period (1958-1963), job growth in high density urban areas with topographic barriers of some kind

(rivers, hill) served by freeways was compared to job growth in similar urban areas without freeway service.

Benefits of the Interstate Program

Job Growth Per Thousand Population		
	With Freeway Access	Without Freeway Access
Fast Growing Cities in SE, Midwest, NW	43	23
Other Cities	27	2

Deeper into this early report, it seems apparent that improved access had increased land values and the ability of local business to market products. A follow-up report[3] noted that population had migrated to those high job growth areas, and, in some cases, the population migration was faster than the job growth.

By 1980, a report on the impact of the Interstate System on non metropolitan areas[4] had been released which included analysis of 1960-1975 data. The effects were similar to those noted earlier for densely populated cities. Of course, the positive relationship was not universal. For example, some counties, that contained an Interstate highway, had no interchanges and thus were not served by the Interstate. It would be unsurprising if in some of these counties, employment dropped when the Interstate was constructed.

Of course, even by the 70s, much of the highway program funds were being expended to improve non Interstate highways and, in the 80s, the highway program funds began to be used for improving transit, and in the 90s for such uses as transportation enhancements.

Thus, by the 90s, relatively little of the highway program was being expended on new Interstate highway construction. Furthermore, the domestic economy has evolved steadily and is now less oriented to manufacturing and mining and more oriented to information technology. Hence, the degree to which 70s research still applied is open to some question.

You Know - Some 90s Factoids and Their Applicability

Four studies done in the 90s seem to shed some light on the relationship of transportation improvement and economic development. Two studies concentrated on the Appalachian region, which includes portions of 13 States and two concentrated on the Lower Mississippi Delta region, which includes portions of 7 States.

The first of the Appalachian region studies[5] looked at income. This was considered appropriate because the goal of the Appalachian Development program was to promote economic development and decrease poverty in the region. The study examined which low income counties

(defined as having per capita income less than two thirds the national average) were successful in climbing out of that situation. Some examples of success and non success were:

Poverty Alleviation in Appalachian Region

State	# of counties low income in 1965	# of counties low income in 1990
Pennsylvania	7	1
North Carolina	16	6
Georgia	23	4
West Virginia	35	26
Kentucky	46	42

The study notes a number of reasons for the relative success of Pennsylvania, North Carolina and Georgia and the relative lack of success of West Virginia and Kentucky. One reason is that the 80s was the decade in which the mining industry restructured and retrenched. Indeed, West Virginia had only 16 counties in the low income status in 1980 and Kentucky had 35. However, two other reasons were noted. The first was that the low income counties in those two States were more distant from metropolitan areas. The second was that, in these two States, substantial portions of the highway corridors to be improved as part of the Appalachian Regional program were not yet improved.

The second of the Appalachian region studies[6] compared 391 of the counties in the Appalachian region to 391 nearby counties and parishes outside the region which were demographically similar (no matches were sought for the two counties added to the Appalachian region in the early 90s and no match was found for 6 counties in the region). The comparison included changes in demographics and earnings by major economic sector.

Relative Income Growth Sectors in Appalachian Region
Percentage by which the Appalachian county
income increased more than its counterpart

Services	137%
Finance, insurance and real estate	135%
Manufacturing	87%
Retail Trade	67%

The effect of the Appalachian highway program may be partially understood by examining the differences between the growth rate of subsets of these counties. One comparison shows the relative success of counties which had at least 3 miles of Appalachian highways and those which had an interstate highway or who had growth center funding (the latter was a program that provided substantial funding in the 60s and early 70s). It is useful to note that the counties with interstates include those with no interchanges or with only a diamond interchange and the growth center counties include those containing centers which didn't grow.

Benefits of the Appalachian Highway Program

	Percentage by which the Appalachian county increased more than its counterpart in Per Capita Income	Number of County Pairs
All pairs	17%	391
Appalachian Highway Counties	32%	110
Appalachian Growth Center Counties	14%	90
Appalachian Interstate Hwy Counties	15%	152

The first Lower Mississippi Delta region study[7] concentrated on employment because of a 1990 CNN video report. In this report, the virtually unanimous opinion in on-camera interviews was the first priority of the region should be more jobs. This, despite the well documented problems in education, health, etc. The study itself was undertaken as a follow up to a Commission established in the late 80s which had resulted in 55 transportation improvement recommendations (the vast majority of which were highway related). Two participants in the Commission are worth noting. The chairman of the Commission was then Arkansas Governor Clinton, who at the time of the update was President Clinton. A prominent advisor to the Commission was then Arkansas Highway Commissioner Slater, who at the time of the update was FHWA Administrator Slater and shortly thereafter was DOT Secretary Slater.

In the course of doing the study, FHWA found that counties and parishes with job growth at better than the national average, or with average job growth in spite of the loss of a military base, had made substantial highway improvements. Although FHWA was unable to obtain detailed and comprehensive information about improvements in non transportation areas, some such information was obtained. Some examples of these success stories showing both transportation and non transportation influences were:

Some Success Stories in the Delta

County/Parish	State	Job growth 1990-1995	Factors
Caldwell, Lyon, and Trigg	KY	+22%	• major highway improvements • industry incentives
Rapides	LA	+ 8%	• major highway improvements • airport access improvement • local promotions • loss of England AFB
Howell	MO	+16%	• some highway improvements • more improvements programmed • employee/local govt programs
Madison	TN	+25%	• many highway improvements • improved airport access • improved education facilities
			•
Massac	IL	+25%	• highway improvements* expansion of gaming industry
			•
Mississippi	AR	+ 7%	• many highway improvements* local self help efforts* loss of Eaker AFB
Tunica	MS	+80%	• major highway improvements • expansion of gaming industry

The second Lower Mississippi Delta region study[8] was a follow up to the update. The objective was to estimate how much of the increase in employment in seven non metropolitan counties and parishes (Avoyelles Parish, LA, Crockett County, TN, Drew County, AR, Howell County, MO, St. Francis County, AR, Trigg County, KY and Tunica County, MS) with rapid job growth could be attributed to transportation improvements. Since, among other problems, there is no way to obtain this information directly, the methodology was to use focused interviews, which is an indirect, rather than direct empirical method and, which is also subject to various possible errors (for example interviewees may subconsciously or consciously tell interviewers what they think the interviewer wants to be told). However, focused interviews do have the advantage of aggregating opinions of people who do have substantial direct evidence, and to do so at a reasonable cost. The principle investigators, subsequent to review of interview information plus other information publicly available, made the following estimate:

Component of Job Growth Attributable to Transportation (mostly highway) Improvements	
Counties/Parishes without gaming	40% to 65%
Counties/Parishes with gaming	25% to 40%

In the course of the interviews, the officials being interviewed provided numerous direct links between improved highways and job growth. In the counties without gaming, these, typically, were observations such as, "... and the XYZ company moved in here to take advantage of 4 lane highway ... and...". In the other Counties, a typical observation was, "... we knew the casino would need a 4 lane highway but would generate tax revenue in return, so we....".

These responses to interviews also show two general causal sides to the transportation and economic development relationship, that is, the 'who caused what' issue.

All I Really Want - Some Concluding Thoughts

What can we make of all this? Well, for one thing, it seems irrational to hold that the 'anti build' themes cited at the beginning of this paper are, as a general rule, true. Furthermore, one can qualitatively argue that: transportation and trade jobs do tend to be reasonably high in salary; productivity improvements do result from certain transportation improvements; transportation, especially Interstate highway, access features prominently in the advertising that economic development professionals do to attract high paying industry; and, industry centers are frequently named for the highway that serves them, etc. However, it is fairly easy to document or, at least imagine, situations where: freeway construction (or heavy rail line) was followed by decay of certain neighborhoods; or, a highway improvement was quickly followed by the movement of near by low wage manufacturing to Mexico; or, a highway improvement was followed by the establishment of numerous fast food businesses: or when a highway (or rail or bus or other transportation) improvement didn't bring an increase in manufacuring jobs. Thus, there are times when TIP, STIP and plan developers will be less than confident of their projections. It does not seem that we will ever be sure under what conditions highway/transportation improvements lead to a growth in 'good jobs'. It is not even certain whether or not research can answer this question as fast as the economy changes the meaning of the phrase 'good jobs'. However, FHWA does intend to promote an expansion of the scope of economic development before/after type studies to other parts of the country and to improvements other than new access or capacity expansion. These efforts would at the very least deepen our understanding of the transportation improvement and economic development relationship. In the most optimistic case, they would result in some sort of 'rules-of-thumb' to support economic development considerations in projects, programs and plans.

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SESSION 2 - INTEGRATED TRANSIT: STATE, REGIONAL AND LOCAL PERSPECTIVES

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Session #2

The Intercity Network ¾ A New Approach For Statewide Mobility

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Abstract

The Intercity Network - A New Approach For Statewide Mobility

How can passenger travel between communities be enhanced to enable people statewide access? What criteria should be used to identify which communities need to be linked and what minimum level of service is desired? Throughout the nation transportation planners have struggled with the issue of how to provide a minimum level of passenge r intercity service. Furthermore, how should the service be funded? This abstract presents an overview of the Washington State Intercity Public Transportation Network Project. The project provides a practical model for a statewide network to guide the development of intercity travel between rural communities and urban hubs.

This paper identifies the important stake holders and their potential roles. Current providers of intercity passenger transportation are described (private bus carriers, ferries, Amtrak, airport shuttles, and local transit providing corridor type service) along with a summary of their services and facilities. The survey and data collection techniques used (e.g., GIS) to develop the inventory are presented.

This is followed by a description of how the designated Intercity Network was developed, starting with the primary building blocks of the communities or "places" that should be served. Criteria to select the places will be discussed and include population size and important destinations, such as county seats, universities, military bases and regional medical facilities. The designated places are linked by corridors along interstate, state, and local highways and rail lines. Standards are presented for service along the network.

For the intercity traveler, access within communities is also important . *Entry points* identify where the linkage is made within the communities to enhance traveler access to regional and local transportation choices. These transfer points are identified, some of which already serve as existing transportation facilities (e.g., Spokane Intermodal Station).

Current intercity service is then measured against the designated Intercity Public Transportation Network standards to determine if there are any gaps. Population growth over the next 20 years is analyzed to anticipate its effect on the network. Identified deficiencies are analyzed to determine solutions that are then translated into projects. Project examples include adding a bus shelter and bus turnouts in a rural community and improving electronic signage and traveler information in small urban areas.

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The goal of the Intercity Network Project is to provide guidance to local, regional, and state transportation providers about where service and facility improvements can be made to enhance statewide mobility. It is not a mandate on local government regarding their resource allocation decisions. By creating a state significant intercity network and identifying associated projects the state plays an advocacy role for the development of statewide mobility. Project implementation is achieved through state, regional, and local partnerships.

The Intercity Network – A New Approach For Statewide Mobility

PURPOSE OF THE PAPER

This paper presents a practical approach to defining a passenger transportation intercity network of statewide significance and identify improvements needed for intercity public transportation. The paper describes the methodology used to set standards for service and connecting facilities, measure whether the standards are being met, identify current and future facility and service deficiencies, and develop a program of improvements to address the deficiencies.

INTERCITY MOBILITY IS IN THE STATE'S INTEREST

The *Washington Transportation Plan (WTP)* was developed in compliance with the requirements of the federal ISTEA (Intermodal Surface Transportation Efficiency Act). Issues of "state interest" and "state responsibility" were important considerations in the development of the *WTP*, especially for the *Public Transportation and Intercity Rail Passenger Plan*, a more detailed element of the *WTP*. The Washington State Department of Transportation (WSDOT) has an interest in private and public transit systems even though the state does not have direct ownership and control of these systems.

WTP's "objectives" (developed through a collaborative stakeholder process) defined the "state's interest" for the system plan; "action strategies" (stating how the objectives would be met) defined the "state's responsibility" for WSDOT. Intercity mobility is addressed in the objective, "Integrate public transportation services into a coordinated system linked by intermodal facilities". The proposed report represents the state's initial action strategy to meet this plan objective.

Washington State recognizes that there should be multimodal opportunities for travel between communities. Many of the riders on the intercity public transportation system depend on these services as their only means of travel. Data from intercity bus rider surveys indicate that the majority of bus riders either do not own a car, or do not have access to a reliable vehicle. Typically, their annual incomes are very low, often below the poverty level. Surveys done for Greyhound (national) and for the states of Minnesota and Florida indicated that a high percentage of riders are young, unmarried females. In contrast, the Washington Olympic Connection Survey indicated that a significant majority (67%) of their riders is male.

Trip purposes of riders also were quite different in these surveys. Female riders (in the national survey) traveled primarily for social/recreational purposes. The majority of the men surveyed for the Olympic Connection service were traveling to/from work. Seniors, who represent a significant number of intercity bus travelers, may have additional reasons for using the bus, such as safety and convenience. Seniors often use the bus, rather than driving personal vehicles, to reduce the stress of driving in unfamiliar places.

PROJECT DEFINITION OF INTERCITY PUBLIC TRANSPORTATION

"Intercity transportation" has been defined in numerous ways depending upon the purpose and agency developing the definition. The definition for Washington State was developed with the assistance of an Advisory Committee established for this project. The definition sets parameters for the types of public transportation services and facilities to be included on the " Intercity Public Transportation Network of Statewide Significance". In Washington State, intercity public transportation is defined as:

Regularly scheduled transportation services available to the general public that operate across jurisdictional lines and connect rural areas and urban centers along corridors; and enhance the intermodal linkage to other modes that are part of a local and/or regional transportation system.

Intercity bus service operates between two or more cities and offers connecting services to other buses and more distant points. Nationwide, intercity bus services are provided primarily by private, for-profit firms. Greyhound Bus Lines, which provides the most extensive service in Washington, is the only nationwide provider of regularly scheduled intercity bus service currently operating in Washington. Several smaller operators provide intercity passenger service; however, their operations usually are limited to a single region or a single route.

Some public transit agencies in Washington provide intercity public transportation, as defined above. Specific providers include Sound Transit, formerly known as the Regional Transportation Authority (RTA). The RTA was created to design and build a system of light rail, commuter rail and transit service for regional travel in the Puget Sound area. Planned commuter rail and express bus service will provide service across jurisdictional boundaries between cities in Snohomish, King and Pierce Counties. In addition, a number of PTBA's (Public Transit Benefit Authorities) provide intercity public transportation, including Pierce Transit, Community Transit, Island Transit, and Benton-Franklin Transit.

Charter buses, bus tours, and demand-responsive transit services are not considered to be intercity public transportation since these services may require advance reservations, may be limited to specific types of riders (rather than the general public) and/or may be restricted to certain types of trips.

DEFINING THE INTERCITY NETWORK

The intercity public transportation network includes four major elements:

- Travel modes used for intercity travel,
- Places (communities) that should be served by the intercity network,
- Links (corridors) that connect places on the network, and
- The points of entry (facilities) travelers use to access the intercity public transportation network.

Short descriptions of the different components that comprise the intercity network are provided below.

Travel Modes

Travel modes included in the intercity network of statewide significance must meet the definition of intercity public transportation adopted for this plan, and must have stable, on-going funding. For this project, travel modes were limited to surface transportation. Air transportation is addressed in a separate element of the *Washington Transportation Plan*. Specific travel modes/services included for this project include:

- Private sector, non-profit and for-profit intercity bus providers (e.g. Greyhound, Trailways Northwest and Wheatland Express),
- Passenger rail (Amtrak),
- Public and private ferries,
- Public transit agencies that provide intercity service, and
- Airport shuttles available to the general public without advance reservations (e.g., Quick Coach Lines, San Juan Transit, and Gray Line of Seattle).

Network Places

"Places" on the intercity network include communities, or clusters of communities, with a population of more than 2,500 people, and specific destinations that provide services to a large geographic area. Places identified for the intercity network include:

- Population centers with at least 2,500 population,
- Clusters of communities within five miles of each other with a combined population of 2,500 or more
- County seats,
- Communities with state universities and community colleges,
- Communities with WSF ferry terminals,
- Communities with hospitals of at least 100 beds, and
- Military bases with on-site populations of 2,500 or more.

In many parts of the state, connections to these destinations are provided by local transit service that in turn is linked with an intercity provider. In fact, local transit providers work as feeders in rural areas linking many small towns to the larger city in the region.

GIS was used as a tool to map different levels of population concentrations throughout the state. Maps were produced that displayed cities with population at: greater than 50,000; 20,000 to 50,000; 5,000 to 19,999; 2,500 to 4,999; and under 2,500. The advisory committee used the maps as a efficient way to determine what population level to use as a standard for the statewide network. A population standard of 2,500 and above was selected because it highlighted access needs for rural communities in Eastern Washington; a standard of 5,000 and above would have eliminated many rural communities from consideration in the intercity network.

Network Corridors (Transportation Links)

"Links," or corridors, connect the "places" on the intercity network. Links on the intercity network include interstate and state highways, some county or local roads (providing connections between designated "places" and "entry points" to the intercity transportation network), active passenger rail lines, and ferry routes. These links connect individual "places" on the designated intercity network, and serve state and interstate travel movements. These links are described in detail in the following paragraphs.

Interstate, State Routes, and Local Connectors

The National Highway System (NHS) in Washington includes highways and ferry routes that are "…determined to be essential to the health and vitality of the state's economy." In 1991, Congress created the National Highway System (NHS) Program. The NHS is defined as "an interconnected system of principle arterial routes" that serves nationally important functions. To be included on the NHS, a transportation route must be: an interstate route, a strategic highway network serving military installations, a route that provides intermodal connectivity, a route that promotes rural urban connectivity, or a route that includes an international border crossing.

Whether rural or urban, NHS routes are critical connections between the state's population centers, economic centers, military bases and intermodal centers (e.g., ferry terminals, shipping ports, and airports.) The National Highway System provided the starting point to identify highway links to be included on the intercity public transportation network of statewide significance.

NHS roads connect the majority of the "places" on the network. Links to designated "places" that are not on the NHS were added to the NHS facilities on the designated intercity network. NHS routes to freight-only marine ports or military bases with populations of less than 2,500 were deleted. This collection of interstate freeways, state highways and county/local roads became the intercity network of statewide significance.

Rail Lines

Rail lines used by Amtrak passenger trains are the only rail lines included in the designated intercity network. Tracks currently used for freight trains provide a potential resource for additional passenger rail service. However, these facilities are not included in the designated network since passenger transportation is not provided on them currently.

Ferry Routes

All ferry routes served by the Washington State Ferries, WSDOT, county ferries, and private ferry companies that provide service between different jurisdictions are included in the designated intercity network.

Network Entry Points

"Entry points" are the locations where travelers gain access to the intercity public transportation network of statewide significance. These entry points include ferry terminals, Amtrak stations, Greyhound bus stations and stops, airports, transit centers served by intercity bus routes, airporter stops at hotels, and park-and-ride lots with intercity transportation services.

At least one "entry point" to the intercity network was identified for each "place" on the designated intercity network. Some "entry points" serve a single travel mode; other entry points serve several intercity transportation modes at one multi-modal location.

Intercity Network Map

The designated *Intercity Public Transportation Network of Statewide Significance* for Washington is shown in Map 1. Network "corridors" on the map link the designated "places" on the intercity network. Public transportation services in these corridors allow people to travel between communities in Washington, and reach major medical facilities, public colleges and universities, county seats, and major military installations. Larger cities may have multiple travel modes and services, and multiple entry points to the intercity network. Smaller towns may have a single bus stop along the roadside or at a local restaurant.

INTERCITY NETWORK SERVICE CRITERIA AND STANDARDS

Following the designation of the *Intercity Transportation Network of Statewide Significance*, specific standards were developed to evaluate the existing intercity public transportation network, and to identify deficiencies that should be addressed. Standards were developed for transportation service and for the entry points (or facilities) where travelers gain access to the network. Service standards for the intercity network vary in relation to community size, and the community's location in relation to cities with 50,000 or more people. Standards were developed for each of the five types of communities described below.

- "Hubs" - cities greater than 50,000 population,
- Communities with a population between 20,000 and 50,000, located within 20 miles of a "Hub",
- Communities with less than 20,000 population, located within 20 miles of a "Hub",
- Communities with a population between 20,000 and 50,000, located more than 20 miles from a "Hub", and
- Communities with less than 20,000 population located more than 20 miles from a "Hub".

Service Standards for Intercity Transportation Network

Table 1 presents the LOS (Level of Service) standards for the intercity network. Standards were developed for three different measures of service: (1) Availability of service (measured by the number of trips provided each day by an intercity transportation provider), (2) Quality of service (measured by the proportion of trips that occur between 6:00 AM and 9:00 PM), and (3) Connections between intercity service and local transportation service (measured by the frequency of local transit service to the intercity network entry point(s)).

Hubs have the highest standards for service. The minimum standard for intercity service for hubs is service every two hours during the period between 6:00 AM and 9:00 PM (eight trips per day). The standard for communities between 20,000 and 50,000 is four trips/day; and the standard for communities with less than 20,000 people is two trips/day.

The minimum standard for intercity service quality is the same for all communities – 75 percent of the intercity service for the community should arrive/depart between 6:00 AM and 9:00 PM. While these hours are typical for local transit providers, some intercity services, such as Amtrak and Greyhound, arrive/depart in the middle of the night. This occurs on long distance routes where schedules are established based on the arrival/departure times for major cities along the route.

Connectivity standards are based on the convenience of connections between intercity transportation services and local public transportation services. Travelers using the intercity public transportation network need public transportation services within communities to reach the entry points to the intercity network, to transfer between different modal entry points on the intercity network, and to travel between intercity network terminals and local destinations. Standards for connections to local service range from hourly connections in hubs, to local service meeting intercity service arrivals in smaller communities.

TABLE 1: Standards for Intercity Public Transportation Services

LOS Criteria	Hubs	Communities within 20 miles of Hub		Communities more than 20 miles from a Hub	
Community size	**> 50,000**	**< 20,000**	**> 20,000**	**< 20,000**	**> 20,000**
Availability					
Frequency –number of trips per day by intercity transportation providers	8	2	4	2	4
Quality					
Proportion of trips between 6 AM and 9 PM	75%	75%	75%	75%	75%
Connectivity					
Connections to local public transit service or other intercity modes, via public transportation	Hourly	Meets intercity service	4 times per day	Meets intercity service	Meets intercity service

Facility Standards for the Intercity Transportation Network

Each "place" on the intercity network has at least one entry point to the network. Additional entry points may exist depending on the different types of intercity transportation services provided to a community, and whether multiple modes have separate or combined terminals. Standards for the different types of entry points were established based on community size (50,000+, 20,000 to 50,000, and less than 20,000 population), and the type of facility (intercity multi-modal terminals, and intercity single mode terminals).

- Multi Modal Intercity Facility --- two or more intercity transportation providers use this facility, e.g., intercity bus and rail; air service and intercity bus; ferry and intercity bus; ferry and rail;

- Single Mode Intercity Facility--- only one intercity provider uses this facility, e.g., a rural intercity bus stop.

Setting facility standards began with the identification of amenities associated with transportation facilities, e.g.. seating, parking, phones, shelters, food and information about connecting transportation services. Different potential levels were identified for each of the identified amenities. Specific standards for these amenities were assigned depending on the size of the community in which the facility is located and whether the facility serves multiple intercity travel modes or a single mode. Facility amenities are shown in Table 2 and the facility standards for intercity public transportation facilities are shown in Table 3. In addition to these standards, facilities must meet local community zoning regulations, local transit design codes, and federal requirements including ADA (Americans with Disabilities Act) requirements.

TABLE 2: Potential Amenities for Facilities on the Intercity Network

AMENITIES	CHARACTERISTICS
Parking	Improved (paved) Gravel with ADA Requirements
Sidewalks	Improved
Shelters	Enclosed Covered
Seating	Inside Outside Covered
Public Restrooms	Available for Service none
Ticket Sales	Ticket for sale on site or on mode
Information	Real Person Electronic or Real Person Bulletin Board
Bicycle Storage *	Bike Lockers Bike Racks
Luggage Storage	Locked Storage Lockers No Storage
Food Service	1 – Hot / Menu 2 – Food and Drink Vending Machines 3 – Drink Vending Machines

Security	1 – Police/Security Monitored 2 – Lighting
Public Phones	Yes No
Passenger Loading/Unloading	Off Street On Street
Local Transportation	Frequent Service (hourly) Frequent Service (4x/day) On Call Service

* Not suggested for airports

TABLE 3: Standards for Facilities

Amenity	Intercity Multi Modes			Intercity Single Modes		
	50,000+	20-50,000	<20,000	50,000+	20-50,000	<20,000
Parking	Improved	Improved	Improved	Improved	Improved	Gravel w/ADA req. 's
Sidewalks	Improved	Improved	Improved	Improved	Improved	Improved
Shelters	Enclosed	Covered	Covered	Enclosed	Covered	Covered
Seating	Inside	Covered	Covered	Inside	Covered	Covered
Public Restroom	Yes	Yes	Yes	Yes	No	No
Ticket Sales	Ticket Sale on site or mode	Ticket Sale on site or mode	Ticket Sale on site or mode	Ticket Sale on site or mode	Ticket Sale on site or mode	Ticket Sale on site or mode
Information about schedule and connections	Real Person	Electronic or real person	Bulletin Board	Electronic or bulletin board	Electronic or bulletin board	Bulletin Board
Bicycle Storage	* Bike Lockers Bike Racks	Bike Lockers Bike Racks	Bike Racks	Bike Lockers Bike Racks	Bike Racks	Bike Racks
Luggage Storage	Yes	No	No	No	No	No
Food Service	Hot Food	Food and Drink Vending	Food and Drink Vending	Food and Drink Vending	Drink Vending	Drink Vending
Security	Police/ Security Monitor	Lighted	Lighted	Lighted	Lighted	Lighted
Public Phones	Yes	Yes	Yes	Yes	Yes	No
Passenger Loading/Unloading	Off	Off	On	Off	On	On
Local Transportation*	Frequent Service (hourly)	Frequent Service (4/day)	Service or on call service	Frequent Service (hourly)	Frequent Service (4/day)	Service or on call service

* Not suggested for airports.

IDENTIFYING DEFICIENCIES FOR THE INTERCITY TRANSPORTATION SYSTEM

Public Transportation Services and Facilities Database

WSDOT assembled a large database describing public transportation services and facilities in Washington. The database includes information gathered from a survey of transportation providers and a field survey of transportation facilities throughout Washington. Information is

coded in a standard format, and all facilities are located using global positioning system (GPS) coordinates. The database is used with GIS (Geographic Information Systems) software to produce maps showing the location of facilities and other types of information. In addition the database can be "overlaid" on GIS maps of population and other demographic information to allow for analyses of different kinds.

The initial WSDOT database was supplemented through an inventory of intercity transportation services and facilities conducted for this project. Service providers were contacted to complete and update information about their services; additional information was gathered about additional facilities to be included in the WSDOT database, and to add information about the specific amenities at each facility.

Identifying Current Deficiencies in the Intercity Network

For each "place" on the intercity network, existing services and facilities were measured against the standards to identify deficiencies in the intercity public transportation network. Daily trips to/from each community on the network were totaled for all intercity modes serving that community. If a city was part of a cluster of cities, services to all the cities in the cluster were counted. For cities within a 20-mile radius of a hub (50,000+ population) with local public transit service to "hubs", service was evaluated in relation to the connectivity service standards.

For each place on the network, at least one "entry point" was selected; in addition, all intercity entry points (e.g., airports, ferry terminals, rail stations , intercity bus terminals and stops and park and ride lots served by intercity service providers) were identified. These entry points were grouped by type (multi-modal or single mode for intercity service) and by the size of community in which they were located. Amenities at each of these facilities were compared to the standards to identify deficiencies in the facilities, or entry points, for the intercity public transportation system.

Current service deficiencies are shown in Map 2.

Identifying Future Deficiencies

The identification of future deficiencies for the intercity network was based on analyzing population projections for 2020 in relation to the intercity transportation network expected to be in place at that time. Some communities that are not large enough to be on the current network were added because they are projected to grow to 2,500 or more. Other communities changed categories due to projected growth; consequently, different standards were applied to assess future deficiencies. This analysis resulted in the identification of additional deficiencies for the intercity network.

RECOMMENDED IMPROVEMENTS TO ADDRESS SYSTEM DEFICIENCIES

Improvements were identified to address four types of deficiencies in intercity public transportation services. These deficiencies include:

- Service gaps – areas without any service,
- Vulnerable routes – locations where service is available but long term funding is uncertain,
- Underserved corridors – where service is available but it does not meet the state standards, and
- Inconvenient service – areas where service doe not meet the standard for convenience.

The report describes service and facility improvements to address these deficiencies. Specific recommendations include:

- WSDOT taking the lead in assisting in the establishment (or re-establishment) of service in deficient corridors,
- Establishing a permanent funding mechanism to support services in vulnerable corridors/locations, and
- Coordination between WSDOT and current intercity service providers to improve intercity services throughout the state.

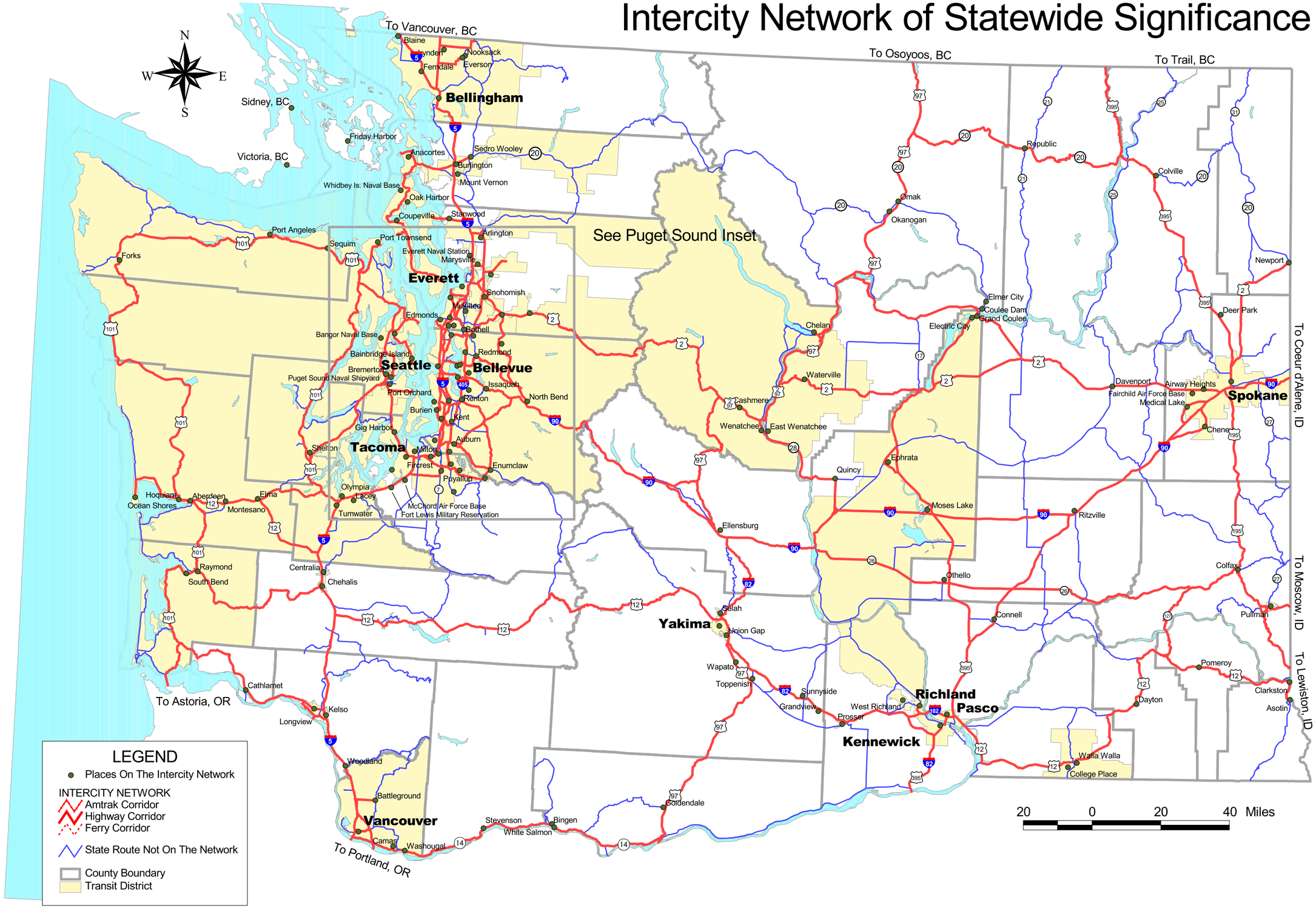
Recommended improvements for facilities are also included in the report. Based on the deficiencies analysis, over 1,000 specific improvements were identified for more than 250 individual facilities. Recommended improvements range from adding minor deficiencies (pay telephones and inside seating) to substantial improvements (off-street parking and secured waiting areas).

CONCLUSIONS

The approach used for this project provides a logical and consistent way to identify deficiencies in intercity public transportation. Through the designation of an intercity public transportation network of statewide significance, WSDOT can guide the provision of intercity transportation facilities and services to achieve an acceptable level of statewide mobility for those travelers who rely on public transportation to travel between communities.

The project report is intended to provide guidance to local, regional and state transportation providers (public sector and private sector) about where service and facility improvements for intercity public transportation should be made. It does not mandate local governments to allocate their funds to these projects. However, it does provide a "blueprint" for improvements that can be achieved through state, regional, local, and private sector partnerships. The project improvement list and the associated costs will be included in the next iteration of *Washington Transportation Plan*.

Intercity Network of Statewide Significance



Map 1

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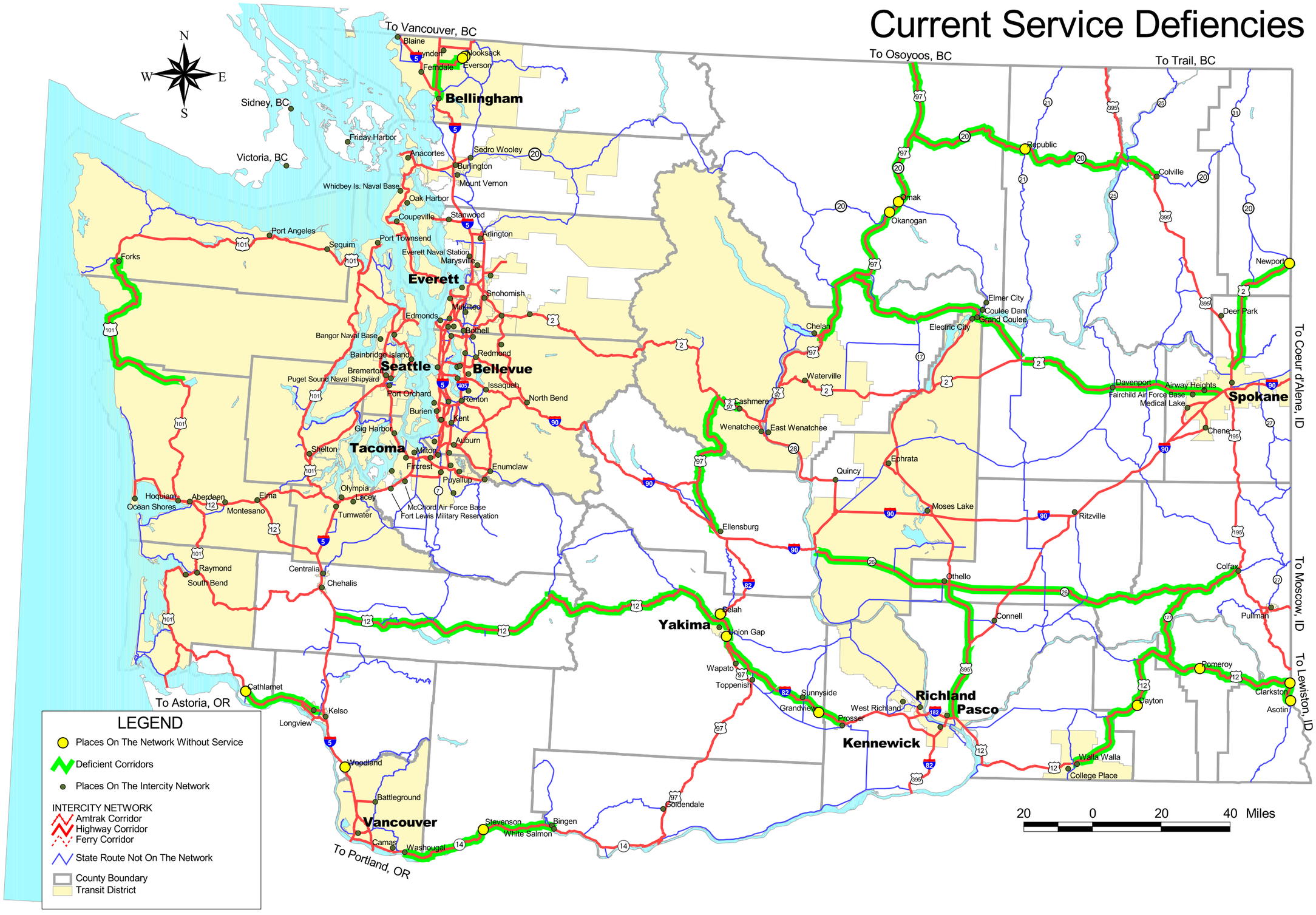
Current Service Defiencies



Map 2

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Session #2

BUS RAPID TRANSIT: AN INNOVATIVE TRANSIT STRATEGY FOR MEDIUM-SIZED CITIES

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ABSTRACT

This paper describes an innovative transit strategy for small and medium-sized cities that provides a cost-effective alternative to rail-based rapid transit systems. Bus rapid transit is a strategy that is being developed in Eugene, Oregon to meet the community's need for an enhanced transit system, without making the capital investment required for a rail-based system.

Small- and medium-sized communities struggle with the challenge of providing efficient transit service that can attract choice riders by being competitive with the automobile. While many larger communities have turned to light-rail systems as the solution to getting people out of their cars, smaller communities have neither the population base nor the financial resources to support these systems.

Lane Transit District has identified a bus rapid transit (BRT) system as the most cost-effective means of achieving the community's goals to increase the use of transit. BRT is most easily envisioned as using buses to emulate the speed, comfort, and convenience of rail systems. The proposed BRT system is composed of high-frequency, fast transit service along major corridors, with smaller buses providing access from neighborhoods to the BRT lines, as well as to nearby shopping and employment. System features include exclusive bus lanes, transit signal priority systems, barrier-free fare collection and limited stops with improved facilities.

BRT is well suited to medium-sized communities because it can be implemented incrementally, as funding becomes available. BRT also uses existing technology that may be easier for smaller communities to implement in the absence of planning funds. Because it emulates rail in terms of exclusive right-of-way and land use patterns that develop along the transit corridor, it can be a precursor to an eventual rail system as population continues to grow.

This paper describes the benefits of BRT to medium-sized communities, focusing on the ability to implement this system easily without huge planning or capital investments. In addition, the paper describes some of the challenges to overcome in the planning process, including political issues and inter-jurisdictional coordination.

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BUS RAPID TRANSIT: AN INNOVATIVE TRANSIT STRATEGY FOR MEDIUM-SIZED CITIES

Introduction

Many medium-sized cities experience the big city problem of traffic congestion, yet few cities have the financial resources to solve the problem. Although larger cities have turned to rapid transit solutions such as light rail transit (LRT), smaller cities do not have the population base nor the funding support to build LRT. In spite of staggering costs, LRT is seen as an attractive transit solution because of its broad appeal to riders and its contribution to a city's urban character. While out of the financial reach of smaller cities, recent debate suggests that even larger U.S. cities should not be building LRT, but should be pursuing less costly solutions. The extraordinary per mile cost is difficult to justify considering the marginal increase in transit use, and federal funding projections fall far short of meeting the needs of LRT projects currently in development. Given the lack of viable solutions, medium-sized cities have struggled with the challenge of improving transit service in order to increase ridership and better compete with the automobile.

Lane Transit District (LTD) in Eugene, Oregon, has been working on the development of a bus rapid transit (BRT) project. BRT has been identified as an innovative, low-cost transit strategy that can meet the needs of the Eugene-Springfield metropolitan area. BRT is envisioned most easily as using buses to emulate the speed, comfort, and convenience of rail systems. The proposed BRT system is composed of high-frequency, fast transit service along major corridors, with smaller buses providing access from neighborhoods to the BRT lines, as well as to nearby shopping and employment. A much lower per-mile cost than rail-based systems, BRT is being proposed as an appropriate and cost-effective solution for medium-sized cities that offers elements of the appeal of its LRT counterpart.

About Lane Transit District

Lane Transit District (LTD) is a public transportation agency that operates 110 buses and provides other alternative transportation services in metropolitan Eugene-Springfield, as well as portions of rural Lane County. LTD currently provides approximately 6,000,000 trips per year. The past decade has been marked by consistent growth in ridership and in the demand for the District's services, resulting in corresponding additions to routes, facilities, and the fleet. The District's goal is to provide a safe, convenient, and efficient transit service that is competitive with the automobile through quick travel time and direct routing.

LTD has had a history of innovation and forward-thinking. LTD's fixed-route bus system has been 100 percent wheelchair accessible since 1985, well before the passage of the Americans with Disabilities Act. LTD currently provides over 6,000 lift rides per month and has developed a reputation for creating a positive partnership with the disabled community. LTD has received State of Oregon and Federal Department of Energy awards for its successful Group Pass Program

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partnership with the University of Oregon. Two years ago, LTD put bike racks on 100 percent of the bus fleet and now provides over 7,000 bike rides per month.

LTD consistently has been ranked among the nation's top public transit systems. A national study conducted by the University of North Carolina at Charlotte has ranked LTD third in the nation among its peer group of transit systems and twenty-first among all of the nation's transit systems that were represented in the study. LTD's recognition in the transit industry is largely due to its innovation in developing new programs and its efforts to provide better service. BRT represents LTD's newest strategy for innovative transit service.

Why BRT?

In response to the community's growth and the increasing demand for faster, more convenient transit service that provides an effective alternative to the single-occupant automobile, Lane Transit District has begun preliminary engineering work for the implementation of a BRT system. The BRT system is based on light-rail transit principles, but instead of the required capital investment in trains and track, it utilizes buses in service that is integrated with key components of the existing automobile transportation infrastructure, such as roads and rights-of-way, intersections, and traffic signals. Therefore, BRT is more affordable, flexible, and appropriate in scale than light rail for a medium-sized area such as Eugene-Springfield. In addition, it allows for incremental construction and implementation and can be easily tailored to meet the specific transportation needs and opportunities within individual neighborhoods and transportation corridors.

BRT offers many advantages to regular bus service, including greater reliability, improved image, increased capacity, and speed. The following service features will increase travel speed and service capacity, and will reduce passenger travel time on the BRT corridor:

- Bus lanes, including guided busways
- Fewer stops than traditional transit service
- Signal prioritization technology to reduce delays
- Increased service frequency
- Smaller, neighborhood-friendly buses that can improve service coverage
- Easy access, low-floor, multiple-door buses
- Prepaid fare instruments

LTD's application of bus rapid transit is a "systems" concept that addresses all elements of service. As a systems approach, the objectives of BRT in the Eugene-Springfield area are very different from the BRT systems that were adopted by several North American cities in the 1970s. These focused primarily on exclusive rights-of-way with no attention given to other service elements.

The introduction of a BRT system in Eugene-Springfield represents a realistic and responsible approach to meeting the area's transportation needs. The protection of rights-of-way for transit use helps to position the system for the introduction of higher technology modes, such as LRT, if they become appropriate in the future as a result of the community's growth and population density.

Pilot Corridor Selection

Planning and development of the Eugene-Springfield BRT system includes the implementation of a pilot corridor within the next three to four years. The pilot corridor has been identified as a 10-mile, east-west alignment from east Springfield to west Eugene (see Figure 1). Four BRT alignments were analyzed for the selection of the pilot corridor (see Figure 2). Specific criteria considered as part of the selection process include population and employment density, existing ridership, corridor length, major destinations, and bus speed relative to automobile speed. Table 1 shows a summary of the corridor analysis.

A nonquantitative factor in selecting the corridor was the inclusion of both cities in the corridor. While including two cities in the planning process would involve more work in terms of public involvement and inter-jurisdictional coordination, the benefits of including both communities was seen as politically significant. An inter-jurisdictional Technical Advisory Committee (TAC) was convened to provide input into the corridor selection process. The TAC was comprised of planning and engineering staff from the following agencies: City of Springfield, City of Eugene, Lane County, Oregon Department of Transportation, Lane Council of Governments, and Federal Highway Administration. The selection of the east-west corridor was endorsed by the TAC and was supported by the LTD Board of Directors.

Upon implementation, BRT service in the pilot corridor will consist of a main trunk route along the east-west corridor, with connector routes to provide neighborhood service connections. The implementation of the pilot corridor will not preclude the operation of regular "local" bus service and some associated neighborhood service within that same corridor, as a supplement to the "express" BRT line and neighborhood connector services. BRT service improvements will be complemented by appropriate support facilities such as boarding stations, Park & Ride lots, and ticket machines.

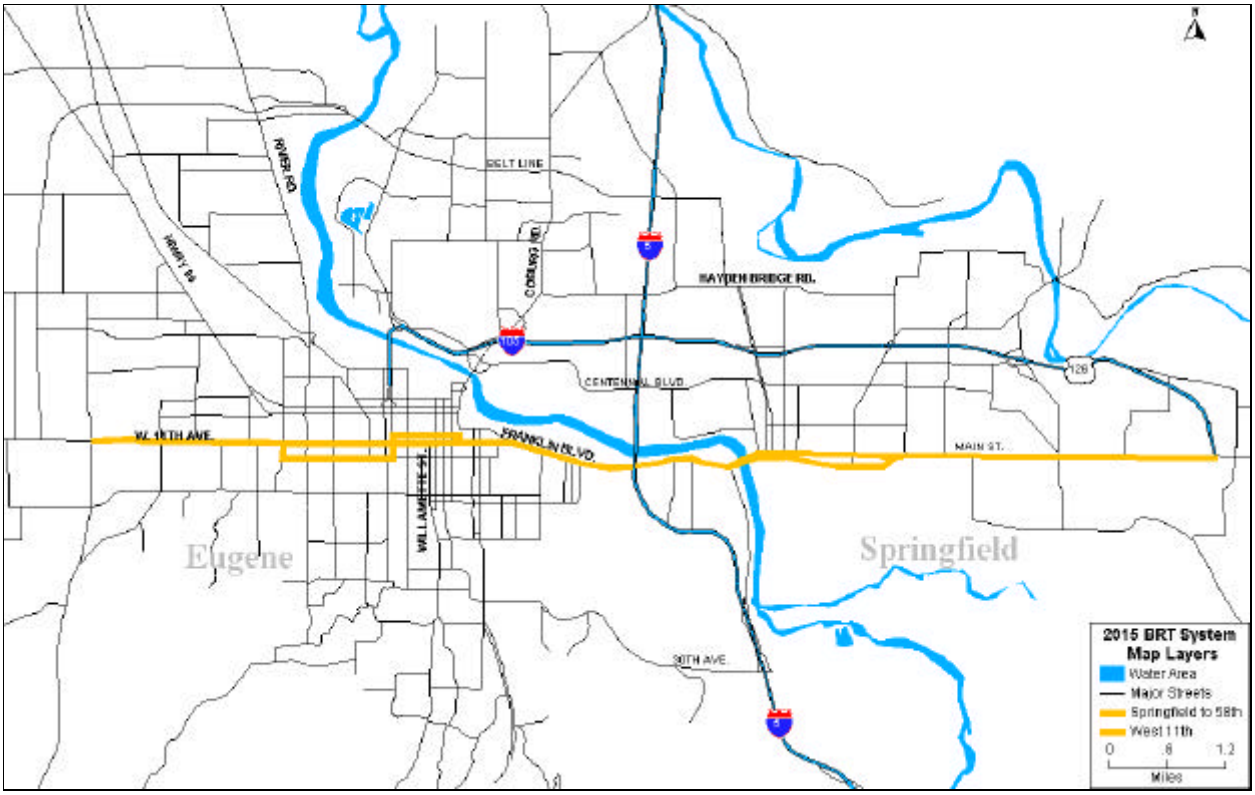

Figure 1 - Bus Rapid Transit Pilot Corridor Map

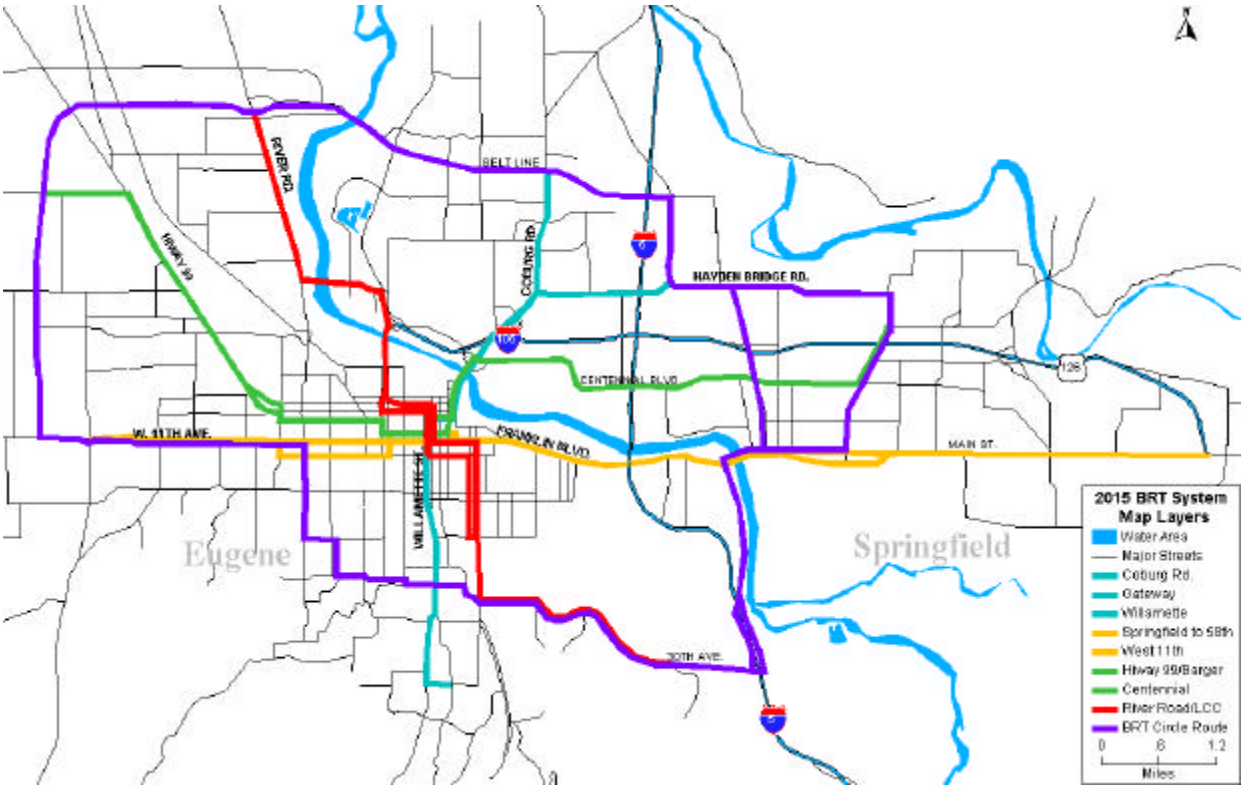

Figure 2 - 2015 Bus Rapid Transit System Map

Table 1
Pilot Corridor Selection Summary Table

ROUTE	PROS	CONS
COBURG ROAD TO CRESCENT	Ferry Street Bridge Corridor ROW Potential Developing Area	Bridge Construction Delays Relatively Low Ridership
HARLOW ROAD TO GATEWAY	Ferry Street Bridge Corridor Springfield Connection ROW Potential New Gateway Area Development	Congestion Not a Problem Bridge Construction Delays Low LUM Nodes Relatively Low Ridership
SPRINGFIELD STATION	High Ridership High LUM Nodes High Number of Existing Lanes High Population High Potential for Decreasing Travel Times Springfield Connection Signalization Possibilities Serves UO	Requires Relocation of Springfield Station Low Development in Glenwood Area
WILLAMETTE TO 29TH	High Ridership High Population High Employment Historical Center of Eugene	Short Route Constrained ROW Low Potential for Decreasing Travel Times Low LUM Nodes Minimal signal improvement potential
WEST 11TH	High LUM Nodes High Number of Existing Lanes High Potential for Decreasing Travel Times High Ridership ROW Potential	May Require Parking Removal May Require Contraflow Lanes

Service Components: Guided Bus

As stated previously, BRT combines a number of proven transit strategies into an innovative service package. A key component of this service package is the application of guided bus technology. Guided busways have been implemented in other countries but, to date, have not been applied in North American transit service. Cities that have successfully implemented guided bus technology are Leeds and Ipswich, England; Essen and Mannheim, Germany; and Adelaide, Australia.

Guided bus is a technology designed to efficiently provide exclusive bus lanes. The idea is simply to operate the bus between two curbs using guide wheels mounted to the side of the bus. Figure 3 illustrates the guide wheel technology.

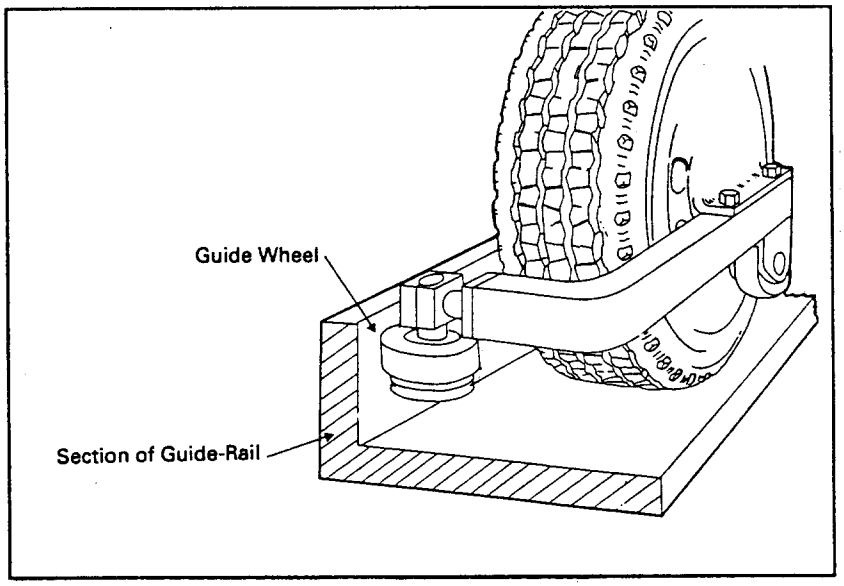

Figure 3. Mechanical Guidance System

The main advantage of guided bus is that the required lane width is reduced from 12 feet to 8.5 feet, which is the width of a standard bus. This greatly reduces the total amount of right-of-way required to implement an exclusive busway. In addition, only the wheel track requires paving, which allows the center of the track to remain unpaved, providing opportunity to add green space back into the roadway and enhance the appearance of the corridor. See Figure 4 for an example of the guideway.

Figure 4. Guided busway, Essen, Germany.

Because of the wheel tracks and median strip, automobiles cannot easily operate in the guideway, providing self-enforcement of the exclusive busway. The guideway also provides separation of buses from mixed traffic, allowing for improved traffic flow for both buses and automobiles, which will no longer be "stuck" behind buses at bus stops. Guided bus wheels can be retrofitted to virtually any standard bus at a minimal cost of $1,000 per bus.

Local Planning Efforts

Eugene-Springfield is in the process of updating the region's transportation system plan, *TransPlan*. LTD has participated as one of many regional public agencies providing input into the planning process. As part of the *TransPlan* planning process, a range of transit options was considered. The base case (or existing system), an enhanced bus system (base case plus 10-minute frequencies on all major corridors), and BRT were modeled to evaluate their impact on future congestion. This modeling indicated that the BRT system would result in the highest transit ridership. The modeling also indicated that supporting land use designs would significantly improve transit ridership.

The three transit options were presented to the public along with other transportation strategies, through a series of public workshops, stakeholder symposia, and various other public involvement tools. At the final stakeholder symposium, BRT was selected as the preferred transit strategy to put forward in the draft *TransPlan*.

The draft *TransPlan* is currently undergoing a public review and comment period, and it is anticipated that it will be adopted by local elected officials in the spring of 1999. In anticipation of *TransPlan* being adopted, LTD is proceeding with corridor planning and preliminary engineering for the pilot corridor.

Political Considerations

Throughout the development of the draft *TransPlan*, LTD worked with local agency staff to gain support for the BRT concept. In addition, the LTD Board of Directors and staff met with local elected and appointed officials to introduce the BRT concept and get feedback about the project. In order to ease concern regarding the implementation of BRT, such as the operation of signal priority and exclusive busways on local streets, LTD proposed language in the *TransPlan* that placed conditions on the implementation of BRT. The proposed policy is as follows:

> Establish a Bus Rapid Transit (BRT) system that provides frequent, fast transit service along major corridors and neighborhood services that connects with the corridor service and with activity centers, *if the system is shown to materially reduce existing or projected traffic congestion, if local governments demonstrate support, and if financing for the system is feasible.*

While the proposed language provided a level of comfort with the strategy to generate conditional support for BRT in the draft *TransPlan*, it also places the burden of meeting conditions on LTD if BRT is to be implemented. It should be noted that no other strategy in the *TransPlan* document had conditions placed upon their inclusion in the plan.

Concerns have emerged since the development of the revised BRT strategy language regarding the feasibility of meeting the specific conditions and the appropriateness of the measure chosen to determine success of the BRT project. Specifically, the phrase "*materially reduce existing or projected traffic congestion*" may be impossible to gauge and is not necessarily a good indicator of the success or failure of the BRT system. As currently written, if this condition is not met, BRT may be difficult to implement. LTD is considering proposing alternate language that meets the intent of the wording and more accurately reflects the goal of BRT, such as "*if shown to increase transit ridership.*"

LTD's primary interest in developing acceptable language in the draft *TransPlan* is to assure community members and elected officials that the project will only proceed with the support of both communities, and the effected road jurisdictions.

Public Involvement

In addition to public involvement efforts made as part of the TransPlan process, LTD has launched a broad-based public involvement plan. Since 1995, LTD has made significant efforts to introduce the BRT concept to the community. This has been done through regular mailings to

more than 1,000 community residents, three community open houses, and periodic updates and presentations with local organizations. In addition, LTD has held four focus groups with residents, businesses, and travelers along the proposed BRT pilot corridor. LTD staff have met one-on-one with hundreds of individual community members and business owners to discuss and get feedback about the project. A BRT video has been produced and widely circulated to agency staff, elected officials, and interested parties. LTD has advertised BRT through a variety of mediums, including TV and radio spots.

LTD has been working with a BRT Technical Advisory Committee (TAC) comprised of transportation engineering and planning staff from the cities of Eugene and Springfield, Lane County, Oregon Department of Transportation, Federal Highway Administration, and Lane Council of Governments. The TAC has been informed about preliminary engineering and public involvement efforts. In addition, a BRT Steering Committee was formed and is comprised of a city councilor from Eugene and Springfield, a member of the Lane County Board of Commissioners, three LTD Board Members, a regional manager from the Oregon Department of Transportation, and two at-large members. The BRT Steering Committee has an advisory role in engineering, planning, and public involvement activities and will forward recommendations regarding BRT to the LTD Board of Directors.

A BRT public involvement plan has been developed to address public involvement for corridor planning. The goal of the plan is to provide the public with information on all aspects of the project. Additionally, the goal is to provide an opportunity to express concerns about the alignment and to present additional ideas to improve alternatives or mitigate their impacts. As part of the plan, LTD staff will meet individually with all property owners along the pilot corridor. For planning and engineering purposes, the corridor has been divided into eight segments. The public involvement plan is also organized by corridor segment and focuses on neighborhood input into the segment design process. A series of open houses and design workshops is scheduled and will be accompanied by newsletters and direct mailings to residents. Although planning and public involvement for each corridor segment will be similar, the process will also be flexible to respond to specific issues along each segment. The BRT public involvement process will be refined as the corridor study is developed for the various segments. A complete process review and refinement will occur in December 1998.

Federal Support

The Federal Transit Administration (FTA) is very enthusiastic about the BRT concept. LTD has met with the FTA Administrator Gordon Linton to discuss conceptual ideas for implementing a BRT system in Eugene. The FTA has demonstrated support for the concept, both for the Eugene-Springfield project and for developing a national BRT prototype. Given the funding climate for transit projects, the FTA is concerned about the availability of federal funds to finance LRT projects that are currently in development. The FTA sees BRT as a viable transit option for cities of any size, including larger cities that would otherwise consider LRT. In addition to FTA support, Congress has also been extremely supportive of LTD's BRT project, as evident by the full funding of LTD's request for planning and preliminary engineering funds. As part of the TEA

21 transportation bill, Congress authorized 9.8 million dollars to plan and implement the BRT pilot corridor. Congress is attracted to the BRT project for similar reasons as FTA, primarily because BRT can be implemented at a fraction of the per mile cost of LRT.

Conclusions

BRT is unique because it combines a range of low-cost transit technologies that can be implemented incrementally. Depending on funding and local planning constraints, different combinations of technologies can be applied with good results. LTD is endeavoring to implement the full range of BRT components to maximize the potential of this system to effectively compete with the automobile in terms of travel time. LTD has packaged "BRT" as an integrated transit system. However, any of the components implemented individually can realize transit service improvements. If political or funding constraints prohibit the full implementation of BRT as described, LTD intends to implement many of the other components, including low-floor buses, prepaid fare mechanisms, increased service frequency, and signal priority.

BRT provides the opportunity to significantly improve transit service at a cost that is affordable for a medium-sized city. If desirable, and if population and employment levels support it, BRT can be seen as a precursor to a rail-based system. By preserving right-of-way now, and establishing exclusive busways, the conversion to a rail system would be significantly less expensive in the future. BRT is a flexible system to implement. Unlike a rail system, BRT can be implemented incrementally as funding and right-of-way acquisition allows. If funding or political support is limited, it is possible to construct exclusive busways in only the most congested segments initially. As funding becomes available, or the system gains wider community support, the busways can be extended to other segments. Finally, BRT provides an appropriate technological solution for a medium-sized city. For many years, medium-sized cities have settled for lower levels of transit service than their population and land uses would support. BRT provides an affordable and attractive transit solution for these communities.

Session #2

IMPROVING PEDESTRIAN ACCESS TO TRANSIT:
City of Gresham's Ped-to-MAX Program

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ABSTRACT

Accommodating multi-modal travel on high speed arterials is a challenge, particularly in Gresham where numerous arterials transect the city, creating barriers to pedestrians, bicyclists, and transit users. The "Ped-to-MAX" program was created to ease these barriers and improve the pedestrian environment around Gresham's eight light rail stations and town centers, where pedestrian activity is high, even though traffic volumes are heavy and moving at fast speeds.

The Ped-to-MAX program redesigns existing street right-of-way and constructs facilities for pedestrians which will improve safety yet accommodate traffic. The program's objective is to create safe pedestrian areas where traffic speeds are slowed and the streetscape is aesthetically appealing, thereby encouraging more pedestrian activity and increase transit ridership. Improvements include texturized crosswalks, widened sidewalks, off-street pathways, mid-block crosswalks, intersection improvements, medians, curb extensions, street lighting, pedestrian plazas and other amenities.

The City of Gresham's Transportation Planning, Streets, and Parks Divisions teamed with Tri-Met, the regional transit provider, Multnomah County, and various citizen committees in developing this much needed program.

Phase I of Ped-to-MAX will be constructed in summer 1998. ISTEA is the primary source of funding for Phase I along with state and local funding. Phase II, funded through Oregon State's Transportation Growth Management Program, will begin design Fall 1998.

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IMPROVING PEDESTRIAN ACCESS TO TRANSIT:
City of Gresham's Ped-to-MAX Program

INTRODUCTION

Like much of the Northwest, Gresham is growing at an overwhelming rate. In the last 10 years Gresham's population has doubled to more than 81,000 and is now the fourth largest city in Oregon. Although Gresham is served by light rail (MAX), the automobile continues to be the primary mode of travel and the City's development pattern reflects this preference. The arterial street system forms a super-grid providing great mobility for autos but a dangerous and unappealing environment for pedestrians.

To encourage walking and promote light rail use, Gresham developed Ped-to-MAX, an on-going program to improve pedestrian access to Gresham's eight light rail stations. Because the project is federally funding with Congestion Mitigation Air Quality (CMAQ) monies, the primary objective had to be to reduce vehicle miles traveled. However, this objective again focused on automobile use. The City wanted to make a commitment to better the pedestrian environment, first by improving safety with slower traffic speeds and basic pedestrian infrastructure improvements; and then go a step farther, by creating a more aesthetically appealing streetscape. If successful, pedestrian accidents rates would be reduced and more people would walk. The city believed in the theory "if you build it, they will come."

The City had eight months to design Phase I of Ped-to-MAX or risk losing CMAQ funding. The project team had little idea of what to build other than sidewalks, but quickly created a vision and continually reiterated the objective of building for people not for greater car efficiencies. This was a surprisingly difficult task.

BACKGROUND

Gresham is located 15 miles east of Portland. In 1986 light rail service between Gresham and Portland opened. During the development phase, the proposed light rail service met with great opposition by Gresham residents. As a result the light rail alignment is poorly located and was not supportive of existing land uses.

Despite the poor alignment, Gresham residents account for almost 30 percent of MAX's peak hour ridership. With such high use under truly inadequate conditions, City staff theorized that ridership could improve if the conditions around the station areas improved.

The issues facing Ped-to-MAX were many. The light rail line occupies the center median of a major arterial (Burnside) on its trip into Gresham. This creates a huge barrier for pedestrians. Because of Gresham's super grid arterial pattern, the block lengths are very long with limited safe pedestrian crossings. Also, traffic speeds are generally faster than posted speeds because of the super grid layout. The arterials have

numerous driveways and continuous center turn lanes that make left turn access to cross streets and adjoining properties readily available, but results in undesirable and unsafe conditions for pedestrians and bicyclists.

In 1994 City staff conducted a study *Accommodating Pedestrians to "MAX" Light Rail stations in Gresham*, and found that many Gresham citizens are discouraged from using transit because of both real and perceived barriers to pedestrian travel. The study identified more than 30 project areas where better pedestrian connections to MAX were needed and made design recommendations to encourage more walking throughout the City. The study also recognized the potential for enhancing community identity and prompting private investment through a public financial commitment to pedestrian infrastructure improvements.

The project team knew existing conditions in Gresham were in a sorry state. The basic infrastructure was inadequate and the walking experience was poor. Primary walking routes lacked any pedestrian amenities. However, based on the *Highway Capacity Manual*'s measure of pedestrian level of service, Gresham pedestrians currently experience level of service A at most times of the day at most locations, but the City found this measure did not take into account all the factors that encourage walking and referred to 1000 Friends of Oregon's *Pedestrian Factors* as a standard measure.

Noting 1000 Friends of Oregon's *Pedestrian Factors* research, Ped-to-MAX took into account the influence convenience factors may have to encourage more walking, such as; the ease of street crossing, sidewalk continuity, street connectivity and topography. Other factors considered were the facilities themselves such as; ability to select walking speeds and avoid conflicts with others, degrees of crowding in queuing areas such as sidewalk corners and transit platforms and obstructions such as poles, and trees and street furniture that restrict the amount of pedestrian space.

The streetscape improvements proposed by Ped-to-MAX have the benefit of transit supportive land use policies now in place at the City. As required in Oregon's Transportation Planning Rule, new buildings on transit streets must have a primary entrance oriented to the street, no more than a 20-ft setback with landscaping and frontage improvements. This tool has immeasurable benefits to the pedestrian environment.

OBJECTIVE

Beyond encouraging greater transit use, the main project objective is to strengthen the pedestrian environment with safe, convenient, and aesthetically appealing streetscapes. Ultimately the project would create great pedestrian environments by developing exciting urban public spaces, which in turn enhance community identity and livability.

PED-TO-MAX PROJECTS

Of Gresham's eight light rail stations, three were prioritized for Ped-to-MAX Phase One design; Rockwood, City Hall, and Central Stations. These are the three most highly used stations in Gresham. These areas also experience high pedestrian activity even though traffic volumes are heavy and travel speeds fast.

Of the 38 projects identified in the Ped-to-MAX study, the top ten were selected for design. Because of funding constraints, only four were taken to construction.

Rockwood Station Area:

Rockwood was recently annexed by the City of Gresham and lacks basic infrastructure improvements needed to support the high density zoning recently enacted and the great pedestrian activity it currently experiences. It has a surprising number of pedestrians given the ugly, dangerous, and car-oriented environment. This conflict is made clear given that Rockwood has the highest number of pedestrian accidents in the City.

At the Rockwood Station, all of the retail buildings near the station are set back from the street and are fronted by large parking lots. Traffic moves very fast on the arterials and the pedestrian environment is difficult as well as extremely dangerous.

There are also problems with real and perceived safety in Rockwood. The negative behavior of many of the teenagers who loiter in and around the stores and transit stop detract significantly from the image of the area.

Project staff met with Gresham Police asking for their insight on the area. The Police felt it essential to add pedestrian-scale street lighting with a more horizontal cast than the typical street light. This type of lighting will decrease the shadow cast of vertical lighting and illuminate pedestrians more clearly. In the opinion of the Police Department, if nothing but proper lighting were added to the area, the project would be a success.

The Ped-to-MAX study identified two project sites in the Rockwood Station Area: the Rockwood Urban Plaza and the 188th Street Transit Center. The proposed plaza site is on private property and links bus travel with light rail.

The plaza site is located across the street from the light rail station in a high activity area in the center of the Rockwood Town Center. The site is currently vacant with two fast food restaurants as neighbors. The site is an gravel lot serving only as an eyesore to the neighborhood and is notorious for gang and drug activity.

The proposed plaza is a small 8,600 square foot area. The space is intended and designed as a respite from the busy surroundings, as well as a transit transfer station between light rail and bus. At issue was developing a pedestrian space that had an unknown development future, no physical boundaries, and would continue to be

surrounded by auto-dominated uses. Color and vertical space were the two characteristics staff wanted to include in the final design to achieve the project objective of developing energetic urban spaces.

From aerial photos, it was clear that the primary color in the neighborhood was concrete gray. After many rounds of discussion and considering the financial restrictions, it was concluded that clay bricks in red and blue tones would be the dominate material of the plaza. Phase I would add a intricate pattern in the center of the plaza until additional funds could be found to replace the central brick pattern with a fountain or other water feature.

The vertical issues were resolved in numerous ways. Grassy berms and Cherry Trees that flowered twice annually were used to shape the edge of the plaza and provide some definition. At the front of the plaza, an elevated, concrete, circular seat was designed that in the center could hold a Christmas tree. This accent was added to accommodate community gatherings. Other seasonal events could be promoted for the plaza by Rockwood neighborhoods.

Negotiations for the plaza property were drawn out for over a year, but were unsuccessful and led to the need for condemnation. Unfortunately, Gresham's City Council denied action and the plaza construction is now on hold.

With the delay of the plaza construction, the City is working to establish uses and generate activity in the area to improve image and generate more "eyes on the street." Some more short term uses being considered in the proposed plaza space and on 188th include weekend markets , which can also help to incubate new businesses for the area, and a game cart that would loan out board games in the summer months. Vending carts with espresso or flowers are also to be encouraged in the area.

The transit center on 188th is a block- long section of street improvements including sidewalk widening, mid-block crosswalk, texturized crossings, street trees, street lighting, and new covered bus stops. The only issue to arise with the transit center was placement of the mid-block crossing.

To improve pedestrian safety when crossing Stark Street, a five-lane, high speed, high volume arterial, a mid-block pedestrian crosswalk and refuge was proposed. Field observations indicate substantial pedestrian traffic crossing Stark Street to reach not only the transit station, but the many retailers in the area. Marked and unmarked pedestrian crossings across Stark Street are available, but, many, if not most pedestrians, cross at mid-block locations.

Several locations along Stark Street were evaluated as possible crosswalks. The location recommended for improvement with a marked crosswalk and pedestrian refuge island is on the east side of the Stark Street and 188th Avenue intersection. Improvements also include widened sidewalks and street trees and pedestrian scale lighting. This will not

only reduce the crossing distance for pedestrians, but change the visual environment for drivers and slow travel speeds.

The pedestrian refuge island proposed on Stark Street near 188th Avenue meets the minimum size of about 50 square feet. The refuge site does prohibit left turns into two businesses. Through one-on-one meetings they were resolved.

In the long term, the City is proposing major improvements to the arterials to slow traffic in the Rockwood Town Center by creating tree lined boulevards with on street parking, medians and other pedestrian amenities from the now five-lane arterials.

City Hall Station Area:

City Hall station is the second most highly used station of Gresham's eight stations. Most riders use the park and ride lot associated with the station. For those who walk, they must navigate a series of high speed, high volume, five lane arterials. The major of those being Division Street. The pedestrian environment in this location is bleak and visitors who may be using transit to reach downtown Gresham would have no clue how to find their destination.

The Ped-to-MAX projects will link Gresham's historic downtown and the new Gresham Civic Neighborhood, a transit-oriented development and the major destinations in between: Gresham City Hall, Gresham High School, and a major shopping center. The major street running between the two areas is Division, a five-lane, well traveled arterial with curb-to-curb widths of approximately 75-feet.

One option to improving pedestrian access is to reduce pedestrian crossing distances. The existing lane width on Division Street is 11-feet with a continuous 12-foot turning lane. City Staff wanted to reduce the 75-foot crossings to a more manageable distance of 60-feet. One possible street configuration included 10-foot travel lanes, 12-foot turn lanes and 6-foot bike lanes.

Another option would be a 14-foot wide outside or curb lane that would be shared by motor vehicles and bicyclists. This option is described in the *Oregon Bicycle and Pedestrian Plan* for use where right-of-way or topographic constraints prevent striped bike lanes. With a shared motor vehicle-bike lane, the total curb-to-curb width would be approximately 4 to 6 feet less than with designated bike lanes. This reduction in curb-to-curb width would reduce the time it takes for pedestrians to cross by 1 ½ to 2 seconds. However, City Staff eliminated this alternative given the volumes of traffic and projected speeds lowered to 35 mph would not be enough to support a shared bike lane.

The proposed project area on Division was a four block section of street calling for major changes to both the automobile and pedestrian environments. Because of this, Multnomah County, who owns and maintains the road, called for a more in-depth

study of the project and expanding the project boundaries to accommodate a better transition into downtown Gresham. Because of this, project construction was delayed and the project boundaries were expanded. The new project area is now under design through grant award from Oregon's Transportation Growth Management program. Construction funding has been earmarked in TEA 21 as a demonstration project and is scheduled for construction in 2001.

Central Station Area:

Central Station is a major bus center with links to a light rail station and the only structured park-and-ride garage in Gresham. It is near the end of the light rail line and is the closest stop to historic downtown Gresham (four blocks away).

The Gresham Downtown Development Association has been eager to improve the link between the core business community and light rail and saw Ped-to-MAX as a prime opportunity to do this. In 1990 the City redesigned Main Street through downtown by widening the sidewalks and curb extensions and narrowing travel lanes. Street trees and historic street lighting were added to the streetscape greatly improving the business district and re-energizing retail activity. With additional funding a second downtown street was improved.

The business community felt that the brick work associated with the sidewalks downtown functioned as a "yellow brick road" in that visitors would not stray from the improved streets without the brick. Through observation, city staff found this to be true. Visitors would park in downtown and follow only the streets with brick work. Once the bricks stopped so did the visitor.

To extend the "yellow brick road" and better link downtown to Gresham, Hood Street was chosen as a project for construction. Hood Street is classified as a neighborhood collector. It is one of the few through streets through town, but travel speeds and volumes were not high. The street has a mix of commercial and residential with both single family homes and multi-family apartments. High school students use the street to gather and use transit.

The focus of the Hood Street improvements was aesthetic. Travel lanes were narrowed to physically control travel speeds and provide pedestrian amenities within the given right of way. To reduce construction costs only one curb was moved. Street trees, street lights and texturized crosswalks were added to increase the awareness of pedestrian activity.

10th Street:

Mature street trees were added to 10th Street, a street perpendicular to Hood which links Main Street and Gresham High School to the Central Transit Center. The project area is noted as a top ten priority in the Ped-to- MAX study. 10th Street is a new concrete street parallel to the light rail tracks, but very bland and unfriendly. At a low

cost, ($5,000) the city found mature 40-foot Armstrong Maple trees and planted them at the back-of-curb. This inexpensive simple improvement has made a significant difference in the pedestrian environment. It adds a much needed vertical element which better defines the pedestrian space.

Powell Main Intersection:

Also identified as a priority project in the Ped-to-MAX study is improving the link between historic downtown, Gresham's Main City Park, and the Springwater Trail, an off-street, multi-use path. This entailed improving the intersection of Main Street with State Highway 26, or Powell Boulevard. Curb extensions, bike lanes, and on-street parking were added to slow traffic, sidewalks were widened and texture was added to the crosswalks, street trees and street lighting were added to improve the pedestrian environment.

PUBLIC INVOLVEMENT

A great deal of coordination was needed for Ped-to-MAX. Not only were three City divisions involved, but Multnomah County and the Oregon Department of Transportation, because projects were located on their roads, TriMet, the transit service provider, and numerous neighborhood associations, the downtown business association, and private businesses.

The two public workshops held in each project area were so poorly attended, it became a much needed staff retreat. Project for Public Spaces (PPS), a private consulting firm, was integral in developing the project vision. PPS made project staff aware of the need to expand the project boundaries beyond sidewalk infill and create livable, enjoyable space. PPS also enforced the need to slow travel speeds if the pedestrian environment is to be improved.

PROJECT FUNDING

The City requested and received $1 million in Federal ISTEA grant funds for project design and construction. The City's Transportation Planning Division teamed with the City's Streets and Parks Divisions to compile all necessary funding. Because gas tax monies can not be used outside of the public right of way, Parks funding (from System Development Charges) was essential. Money designated for a bike project in the State Transportation Improvement Plan was transferred to Ped-to-MAX. The City was also awarded an Oregon Department of Transportation Local Assistance Grant.
The overall project construction budget is $1.6 million or approximately $360 a linear foot.

CONCLUSION

At issue throughout the project was how to prioritize pedestrians over automobiles. It was a reversal of thinking for the City that came slowly and painfully. It is a new way of thinking that needed constant reaffirmation.

The City lacked the initial vision of what Ped-to-MAX would be and what purpose it would serve. It wasn't until the public involvement phase that the real project began to develop. Ped-to-MAX became more than just sidewalk infill, but a comprehensive pedestrian program that included traffic calming and creating neighborhood identity.

Political support is vital to the on-going success of the project, particularly when sensitive issues such as condemnation arise. Gresham City Council and Planning Commission were well briefed on the progress of the project. To the point of one Councilor saying he'd "heard enough already." What would have been more effective is one-on-one meetings. The project team should have prepared to take condemnation action early in project development.

Providing a balanced environment of cars and people is essential. Many of the successful pedestrian improvement projects don't isolate pedestrians but effectively mix them with an active streetscape, of which cars are a part.

Construct a "show job" to show funding sources and decision makers that pedestrian projects are successful and needed. This will make continuing the program a greater reality.

SESSION 3 - SHOW ME THE MONEY

Moderator: Joe Guyton
Howard, Needles, Tammen & Bergendoff, Missouri

Panelists: Cory J. Crebbin and Martin Hoppe, City of Lacey, Washington
William F. Grimes, Studio Cascade, Washington
Elizabeth Rushley, Ohio Department of Transportation
Scott M. Smith, Howard, Needles, Tammen & Bergendoff, Missouri

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Session #3

Streamlining Traffic Mitigation Fees

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Abstract

The City of Lacey rewrote the ordinance governing collection of fees to mitigate development impacts on the transportation system. Previously developers submitted traffic generation and distribution reports prepared by qualified traffic engineers. The impacts were reviewed and the mitigation required at each site in the City were iteratively negotiated. This process required substantial investment by the developer and the City. Funds collected could only be used on the specific project for which they were collected.

In developing a new ordinance, the City requested public input. Roundtable discussions included builders and developers. The application of mitigation fee formulas to commercial and residential projects, as well as trip generation and distribution methodology, were discussed in these sessions.

The final ordinance included trip generation reductions for commercial property and a per trip mitigation fee cap for residential properties. The ordinance also allows the City to pool money from various projects for a single project under certain circumstances, and mitigation fees can be collected for projects already built until the project costs are fully amortized. An additional result of the roundtable discussions is that the City developed a trip distribution map for each Traffic Analysis Zone (TAZ). A proposed development can use this distribution, or in the alternative may hire a traffic engineer to develop an alternative distribution to be negotiated as was done under the previous ordinance.

All of these tools are based on existing information. Trip distributions were plotted using the City's transportation model assembled as part of the Transportation Comprehensive Plan. All projects to be mitigated are listed in the City's Six-Year Transportation Improvement Plan.

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Streamlining Traffic Mitigation Fees

Background

Lacey is located at the southern end of Puget Sound between the City of Olympia and the Nisqually River. It is the second largest city in Thurston County with a population of 27,570. An additional 29,575 people live within Lacey's Urban Growth Boundary.

Interstate 5 runs through Lacey and two freeway interchanges are within the City limits. The busiest arterial is Martin Way with average daily traffic of 36,449 vehicles.

Lacey devotes $300,000 per year from the City's general fund toward transportation capacity improvement projects. The six-year Transportation Improvement Plan (TIP) identifies $62M in required projects. The $60M difference must be funded by grants, private financing, or debt. Approximately $26.5M of the TIP projects are currently funded.

The Old Way

Lacey developed and passed a traffic mitigation fee and transportation infrastructure ordinance (Lacey Municipal Code 14.21) as required by the Growth Management Act in the Revised Code of Washington (RCW) 36.70A. The City required any development generating more than 20 peak hour vehicle trips or sending 10 additional trips through a potential project to submit a traffic impact analysis prepared by a qualified traffic engineer. This analysis was reviewed and critiqued by City staff and returned for incorporation of comments. Eventually, through a series of meetings, phone calls, and correspondence, the impacts were agreed to. The time required to reach agreement varied widely; from several days to two months or more. Each "project site" through which more than 10 trips passed required mitigation to be paid based on the following formula:

(Trips - 10) * (Project cost/projected capacity[(1)])

[(1)] "Projected Capacity" was a consistent denominator based on the roadway classification and typical ultimate configuration after future improvements.

The first 10 trips through each project were essentially free. This provision was included to ensure that large developers would receive the same discount provided to smaller developments which did not generate sufficient trips to require a traffic impact analysis.

In addition to traffic mitigation fees, the Washington Growth Management Act requires the City to establish the acceptable Level of Service (LOS) and to certify that the infrastructure necessary to maintain the established LOS is in place at the same time as growth generates new volumes/users. The common term for this requirement is "concurrency", indicating that infrastructure must be concurrent with growth. The City and the Regional Transportation Planning Organization (RTPO) established Level of Service (LOS) standards for the transportation system. In Lacey, a LOS of 'E' is

acceptable for urban core areas (typically consisting of dense retail and commercial) and LOS 'D' is required for all other areas. Any degradation to the LOS is identified during the traffic analyses. If the TIA for a development indicates that the LOS will be degraded below the established standard, triggering the concurrency requirement, the development will not be approved unless the developer agrees to construct adequate improvements to restore an acceptable LOS as a condition of approval. The result is a disproportionate burden on any property which delays development until existing transportation capacity is depleted.

Additional constraints on the City under the previous ordinance were that mitigation fees paid for a project could only be applied to that specific project and after project construction mitigation fees could no longer be collected. Under these constraints, a facility could be expected to fail to meet the established LOS long before adequate funding was available to construct additional capacity. No developments could be approved unless the proponent agreed to fund the entire remaining project shortfall, and no additional mitigation fees for a failed project site could be collected because the concurrency provisions of the GMA precluded the City from approving additional developments.

The Change Process

The concurrency provision of the Washington Growth Management Act was cited by the Lacey Hearing Examiner upon examination of the Traffic Impact Analysis (TIA) for a development which routed more than ten trips to the intersection of Marvin Road and Interstate 5 (I-5). This freeway interchange includes a city street on the north leg (Marvin Road), a state highway on the south leg (State Route 510), and the interstate highway running east-west.

The TIA for this development indicated that any additional trips lowered the LOS E, and the LOS established by ordinance for this interchange was D. In essence, the hearing examiner found that no development routing more than 10 trips to this freeway interchange could proceed until capacity improvements were financially guaranteed. At that time it was anticipated that the needed improvements would cost approximately $12 million. No federal or state funds were available to expand this interchange (ca 1995). This de facto development moratorium affected several hundred acres and several large developments which had already paid approximately $15M to extend water and sewer service to their parcels.

The inability to continue to collect fees after a project is built created an extreme financing problem for the interchange improvements at Interstate 5 and Marvin Road (State Route 510). One option was to debt finanance the construction, but the City had no way to generate revenue for loan repayment since mitigation fees were not collected after project completion. Another option was to lower the LOS. This was undesirable because large areas served by the needed project is zoned industrial and commercial, and includes a free trade zone. Lowering the LOS would reduce freight mobility and hinder the City's efforts to attract development to these areas.

A third option was private financing for the project. The City was asked by several property owners to establish a Local Improvement District (LID) to fund the transportation improvements required to provide an adequate LOS and allow them to develop their land. A LID is a mechanism by which the City finances the project with municipal bonds and the benefiting property owners repay the bonds via property assessments over 15 years. Washington state law is quite specific regarding assessment of property owners for improvements. A property's value must increase by more than the costs of improvements as a result of constructing such improvements. This increase in appraised value is termed "special benefit". This requirement applies to each parcel individually. In addition, if for any reason a property is not required to reimburse the full proportionate share (based on proportionate special benefit) of costs, the shortfall must be specifically paid by another entity.

The initial analysis of the benefit district revealed that the area would be large; even huge. The freeway interchange serves all of eastern Thurston County as far as the City of Yelm, which is 13 miles from the freeway. It was impractical to form a LID that large, but to except parcels which received benefit is not fair nor is it allowed by state law. An additional concern was the inequity of assessing all properties within the LID boundary, even if they generate fewer than 10 trips, while exempting similarly benefited properties outside of the boundary which generate fewer than 10 trips.

The "crisis" which the City faced in developing a financial plan for construction of a new freeway interchange within all of the constraints of state law and the existing transportation mitigation fee ordinance was the impetus behind the complete revision of the transportation mitigation fee ordinance. There were two other areas of the City in which LOS had failed, also. The City Council passed resolutions to guarantee that these areas will be mitigated in accordance with GMA requirements, but it was becoming apparent that the existing process would probably not generate the funds required to meet the 6-year deadline which the GMA imposed.

Other areas of the City were also experiencing LOS and concurrency concerns. Many large developments were submitted with phases structured such that Phase I did not send more than 10 trips through any area where LOS was a concern or per trip mitigation fees were high. The result was that the City was not collecting adequate mitigation fees to improve the transportation system and many parcels were unable to develop because all capacity had been allocated. Development was still occuring and additional trips were continuing to degrade the LOS of the transportation system.

The City recognized that this was an opportunity to improve customer service while revising the process for computing and collecting transportation mitigation fees. Major complaints from the development community regarding the City's traffic mitigation process included: projects took too much time to be approved, they were paying too much money for traffic engineering, and they could not determine what the traffic mitigation

costs would be prior to buying land. All of these complaints were compounded by the iterative negotiation process to settle on traffic impacts.

Informal discussions between City staff and developers revealed that most developers were willing to pay their fair share for necessary transportation projects. It was agreed to initiate a formal process for revision of the City's ordinance which included input from developers, builders, and traffic engineers.

The New Way

After a series of roundtable discussions which included parties who computed and paid traffic mitigation fees, the City proposed a new traffic mitigation fee ordinance. The 10-trips "free" threshold was eliminated after research revealed that only 4 short plats had been reviewed in the previous 4 years. A short plat is any development creating 9 or fewer residential lots. Other terms of the new ordinance included:

a) A residential per trip cap of $1,040 was established. This cap is escalated each July 1 based on the Construction Cost Index as reported by "Engineering News Record".
b) Commercial development pays mitigation on 50% of their trips. This was justified by:
    1) considering that most of these trips have been paid for "at the other end" by residential development,
    2) GMA and RCW 39.92 require that the City consider the future tax revenues generated by new development when analyzing impacts. It is also consistent with how neighboring jurisdictions assess traffic mitigation on commercial development.
c) A $500 trip mitigation fee for the Interstate 5 interchange at Marvin Road is established and this fee is not included under the residential cap or commercial discount. In other words, *every* trip going to the interchange pays $500.
d) The mitigated project list is the 6-year Transportation Improvement Plan.

In addition, the City agreed to provide a simplified alternative for establishing traffic mitigation. The City created a "traffic atlas" in which trips are generated from each Traffic Analysis Zone (TAZ) and a traffic distribution map is created for each TAZ. The distribution is based on the existing transportation model. The resulting percentages are applied to the traffic generation of any new development within that TAZ. Any project within a TAZ may apply this pre-distribution to their traffic generation. The City computes traffic generation for a project on request and a table is generated showing how many trips impact each project. No consultant is required and the proponent receives the tabulation of project traffic mitigation fees in one week or less. Any project generating fewer than 50 trips is eligible to use the simplified procedure.

The new formula to compute traffic mitigation fees for a project is:

(# trips / projected capacity) * project cost

- # trips = the number of adjusted trips (50% for commercial) impacting project
- projected capacity = vehicle capacity at project completion based on typical configuration for street classification (minor collector, etc.)
- project cost = the planning estimate for the project included in the City Transportation Improvement Plan (TIP)

The residential cost cap is applied to the total trips generated. For example, if the total mitigation for a residential development generating 40 trips were $50,000, the cap would result in a total mitigation of $41,600. The fees collected are prorated to each project. For example, a project for which full mitigation would be $10,000 is allocated (41,600/50,000)*$10,000 equals $8,320 using the previous figures.

The new process also allows the City to pool project funds in order to construct improvements. If a development pays to mitigate 6 different projects, the development's total fees may be applied to 1, or fewer than 6, of those projects. Mitigation fees can also be collected after the project is completed because the new ordinance is pursuant to RCW Chapter 39.92, "The Local Transportation Act". This allows future mitigation fees for completed projects to be used to "repay" the incomplete projects from which construction funds were pooled or "borrowed".

Concurrencey still applies and the potential that a development will have to construct significant off-site transportation improvements exceeding a fair share remains. Under the new ordinance, a developer can recoup a portion of excess expenses from mitigation fees paid by others for the necessary improvements after the project is completed. For example; if a developer's fair share of a project is 20% and 80% of the project costs are required to be contributed due to concurrencey, the developer will receive 60% of future mitigation fees collected for that project (80% contribution - 20% fair share = 60% excess contribution).

How is it Working?

The new procedures have a high level of acceptance because it is simpler, quicker, and more predictable. This increased level of acceptance has occurred in spite of the fact that the City actually collects more in traffic mitigation fees than under the previous methodology.

One of the major complaints about the old system was that a developer would not know how much traffic mitigation would cost until they had purchased the land and were far into the Site Plan Review process. The new system, with pre-distributed traffic volumes and known per trip mitigation costs, allows a developer to generate a close estimate of traffic mitigation fees for proposals prior to obligating themselves to property purchases.

A major advantage to the City is the ability to pool money amongst projects, thus creating adequate capital to actually complete projects within the 6-year time frame in which the collected funds must be spent. Also, future mitigation fees can be estimated and used as local match on grant applications. Staff time devoted to review and negotiation of traffic impact analyses has been significantly reduced; an important benefit to a personnel-limited agency. (The City of Lacey Engineering Division Transportation Section consists of two full-time employees and as many interns as we can get.)

The end result has been a win-win process in which the collection of traffic mitigation fees has improved the predictability of costs for developers and enhanced financial flexibility for the City.

Session #3

Allocating Fair Share costs in a Rural Community: A Home-Grown Approach

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Abstract

Smaller communities, like their larger cousins, must modify their transportation networks to suit changes in demand. However, unlike larger communities, smaller communities may lack the ability to pay for these improvements, either through developer contributions or through an effective capital projects budget. With the availability of capital projects grants decreasing over time, small, rural communities are becoming even less able to perform necessary system improvements to keep pace with increasing demand. This presentation discusses the constraints facing small, rural communities and how two cities and a county worked together with the assistance of local citizens, integrating land use planning, transportation planning and a geographic information system and using a simple model to begin to allocate "fair share."

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Allocating Fair Share costs in a Rural Community: A Home-Grown Approach

The Issue

Funding transportation system improvements is a real challenge for any agency. For small, rural agencies, however, it can be nearly impossible. Rural communities have few resources upon which to draw to make the necessary improvements for handling even modest increases in traffic levels. When the communities experience sharp increases in growth, as has been the case with Washington's Central Okanogan Valley, transportation improvements may either lag far behind demand or never occur at all. The communities experience increased congestion and yet have limited means with which to address it.

This is not a new phenomenon, but effective mechanisms to deal with it are scarce. Some communities exact development impact fees or environmentally based mitigation fees to help compensate for individual projects' impacts on the existing transportation networks. In some cases, however, such as in Moreno Valley, California, development impact fees include amounts to remediate deficiencies in the existing roadway system. The development community's willingness to pay burdensome exactions to supplant local transportation improvements may be dwindling, as the increasingly loud call for "fair share" assessments would indicate. In areas where development has historically been allowed to occur without the assessment of impact fees, the creation of new impact fees may be especially difficult. Also, planning enabling laws in various states continue to be modified to narrow the scope for which development impact fees can be charged and often impose strict time limits for the expenditure of revenues raised by those fees.

As communities grow, the need for transportation improvements increases, but the capability of local communities to adequately fund new improvements and fix old problems is decreasing. This paper examines the efforts of a rural Washington community to develop a program identifying and designing needed transportation improvements while creating a system to fairly assess impact costs to new development projects.

The Setting

North-central Washington State is rural and mostly arid, leeward of the Cascade Mountains and protected from the marine weather inflicted on the west side of the state. This area stretches northward from Wenatchee to the Canadian border, encompassing much of the Columbia River and the Okanogan Valley. Chelan County, Douglas County and Okanogan County comprise the North-Central Regional Transportation Planning Organization (RTPO), a little sister of metropolitan planning organizations (MPO). Though the land area, at roughly 83,000 square miles, is about 15% of the State's total, the three counties' combined population is only 120,000, or about 2% of the State's total. The vast majority of that population resides in the metropolitan area surrounding Wenatchee and in the larger towns in Chelan County.

Much of the land is undeveloped, publicly held or devoted to agriculture. Those people residing outside of the region's larger cities generally are clustered in smaller towns in the Okanogan and Methow river valleys. These towns, the largest of which is Omak with a population of 4,600, have

historically been the commercial centers for the surrounding agricultural, timber or mining industry. In Okanogan County, where overall population density is just over one resident per square mile, the US Government and the State of Washington own over 27% of all land. The Colville Indian Reservation covers an additional 7,000 square miles of the southeastern county. This is a typical Western picture where small towns have grown up to serve the commercial needs of resource-based industry and where governmental land ownership in the shape of Indian reservations, national parks or national or state forests is significant.

State Route 97 runs south from the Canadian border through Okanogan County and along the Columbia River to Wenatchee. It continues south to the Oregon state line, passing through Ellensburg and Yakima along the way. Over time, this highway has become an attractive, less congested, international transportation alternative to Interstate 5 which runs along the western side of the Cascades. Okanogan County towns have begun to cater to the increasing highway traffic, locating commercial, medical, recreational and residential land uses along the highway corridor.

Most of the county's new commercial and residential activity has centered around the City of Omak, home of the annual Omak Stampede and Suicide race and the large lumber mill that has been the historic economic heart of the central Okanogan Valley. To the immediate south, the City of Okanogan, with just slightly over half the population of Omak, is the seat of county government with a commercial and industrial sector geared more toward the area's farming community.

Omak and Okanogan are connected by SR 97 and by SR 215, a highway paralleling SR 97 along the western side of the Okanogan River. While SR 97 runs through a predominantly rural portion of the community on the Colville Indian Reservation, SR 215 runs through the downtowns of each city, functioning as "Main Street" and carrying the highest traffic volume of any urban road segment in the County. In fact, the first traffic signal installed in Okanogan County, and the only one existing until 1995, was installed at the intersection of SR 97 and Central Avenue in downtown Omak.

As these two cities have evolved and become ever more interdependent, SR 215 has become an increasingly important and heavily traveled link. Commercial properties along the highway fetch premium prices and peak-hour traffic provides a show few expected to see in Okanogan County. As property values and traffic flows have increased, building has intensified and delays at road intersections have become prolonged. SR 215 is a new urban corridor in the middle of a rural community.

The Problem

As development and traffic congestion increased, the need for significant improvements to SR 215 and to the roads feeding into it increased as well. The cities of Omak and Okanogan identified problem areas in their comprehensive and capital facilities plans, but neither town could afford to construct the improvements on its own. Additionally, much of the impact to the urban corridor appeared to be generated by development in unincorporated Okanogan County. New residential construction in Okanogan County added daily trips to the corridor, increasing congestion at intersections located in the two cities.

State Route 215 is a State highway, and all improvements within the right of way must be coordinated with or performed by the Washington State Department of Transportation (WSDOT).

Though the State tries to keep up with highway maintenance, it cannot afford to make the major improvements the current growth demands.

The cities of Omak and Okanogan, the County of Okanogan and the Colville Confederated Tribe of Indians, in conjunction with WSDOT, the North-Central RTPO and a collection of private citizens, property owners and local developers, met to try to identify and resolve the transportation problems SR 215 presents. This group, known as the Central Okanogan Valley Transportation Team, convened initially to study the traffic impact to the northern section of SR 215 as the result of upcoming commercial and residential development in North Omak and the nearby portions of unincorporated Okanogan County. This first study was to identify specific improvements, estimate costs and determine how to allocate those costs fairly across the community.

The initial study's recommendations, however, derived from traffic engineering methodology and standards, seemed to be skewed toward more urbanized solutions out of character with the community's rural nature. The recommendations also tended to address only those areas included within the initial project boundaries, leaving out otherwise attractive alternatives and complementary improvements to other parts of the neighboring circulation system. For example, this study recommended extremely costly right of way acquisition and widening for the SR 215 segment within the study area and ignored other alternative solutions just outside the study boundary that would achieve the same results without devastating a fully developed neighborhood.

The model used to determine the needed improvements was "capacity-driven", indicating specific capacity improvements needed to serve the expected increase in demand within a tightly-defined study area. This led to a series of recommended road and intersection improvements, but took into account no revisions to land use policy and no sharing of the projected traffic load outside the study area. It also did not consider the affordability of the individual improvements given the community's size, rate of development and capability to raise revenue.

As this initial study neared completion, it became apparent that other portions of the SR 215 corridor facing similar pressures needed to be included in a more comprehensive corridor study, and that the study's final recommendations needed to be more affordable, less capacity intensive, and more sensitive to the community's needs.

The Challenges

The State of Washington has laws that guide the exaction and disposition of development impact fees by local agencies. There are two basic ways by which local agencies can collect payment from developers to offset impacts caused by their projects. The underlying theme for each method is that the exaction needs to represent a fair assessment of the fee based on the relative proportion of anticipated impact. Additionally, once an impact fee is collected, it must be dedicated to a specific public works improvement and then expended within a short time, usually within five years.

The two methods revolve around the state's Growth Management Act (GMA) and its State Environmental Policy Act (SEPA). In the case of GMA, only those agencies planning under GMA are allowed to charge impact fees. The philosophy is that only those agencies either large enough or growing fast enough to be concerned with funding needed public facilities are also those agencies required to plan under growth management statutes. The GMA also states that any collected

impact fees must be either expended on a specified project or returned to the developer with interest.

Impact fees collected under SEPA must be tied to the mitigation of a recognized environmental impact anticipated as a direct result of the project. The impact fees must be collected and used exclusively to mitigate the identified impact. If the funds are not used, they must be returned to the payer with interest.

Okanogan County is one of seven Washington counties not planning under Washington's GMA. Though its growth rate is slightly higher than 20% over ten years, its small population exempts it from the full GMA provisions. Because it is not planning under GMA, Okanogan County and the incorporated communities within Okanogan County cannot charge development impact fees.

SEPA could provide some ability to charge mitigation-related fees, but the actual amount of development would not be enough to ensure that any money could be expended on targeted improvements before that money would need to be returned to project sponsors. Though the growth rate in Okanogan County may have been 20% over the past ten years, it is still a small county. The real number of subdivisions and building permits is relatively low. Any significant public works improvement would require a high level of continuous development to amass an adequate amount derived from mitigation fees.

Neither the GMA nor the SEPA based impact fees would be appropriate for use in Okanogan County. Any successful program to fund public works improvements would need to be voluntary, where developers were assured that their contributions toward facility improvement were based on a fair share allocation based on the demand anticipated from their projects.

The Approach

The two cities, the County and the Tribe joined with WSDOT and the RTPO to more closely study the roadway improvements along the entire SR 215 corridor. The group also included one of the community's most prolific developers and several representatives from local businesses. This team identified eight potential trouble spots where regional traffic was having the most significant impact.

The underlying philosophy of this group's activity was to produce, at the least possible cost, a reasonable design alternative for each trouble spot and a method for the assessment of fair share costs to developers whose projects would likely impact those trouble spots. The creation of schematic designs for the trouble spots was intended to allow adjacent land owners with immediate development plans to proceed with their projects as long as they reserved right of way for the eventual improvement of the roadway according to the schematics. The assessment method, given the constraints on the imposition of development impact fees, was designed to foster voluntary contribution by developers of projects of regional significance and to demonstrate to what extent the existing development was responsible for improving the transportation network.

The Cost Allocation Model

During the NWOTS, the COVTT used the "T model 2" to project traffic flows and to identify necessary improvements as traffic increased. As the SR 215 corridor study progressed, it became apparent to the team members that the "T" model would be an expensive one to maintain and that

its modeling approach might not identify the best or the most cost effective transportation system improvements. Additionally, with the completion of the schematic designs for the specific trouble spots, some aspects of the model, particularly regarding roadway capacity increase, became less important.

The community needed to develop a simpler model it could use at less expense. That model's main function would be to allocate fair share costs of the proposed schematic improvements to the development impacting those trouble spots. As the type or scope of the improvement would change over time, the model would be re-run to assess current fair share contributions.

This new cost allocation model borrows the traffic analysis zone (TAZ) concept from the "T" model to help forecast demand. Instead of using that forecast to determine necessary capacity improvements, however, it uses the forecast to allocate proportional cost responsibility based on the expected impact each TAZ will have on that specific improvement.

This approach circumvents one of the more costly and controversial components of the "T" model by assuming that the roadway design has already been established. By making this assumption, it places some of the responsibility of congestion management on the local land use authorities, encouraging trip reduction and system management over system capacity increases. As evidenced in the COVTT meetings, the community does not want to see wholesale increases in roadway capacity to meet forecasted traffic demand. It would much rather see techniques to spread future traffic across the existing network and to explore ways to reduce the impact of regional development on the local network. To make this model succeed, to keep fair share costs reasonable, and to reduce necessary capacity increases, the local land use authorities will need to consider trip reduction methods and to plan future land uses to rely less on the congested local network.

The Case Study

The trouble spot examined in this paper is the intersections of Oak Street and Pine Street with SR 215 (Second Avenue) in downtown Okanogan. As the intersection is currently configured, a four-way stop exists at the intersection of Oak and Second, and a two-way stop, with Second having the right of way, exists at Pine. Oak Street brings traffic into downtown across the Oak Street bridge to the east, while Pine Street brings traffic into downtown from the hillside residential areas to the west. Second Avenue traffic waiting for the four-way stop at Oak causes traffic entering from Pine to queue until there's adequate separation on Second. At peak times, the wait at Pine can be up to one minute per car.

Much of the traffic using Pine Street originates from unincorporated county land west of the city and within Okanogan's proposed urban growth area. Pine Street is the terminus of a series of county roads providing access to thousands of acres of orchards and new large-lot residential development. It also provides primary access to the County Courthouse. Pine Street's traffic consists of a mix of private autos and a variety of farm vehicles, including full-size semi-haulers bearing apple bins or other agricultural supplies. As traffic on Second has increased, the inconvenience of turning movements from Pine onto Second has increased as well, motivating drivers to divert away from that intersection and use residential streets nearby.

The City of Okanogan recently approved a preliminary plat map approximately 1/2 mile west of this intersection, allowing the construction of up to 35 single-family homes. Though this trouble-spot intersection lies at the heart of Okanogan's downtown, the City and the developer agreed that the new subdivision would have some impact on the intersection and on the arterials (Pine Street and Orchard Grade) leading to it from the west. Though the developer agreed his project would have some impact on future conditions, he was not inclined to fund a "reachback" to help remediate the existing problems.

To help determine a fair share allocation for this particular project, the City of Okanogan borrowed the TAZ concept and made several assumptions in the creation and application of the new model. Those assumptions were:

- The TAZs represented areas of relatively homogenous traffic generation characteristics. Each individual TAZ was defined by an aggregation of census blocks and then differentiated by the type of development expected within each and the specific transportation network in place to serve each. This differentiation made it possible to assign total build-out trip generation for each TAZ, to identify which arterials would serve each TAZ and how the total trips generated within the TAZ would likely be distributed among the various arterials.

- Land development would occur in a manner, at the level of intensity and at a rate consistent with the comprehensive plan.

- The City of Okanogan, in conjunction with WSDOT, was responsible for remediating the current problems and that future developers would be responsible only for the accrued impacts expected to be caused by their projects.

- Project cost estimates would increase at a rate consistent with national inflation and fair share cost allocations for each project would be based on the prevailing costs to accomplish the improvement.

- Fair share allocations would be voluntary in nature, agreed to by the future developers as part of a "mitigation" agreement or other instrument not specifically tied to the State's growth management or environmental protection laws.

- Funds received by the City would be collected at the time of map recording and would be deposited in a reserve account dedicated to accomplishing the proposed improvements.

- Land use and transportation policies would complement the proposed improvement design, ensuring that the design used for estimating costs would not become functionally obsolete because of increased traffic flows.

The first step was figuring the proportion of future development in each TAZ conceivably linked to the trouble spot. To do this, the City used its desktop GIS program to calculate the total developable acres within each land use designation and to multiply that by each land use designation's expected development density. Once that was complete, the City estimated the proportion of future development to existing development within each TAZ and the relative

distribution from each TAZ to the trouble spot. Without haggling over the number of trips generated by each individual project, this method assigned proportional responsibility between already established uses within the TAZ and those that have yet to materialize.

When the City had reached this point, it needed to assign a proportion of the responsibility to fund the proposed improvements on areas within the TAZs and those outside the TAZ boundaries, mostly within already developed city limits. As a result, the City could assign relative responsibility for sharing the costs between the future developers and the City, presuming the City should bear responsibility for traffic generated by established land uses.

The next element of the cost allocation model was the estimation of the project costs. The estimates were based on 1998 dollars and would be accelerated annually to ensure that developer contributions remained equitable over time.

Finally, the prorated responsibility of each TAZ was multiplied by the project cost, resulting in an aggregate responsibility in dollars to be borne by each TAZ. Dividing that aggregated responsibility by the total anticipated future development within the TAZ provided an allocation per individual unit.

Working It with the Numbers

Step One - Determining levels of development in each TAZ:

This step calculates the projected growth within each TAZ and then subtracts existing development from that total growth figure. It then expresses the extent of future growth as a percentage of total future development.

TAZ 1	40 acres @ 4 du/ac =	160 units
	80 acres @ 2 du/ac =	160 units
	400 acres @ 1 du/ac =	400 units
	Units now existing =	(8 units)
	Growth projection	712 units
	Growth proportion (712/720)	99%
TAZ 2	160 acres @ 2 du/ac =	320 units
	80 acres @ 1 du/ac =	80 units
	Units now existing =	(18 units)
	Growth projection	388 units
	Growth proportion (382/400)	97%

Step 2 - Determining existing and future development responsibility

This step differentiates between what is a regional impact whose costs to remediate should be borne by a regional transportation authority and the local impact whose costs should be borne by a local authority, in this case the City of Okanogan. It then goes on to differentiate how that local share should be split between existing development and that growth expected in the future. The 80% and 20% figures for TAZ 1 and TAZ 2, respectively, represent their proportional

contributions to the trouble spot. In other words, 80% of all traffic originating from or traveling to TAZ 1 will pass through the trouble spot intersections.

Overall responsibility (based on trip counts)	
Regional share =	25%
Local share =	75%
Current/future responsibility (based on levels of development)	
City (developed) share 50%	
Vacant share	50%
Prorated impact by TAZ (percentage of "vacant" share)	
TAZ 1	80%
TAZ 2	20%

Step 3 - Project Costs

This step includes the cost estimates for each of the three elements of this particular project.

Part One - Consolidating curves	$195,000
Part Two - Intersection realignment	$216,000
Part Three - Street enhancement	$158,000
Total Cost	$569,000

Step 4 - Cost allocation

This step brings it all together, allocating proportional costs for each TAZ, reducing that cost slightly to adjust for existing development within each TAZ, and then figuring the final cost for each new unit developed within each TAZ.

Total project cost		$569,000
Local share (75%)		$426,750
Vacant share (50% of local)		$213,375
TAZ 1		
	80% of vacant	$170,700
	99% for new growth	$168,993
	Unit share (712 du)	**$237/unit**
TAZ 2		
	20% of vacant	$42,675
	97% for new growth	$41,395
	Unit share (388 du)	**$107/unit**

Concluding Thoughts

This model was developed to provide a simple method for calculating a voluntary contribution toward solving local transportation problems. It was designed to be employed by a City Clerk, Permit Official, Planner, City Engineer or other official whose responsibilities are vast and whose time is limited. It was designed to eliminate the need to run a complex and costly model each time a new development was proposed. It was designed to follow a direct course in determining

allocations to help developers understand its methodology and be more willing to voluntarily contribute to the cause.

This model's drawbacks are that it presumes build out will occur as described in the current comprehensive plan, though revising the allocation would be a relatively simple matter if those land use designations were to change over time. It also requires long-term accrual of developer contributions before any improvement is made, providing those funds are the only revenue source for the project. It also requires, if the local agency is committed to improve facilities concurrent with development, that the local agency leverage itself to get the job done regardless of the level of developer contributions to date. However, any level of contribution would help if the local agency is required to establish a match portion before project funds could be either lent or granted.

The advantages are that it involves the development community in a voluntary program to fund a perpetual improvement reserve account. This frees it from the time limits imposed on the collection and expenditure of impact fees or mandatory mitigation payments. The model is easy to manage and, once run, is easy to use by any agency staffer for allocating individual unit contributions. Additionally, the concept has almost universal applicability to other infrastructure projects where a mix of established and future interests would be served by the improvement.

Session #3

Funding Large Projects in Ohio's Small and Medium Sized Metropolitan Planning Organizations

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ABSTRACT

This abstract addresses how the state of Ohio assists the smaller MPO areas in funding larger transportation projects. The amount of funds and corresponding obligation ceiling available to an individual smaller MPO in a particular year make the funding of a large transportation project (>$1,000,000) virtually impossible.

The intent of this paper is to describe the options the Ohio Department of Transportation and the Ohio MPOs employ in assisting the smaller areas in funding a larger project. These options would be useable by any other Department of Transportation or MPO.

The Ohio Department of Transportation (ODOT) suballocates STP funds to all sixteen MPO areas. The allocation formula for an area with less than 200,000 population is based on a per capita amount derived from the distribution formula in TEA-21 for the over 200,000 MPOs. ODOT also distributes obligation limits based upon the same percentage as the state's ceiling.

In large MPO areas, the amount of funds available allow the agencies to fund a number of project in any given year. However, a smaller area receives an average of $435,000 each year and can commit roughly $400,000 to fund projects. ODOT and the MPOs have developed several options to assist these areas in funding larger transportation projects while allowing the Transportation Improvement Program to remain fiscally constrained. These options include State Infrastructure Bank loans, borrowing/using funds and obligation limits allocated to other MPO areas.

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Funding Large Projects in Ohio's Small and Medium Sized Metropolitan Planning Organizations

Background

With a 1990 census population of over 10.8 million, Ohio has twenty urbanized areas with a total population of approximately 6.7 million. These urbanized areas are served by sixteen Metropolitan Planning Organizations (MPOs). Eight of the MPOs have populations of over 200,000 population, and are classified as Transportation Management Areas (TMAs). Of these, three have populations between 1.5 and 2 million and the remainder have populations ranging between 300-700,000. Of the eight smaller MPOs, the largest has a population of 90,000. Five Ohio MPOs are multi-state and four of these are classified as small MPO areas. In accordance with state regulations, Ohio MPO boundaries must incorporate at least one entire county and as applicable, whole townships in surrounding counties. Four of Ohio's MPOs serve one county, with the largest MPO serving seven counties in two states. The number of MPOs, and the varying population ranges pose a formidable challenge for transportation funding distribution within the state.

Distribution of Funds to Ohio MPOs

In 1991, Congress passed the Intermodal Surface Transportation Efficiency Act (ISTEA). The Act created several new transportation funding categories. One new category was the Surface Transportation Program (STP). The distribution formula for the newly designated STP funds specifically allocated these funds to MPOs with populations exceeding 200,000. The new transportation authorization legislation, the Transportation Equity Act for the 21st Century (TEA-21), continues this funding category and the distribution formula. The Ohio Department of Transportation (ODOT) has chosen to allocate STP funds to its eight smaller MPOs, with populations under the ISTEA/TEA-21 threshold of 200,000, as well as, to cities with populations between 5,000 and 49,999. This additional allocation is based on a per capita amount derived from the previous distribution formula.

The federal legislation establishes the fund allocation for each state. Subsequent legislation appropriates the funding amounts by fund type which the state may actually obligate or authorize. This obligation limit or ceiling is the maximum amount for each funding category which a state may use in any one year. This ceiling is usually expressed in terms of a percentage of the allocation.

Beginning in Fiscal Year (FY) 1996, ODOT elected to hold the MPOs to the same obligation limits as had been established for the state as a whole. These obligation limits are based on the federal appropriation level for the State of Ohio for each federal fund type which the MPO receives. For example, if the federal obligation limit for Ohio's federal funds is ninety percent of

allocations, then ODOT holds each MPO to ninety percent of the STP funds allocated to them. In layman's terms, an MPO can only spend ninety percent of their annual allocation in any one year. If MPO-A is allocated $711,844 in STP funds, it can only actually obligate $640,660.

STP funds may be carried over for a limited number of years, however, the obligation authority given by Congress is for one year. The obligation authority may not be carried over. The state may take advantage of whatever authority is left over late in the fiscal year to advance other transportation projects.

Small Ohio MPOs

Before reviewing the actual population and funding distributions for the eight small MPOs, it must be understood that the four (small) bi-state MPOs only receive STP funds from Ohio for the actual portion of the urbanized area population which resides in Ohio. Table 1 below shows the Ohio population range for the small Ohio MPOs is 6,840 to 89,943.

Table 1
Ohio Small MPO Funding Distribution

MPO	1990 Population	1998 STP Allocation	1998 CMAQ Allocation	1998 Total Allocation	1998 Obligation Limit
MPO1	33,791	$346,937		$346,937	$302,703
MPO2	68,621	$704,541		$704,541	$614,712
MPO3	76,521	$785,652		$785,652	$685,481
MPO4	54,063	$555,072	$489,157	$1,044,229	$911,090
MPO5	6,840	$70,227		$70,227	$61,273
MPO6	89,943	$910,172	$618,797	$1,528,969	$1,334,025
MPO7	38,855	$398,930		$398,930	$348,066
MPO8	25,255	$259,297		$259,297	$226,237

Based on the distribution formula the STP funding per year ranges from $70,000 to $900,000. Currently, a medium sized transportation project averages around $500,000, while a large project is generally over $1,000,000. Considering the average STP allocation for each small MPO is approximately $430,000 per fiscal year, this leaves a gap in the total funds needed for transportation projects. Each area sponsors different types of projects based on local needs and priorities. This varies from collector street resurfacing projects, to safety upgrades on the National Highway System (NHS), to regional ozone action programs. Some of these projects may be on state highways inside cities or villages, and by regulation the state is only responsible

for state highways outside of cities. While the MPOs may act as sponsors for transportation projects, they are not project implementors.

Another complicating factor in funding projects for the small MPOs is the lapsing of funds. Under Title 23 of United States Code, federal funds not obligated within four years of allocation, revert to the U.S. Department of Transportation (USDOT). Large MPOs, generally expend a majority of their allocations each year. If some funds are carried over into the next fiscal year, the funds are obligated in that year. However, a small MPO may try to "save" several years worth of allocations for one project, and the four year lapse can pose another difficulty. The lapsing of funds has become less of a difficulty since ODOT began passing down the obligation limitations to the MPOs, since the obligation ceiling may not be carried over.

Funding Small MPO Projects

ODOT has recognized that the smaller MPOs have unique problems which demand creative and flexible funding scenarios. Several alternatives have been employed by the state of Ohio and the MPOs as transportation partners to bring project construction to reality. Some practices have been discontinued and other have evolved over time.

The ability to fund projects varies with the size of the small MPO. MPO5 receives under $71,000 per year to spend in Ohio, while MPO7 receives over $900,000. Because of the wide range of available funds, and the high costs of some transportation projects, some MPOs have become creative in how they make use of their available funds.

In the past ODOT allowed the smaller MPOs to advance projects outside of their obligation limits by using some to the state's obligation authority. This practice was discontinued after several large projects required assistance in the same year. Each MPO had been promised that their project would be allowed to advance using state obligation authority. The state however, did not have control over when those projects would be ready for construction and the projects were not tracked well enough to foresee this difficulty prior to authorization. Innovative funding techniques were needed to avoid these problems in the future. Several examples follow which illustrate these innovative funding practices.

Example 1

Situation: MPO3 had saved a total of $1,000,000 in STP allocations (over several years), to fund a large project. However, the total construction funding required by this project was $5,000,000.

Solution: Under informal agreement with ODOT, the MPO sold the project in two phases (over two years) using the accumulated funds. The balance of the needed funds was loaned to the MPO from the state in order to authorize the entire project. The two phases of the project were sold in

Fiscal Years 1995 and 1996. The MPO is in the process of repaying the state for the advanced funds using subsequent annual STP allocations through FY 2002. In addition, the obligation authority associated with their allocation is made available to ODOT. In this scenario, TIP fiscal constraint must be viewed in the broader statewide context or multi-year MPO context.

Example 2

Situation: MPO2 wanted to fund a project with total costs beyond its annual allocation and obligation ceiling.

Solution: The MPO borrowed funds from Ohio's State Infrastructure Bank (SIB). Ohio's SIB was initialized by the U. S. DOT as the nation's first pilot SIB. Using second generation funds from the SIB, the MPO borrowed the necessary funds through bonds issued by the SIB. The revenue stream (funds which would be available to repay the loan), required to qualify for the SIB loan, was the future STP allocations to MPO2. This option includes initializing costs and interest payments which raise the overall cost of the funds. In this case, local priorities placed on the project justified the additional costs.

Example 3

Situation: MPO6 had already funded several projects early in the fiscal year when the plans for a regionally significant signalization project were ready for construction earlier than expected.

Solution: The ODOT District within which the MPO is located, loaned them the necessary funds and obligation authority to advance the signalization project. The MPO did not have sufficient funds remaining to advance the project and the District had a vested interest in this project because it involved a state highway. In order to expedite this project, the District (informally) loaned the MPO funds from their pavement allocation program. The loan was repaid using the MPO's next annual allocation.

Example 4

Situation: MPO1 did not have a project scheduled within the year which could use the $300,000 in annual obligation authority, but they did have a larger $500,000 project in the early stages of development. At the same time, a large MPO was facing having to use most of its remaining Minimum Allocation Funds by year's end to accommodate several projects.

Solution: The two MPOs exchanged obligation authority, giving MPO1 sufficient obligation ceiling to authorize their project later and also allowed the large MPO to accommodate their projects but preserve some of their Minimum Allocation Funds for later use. Minimum Allocation Funds are not subject to the obligation limits.

Example 5

Situation: MPO4 had plans to obligate funds for a project which would use most of a prior year's allocation and were subject to lapse. When allocated funds lapse, the MPO loses the funds entirely and forfeits the corresponding obligation authority. The project was scheduled for sale late in the fiscal year, but the project plans were delayed in begin completed and it appeared that the project would not be ready for sale before the close of the fiscal year.

Solution: The MPO researched options to avoid loss of the funds that were subject to lapse. MPO4
loaned these funds, and the corresponding authority to another large Ohio MPO. The large MPO had several active construction projects with expensive change orders (amounting to approximately $1 million) but only $600,000 remaining in obligation authority. The two MPOs drew up an agreement between them outlining the process and schedule of repayment so that when, MPO4's delayed project was ready for sale early in the next fiscal year, the funds would be available to accommodate the project.

Example 6

Situation: MPO6 had not resolved the fiscal constraint issue associated with funding several large projects in the necessary timeframe when developing its Transportation Improvement Program (TIP).

Solution: The MPO applied for and received a SIB loan for the acquisition of right-of-way for one of the major projects in one year (totaling $2 million). The MPO was promised a second loan (approximately $8 million) in the following year to be used for the construction of that project and another major project. The revenue stream for these loans is again the MPO's STP allocations for the next eight years. The SIB loan has allowed two critical local projects to advance within the allocation and obligation limits.

CONCLUSION

These are examples of how small Ohio MPOs have developed innovative solutions to funding larger projects within the fiscal constraints of annual allocations and obligation ceilings. At the same time the MPOs retained control over the decision making process.

Each solution incorporated features which may be useful to other MPOs. These options may be combined with each other to create new options. The problems were unique and the solutions were tailored to each individual situation, but these examples have value in being reviewed by others. This paper is prepared with the intent to provide other MPOs with innovative concepts for more effective use of limited federal funds. It is anticipated that additional options will be developed as transportation funding is continually evolving.

Session #3

THE GRASSROOTS PUBLIC/PRIVATE TOLL MOVEMENT - THE LAKE OF THE OZARKS COMMUNITY BRIDGE

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ABSTRACT

From the 1930's through the 1960's, most of the toll-financed transportation facilities in the U.S. were large, statewide initiatives, such as the New Jersey, Massachusetts, and Kansas Turnpikes. When the toll movement was reborn in the form of innovative financing in the late 1980's and early 1990's, many of the proposed projects were mega-projects, such as the Orange County Tollroads and Denver's E-470. From the mid-1990's into the 21st century, a new type of toll project has emerged – the relatively small, regional project which integrates the strengths of private and public financing to meet community and regional transportation needs. The Lake of the Ozarks Community Bridge, in the State of Missouri, is a successful prototype of this new grassroots public/private toll project.

Construction of the 2,695-foot (821 m), $18.2 million toll bridge began in March, 1996. Opened in May, 1998, the bridge connects the east and west sides of the Lake of the Ozarks, a popular recreation and resort attraction in central Missouri. The bridge is owned and operated by a private, not-for-profit corporation — the Lake of the Ozarks Community Bridge Corporation (LOCBC). The project was financed through the sale of $40.1 million in tax-exempt, toll revenue bonds by the LOCBC.

The LOCBC was Missouri's first transportation corporation, formed under the 1990 Missouri Transportation Corporation Act, which authorized the formation of non-profit corporations to develop and advance transportation projects. The bridge project is a joint effort of the LOCBC and the Missouri Department of Transportation, which funded and constructed the $5.5 million approach roadways to the bridge and provided technical assistance to the LOCBC for the bridge project.

For these grassroots projects to be successful, they must address a *public need*, be driven by *private-sector opportunity*, be authorized by *enabling legislation*, represent a *viable project concept*, and be implemented through a *public/private partnership*. The Lake of the Ozarks Bridge project will be described through each of these factors, and lessons learned which apply to other project opportunities will be discussed.

The author believes that, although such projects may not represent the leading edge of transportation privatization, these small to mid-size projects are more within the "institutional comfort zone" of state DOT's, regulators, designers, contractors, and investors. Therefore, they

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are more implementable and may offer more real opportunities to improve our transportation systems.

The Public/Private Toll Movement -- The Lake of the Ozarks Community Bridge

From the 1930s through the 1960s, most of the toll-financed transportation facilities in the U.S. were large, statewide initiatives, such as the New Jersey, Massachusetts, and Kansas Turnpikes. When the toll movement was reborn in the form of innovative financing in the late 1980s and early 1990s, many of the proposed projects were mega-projects, such as the Orange County, California Tollroads and Denver's E-470.

In the mid-1990s, a new type of toll project has emerged -- the relatively small, regional project which integrates the strengths of private and public financing to meet community and regional transportation needs. The Lake of the Ozarks Community Bridge, in the state of Missouri, U.S.A., is a successful prototype of this new grassroots public/private toll project. It represents the innovation that will move toll projects well into the 21st century.

PROJECT BACKGROUND

The Lake of the Ozarks is a popular recreation and resort area in the central portion of Missouri. The lake was formed by the construction of Bagnell Dam for power generation, from 1929 through 1932, by the Union Electric utility company, headquartered in St. Louis, Missouri. In addition to its function of power generation, the Lake of the Ozarks became a major regional recreation and tourism attraction. For over 50 years, the lake has drawn visitors, primarily from Missouri, Illinois, Iowa, Kansas, and other midwestern states, for boating, fishing, and golf. Over the last few decades, the lake has become a popular retirement area for midwesterners, as well.

Although the lake has provided significant economic opportunity for central Missouri, it also has been a barrier to travel. Compared to the other major lakes in Missouri, the Lake of the Ozarks has significantly fewer bridges crossing it. Table 1 shows that the Lake of the Ozarks has far fewer bridges per mile of shoreline than the other major Missouri lakes. As a result, highway routes around the lake are circuitous. Routes from the east side to the west side of the lake average about 30 miles around the south and about 54 miles around the north. During the busy summer tourist season, traffic on portions of these routes is often stop-and-go, resulting in lengthy travel times and frustrating delays.

Due to the inconvenient travel from one side of the lake to the other, the lake area has developed into what is often viewed as two, separate tourist areas -- the "St. Louis side" on the east and the "Kansas City side" on the west. There is less economic and social interaction between the two sides of the lake than one would expect based on their proximity. Area business leaders feel that this has impeded the realization of the full economic potential of the Lake of the Ozarks.

Table 1 - Bridges Over Major Missouri Lakes

Lake	Miles Of Shoreline	Bridges	Ratio (Shoreline-To-Bridges)
Stockton	298	9	33
Bull Shoals	740	16	46
Table Rock	745	8	93
Truman	958	17	56
Lake of the Ozarks	1150	4	288

KEYS TO SUCCESS OF PUBLIC/PRIVATE PARTNERSHIPS IN TRANSPORTATION

The Lake of the Ozarks Community Bridge (LOCB), which opened May 1, 1998, will help overcome these problems. The project is a public/private partnership of a private, not-for-profit corporation — the Lake of the Ozarks Community Bridge Corporation (LOCBC) and the Missouri Department of Transportation (MoDOT). This relatively small, regional project, which integrates the strengths of private and public financing tools and meets community and regional transportation needs, can be viewed as a successful prototype of a new era of grassroots public/private toll projects.

For these grassroots projects to be successful, they must:

- address a *public need*,
- be driven by *private-sector opportunity*,
- be authorized by *enabling legislation*,
- represent a *viable project concept*, and
- be implemented through a *public/private partnership*.

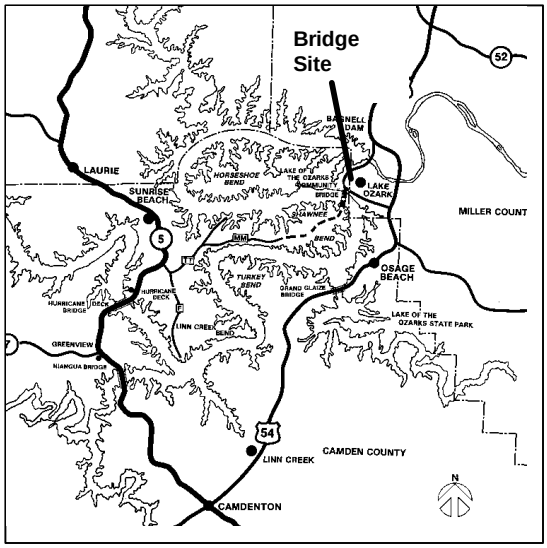
The LOCB project, which has each of these key ingredients, provides several lessons applicable to other public/private project opportunities.

Public Need

For 30 years, residents and business leaders at the Lake of the Ozarks pushed for a bridge across the main channel of the lake. The LOCB provides a 10-mile route from the east side to the west side of the lake, in contrast to the 30- to 50-mile existing routes (Figure 1).

The bridge provides a much-needed transportation *system linkage*, improving route continuity and reducing out-of-direction travel. Traffic models estimate that in its first year of service, the LOCB will save motorists over six million vehicle-miles of travel (VMT) in the lake area. This new link in the

Figure 1 – Project Area Map



highway network will improve overall transportation *system efficiency*. It is estimated that the bridge will result in over $60 million in highway user costs over the next 20 years. (This estimate includes only vehicle operating costs and delay savings and does not include the significant reduction in accident costs which is anticipated due to the reduction in VMT.)

One of the major problems resulting from the circuitous nature of the lake area highway system is the long response time for emergency services such as law enforcement, fire protection, and emergency medical services. There have been many cases in which the lengthy response times for these services have had tragic results. The bridge will improve *public safety* by reducing the access times for these services.

The LOCB will facilitate *economic development* of the lake area by increasing the economic and social interaction of all parts of the region. The isolated pockets of economic development around the lake will be combined into a three-county, lake area economy. It is believed that this will have a synergistic effect on local economies -- creating greater economic opportunity and activity for the region as a whole than for the sum of its current parts.

For these and other reasons, the LOCB clearly meets a public need in the Lake of the Ozarks region.

Private-Sector Opportunity

Although the Lake of the Ozarks area has enjoyed significant land development over the last half-century, there is still vast development potential in the region. Among the least developed areas is Shawnee Bend. The eastern end of Shawnee Bend includes approximately 3,000 acres of undeveloped land. Most of this undeveloped land is owned by one company -- the owners of the Lodge of the Four Seasons -- one of the major resorts at the Lake of the Ozarks. The owners of the Lodge of the Four Seasons long have recognized that improving the access to Shawnee Bend, particularly from the east side of the lake, would greatly improve the development potential of this holding.

A master plan has been prepared to guide the development of Shawnee Bend. This master plan gives a quantitative indication of the magnitude of the private sector opportunity which the LOCBC will open up. The master plan includes, in part:

- 6,000 residential units
- Several golf courses
- Retail village and other commercial facilities
- Marina
- 700+ acres of open space of the Ozarks environment

The master plan continues to evolve over time as market conditions vary.

Because of this private sector opportunity, the landowners have been the prime movers of the bridge project from its inception. They provided the initiative and tenacity to overcome uncertainties and difficult bottlenecks during the development of the project. Business leaders

supported and actively lobbied for passage of the authorizing legislation. The owners of Shawnee Bend funded the application for and formation of the private, not-for-profit implementing corporation. They also guaranteed a portion of the costs of performing the preliminary and final feasibility studies for the bridge project and of final design and plans. Finally, Four Seasons Lakesites has contributed approximately 90 percent of the land required for right-of-way for the bridge and its approach roadways.

Enabling Legislation

In 1990, the Missouri legislature passed the *Missouri Transportation Corporation Act*. The preamble of the act states:

> "The . . . traffic congestion and limited roadways, . . . And the limited availability of state funds, require as a public purpose the promotion and development of public transportation facilities . . by new and alternative means."

The act provides for the formation of private, not-for-profit "transportation corporations" to fund, promote, plan, design, construct, maintain, and operate eligible transportation projects. Each transportation corporation must be authorized by the Missouri Highway and Transportation Commission (MHTC) -- the governing body of MoDOT. The projects advanced by transportation corporations must serve a public purpose.

The LOCBC, the first transportation corporation in Missouri, was formed in May, 1992, following the required application, hearing, and reviews. The application and review process was accomplished through the volunteer efforts of local supporters, with out-of-pocket expenses borne by the previously mentioned landowners. In November, 1992, the foundation of the public/private partnership was laid when the LOCBC and MHTC entered into a feasibility study agreement. Each partner agreed to pay half of the cost of the comprehensive feasibility study; this study would be needed to advance the project to the financing stage.

Viable Project Concept

In December, 1992, the LOCBC selected HNTB Corporation to conduct the comprehensive feasibility study for the project. HNTB subcontracted the traffic and revenue studies to Wilbur Smith Associates.

The engineering and environmental studies by HNTB included location alternatives analyses, roadway and bridge engineering studies, an environmental assessment, cost estimates, financing alternatives, and implementation planning. The bridge design consists of 11 constant-depth, welded steel plate girder spans, each 245 feet long, for a total bridge length of 2,695 feet. The substructure of the bridge consists of large-diameter (8-foot) drilled shafts socketed into bedrock. The piers vary in height from 75 feet to 235 feet from the bottom of the lake. Approximately 3.6 miles of approach roadways connect the bridge to the state highway system.

The traffic and economic studies by Wilbur Smith Associates included corridor growth studies,

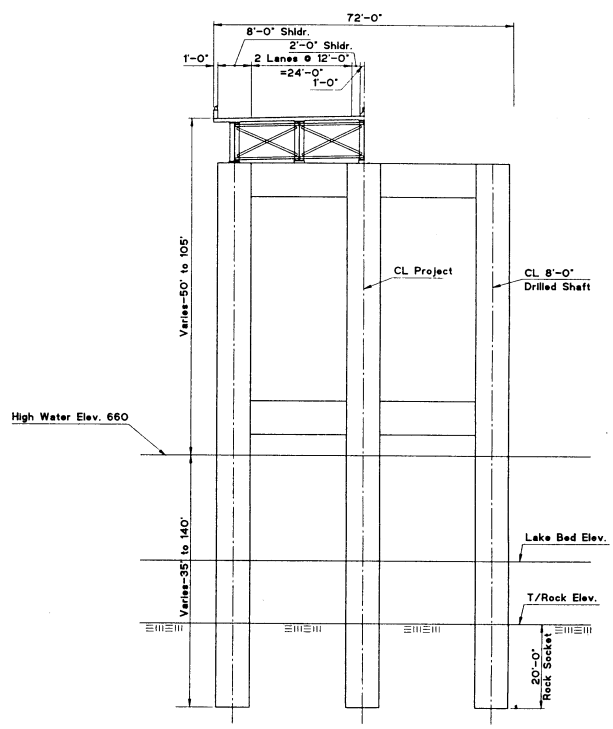
analyses of existing and projected traffic and travel characteristics, origin-destination surveys, and estimates of bridge traffic and toll revenue. The traffic and revenue estimates are summarized in Table 2.

Table 2 - Summary of Traffic and Toll Revenue Estimates

	Opening Year 1998	Design Year 2018
Average Daily Traffic		
Summer	3,100	13,500
Winter	1,900	9,200
Annual Toll Revenue	$ 1.59 million	$ 8.85 million

The traffic volume forecasts indicated that a two-lane bridge will provide sufficient capacity for the initial years' operation, but that a four-lane bridge will be needed sometime in the second decade of bridge operations.

Figure 2 – "Two-on-Four" Bridge Section



The draft feasibility study report was published in August, 1993. The feasibility analysis indicated that toll revenues would be sufficient to finance the construction of a two-lane bridge and approach roadway. However, since a four-lane facility would be needed to handle 20-year volumes, both the LOCBC and MoDOT believed that it was important to provide for the ultimate four-lane structure, to be constructed when traffic volumes demanded and toll revenues permitted.

The report recommended a staged implementation of the bridge to match the capital cost requirements with the toll revenue potential. The initial bridge would be a "two-on-four" structure with a two-lane deck constructed on a four-lane substructure (Figure 2). Likewise, the approach roadways would be constructed initially as two lanes on a four-lane right-of-way.

The financing analysis indicated that a "two-on-four" concept would not be feasible as a strictly private project. The concept would be feasible as a public/private partnership under either of two approaches. In the first approach, the state would contribute approximately $10 million, to be combined with revenue bond financing for a single, bridge/approach roadway project. In the second approach, the state would construct the approach roadways as a separate project, at a cost

of approximately $10 million, leaving the LOCBC to finance and construct only the bridge and toll plaza as a revenue bond project.

Public/Private Partnership

The Missouri Transportation Corporation Act gives transportation corporations broad authority to contract with public and private entities for a number of purposes. Therefore, the feasibility study explored a number of project delivery options for the LOCB. Among the options considered were:

- Private project developer -- Build-Transfer-Operate or Build-Operate-Transfer
- Design/build
- Conventional design/construction bid

It was concluded that the LOCBC could achieve the most economical project implementation under a conventional design/construction bid delivery option. Since this was the first private project in the state of Missouri under this act, project developers or contractors might have demand a premium to assume a higher-than-normal implementation risk in a first-time institutional environment. Therefore, the bridge project was bid conventionally in a manner as similar as possible to MoDOT projects.

Once the feasibility study findings were presented to the LOCBC and the MHTC, the public/private partnership evolved further. Two separate projects were established (Figure 6) -- a toll-financed bridge/toll plaza project by the LOCBC (the "Corporation project") and a state highway-funded approach roadway project by MHTC, with a maximum contribution by the state of $10 million (the "Commission project"). Each project was to be advertised for conventional competitive construction bids. Cost estimates for the two projects are summarized in Table 3.

Table 3 - Cost Estimate Summary

	Corporation Project	Commission Project	Total
Construction	$ 21.7 million	$ 6.9 million	$ 28.6 million
Right-of-Way	$ 0.7 million	$ 0.5 million	$ 1.2 million
	---	---	---
Total	$ 22.4 million	$ 7.4 million	$ 29.8 million

To provide the necessary close coordination between the two separate projects, with two separate owners, the projects were bid as a required combination. Contractors had to bid on both projects; the low bid would be the low sum of the two project bids; and both projects would be awarded to the lowest responsive bidder. In addition, other tools were used, including coordinated liquidated damages in both project contracts -- both projects must be completed by a certain date to avoid the assessment of liquidated damages.

The public/private partnership was formalized in a Cooperative Agreement between the LOCBC

and MHTC. MODOT agreed to provide right-of-way acquisition services, such as appraisals and negotiations, with its right-of-way staff for not only the Commission project but also for the Corporation project. The LOCBC reimbursed MODOT for the cost of these services attributable to the Corporation project. The LOCBC would be responsible for toll collection and operations and maintenance of the toll plaza. MODOT agreed to provide roadway and bridge maintenance with its forces for the Corporation project, with the cost of these services reimbursed by the LOCBC.

PROJECT IMPLEMENTATION

Throughout the feasibility study phase of the project, a number of optional financing plans and funding sources were being considered. Federal-aid highway funds from the Intermodal Surface Transportation Efficiency Act (ISTEA) were one potential funding source. Therefore, the project team decided to meet all federal project development and environmental clearance requirements so that the project would remain eligible for federal funding. The following clearances and permits were obtained for the project, in full conformance with state and federal laws and regulations:

- Environmental Assessment (EA)/Finding of No Significant Impact (FONSI)
- U.S. Coast Guard - Rivers and Harbors Act - Section 9 Permit
- U.S. Army Corps of Engineers - Clean Water Act - Section 404 Permit
- Federal Energy Regulatory Commission (FERC) Permit

Construction Contracting

The two projects were advertised for construction bids by MODOT in November, 1995. Consistent with the project delivery strategy, the invitations for bids were virtually identical to standard MODOT bid packages, with the exception of the liquidated damages mentioned earlier and some specific insurance provisions for the Corporation project. Five bids were received -- bids for the Corporation project ranged from $18.2 million to $21.7 million; bids for the Commission project ranged from $5.5 million to $6.2 million; and the total bids ranged from $23.7 million to $28.0 million. The successful bidder was Edward Kraemer & Sons, Inc., of Plain, Wisconsin. The low bid was 11.6 percent below the engineer's estimate.

Project Financing

In late 1993, the LOCBC selected Smith Barney Inc., as the project underwriter, to develop a structure for the financing based on the issuance of uninsured, unrated toll revenue bonds. The basic marketing strategy focused on institutional investors. Smith Barney's experience with this investor group on similar projects guided the development of the financing structure, with reserve and contingency funds serving as safety nets in those areas of known investor concern. Substantial construction contingency funds and debt service reserve funds were structured to reduce investor concerns about the start-up nature of the project and the non-recourse financing.

Once a firm construction bid price was received, the financing plan was finalized. The bond

pricing occurred in mid-January, 1996. The size of the bond issue was $40.085 million, and the net interest cost was 6.59 percent. This rate was only about 110 basis points above what insured, rated Missouri municipal bonds were priced at the same time. The bond issue was oversubscribed by more than 100%, with offers to purchase the bonds totaling more than $100 million. Smith Barney allocated the bonds to 11 investors. The bond sale was closed on February 7, 1996. In response to favorable market conditions, the LOCBC refinanced its bonds in February, 1998. The new bonds were issued at a net interest cost of 5.41 percent.

Construction

With project financing in-hand, the LOCBC awarded construction contracts in mid-February, 1996. Construction began in March, 1996 and was substantially completed by May 1, 1998. The project was completed on time and within budget.

Operations and Maintenance

From early on, the LOCBC's operational philosophy was to minimize the number of staff on the Corporation. An Executive Director (part-time) and a secretary are the only employees of the Corporation. Toll collection and toll plaza maintenance have been contracted to a private contractor – All-Tech, Inc. The toll operations contract is a five-year contract with payment on a cost plus fixed fee basis. Bridge and roadway maintenance are provided by MoDOT, reimbursed by the LOCBC.

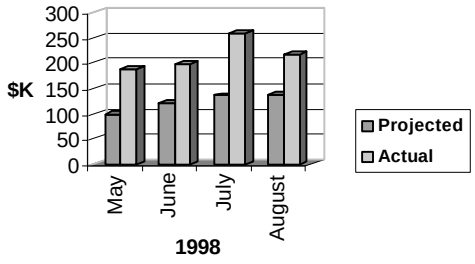
STATUS OF THE PROJECT

A ribbon-cutting ceremony was held on May 1, 1998, and the bridge opened for revenue service on May 2, 1998.

Traffic and Toll Revenue

The monthly toll revenues to date are shown in Figure 3 along with the budget projections for each month. For the first four months, toll revenues have exceeded the projections by about 75 percent. The winter, off-season travel patterns have not yet occurred with the bridge in operation. Therefore, it is too early to assess the long-term, year-round traffic and toll revenue outlook.

Toll Revenue Performance



Economic and Development Impacts

It is too early to assess the long-term economic development impacts of the LOCB as well. Land sales on Shawnee Bend and adjacent areas have been brisk since construction of the bridge began, and housing starts are up. In its 2nd Quarter, 1998, U. S. Housing Market Conditions, the U.S. Department of Housing and Urban Development reported,

> "The area is currently experiencing an economic surge related to the recent opening of the Lake Community Bridge…"
>
> "With the new accessibility of these properties to services and the general attractiveness of the Lake of the Ozarks, strong growth is likely to continue."

CONCLUSIONS AND LESSONS LEARNED

The model of public/private partnership established for the Lake of the Ozarks Community Bridge was quite successful. The partnership resulted in the implementation of a project which had gone unbuilt for 30 years. In addition, the public/private team developed the LOCB project on a very fast track. The period from the formation of the Corporation until the ribbon-cutting opening the bridge for service was only six years! Similar public sector projects could easily take from ten to fifteen years.

Projects like the LOCB may not represent the leading edge of transportation privatization. However, these small to mid-size projects are more within the *"institutional comfort zone"* of state DOT's, regulators, designers, contractors, and investors.

- Public/private projects need the foundation of *specific authorizing legislation*. It is not enough to have just permissive legislation. Investors, business leaders, and public officials need the legal umbrella of specific authorizing legislation to provide a level of comfort in supporting, approving, and investing in a project.

- *Small- to medium-size* projects do not have overwhelming capital requirements and, therefore, simply are not as onerous to investors as mega-projects.

- Effective public/private models *allocate to the private and public sectors the things which these sectors do best*. For the LOCB, the MODOT undertook tasks such as right-of-way acquisition, bid letting, and bridge maintenance, functions in which it has long-standing experience and excellent staff capabilities. The LOCBC and its project team took the lead in upfront project development support, fast-track planning and design, and knowledgeable securities marketing -- tasks which benefited from private sector participation.

- The LOCB project benefited from establishing a *credible project team* with extensive experience in innovative transportation projects. Well-qualified firms were retained for all aspects of the project, including traffic and revenue studies, feasibility studies, design, financial underwriting, bond counsel, and corporate counsel. For a first-of-a-kind project in Missouri, no one knew in advance exactly how the project development, financing, and implementation

would fall into place. However, the experienced team helped create innovative, credible solutions when roadblocks were encountered.

- Using *familiar construction documents and bid procedures* resulted in obtaining very competitive construction bids. A number of contractors indicated after the bid that they were somewhat uncertain about bidding on a project for a private, not-for-profit client but that the familiar nature and appearance of the plans and bid documents improved their confidence in the project and reduced their bid prices. The contractors were not asked to assume unreasonable risks and, therefore, did not need to bid premium prices to cover such risks.

Grassroots, public/private projects like the Lake of the Ozarks Community Bridge can stay within this "institutional comfort zone." There are many transportation projects which are suitable for this implementation model. Therefore, these projects are more implementable than private mega-projects and, in the long-run, may offer more real opportunities to improve our transportation systems.

SESSION 4 - PRACTICAL MODELING METHODS

Moderator: Bob Alguire
University of Arkansas

Panelists: Brian A. Roper, St. Cloud Planning Organization, Minnesota, and Deanna M. Keltner, BRW
William W. Mann and Mazen Dawoud, Virginia Department of Transportation
Shuming Yan, Washington Department of Transportation
Jerry Faris, Transportation Support Group, Florida, and Dane Ismart, Louis Berger & Associates, Florida

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Session # 4 - Practical Modeling Methods

USER BENEFITS OF RAILROAD GRADE SEPARATION IN A SMALL COMMUNITY: PRACTICAL TECHNIQUES FOR APPLYING MICROBENCOST

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ABSTRACT

As transportation system elements of this country continue to evolve, issues that may have seemed foregone to a prior generation have crystallized into topics requiring substantive review. Witness, for example, the growth in both freight railroad and vehicular traffic throughout the United States over the past 15 years. The product of their interaction at grade crossings is a mixture of congestion and safety concerns. The challenge for today's transportation professionals is how to monetize these concerns when reviewing project-specific issues. One tool for assessing economic impacts during the project development process is benefit-cost analysis. This paper presents a framework for estimating roadway user benefits and costs associated with railroad grade separation in a small community by applying the software and methodology of MicroBENCOST. In addition, a specific application of this approach in the St. Cloud, Minnesota metropolitan area (population 100,000) has been included.

MicroBENCOST was released by the Texas Transportation Institute in 1993 to conduct benefit-cost analysis for highway improvements. A brief discussion of the software's current release and status has been included. Like most computer software, MicroBENCOST provides the user with a number of default values. This paper identifies defaults and other data that require the use of project-specific inputs. It also discusses practical techniques to focus productive, yet low cost, data collection prior to analysis. Of greatest importance when considering railroad grade crossing issues are railroad operation values such as train distribution, length, and speed. A methodology for collecting and summarizing this data is described in order to assist others with this task.

Once the necessary data has been collected, MicroBENCOST can be used to develop an input file and test a variety of alternatives. To demonstrate application of this framework, a case study involving a potential grade separation is described. Since there was some uncertainty associated with the forecasted data, a sensitivity analysis was conducted. Tips and traps associated with the use of this software are also presented.

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USER BENEFITS OF RAILROAD GRADE SEPARATION IN A SMALL COMMUNITY: PRACTICAL TECHNIQUES FOR APPLYING MICROBENCOST

INTRODUCTION

As transportation system elements of this country continue to evolve, issues that may have seemed foregone to a prior generation have crystallized into topics requiring substantive review. Witness, for example, the growth in both freight railroad and vehicular traffic throughout the United States over the past 15 years. The product of their interaction at grade crossings is a mixture of congestion and safety concerns. The challenge for today's transportation professionals is how to monetize these concerns when reviewing project-specific issues. One tool for assessing economic impacts during the project development process is benefit-cost analysis. This paper presents a framework for estimating roadway user benefits and costs associated with railroad grade separation in a small community by applying the software and methodology of MicroBENCOST. In addition, a specific application of this approach in the St. Cloud, Minnesota metropolitan area (population 100,000) has been included.

RECENT PRACTICE

Other than MicroBENCOST, few methods have been available over the past 15 years to quantify user benefits and costs associated with converting a railroad-highway grade crossing to a grade separation. To provide a perspective on recent practice, this section identifies the strengths and weaknesses of these approaches.

Guidebook for Planning to Alleviate Urban Railroad Problems - 1974

This joint FHWA/FRA document outlines analytical processes to support the evaluation of railroad relocation activities. Using a number of nomographs and linked worksheets, construction and highway user benefits and costs are calculated in a manner which could also be applied to grade separation analyses. This method's ease of use led to its wide-spread acceptance during the 1970s and 1980s. But, advances in research and updating Consumer Price and Producer Price Indices from 25 years ago can introduce unintended consequences into the results.

Manual on User Benefit Analysis of Highway and Bus-Transit Improvements - 1977

Although not identified explicitly, this AASHTO document contains the data, figures, and methodology for estimating benefits and costs of grade separation. Construction and maintenance costs, motor vehicle costs, accident costs, and the value of travel time can all be taken into account. Unfortunately, the quantity of hand calculations necessary to accurately apply this methodology has hampered its use for problems of this nature. The caveats noted from the 1974 FHWA/FRA report are applicable to this one as well.

Railroad-Highway Grade Crossing Handbook - 1986

This FHWA document describes an economic framework for evaluating improvements to railroad-highway grade crossings. Similar to the AASHTO document, all anticipated costs and values are referenced. No guidance is provided for actually calculating the benefits and the costs. Thus, it is not possible to apply this document directly.

Evaluating Grade-Separated Rail & Highway Crossing Alternatives - 1987

This NCHRP report provides a framework and procedures for determining whether or not grade separated structures should be replaced. In 1995, AASHTO's Standing Committee on Railways cited this approach as an appropriate way to address grade separation issues. The decision-making framework encompasses three levels of analyses to perform on project alternatives. Using diurnal traffic distribution and detailed train information, all relevant benefits and costs can be determined. Caution must be exercised in using the formulas, since a few of the defaults should be revised using field data.

Roadway Vehicle Delay Costs at Rail-Highway Grade Crossings - 1990

In Transportation Research Record 1262, a methodology is explained for computing the length and cost of delays at railroad-highway grade crossings. Since the intent of the application was to perform a broad assessment of over 1000 crossings, many simplifying assumptions based on data collected early in the study were applied to railroad and roadway traffic characteristics. The computation of user costs is based on a procedure developed by FHWA in 1980. Although this approach should not be used as the basis for decision-making, it is an appropriate screening tool in homogeneous rail corridors.

RAILDEC: Public Rail Investment Decision Support Software - 1996

The Federal Railroad Administration (FRA) developed this software for intermodal investment decision support for rail and rail-related investments, including grade separations. RAILDEC incorporated a risk analysis framework to account for uncertainty in model inputs. In addition, the underlying methodology is consistent with the current benefit-cost methodologies employed by USDOT agencies. This project level model contains an extensive default database that can be replaced with more project specific or localized data. Although this approach may be too complex to be used as a screening tool in rail corridors, it is an appropriate basis for decision-making in project level analysis.

Development of Evaluation Tools for Road-Rail Crossing Consideration for Grade Separation - 1997

In Transportation Research Record 1605, simplified tools for evaluating the economic losses caused by at-grade crossings are presented. If the product of daily vehicle traffic and the number of hours per day when the crossing is closed for road traffic is over 13,000, then the crossing is a candidate for grade separation. Since the intent of the application was to perform a broad assessment of over 200 crossings in Israel, a sample was used to develop a multiple linear regression formula for approximating

vehicle delay costs (in Israeli currency). Since the potential user is unable to revise the value of travel time (which is not disclosed), its usefulness for sketch planning in the U.S. is limited.

GETTING TO KNOW MicroBENCOST

MicroBENCOST was developed by the Texas Transportation Institute (TTI) in 1993 for the National Cooperative Highway Research Program (NCHRP) to conduct benefit-cost analysis for highway improvements. This section provides an introduction to the overall methodology and how it is applied to railroad grade crossings.

Basics

MicroBENCOST is a computer program for conducting highway user benefit-cost analysis on a personal computer. The objective of benefit-cost analysis is to put all of the direct effects of a transportation improvement into dollar terms so the effects can be compared using a common measure. Benefit-cost analysis looks at the benefits generated by a project and compares them to the cost incurred over a certain analysis period. A project is considered economically feasible if the benefits are greater than the costs. MicroBENCOST calculates user benefits and costs of an improvement and outputs several economic measures that can be used by decision makers in their planning decisions. It can also allocate corridor traffic and calculate forecasted traffic volumes. The focus of the analysis is directed at the project level and its immediate area impacts rather than at the highway system level.

There are seven project types that MicroBENCOST can analyze: (1) added-capacity; (2) bypass; (3) intersection/interchange; (4) pavement rehabilitation; (5) bridge; (6) safety; and (7) highway-railroad grade crossing. The program compares the motorist (user) costs in the existing situation to the user costs if the improvement is completed. User costs include measures that are easily monetized: the time cost of delay, vehicle operating costs and accident costs. Three economic measures are generated to judge the desirability of a project: the benefit-cost ratio, the net present value, and the internal rate of return. MicroBENCOST also provides the change in fuel consumption and carbon monoxide emissions generated by the improvement. Environmental effects such as these are not easily monetized and are therefore not included in the quantitative economic measures.

Railroad Grade Crossing Module

A project in the highway-railroad grade crossing category is an upgrade to a higher control. There are seven items related to railroad grade crossing that the user can enter and edit.

(1) The type of train warning device: crossbuck, flashing lights, and automatic gates.
(2) The number of trains at the crossing per day.
(3) The percent reduction in speed of a vehicle crossing the tracks when the crossing is open and traffic can cross without interruption.
(4) The time, in seconds, to lower and raise gates while the crossing is occupied.
(5) The average train speed, in mph, when occupying the crossing.
(6) The average train length, in feet, of the trains occupying the crossing.
(7) The train distribution, i.e. the percent of trains during each of the 24 hours.

The delay at railroad grade crossings is comprised of three components. A simple queuing model is used to calculate the delay of the train occupying the crossing and the delay of opening and closing the warning gates. In addition, a formula is used to calculate the delay of slowing down to cross the railroad tracks. The User's Manual provides guidance on speed reduction, based on the roughness and grade of the crossing.

Current Status

In July 1998, the updated manual for the next version of MicroBENCOST was submitted to the NCHRP. A demonstration of the new software to the NCHRP review committee is scheduled for the fall. According to TTI, the railroad grade crossing module is improved in the new version providing more choices to the user.

MicroBENCOST DATA NEEDS

A MicroBENCOST problem data set consists of certain data input by the user and certain data provided by default. As the user enters project specific data, the program automatically pulls in default data. This section describes several of the project specific data needs of MicroBENCOST as well as practical techniques to focus productive, yet low cost, data collection prior to analysis.

Project Specific Data

At the beginning of any improvement project, there is one fundamental question to be answered: What is in place and what should replace it? To use MicroBENCOST, an answer to this question (but not necessarily the final one) must be in place. The following subsections describe how the answer is woven into the application of the software.

Initial Assumptions

The first items required by MicroBENCOST are the initial assumptions about the project. The user must input the following project specific items: current year; area type, either urban or rural; project type, choosing one of seven stated earlier; presence or absence of an alternate route switch; discount rate; analysis period in number of years; and year when the improvement will be completed.

Construction Costs

MicroBENCOST has default values by area type and project type to distribute construction costs across the following six different components: preliminary engineering; right-of-way; major structures; grading and drainage; sub-base and base; and surface. By default, the program assumes that all of these components will be completed in one year. If the user knows the costs of the construction components and the year they will be completed, these values should be updated. For this project, two categories were added for the grade separation alternatives: the temporary railroad structure (shoo fly) and the replacement railroad work. The other construction cost components and the completion years were also updated to be project specific.

Route Segment Data

Project specific inputs are also required for the route segments (for both existing and proposed). The user must input the following: access control, either full, partial or none; segment length in miles; type and number of intersection/interchange/structure, choosing from 11 types; number of lanes in the inbound and outbound directions; and whether to edit data by roadbed or direction. For this study, data was edited by "roadbed = bi-directional".

Geometric data is required for every route segment including the lane width in feet, shoulder width or lateral clearance in feet, percent grade, and degree curvature. Defaults are provided for lane width and shoulder with, but project specific data for these items are easily obtained and should be utilized.

Traffic operation data required includes: additional local AADT; design speed; speed limit; and capacity per lane per hour. Defaults are provided for design speed, speed limit and capacity, but project specific data for these items are easily obtained and should be utilized. Default values are provided for the average running speed of the segment given the hourly demand/capacity ratio. The user is advised to check this data. During this study, the program produced a top average running speed of 60 miles per hour despite a speed limit of 35 miles per hour.

For bridge segments, the user must enter the following: type of bridge structure; whether traffic can be diverted around the bridge; bridge deck width in feet; whether the approach width is greater than the bridge width; and the bridge length in feet. In addition, for bridge segments, the user has the option to enter bridge rehabilitation costs, otherwise, the defaults are zero. For this study, a rough cost estimate for keeping the bridge open for the duration analysis period was entered.

Roadway User Data

Reduced delay, reduction in accidents, and vehicle operating cost savings are three major benefits associated with roadway improvements. A method for updating the MicroBENCOST default values of travel time, vehicle operating costs, and accident costs to current dollars is presented.

Value of Travel Time

The MicroBENCOST default values of time for passenger cars are from a 1986 TTI study and updated to 1990 dollars using the Consumer Price Index (CPI). The Final Report recommends using about 80 percent of the wage rate as the value of time for all adult drivers and passengers of the state (or other geographic area) that is being considered if the user wants to develop their own values based on income levels. The default values of time were updated to current dollars using the CPI.

Travel time savings for trucks represent savings in market costs for transporting commodities. The default values of time for trucks are from a 1975 TTI study (which updated values from an earlier study) and updated to 1990 dollars using the Producer Price Index (PPI). In turn, the values were updated to current dollars using the PPI.

Vehicle Operating Costs

MicroBENCOST has default values for five cost components in operating a vehicle including: fuel consumption, oil consumption, tire wear, vehicle depreciation, and maintenance and repair. The default values are from a 1982 study and updated to 1990 dollars using appropriate price indexes. The MicroBENCOST default vehicle operating costs were updated to current dollars using the CPI for transportation.

Accident Costs

MicroBENCOST calculates accident costs separately for highway segments, intersections and interchanges, bridges, and railroad grade crossings. The default values are from a 1986 study based on a willingness to pay approach and updated to 1990 using the CPI. The MicroBENCOST default accident costs were updated to current dollars using the CPI.

Roadway Traffic Data Collection

The use of project-specific traffic information where possible lends additional credibility to the outcome of the analysis. The collection of existing traffic data and development of forecasted traffic volumes is not particularly complex, but does merit a brief discussion.

Traffic Volumes

Three forecast methods are available in MicroBENCOST to input or generate traffic volumes over the analysis period. The user may input volumes for each year, or use the program to generate traffic volumes with either the annual growth rate method or the intermediate and forecast volumes method. In the annual growth method, traffic volume for the base year and the annual growth rate are used to calculate future traffic volume over the analysis period. For the intermediate and forecast volumes method, the volumes for the base year, intermediate year and forecast year are used to fit a curve between those points for each year over the analysis period. For this study, traffic volumes were forecasted by factoring the results of the MPO's travel demand model. An annual growth rate was then chosen to produce these volumes within MicroBENCOST.

Traffic Distribution

MicroBENCOST provides two methods to distribute AADT: the first is by hours of the day, the second is by hours of the year. Default distributions are provided for both methods, but they can be changed by the user. Project specific traffic distributions by hours of the day were collected during a 48-hour traffic count.

Types of Vehicles

MicroBENCOST provides default percent distributions for vehicle types typically found on highways from the Highway Performance Monitoring System (HPMS). Project specific percent distributions can be obtained through a volume by vehicle type report, though passenger cars are all counted as one

type. Default values for the percentage of trucks were derived from FHWA's document Highway Statistics. For this study, a project specific value for the percentage of trucks was obtained during the 48-hour traffic count.

Railroad Data

Of greatest importance when considering railroad grade crossing issues are railroad operation values such as train distribution, length, and speed. A methodology for collecting and summarizing this data is described to assist others with this task. MicroBENCOST requires as user input the average train length and average train speed. In addition, a uniform train distribution is the default for the percent of trains crossing during each of the 24 hours. A uniform distribution does not reflect the typical weekday operations of trains. Also, the daily train distribution combined with average speed and length does not capture the delay caused by trains crossing. Therefore, for this study, project-specific railroad operations data was collected and summarized.

The BNSF railroad pulled data from HPX recorder modules over a two-week period. Train direction, date and time, train speed, warning time, and total time of crossing occupation were collected. To be consistent with roadway traffic, only movements from noon Monday to noon Friday were used in further data analysis. Distributions of train speed, length, and closure time were developed to determine median and mean values.

To review how closely they correlated, the hourly distribution of trains was compared to the hourly distribution of crossing occupation time. Although the values were similar, it was determined that just using trains alone was not enough. Using the data summaries, a train of typical length and speed was derived to apply with the hourly distribution based on crossing time.

MicroBENCOST does not allow changes in the daily train volumes over the analysis period. Given the uncertainties associated with long range forecasting of daily train volumes, this limitation did not hamper the methodology. In addition, the public did not feel that forecasting trains in excess of today's values was credible.

Additional Data Options

There are several other data items that can be changed but were not considered important to do so for this study. Default values for the following discomfort cost factors were left unchanged: stopped time discomfort; congestion discomfort; rough pavement discomfort and its associated speed adjustment factor. Other data items left unchanged in this study include: pavement condition data; overlay and pavement rehabilitation costs; routine maintenance costs; accident rates and emissions data.

APPLICATION OF FRAMEWORK TO CASE STUDY

Once the necessary data has been collected, MicroBENCOST can be used to develop an input file and test a variety of alternatives. To demonstrate where this has been done, a specific application

of this approach in the St. Cloud, Minnesota metropolitan area (population 100,000) has been included. The case study involves the replacement of a river crossing with or without railroad-highway grade separation.

Background

The St. Cloud Metropolitan Area straddles the Mississippi River in Central Minnesota. Over the past 120 years, river crossings have been constructed to accommodate the increases in population and travel demand. In addition to the river, the mainline corridor of the Burlington Northern Santa Fe railroad also traverses the metro area. This line, which is the highest speed and highest volume rail corridor in Minnesota, serves as a national conduit for intermodal and other freight movement. Carrying up to sixty trains per day (including AMTRAK) at speeds approaching sixty miles per hour, the rail corridor has a significant impact on the St. Cloud area's vehicular traffic.

Since the Mississippi River and the BNSF mainline are parallel in the metro area, river crossings are often accompanied by railroad crossing issues. A study of the oldest Mississippi River crossing in the area has demonstrated this clearly. At the intersection of the roadway and railroad, located on the easterly bridge approach, the highest vehicle/rail conflicts of Minnesota's 5,000 grade crossings can be observed. As a part of the environmental assessment, economic analysis using MicroBENCOST was performed to evaluate the level of benefits and costs associated with grade-separated alternatives compared to the at-grade option and no-build.

Alternatives

The environmental assessment included these four alternatives for further review of social, environmental, and economic impacts: No-Build (existing two-lane bridge, as required by federal law); Alternative 1-A (four-lane bridge, at-grade crossing); Alternative 2-B (four-lane bridge in existing location, underpass of raised railroad); and Alternative 3-E (four-lane bridge in new location, overpass of lowered railroad).

Scenarios

The Year 2020 traffic forecast for the Sauk Rapids Bridge was 40,000 vehicles per day; the railroad reported up to 60 trains per day through the crossing. Some of the stakeholders believed that these values were overstated. In an attempt to address these concerns, reduced vehicular and railroad traffic values were developed for use in a sensitivity analysis. With this information, four scenarios were analyzed for each of the three alternatives. This sensitivity analysis is used to learn how dependent the results are on any one input. The following four scenarios were run:

Traffic = 40,000; Trains = 60
Traffic = 40,000; Trains = 40
Traffic = 30,000; Trains = 60
Traffic = 30,000; Trains = 40

Results

The MicroBENCOST program was run for alternatives 1A, 2B and 3E, comparing all back to the no-build alternative. As stated above, four scenarios were calculated for each alternative to test sensitivity. The results of this analysis are described in general terms in this section. In addition to the benefit-cost (b/c) ratios and net present values for the four scenarios of each alternative, the incremental benefit-cost ratios and net present values are also discussed.

The benefit-cost ratios for the three alternatives, all scenarios, are over one. The b/c ratios for alternative 1A are the highest for two scenarios; alternative 2B had the highest b/c ratios for the other two alternatives. Alternative 3E never had the highest b/c ratio, but did have net present values essentially equal to 2B for all scenarios. The results are summarized below:

30,000 vehicles/40 trains
- B/C ratio for 1A is the highest (less than 2.0)
- Net present values are essentially equal for all three (approximately $4 million)

30,000 vehicles/60 trains
- B/C ratio for 2B is the highest (approximately 3.0)
- Net present values essentially equal for 2B and 3E (approximately $20 million greater than 1A)

40,000 vehicles/40 trains
- B/C ratio for 1A is the highest (approximately 3.0)
- Net present values are essentially equal for 2B and 3E (approximately $7 million greater than 1A)

40,000 vehicles/60 trains
- B/C ratio for 2B is the highest (greater than 4.0)
- Net present values are essentially equal for 2B and 3E (approximately $30 million greater than 1A)

Incremental benefit-cost ratios and net present values were calculated for going from 1A to 2B, from 1A to 3E, and from 2B to 3E. All of the incremental benefit-cost ratios are approximately one for the 30,000 vehicles/40 trains scenario. The incremental B/C ratios for going from 1A to 2B and from 1A to 3E for the other three scenarios are over one, with 1A to 2B consistently higher than 1A to 3E. The incremental B/C ratio of going from 2B to 3E is approximately one for all four vehicle/train scenarios.

The incremental net present values for going from 1A to 2B and from 1A to 3E are essentially equal for each vehicle/train scenario. The incremental net present value for going from 2B to 3E is between -$600,000 and $1,000,000 for all four vehicle/train scenarios.

LESSONS LEARNED

Software

The current version of MicroBENCOST has several problems that will hopefully be corrected in the next release. Various difficulties/design flaws that were encountered while using the software for this study are described below.

The user must enter all of the required user input data before the file can be saved. The data input can be very time consuming and therefore this presents obvious difficulties. Another problem has to do with the default values. The default values called up by the program based on user input are not necessarily updated when the user makes a change to the input. For example, the author encountered accident rates that were not updated after changing a segment from a two lane to a four lane road. The program has a command that allows the user to retrieve the default values, but this replaces values that the user has changed that he wants different from the defaults, such as traffic distribution.
The program sometimes generated specious results. The program presents detailed results by segment and a summary of the discounted benefits. In certain cases, the detailed results and the summary results were not consistent. The problem appeared in an early scenario with a differing number of segments in the existing and proposed routes. In this case, there were four segments in the existing route and seven in the proposed route. This problem was not encountered again after further refinement of the alternative resulted in five segments in the existing route and seven in the proposed.

A difficulty/design flaw mentioned earlier is that certain default values called up by the program based on user input do not appear to vary based on user input. This problem was found with the speed-volume data when MicroBENCOST produced a top running speed of 60 mph when the speed limit for the segment was 35 mph.

The user should be aware that the default capacities in MicroBENCOST are actually adjusted capacities, already multiplied by factors from the 1985 Highway Capacity Manual. If the user overrides the defaults by entering a different value, the program will not calculate an adjusted capacity and the results will be faulty.

Assumptions

Certain difficulties were also encountered with some of the assumptions in MicroBENCOST. The program assumes that the existing condition will remain intact for the entire analysis period. This was a problem for this study because the existing bridge is expected to be unusable in 8 years. To solve the problem, a rough bridge rehabilitation cost was assumed to keep the bridge open for the 20 year analysis period.

Another difficulty/design flaw mentioned earlier has to do with the railroad data. MicroBENCOST's default uniform train distribution combined with an average speed and length of trains does not capture the delay caused by trains crossing. Therefore, a train of typical length and speed were derived based on the hourly distribution of delay.

Recommendations

Despite the criticisms discussed above, the authors found that MicroBENCOST is a useful tool for project level analysis. Most users will find that it is not appropriate as a sketch planning/screening tool due to the level of effort required. The user is advised to review all of the input and output (i.e. open the black box) which should avoid faulty results. Finally, the learning curve is relatively quick, especially if the user has an understanding of transportation and benefit-cost analysis.

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Session #4

SIMPLIFIED 4 - STEP TRANSPORTATION PLANNING PROCESS FOR ANY SIZED AREA

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ABSTRACT

This paper presents a streamlined version of the Washington D.C. region's 4-step travel demand forecasting model. The purpose for streamlining the model was to have a model that could:

- Replicate the regional model, and
- Be run in a new software, TP/4in1, that executes the entire 4-step process in one execution on a PC.

The streamlined model is similar to, but more simplified than, the regional MPO model, with one major difference. The trip generation and mode split steps result in a trip generation rate of 10.0 vehicle trips per detached household for the suburban/rural trip rate. This is more in line with that of smaller communities and yet much higher than the traditional MPO trip rate for larger areas.

The model is now being used for travel forecasting for rural and small communities, such as Fauquier County, Virginia, (55,000 population in 1995) on the urban fringe. This model can be adjusted to local area surveys or used "as is" for any sized area, large or small. Using this model makes executing the traditional 4-step modeling process quite easy, even for the novice model practitioner. This article also describes, very briefly, the new software developed to execute this model and is available for free to any public agency.

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INTRODUCTION

Since the passage of the Clean Air Act Amendments (CAAA) of 1990 and the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, the travel forecasting process has evolved into a very comprehensive and complex process. Prior to 1990, many travel forecasting models were run on IBM mainframe platforms that required about 20% of one's study budget just for the data processing charges. Because they were so expensive to run and because of the lack of funds to improve them, these models were simple and straight- forward. As a result, they could be executed by just about any transportation modeler having access to a mainframe computer. One serious flaw with these models was their inability to address peak hour conditions and speed feed back; e.g., having congested speeds used in trip distribution and mode split.

With the passage of ISTEA, the pendulum has swung in the other direction. Money flowed to Metropolitan Planning Organizations (MPOs) to increase staff and hire consultants to improve these models to address many policy sensitive variables, air quality issues, for use in major investment studies (MIS) and other regional studies. As a result, these new models can now address almost any transportation forecasting issue including forecasting usage for heavy rail, light rail, rail access, express bus, priority bus, fare changes, parking cost changes, HOV-2 facilities, HOV-3 facilities, and HOT (high-occupancy lanes plus toll) lanes. While these models can now perform all these great and wonderful functions, they are so complex that very few regional modelers in any one region can run them. They are also very time consuming making them infeasible to use for smaller subarea studies requiring turn-around times of only a few weeks. What has been ignored over the past few years during the development of these comprehensive MIS-type models, is the need for quick turn-around models that can replicate the MIS models without all the "bells and whistles". A model that can be executed by local jurisdictions for numerous subarea studies in a quick turn-around time frame is needed now, or will be soon, by just about every MPO in the country.

A few years ago, the Northern Virginia District office of the Virginia Department of Transportation (VDOT) saw the need for this type of subarea model for the Northern Virginia subregion of the Metropolitan Washington Council of Governments (MWCOG) region and began model formulation and calibration. Since its development about one year ago, it has been used extensively. The new subarea model is called the VDOT model and is a streamlined version of the MPO/MIS model. New software was developed to run the VDOT model. It is called TP/4in1. This is a DOS based (soon to be Windows 95-based) stand alone software. The software executes the 4-step process in one execution on the computer and does it using network and zonal data from the Washington DC regional model, with 2211 zones and 17,000 nodes. For the Washington region the model executes the entire 4-step process in about two hours on a Pentium 133 Mhz PC.

It is these authors' opinion that every MPO in the country, large and small, currently needs two types of models:

⇒ a regional/MIS type model, to address numerous policy sensitive variables.
⇒ a subarea/suburban type model, calibrated to the same highway network as the regional model, that produces results similar to the regional model and can be run in one execution on a PC computer with minimal set-up time.

This article describes the VDOT model (a streamlined 4-step process) which can be used as a default model for any sized metropolitan area anywhere in the US. It is currently being used for several counties in Northern Virginia studies and other jurisdictions in Virginia. In addition, it is being used as the modeling tool for the development of the 2020 Northern Virginia Transportation Plan (a long- range plan for the region to guide VDOT and local comprehensive planning). This model could be used, as is, in other areas around the country or modified to replicate any region's MPO/MIS model.

TP/4in1 Software

Traditional 4-step travel demand models execute each of the steps sequentially but independently using specific driver files or control files. In most calibrations, validations and area studies, all of the steps must be run with many auxiliary computer runs in each step. TP/4in1 is software designed to execute a streamlined four-step model chain in one execution on an IBM compatible PC computer. It can also be stopped and restarted after each of the steps if desired. Full documentation of the software is provided in the report *TP/4in1, Volume II, Users Manual, March 1997*. TP/4in1 is software that was developed by William W. Mann, P.E., for use by VDOT and any local jurisdiction in the Washington, DC region. The software will be made available to public agencies at no cost once the software has been completely de-bugged. Hardware requirements are Pentium with 16 MB RAM minimum.

TRAVEL DEMAND MODELING PROCESS FOR VDOT MODEL

The Subregional VDOT model executes essentially the same 4-step process as the MPO model and is calibrated to the same area (Maryland, D.C. and Virginia) as the MPO model. The modeled area is shown in Figure 1. The complete modeling process is shown in Figure 2. This figure also shows the INPUTS and OUTPUTS. The four basic model steps in this process are as follows:

- Trip Generation Model
- Trip Distribution Model
- Mode Split Model
- Trip Assignment Model

Each of these submodels is described below:

Trip Generation Model

The development of the trip generation model began with modifying the MWCOG trip generation model. Over the years, numerous traffic counts have been taken in the suburbs, which showed average trip rates for these areas to be 10 vehicle trips per household per day for single family detached homes. These trip rates were measured by counting traffic on roadways with only one access/egress point from the arterial roadway to/from the residential area. In some cases; e.g., in Loudoun County, these rates were as much as 14 vehicle trips per household per day. Thus, one of the stipulations of this new model for subarea applications was to calibrate the model to 10 vehicle trips per detached household in the suburbs, with a descending trip rate for areas with higher densities. This rate is considerably more than the regional MWCOG models.

The VDOT Model applies the trip rates at the 2211- zone-level based on an Area type (density) system, rather than at the 293 District level, currently employed by MWCOG. However, the same four trip purposes presently used by MWCOG are employed, namely:

1) *Home Based Work (HBW)* production and attraction *person* trips based on households, group quarters and total employment by zone by Area Type (density).
2) *Home Based Shopping (HBS)* production and attraction *auto* trips based on households, group quarters and retail employment by zone by Area Type (density).
3) *Home Based Other (HBO)* production and attraction *auto* trips based on households, group quarters and office, retail, and other employment types by zone by Area Type (density).
4) *Non-Home Based (NHB)* production and attraction *auto* trips based on office, retail, and other employment types by zone by Area Type (density).

Note that only the HBW trip rates are defined for person trips requiring application of a Mode Choice Model. The other trip purposes are defined as auto driver trips. This is the same process used by MWCOG. The final trip generation rates are shown in Table 1.

Table 1

Weekday Trip Generation Rates

		Productions					**Attractions**			
HBW-Person										
	Reg. Core	Urban	Fringe	Suburb	Exurb		Reg. Core	Urban	Fringe	Suburb
HH	1.70	1.75	1.93	2.45	2.15	Total E	1.70	1.40	1.40	1.40
GQ	0.26	0.15	0.15	0.15	0.15					
HBS-Auto										
	Reg. Core	Urban	Fringe	Suburb			Reg. Core	Urban	Fringe	Suburb
HH	0.09	0.43	1.33	1.67		Retail E	0.30	2.12	5.41	6.88
GQ	0.04	0.26	0.29	0.34						
HBO-Auto										
	Reg. Core	Urban	Fringe	Suburb			Reg. Core	Urban	Fringe	Suburb
HH	0.35	0.87	3.41	3.80		Office E	0.14	0.28	0.27	0.57
GQ	0.26	0.70	1.27	1.22		Retail E	1.49	1.90	3.71	3.30
						Other E	0.74	1.18	2.90	3.20
						HH	0.36	0.46	0.69	0.63
NHB-Auto + Light Trucks								.		
	Reg. Core	Urban	Fringe	Suburb						
Office	0.12	0.16	0.31	0.52						
Retail	1.03	2.36	5.13	4.76			Same as productions			
Other	0.23	0.29	0.64	0.63						
HH	0.19	0.14	0.21	0.23						
	Notes:									
	HH : Households									
	E : Employment									
	GQ : Persons in group quarters									
	Exurb : Any rural portion of the suburb for HBW only									

Trip Distribution Model

The spatial trip distribution gravity model was calibrated using separate procedures for work and non-work trips. Work person trips were calibrated to match Census jurisdiction-to-jurisdiction trip tables. Non-work trips were calibrated to match ground counts iterating the process shown in Figure 2. Trip generation rates were fixed while the F-curves were adjusted to alter trip lengths to ultimately match ground counts. This approach was used because of more confidence in the measured household trip generation rates than in either the home-interview trip generation rates or the home-interview trip length frequency distributions. And, more specifically, the authors believe that interviewees in travel surveys under-report short trips to a greater extent than long trips and may even inflate the long trips reported for a typical “yesterday”.

Total travel times used in the gravity model trip distribution model are the sum of highway terminal times, vehicle access times, highway network travel times and intrazonal travel times. Vehicle terminal times were derived from MWCOG’s destination times. Network travel times, as processed by TP/4in1, are based on link distances and a look-up table for speeds by facility type and area type. Link speeds are then modified based on each link’s capacity and user specified

Speed Delay Functions calibrated to the region. Intrazonal speeds are determined using a nearest neighbor technique available in TP/4in1.

For the nearest neighbor technique an 80 percent factor was used for both intrazonal distances and times. The derived intrazonal distances in TP/4in1 are used in estimating average trip lengths by trip purpose but are not accumulated in estimating network VMT.

The gravity model estimates travel between internal-to-internal zones, internal-to-external zones, and external-to-internal zones in one gravity model execution by trip purpose. In calibrating this model for the Washington, D.C. region, very steep friction factors were needed for the external stations along the Baltimore fringe. Figure 1 shows the cordon line adjacent to the City of Baltimore. In typical regions where the cordon line is located in the rural areas, the model can be calibrated with one regional F-curve. With the Washington D.C. region's cordon line following the City of Baltimore's fringe, trips crossing the Baltimore external station required special (short trip length) F-curves to calibrate.

Mode Split Model

The third step in the travel forecasting process is the mode split model and is presently applied to work trips only in the Washington region. The mode split factors for all forecast years were taken from MWCOG and are not explicitly modeled by TP/4in1. For this reason, they are referred to as "Freeze Dried Mode Split Factors". A regional factor is used to calculate the auto driver trips from the HBW person trips derived in Trip Generation. These factors can be modified to reflect the impact of express bus, light rail, heavy rail or HOV lanes. Techniques to model these freeze-dried modal split factors are currently being developed and refined as part of a study to develop a multi-modal transportation plan for all of Northern Virginia.

Trips Not Modeled

Trips not modeled were taken from MWCOG for all forecast years and added to the VDOT model results to obtain total vehicle trips. The categories of trips not modeled are:

1) Total truck trips in the Region
2) Miscellaneous trips in the Region including taxi, visitor and school type trips
3) Through trips that travel from external station to external station; that is, trips with neither an origin nor a destination within the cordon line.

Vehicle Trip Assignment Model

Following the trip distribution and mode split steps; the resultant production and attraction format trip tables for each trip purpose are added together by TP/4in1 and balanced using the MWCOG procedure. A single factor is applied to internal attractions to make total productions (internal plus external) equal total attractions. Next, this table is converted to true origin and destination of individual trips based on a 50 percent split in both directions. This approach is suitable for two-way trips in a 24-hour model.

For the trip assignment process, TP/4in1 uses four iterations of the incremental capacity restraint loading of the trips onto the highway network. Each incremental loading adds 25 percent of the

total trips to the network. The 24-hour capacity constraint on individual links is based on the 2KD factors and peak hour LOS-C speeds and capacities.

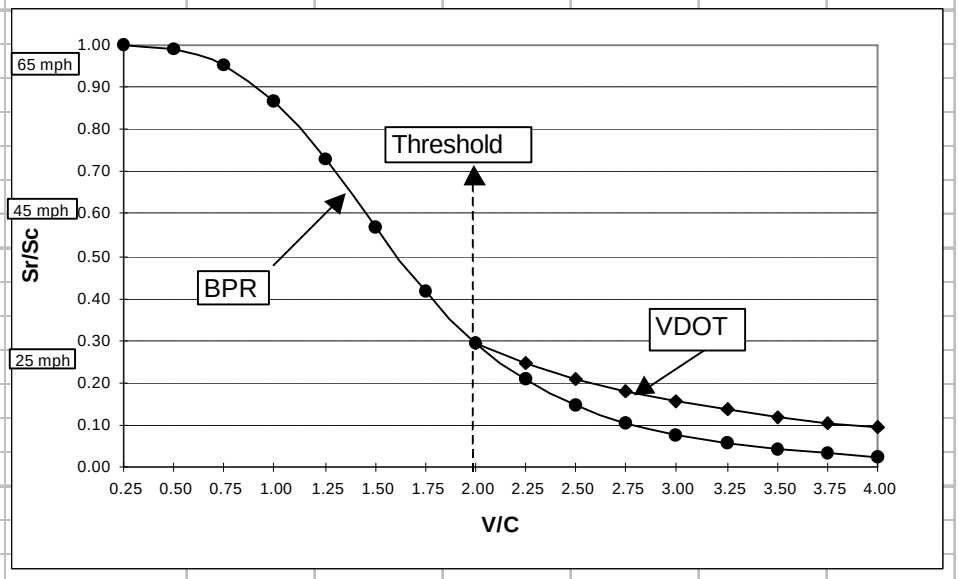
Speed Flow Relationships

Reductions or increases in link speeds, calculated for each successive iteration, are estimated for each path by relating congestion, defined by the volume-to-capacity ratio (V/C), to changes in speeds.

The VDOT Model applies a modified Bureau of Public Roads (BPR) equation to relate speeds at LOS-C to restrained speeds based on changes in V/C ratios. Figure 3 shows the standard form of the BPR equation and the calibrated curve used in the VDOT Model. The modified BPR curve uses a typical fourth power function up to V/C of 2.0 and a second power function for V/C ratios above 2.0. Calibration revealed that this flatter curve is more appropriate when V/C's exceed 2.0. The flatter curve for V/C ratios exceeding 2.0 not only produced better traffic assignments, but the final speeds matched the input gravity model speeds, which was one of the objectives for the model calibration. Federal rules require that gravity model input and traffic assignment output speeds in non-attainment areas be similar or a speed feedback procedure must be used. Thus, the typical speed feedback for the Washington region was not necessary.

Simulated VMT versus ground count VMT were compared across several screenlines and by jurisdiction, facility type and area type. The results showed no model biases in these comparisons after many iterations of model adjustments. At this point, the model was considered calibrated.

Figure 3
Speed Flow Relationship



BPR CURVE V/C < 2.0 : Sr = Sc*1.15 / [1.0 + 0.15(V/C)4]**
VDOT CURVE V/C > 2.0 : Sr = Sc*1.15 / [1.0 + 0.60(V/C)2]**

Where:

Sr = Restrained Speed (Congested Speed)
S_C = Speed at Practical Capacity (Level of Service "C")
V = Volume
C = Practical Capacity (Level of Service "C")

SUMMARY

In brief, some of the features and advantages of the VDOT Model are as follows:

1. Designed as a detailed regional model with up to 2250 zones, 17,000 nodes and multiple trip purposes.
2. Based on the new MIS model network link attributes.
3. Develops trip generation, mode choice and trip distribution on a zonal basis.
4. Capacity to run speed feedback loops, select link analysis, screen line summaries and VMT summaries.
5. Ability to implement link and node delay capacity restraints as well as turn volumes for traffic assignment.
6. Numerous formatted outputs; e.g., trip ends by purpose; trip length frequency distributions by purpose; formatted squeezed trip tables by purpose; and VMT by area, jurisdiction, V/C ratio, and speed ranges.

More importantly, TP/4in1, can run the entire standard 4-step transportation planning process (such as the VDOT model) in one execution on a PC computer, or it can be used to run each step separately.

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SESSION # 4

A PRACTICAL APPROACH TO TRAVEL DEMAND MODELING IN SMALL AND MEDIUM SIZED AREAS

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ABSTRACT

Travel demand forecasting is the foundation of many transportation planning activities such as; 1) long term system planning; 2) sub-area/corridor study; 3) air quality conformity analysis; 4) transportation concurrency analysis; and 5) assessment of development impact fees. Many large urban area transportation planning agencies invest a significant portion of their staff time and resources in developing and maintaining their traffic models. However, small and medium-sized urban area planning agencies have fewer resources to dedicate to traffic model development. These communities can develop and maintain adequate traffic models, but they will have to use some practical and cost-effective approaches.

Through developing, updating, calibrating and applying several large and small urban area travel demand forecasting models, the author has accumulated some practical approaches for travel demand modeling. These practical approaches include roadway network and traffic analysis zone definition, network data collection and processing, socioeconomic variables and trip purpose categories selection for trip generations, gravity model coefficients fine tuning for trip distribution, and model calibration.

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Introduction:

Small to medium sized urban areas differ from large metropolitan areas in many ways. For example, in small to medium sized urban areas: 1) household incomes tend to be more homogeneous; 2) transit plays a smaller role in the transportation system; and 3) any single industry or institute may be a significant trip producer or attraction that warrants special consideration when modeling traffic. In terms of urban form, smaller urban areas are relatively newer and tend to have a less structured street network and census geography. In terms of applications, small urban area models are expected to provide long range travel demand projections, and assist in short range traffic operations analysis --- similar to a subarea model of a large regional model. These differences require that travel demand modeling in small urban areas be handled differently.

This paper describes some practical approaches in developing travel demand forecast models for small to medium sized urban areas. The first part of the paper is a general discussion of these techniques. The second part demonstrates how some of these techniques were applied in developing the Rogue Valley MPO Travel Demand Forecast Model as a case study.

1. Some Practical Approaches

Model development generally includes the following steps: traffic analysis zone (TAZ) and network definitions, the traditional four-step modeling process (trip generation, trip distribution, model split, trip assignment), model calibration/validation, and post model processing. This section describes some practical techniques for carrying out these steps.

1.1 TAZ Definitions

Traffic Analysis Zones (TAZ) are the building blocks of a model. A well-defined TAZ structure will contribute to accurate model trip distribution and traffic assignment. The smaller the zones, the better the model replicates the real world situation. In small to medium sized areas, it is more manageable to define traffic zones relatively small to improve model accuracy.

TAZ's are traditionally defined based on factors such as census and political boundaries, topographical barriers, homogeneous land use and roadway access. Many transportation planners prefer to follow census geography so that data collected in the decennial census can be used with minimal manipulation. This approach is especially applicable for areas with regular census geography and grid street patterns. However, in many small to medium sized urban areas, census boundaries tend to be more irregular and are sometimes too big to be used as a unit for defining TAZ's. Therefore, it is more desirable to reflect traffic access patterns rather than rigidly follow the census geography (see Figure 1). In this case, the relationship between TAZ and the census block can be established to facilitate the retrieval of census data.

In areas with grid street patterns, TAZ's have been traditionally defined with major arterials as their boundaries. To improve model performance, it may be more preferable to have TAZ straddle arterials, especially when transit services are present on the arterials (see Figure 2).

1.2 Trip Generation

Trip generation is the first step of the traditional four-step modeling process. In the trip general model, trips are divided into different categories by trip purposes. Examples of the trip purposes include Home-Based Work (HBW), Home-Based Shopping (HBS), Home-Based Other (HBO), and Non-Home Based (NHB). Generally, the more detailed the trip purpose categories, the more accurate the model.

Small to medium sized urban areas can sometimes be very different from large urban areas in terms of trip types composition. For example, a small city with a large university campus may have a high percentage of Home-Based College (HBC) trips. In this case, to more accurately represent college travels, it is a good idea to establish a HBC trip type. Similarly, small urban areas with a focus on tourism will have a large proportion of recreational trips that may warrant a special trip type called Home-Based Recreational trips (HBR).

(See hard copy for Figures 1 and 2)

Trip generation consists of two sub-models including the trip production model and trip attraction model. Typically, trip production models deal with the trip ends associated with the traveler's home, and trip attraction models deal with the trip ends associated with activities at places other than the traveler's home.

Lodging places such as hotels and motels are frequently defined as trip attractions. For urban areas with a heavy emphasis on tourism, however, it makes more sense to capture lodging places in both trip production and trip attraction models. That is, hotel and motel employees commuting to work should be accounted for in the trip attraction model, while tourists leaving lodging places to visit recreational sites and other places should be accounted for in the trip production model. Consequently, it is a good idea to define an additional trip type called Lodging-Based Recreation (LBR) to more realistically simulate recreational trip distribution patterns. Accounting LBR trips in the trip production model is especially important if trip production is to be held "constant" in the trip balancing process. This is because recreational trips leaving lodging places are made mostly by residents from outside of the modeling areas.

Generally speaking, trip production models deal with travel patterns related to demographic and socio-economic characteristics of households in the TAZ. The single most important variable used to forecast household travel is the household size. Other important variables include home type, income level or auto ownership, number of workers, etc. The more variables used, the more extensive the data required for the model.

For trip production, most large urban areas use some type of cross-classification model that range from simple cross-classification of number of trips and household size to more complicated multivariable cross-classifications. Cross-classification modeling is especially suited to large urban areas where household socio-economic characteristics are more diverse.

Household socio-economic characteristics in small to medium sized urban areas are usually more homogeneous than those found in large urban areas, the need for developing multivariable cross-classification is somewhat less significant to the modeling effort. Furthermore, many small urban areas planners have limited resources (in terms of time, funding, tools and local data) to develop refined cross-classification models for base-year conditions, not to mention the resources needed to forecast these variables for horizon year conditions.

A basic rule of thumb for determining what variables should be included in the cross-classification model is that the variable must be forecastable and will be forecasted. Small urban areas may find it to be more cost effective to develop a set of trip rate adjustment factors to account for variations in travel patterns as an alternative to developing a more complicated cross-classification model. For example, household income has significant impact on household travel, but if it cannot or will not be forecasted, then the income levels can be represented in the model by generalizing the information by geographic areas and their underlying property values.

1.3 Trip Distribution

Trip distribution and trip assignment are the second and fourth steps in the four-step travel

demand modeling process. In the trip distribution step, the trip productions and the attractions are converted to trip origins and destinations; trip origin zones and destination zones are paired. The Gravity model is the most commonly used model for trip distribution. The gravity model coefficient, called the friction factor, is a measurement of spatial separation between trip origin and destination zone pairs. Some modeling packages, such as QRS-II and Tmodel2, use a set of default functions called the gamma function to calculate friction factors. The gamma function is stated as the following:

$$F_{ij} = a * t_{ij}^{b} * e^{c*t_{ij}}$$

Where:
- F_{ij} = the friction factor relating the spatial separation between zones i and j
- a, b, c = gamma coefficients
- t_{ij} = travel time between zone i and zone j
- e = the base of natural logarithms

The coefficients in the gamma function vary according to the size and accessibility of a region. Modeling packages with gravity models built-in usually provide sets of default coefficients for areas of different sizes.

Some modeling packages, such as EMME/2, do not come with default formula and coefficients. Users of those modeling packages will need to supply the model with their own functions and coefficients. The coefficients used in the initial model runs need to be examined and fine tuned in the later model calibration process to achieve desirable trip length for each of the trip purpose types defined in the trip generation step. Since each trip purpose type requires a unique set of coefficients and each gamma function needs three different coefficients, to find several suitable sets of gamma coefficients for different trip purpose types can be very time consuming.

Alternatively, modelers can use a simpler exponential function to determine friction factors:

$$F_{ij} = \exp(-ßT_{ij})$$

Where:
- F_{ij}: friction factor between zones i and j
- T_{ij}: travel time between zones i and j
- ß: distribution parameter

Since this function only has one coefficient, it is much easier to test and find an acceptable value than the gamma function.

1.4 Mode Choice

Mode choice is the third and probably most complicated step in the four-step modeling process. It estimates the modal shares of the travel market when given two sets of data: 1) the time and cost characteristics of the various competing modes (typically transit and private vehicles) and 2) the demographic and socio-economic characteristics of area residents. The mode choice model requires extensive local data to develop. Since the transit mode share in many small urban areas is

less than one or two percent of all trips, small urban area modelers should evaluate the objectives of the mode choice model and the cost-effectiveness of achieving the objectives before committing their resources.

1.5 Traffic Assignment:

Traffic assignment is the fourth step of the four-step process. The traffic assignment process is driven by the relationship of the assigned volume and the resulting speed caused by congestion. This relationship is defined by volume-delay functions. Theoretically, volume delay functions do not vary with urban area sizes.

Traffic assignment is an iterative process. Modeling packages geared toward small to medium sized areas, such as QRS-II and Tmodel2, have a built-in feedback loop between trip distribution and trip assignment for each iteration of the model run to more realistically simulate traffic conditions. However, other modeling packages, such as EMME/2, do not have the automatic feedback loop. It is up to the users to implement this feedback loop in the modeling process. The feedback loop is extremely important in the testing of road improvement alternatives and of road closures.

1.6 Model Calibration

Model calibration/validation represents the final step in the model development process. In this step, base year model outputs, primarily traffic assignments, are compared to observed base year conditions to ensure that the model can reasonably replicate real world situations. The comparisons are usually done at the following levels:

- Link specific volumes
- Screenlines (check trip distribution and assignment)
- Cordon lines (checks both trip generation and distribution)
- Regional statistics such as RMSE (root mean square error) by facility type and volume groups

In the initial model test runs it is very likely that observed and estimated screenline volumes will not be within an acceptable range of values. An analysis of the source of the error will show where adjustments to one or more of the upper level models may be required. These adjustments may include land use inputs, trip generation rates, roadway network and link attributes, traffic counts, gravity model coefficients, volume delay functions, etc.

Model calibration methodologies and procedures are well documented in various literature and research papers. Since small urban areas rarely have local traffic survey data, trip generation rates are frequently borrowed from other areas or adopted from national averages. This practice makes validation of trip generation rates very important.

Residential trip production rates should be evaluated first by comparing screenline total assigned trips to actual total ground counts. If the total assignment is higher than the total ground count, it

is very likely that trip production rates are too high and should be adjusted down, provided that trip production is held constant in the trip balancing. On the other hand, if total assignment is lower than total ground counts, trip production rates may be too low and thus should be adjusted up. Once total assignments and total counts are within a reasonable range, trip generation rates for other land use types can be validated.

To validate trip generation rates for individual land use types, cordon lines can be developed around various areas with homogeneous land uses, such as single family residential areas, shopping centers, office complexes, and industrial parks. For example, if observed total base-year traffic counts along a cordon line around a shopping center are significantly higher than the model assignment, two possibilities exist: the trip rates used for the retail category is too low and/or the number of retail businesses/employees is under counted. This would require the validation of the number of businesses and employees first, then the adjustment of the trip attraction rates for the business types within the shopping center.

2. A Case Study – the Rogue Valley MPO Model

Rogue Valley Council of Governments (RVCOG), the federal designated Metropolitan Planning Organization (MPO) for the greater Medford urbanized area, is located in Jefferson County, Southern Oregon. It encompasses the cities of Medford, Central Point, Phoenix and White City and part of Jackson County with a population of approximately 100,000. Using the EMME/2 software, the regional model was developed in late 1995 to support the development of the MPO Long Range Transportation Plan. In addition to supporting the regional transportation system analysis and planning efforts, the local jurisdictions also expected the model to simulate traffic flow in relative detail to assist short-range traffic operations analysis.

2.1 TAZ and Network Definition

To meet the long range planning needs and local jurisdictions' expectations, TAZ's were defined as fairly small zones and network attributes were defined based on detailed roadway attributes.

Like many small urban areas, the Rogue Valley MPO has very irregular census geography. This is especially the case in its outlying areas. If TAZs are defined by following census boundaries, the TAZ in outlying areas would be too large to produce model results for evaluating specific roadway capacity deficiencies and improvement alternatives. Because the area has GIS based property parcel mapping, it was determined that census boundaries would be followed in the areas with grid street patterns. TAZs in outlying areas were defined by following property parcel boundaries and by considering how traffic accessed the roadway network.

To increase work efficiency, the roadway network was created in the spreadsheet file with detailed roadway geometrics and intersection traffic control types inventoried. Link capacities were calculated based on general per lane capacity adjusted by area types (CBD or urban peripherals, for example), lane width, median types, shoulder presence, down stream intersection traffic control types and the classification of cross street relative to the street under study. Other network data were also processed in a similar manner. The spreadsheet then generated a network

file in the EMME/2 format, which was directly imported into the EMME/2 for model runs.

2.2 Trip Production Model and Jackson County Household Activity Survey

The trip production model was developed based on the 1995 Jackson County Household Activity Survey (JCHAS). Household activity surveys were rarely conducted for medium to small urban areas because of the cost involved. In 1995, with the help of the Oregon Department of Transportation and Portland Metro, the Rogue Valley MPO joined the other three MPOs in the state and conducted the survey. The Sample households were recruited from a random listing of telephone exchanges within the study area. Each household in the sample was assigned a specific two-day period for which detailed data on all activities (even if travel was not involved) was collected. Household data collected included income, auto ownership, household size, dwelling type and personal data pertained to gender, age, ethnicity, employment background, and student status. The survey collected data from 1,781 valid sample households.

The survey revealed that household size was the single most important variable in explaining household travel patterns. Table1 shows the relationship between household size and number of average weekday trips. Also shown in this table is the result of the 1990 NATIONWIDE PERSONAL TRANSPORTATION SURVEY (NPTS) for comparison.

Table 1 - Household Trip Rates by Household Size
JCHAS vs. NPTS

Household Size	Person Trips		Vehicle Trips	
	JCHAS	NPTS	JCHAS	NPTS
One	3.7	3.7	2.9	3.2
Two	6.9	7.5	5.2	6.6
Three	12.3	10.6	8.1	9.4
Four & +	17.2	14.5*	8.6	12.4*

* Note: Estimated due to different number of categories between the two data sets.

As shown in the above table, compared to the national average, person trip rates for different household sizes in Jackson County are consistent with or close to the national averages, however, vehicle trip rates appeared to be lower across the board. Other key findings of the household activity survey are summarized in Tables 2, 3 and 4.

Table 2 - Household Income and Trip Rates

Household Income	Person trips	Vehicle trips
$0 - $19,999	6.3	3.6
$20,000 - $34,999	8.8	5.7
$35,000 - $49,999	11.3	7.0
$50,000 or More	11.1	7.5

Table 3 - Vehicle Trip Rates Cross-classification Household Size and Household Income

Household	Household Size				
	One	Two	Three	Four	Avg.
$0 - $19,999	2.44	3.51	6.29	5.60	3.60
$20,000 - $34,999	3.66	5.10	7.86	8.16	5.72
$35,000 - $49,999	3.17	5.51	8.40	9.09	7.00
$50,000 or More	4.06	6.25	8.91	10.25	7.54
Unreported	2.52	5.31	8.44	8.39	5.57
Weighted Average	2.93	5.18	8.08	8.55	5.78

Based on the household activity survey, trip purposes were divided into Home-Based Work (HBW), Home-Based Shopping (HBShp), Home Based School (HBSch), Home-Based Other (HBO), Non Home Based Work (NHBW) and Non-Home Based Other (NHBO). The percentages of trip type composition are shown in Table 4.

Table 4 - Distribution of Weekday Trips by Trip Purposes

Trip Purpose	Person Trips		Vehicle Trips	
HBW	4040	16.72%	3582	22.62%
HBShp	2906	12.03%	1968	12.43%
HBSch	1961	8.12%	302	1.91%
HBO	8679	35.92%	5562	35.12%
NHBW	1187	4.91%	1007	6.36%
NHBO	5391	22.31%	3416	21.57%
Total	24164	100.00%	15837	100.00%

2.2 Trip Attraction Model

In the travel demand modeling process, employment data was used to measure the attraction side of travel demand. Employment data was obtained from the State Employment Office (SEO). The data were compiled for the State Unemployment Insurance Program at the county level. The data were cross-checked against employment data contained in the County Business Patterns and was then geo-coded and field validated. To improve the estimation of trip rates and trip distributions, employment data was divided into detailed categories based on their trip attraction levels as shown in Table 5.

The trip generation model was implemented in a spreadsheet program to increase efficiency. The output of the spread sheet program was in an origin and destination format and could be directly imported into the EMME/2 program for trip distribution and assignment.

Table 5 - Trip Attraction Rates

Employment Type	HBW Trips	Non Work Trips
High Retail (i.e., super markets)	2.2 /employee	20.0 /employee
General Retail	2.2 /employee	13.0 /employee
Low Retail	2.2 /employee	4.0 /employee
Restaurant and High Services	2.2 /employee	8.0 /employee
General Services/Recreation	2.2 /employee	5.0 /employee
Lodge	2.2 /employee	1.0 /employee
Whole Sale, Trade and Construction	2.2 /employee	1.0 /employee
Industrial	2.2 /employee	0.5 /employee
Government/Education	2.2 /employee	4.0 /employee
Parks	N/A	6.0 /acre
Households	N/A	1.2 /household

2.3 Trip Distribution and Assignment

The gravity model was used for trip distribution and the exponential function $\mathbf{F_{ij} = exp(-ßT_{ij})}$ as described earlier was used to derive friction factors. The distribution parameter **ß** for different trip purposes is shown in Table 6.

Table 6 -Trip Distribution Parameters by Trip Purposes

Trip Purpose	HBW	HBShp	HBSch	HBO	NHBW	NHBO
ß	0.09	0.11	0.11	0.11	0.20	0.20

Since EMME/2 does not have an automatic feedback loop to link trip assignment and trip distribution, a macro feedback loop was implemented in the model as follows:

- The initial (first iteration) traffic assignment was performed using free flow speeds;
- The resultant zone to zone impedance metrics was then looped back into the trip distribution step and trips were redistributed and reassigned (second iteration);
- The second iteration impedance metrics were averaged with the first iteration impedance metrics which were then used as input into the third iteration;
- The feedback loop was repeated in the subsequent iteration runs until traffic assignments reached equilibrium (which usually takes about four to five iterations).

2.4. Model Calibration Results

Because of these detailed approaches, model calibration was very successful (see Table 7 and Figure 3). All indicators met or exceeded the targets set in the Oregon Statewide Travel Demand Modeling Guidelines.

Table 7. Trip Length Distribution Frequency by Trip Type*
(in minutes, exclude terminal times)

Trip Type	Model	Survey	Difference
HBW	10.62	12.33	86.1%
HBShop	10.11	9.25	109.3%
HBSchl	7.67	9.35	82.0%
HBO	8.20	9.46	86.7%
NHBW	7.41	8.75	84.7%
NHBO	6.47	8.40	77.0%
All	9.04	9.67	93.5%

* Note: It is acceptable that model results are slightly lower than the survey due to the fact that survey respondents tended to round up their travel times instead of reporting the actual times.

(See hard copy for Figure 3. Link Scattergram)

Conclusions:

Smaller urban areas differ from large metropolitan areas in many ways. Many small urban areas do not have sufficient resources to conduct expensive travel surveys, nor to recruit and retain a team of very specialized technical staff. Smaller communities have smaller geographic areas and fewer streets to model. Small urban area household income tends to be a more homogeneous socio-economic factor; transit plays a smaller role in transportation systems than in larger urban areas; any single industry or institute may be a significant trip producer or attraction that warrants special consideration. Smaller urban areas have a relatively newer urban form and tend to have a less structured street network and census geography. These differences make it necessary to handle travel demand modeling in small urban areas differently than it is handled in larger urban areas. As demonstrated in the case study, with appropriate care, transportation planners working in small urban areas can turn disadvantages into advantages while developing and maintaining an adequate model to support short and long-range transportation planning activities.

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Session #4

FREIGHT MODELING TECHNIQUES FOR SMALL AND MEDIUM-SIZED AREAS

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ABSTRACT

This paper presents a practical and low cost modeling technique to include freight demand and truck movements in the development of long range transportation plans.

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and the new Transportation Equity Act for the 21st Century (TEA 21) requires that States and Metropolitan Planning Organization (MPOs) consider urban freight in their long-range plans, transportation improvement programs, and annual work elements. However, in the last rounds of MPO long-range plan update certification reviews by the Federal Highway Administration (FHWA), one of the negative themes was the lack of freight and goods movement analysis within the current plans. This lack of analysis has occurred because most States and MPO's have little experience in freight planning, current and historical data on truck movements are limited, and most of the old freight models are extremely complicated.

In September 1996 the U.S. Department of Transportation released the final report on the *Quick Response Freight Manual* through the Travel Model Improvement Program. This manual provides the transportation modeler with simple techniques and transferable parameters which can be used to develop commercial truck movements within a conventional four-step planning model.

This paper combines the techniques presented in the *Quick Response Freight Manual* and a simple four-step TranPlan travel demand model to develop, assign and analyze commercial truck trips in a small to medium urban area. Using the simple techniques and transferable parameters, the model could be developed with a limited amount of actual truck data. In this model, truck trips are broken into three types: four-tire; single unit; and, combination. By keeping the truck trips and the auto driver trips in separate purposes, the modeler can preassign or assign the truck trips (all, four-tire, single unit, and combination) to a regular network or special truck network under a full equilibrium process.

FREIGHT MODELING TECHNIQUES FOR SMALL AND MEDIUM-SIZED AREAS

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INTRODUCTION

In September 1996 the U.S. Department of Transportation released the final report on the *Quick Response Freight Manual* through the Travel Model Improvement Program. This manual provides the transportation modeler with simple techniques and transferable parameters which can be used to develop commercial truck movements within a conventional four-step planning model.

This paper combines the techniques presented in the *Quick Response Freight Manual* and a simple four-step TranPlan [2] travel demand model to develop, assign and analyze commercial truck trips in a small to medium sized urban area. The goal of this technique is to allow the planner to:

1. Estimate truck trip generation using default rates
2. Prepare a truck network from existing highway network
3. Split truck trips into light, medium and heavy trucks
4. Distribute the trips purposes with a Gravity Model
5. Assign and analyze truck trips to a truck network
6. Assign and analyze truck trips, along with passenger car trips, to the entire network

.

Commercial vehicles under the quick response technique are broken down into three categories or purposes: Four-Tire Vehicles, Single Unit Trucks (6+ Tires) and Combination Trucks.

Existing Model Structure

This process assumes the urban area has a conventional four-step planning model with/or without a transit model or with/or without a separate truck purpose. For this discussion, let us assume that the area has a four-step planning model (using TranPlan), without transit, and with separate purposes for home-based work, home-based non-work, non home-based, truck, internal-external, and external-external.

One of the goals of determining the number of commercial vehicles is to be able to assign the medium and heavy trucks to a truck network. One simple approach is to develop a medium/heavy truck network from the existing highway network by removing most of the minor arterials and collectors from the network. Sufficient detail must be retained to allow access to each zone to be connected to the network for vehicles involved in local distribution. Another approach in establishing a truck network is to look at weight limits, truck restrictions and signed truck routes in the urban area. By creating the network with selected link identifiers, restrictions could be identified through a special lookup table.

Zonal Data Files

A typical urban area normally organizes its demographic data into employment categories by the Standard Industrial Classification (SIC)[4] code for each traffic analysis zone. The existing employment categories will continue to be used to develop the initial productions and attractions for the internal purposes. An employment breakdown is shown below:

Industrial Employment (SIC 01-39)
Commercial Employment (SIC 50-59)
Service Employment (SIC 40-49, 60-99)
Total Employment (SIC 01-99)

In the quick-response trip generation for commercial vehicles, the recommended procedure breaks employment categories into four categories using the noted SIC codes for each traffic analysis zone. This set of employment data will be used to develop the internal-internal commercial trips.

Agriculture, Mining and Construction (SIC 1-19)
Manufacturing, Transportation/Communications/Utilities and
Wholesale Trade (SIC 20-51)
Retail Trade (SIC 52-59)
Office and Services (SIC 60-88)

Trip generation rates, shown in Table 1, will be applied to employment and dwelling unit by traffic analysis zone. These rates were taken from a survey in Phoenix, Arizona as detailed in the *Quick Response Freight Manual*. Although there are many freight trip generation studies that were reviewed as part of the effort to develop the QRF Manual, the Phoenix rates were selected as the default generation rates. The Phoenix rates were found to be close to the median value for all of the available generation studies. Additional values can be reviewed in the FHWA manual, "Characteristics of Urban Freight Systems."

In order to compute truck productions and attractions simple spreadsheets can be utilized. It is recommended that production and attraction be created for all three truck categories. This step is critical because as will be shown later in the paper the trip length frequency for the three truck categories are significantly different and must be distributed separately.

During the trip generation balancing process the trip destinations or attractions will be set equal to origin or productions. Shown in Table 1 are the recommended truck trip generation rates. If more current rates are available from local or state studies those rates should be used.

TABLE 1 TRIP GENERATION RATES[3]				
Generator	Commercial Vehicle Trips Per Day			
Employment	Four-Tire Vehicle	Single Unit (6+ Tires)	Combinations	Total
Agriculture, Mining, Construction	1.110	0.289	0.174	1.573
Manuf, Comm,Util, Wholesale	0.938	0.242	0.104	1.284
Retail	0.888	0.253	0.065	1.206
Office & Service	0.437	0.068	0.009	0.514
Households	0.251	0.099	0.038	0.388

External-Internal

The external-internal productions can be determined by using the existing external-internal purposes and applying the default values in Table 2 - Percent Distribution of Traffic by Vehicle Class, Surveys: HPMS Defaults, *Quick Response Freight Manual*, the vehicle types can be assessed at each station. If external station surveys or classification studies near the external stations are conducted, they should be used rather than Table 2.

TABLE 2 Percent Distribution of Traffic by Vehicle Class					
Functional Class	Non-Commercial Vehicles	Commercial Vehicle			
		Four-Tire Vehicle	Single Unit (6+ Tires)	Combinations	Total
Rural					
Interstate	87.20%	3.3%	2.9%	12.2%	100.0%
Other Principal Arterials	88.50%	4.7%	3.2%	4.9%	100.0%
Minor Arterial, Collector, Local	86.60%	5.3%	3.6%	2.6%	100.0%
Average - Rural	86.60%	4.7%	3.4%	5.3%	100.0%
Urban					
Interstate	88.20%	5.5%	1.8%	4.5%	100.0%
Other Freeways/Expressways	90.50%	5.5%	1.7%	2.3%	100.0%
Other Principal Arterials	89.50%	6.6%	1.7%	2.2%	100.0%
Minor Arterials	90.40%	6.4%	1.7%	1.5%	100.0%
Collectors	90.30%	6.4%	1.8%	1.5%	100.0%
Locals	91.00%	6.4%	1.8%	0.8%	100.0%
Average - Urban	89.80%	6.2%	1.7%	2.3%	100.0%

Source: Vehicle Classification Data of FHWA and Census' Truck Inventory User Survey[2]

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External to internal productions are normally established from existing counts and percent splits between external-external and external-internal for each station. The resulting external-internal number at the external station becomes the total vehicle production for the station. The external-internal productions are then split by non-commercial and commercial vehicles as noted in Table 2. The total internal-internal attractions computed during the internal-internal generation step can be utilized to scale the internal-external attractions to the internal-internal productions by each purpose.

External-External

The existing trip table can be factored using Table 2 Percent Distribution of Traffic by Vehicle Class as noted above to develop a new set of external-external trip tables for four-tired, single unit, and combinations.

MODEL PREPARATION

The existing trip purposes have been expanded to accommodate the commercial truck breakdown. From the existing six purposes, trucks is the only purpose not used in creating the eleven new purposes as noted below:

Existing Purposes	
Purpose 1 - HB Work	No Change
Purpose 2 - HB Non Work	No Change
Purpose 3 - Non HB	No Change
Purpose 4 - Truck	Not Used - New purposes
Purpose 5 - External-Internal	Non Commercial - New purpose
Purpose 6 - External-External	Non Commercial - New purpose
New Purposes (Trucks Internal-Internal)	
Purpose 7 - Int-Int Four-Tired Trucks	New
Purpose 8 - Int-Int Six-Tired Trucks	New
Purpose 9 - Int-Int Combination Trucks	New
New Purposes (Trucks External-Internal)	
Purpose 10 - Ext-Int Four-Tired Trucks	New
Purpose 11 - Ext-Int Six-Tired Trucks	New
Purpose 12 - Ext-Int Combination Trucks	New
New Purposes (Trucks External-External)	
Purpose 13 - Ext-Ext Four-Tired Trucks	New
Purpose 14 - Ext-Ext Six-Tired Trucks	New
Purpose 15 - Ext-Ext Combination Trucks	New

Simple spread sheets can be utilized to compute the internal-internal and external-internal truck purposes. By using the Matrix utility program in TranPlan the external-external trip table was split into the commercial and non commercial vehicle trips.

Since the new purposes created by this procedure are all auto driver trips and assumed to have one person per vehicle, this procedure will work for both transit and highway only models. The trip purposes may be referenced by a different number. However, the process is the same.

MODEL APPLICATION

The model application includes the following additional steps in the process:

Truck Network

Building the truck network
Building minimum time paths
Skimming the truck minimum paths

Distribution

The distribution process uses the Gravity Model to distribute the productions and attractions. This process is divided into three passes as noted below:
Pass 1 - Non-Commercial: Computes standard distribution for HB Work (1), HB Non-Work (2) and Non Home-Based (3).

Pass 2 - Light Truck: Computes distribution for external-internal and internal-internal trip purposes using the normal updated free-flow skim paths. This pass will compute trip tables for int-int four-tired trucks (7), ext-int non-commercial vehicles (5) and ext-int four-tired trucks (10).

Pass 3 - Medium and Heavy Trucks: Computes distribution for external-internal and internal-internal trip purposes using the special updated free-flow truck skim paths. This pass will compute trip tables for int-int six-tired trucks (8), int-int combination trucks (9), ext-int six-tired trucks (11) and ext-int combination trucks (12). Friction factors may need to be adjusted to account for the heavy trucks.

When applying the gravity model, separate friction factors will have to be used for the three truck classifications (four-tire commercial, single unit-six tired, and combination) due to their different trip length characteristics. If local friction factors are not available default values from the QRF manual are available. Table 3 lists the default values.

Table 3
Friction Factor Default Values

Four-tire Commercial Vehicles	-	Fij = e-0.08*tij
Single Unit Trucks	-	Fij= e-0.1*tij
Combination Trucks	-	Fij= e-0.03*tij

The important characteristic of Table 3's friction factors is that combination vehicles will have a longer average trip length than four-tire and combination trucks.

Mode

Each of the trip tables are converted to auto driver trips (purposes 1-3), split into origin and destinations and saved as individual trip tables. This allows the trip tables to be combined in different ways during the assignment process. A simple matrix utility is utilized to combine the individual trip tables. A vehicle occupancy conversion is not necessary for truck trips since they are considered to single occupant vehicles.

Assignment

Three assignment processes are setup for this analysis. The first process assigns medium/heavy trucks to a special truck network. The second process preloads medium/heavy truck trips and assigns the remaining light trucks, non-commercial vehicle trips to the full network using the equilibrium assignment techniques. The third process preloads medium/heavy truck trips and assigns remaining light trucks to the full network using an all-or-nothing assignment technique.

The preload technique is part of TranPlan Modeling Package. This technique can be utilized with the equilibrium assignment technique.

CONCLUSIONS

This quick response process of developing truck trips using the default generation rates and external truck classification can be successfully implemented in TranPlan or any other planning model as a first step in the evaluation of truck trips. Later, as existing truck counts are obtained and internal and external surveys are completed, the default values could be replaced with local updated parameters. This procedure is valid for small to medium sized urban areas.

Application of this procedure has also been done in larger urbanized areas such as Detroit. In the Detroit application overall truck vehicle miles travel (vmt) simulated from the truck model was

consistent with vmt truck estimates from field surveys. There was a tendency for truck forecasts to be high or low by 20% when stratifying the results by highway functional classification.

REFERENCES:

1) U.S. Department of Transportation, Travel Model Improvement Program, Quick Response Freight Manual, Final Report, September 1996, Washington, D.C. 20590

2) The Urban Analysis Group, URBAN/SYS User Manual for TranPlan, Version 9.0, Hayward, CA 94541

3) Earl Ruiter, Cambridge Systematics, Inc, Development of an Urban Truck Travel Model for the Phoenix Metropolitan Area, February 1992, Report Number FHWA-AZ92-314, prepared for the Arizona Department of Transportation and the Federal Highway Administration.

4) U.S. Department of Transportation, Travel Model Improvement Program, Quick Response Freight Manual, Appendix C, Standard Industrial Classification (SIC) Codes, Final Report, September 1996, Washington, D.C. 20590

SESSION 5 - COORDINATING TRANSPORTATION AND LAND USE PLANNING

Moderator: Libby Rushley
Ohio Department of Transportation

Panelists: Cindy Gray, Fargo-Moorhead Metropolitan Council of Governments
Terry R. Klim, TransCorp and Doug Bilse, Transportation Agency for Monterey County
Dr. Frederick H. Wegmann and Dr. David Clarke, University of Tennessee
Mike Partridge, Washington Department of Transportation

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Session #5

Fringe Land Use Guide and Street Plan

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ABSTRACT

The Fringe Land Use Guide and Transportation Plan has been developed over the past two years by the F-M Metropolitan Council of Governments. One of the primary purposes of the project was to extend arterial and collector street planning beyond city limits, and even beyond the two mile extraterritorial area, to allow Cass County to more effectively plan for the future urban characteristics of the area. Another effort of the study was to identify and resolve issues of incompatible land uses in the areas where Fargo, North Dakota and West Fargo, North Dakota are growing together. The study included portions of Cass County, to address fringe areas outside the city limits where a significant amount of rural development is occurring. This study is also part of a larger effort to help policy makers understand that there is a strong relationship between transportation and land use planning.

The combined population of Fargo and West Fargo, North Dakota is approximately 97,000. There is no physical separation between the two communities, such as a river or highway, so in many areas the two cities are growing together and only a city limit line separates them. This has caused problems between the two communities related to the approval of incompatible land uses across city limit lines and varying philosophies/policies regarding the function and location of arterial and collector streets. Further complicating these issues is the fact that the extraterritorial area of the two cities overlap, and there is some competition for new growth areas.

Techniques which could be applied in other Metropolitan Areas

- **Formulation of recommendations for future ROW acquisition and access management along corridors identified as future arterial roadways -** Adoption of the study provides a guideline for the County and townships with regard to ROW requirements and limited access policies that should be implemented, even if they are decades in advance of urban development in the area.
- **Formation of a review process for future land use and transportation changes in the area defined as the "fringe area" -** Planners from all three jurisdictions and the MPO will convene to discuss the effects of proposed land use or roadway changes in the fringe areas, where they have the greatest potential to effect the other two jurisdictions. Input from the group will be provided to the Planning Commission considering the

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proposed change. A process for this was set up in the study.

- **Incorporated land use and transportation plans of all three jurisdictions onto a single map -** The map then became a tool for review and discussion of incompatible land use combinations and transportation planning issues. As a result of the review process described above, the map will be updated and refined on a regular basis.
- **Development of a map showing likely first and second tier of future urban development -**Projected annual acreage of urbanization was calculated, resulting in "moderate" and "high" development scenarios for the metropolitan area. The results will be used to guide the cities during decisions regarding infrastructure expansion, etc. and also provide good public information.

Introduction

The purpose of the Fringe Land Use Guide and Transportation Plan was to help local governments work together to plan for transportation facilities in their growth areas. In addition, it was to assist local governments to work together to plan compatible land uses in their growth areas. The intent was to focus on land use compatibility with future transportation facilities and land use compatibility with adjacent land uses.

The project was initiated by two elected officials who believed that more cooperation with regard to land use and transportation planning between the three neighboring jurisdictions of Fargo, West Fargo, and Cass County would be beneficial. Most of the local planning staff agreed, but the project was not well defined.

In one or two of the participating jurisdictions, staff and/or elected officials viewed the project as an attempt to usurp local approval authority for development proposals. They seemed to fear that the project would give adjacent jurisdictions too much authority in what was developed in their own jurisdiction.

One of the interesting aspects of the project is that it was strongly supported by the Cass County planning and engineering staff. These individuals had concern over land use, right-of-way, and access decisions that would be incompatible in a future urban situation.

Evolution of Project Goals: One Product Leads to the Desire for another Product

The study review committee for the project was made up of planning staff from each of the three local jurisdictions participating in the project. Engineering staff was consulted throughout the project. At various points throughout the project, the Study Review Committee was expanded to include an elected official from each jurisdiction. This allowed the staff on the Committee to present our decisions about the direction of the project and the products to a small group of elected officials for early feedback. This direction often resulted in an expansion of the project goals. Some examples of how the direction of the project evolved are described below.

Study Area

The initial focus of the study was a high growth area south of Fargo and West Fargo, where the two cities were growing together and growing into the County. In addition, there is a significant amount of rural development taking place in this area. Upon consultation with the elected officials on the Study Review Committee after completing some of the initial products of the study, the study area was expanded to include all of the two mile extraterritorial zoning area of Fargo and one mile extraterritorial area of West Fargo.

Land Use Planning

Initially, the focus of the project was to compare land use plans that had already

been prepared by the Cities, for the purpose of identifying any areas where land use planning adjacent to city boundaries was incompatible with land uses in the adjacent jurisdiction. This effort was carried out by compiling the land use plans of the two jurisdictions, and placing them on a single map. Several potentially incompatible situations were identified and discussed as to how the land use plans could be changed to eliminate the incompatibility.

Since the City of Fargo did not have a comprehensive land use map that included all of their extraterritorial area and West Fargo had not updated its comprehensive plan since the mid 1980s, there was a significant amount of extraterritorial area in which no future land use planning had been carried out. In addition, Cass County does not carry out land use planning or zoning, and one of the six townships within the study area had a zoning ordinance which dealt with rural types of development.

The lack of planning in the extraterritorial area became very obvious to the elected officials when the land use plans of the two cities were plotted on one map showing city boundary lines and extraterritorial limits. At this point, the Study Review Committee decided to develop land use "guidance" for the rest of the extraterritorial area. This resulted in a cooperatively developed land use map including the entire extraterritorial area of both jurisdictions.

Functional Class Designations and Right-of-Way Requirements

With regard to transportation planning, the project was originally intended to identify future urban roadway designations in the extraterritorial area and several miles beyond. Future arterial roadways were identified up to approximately five miles beyond existing city limits. Specific locations for collector streets were only identified in the first mile or two beyond existing city limits, since those were the areas in which more detailed planning had taken place. In the remainder of the study area, it was noted that at least one continuous north/south and east/west collector street was needed per section of land, to allow drivers to get from one arterial to another without significant diversion through neighborhoods.

Upon further discussion by the Committee, it was determined that it would be important to determine the amount of right-of-way that exists in the location of the future arterial roadways. Most of these arterials will be located on existing section lines, where a minimum of 66 feet of right-of-way already exists. Some facilities have varying amounts of right-of-way, ranging from 66 feet to 150 feet. The Committee agreed to recommend that right-of-way of 150 feet be preserved for all future arterial roadways. This was based on three reasons:

1) a ROW of 150 feet is needed for a two lane paved rural roadway and road ditches,
2) a ROW of 150 would allow for a future four lane roadway with left and right turn lanes, a raised median, boulevards, a

sidewalk on one side, and a bikeway on the other side, with adequate ROW for expansion to a six lane roadway if needed, and

3) the public had recently responded very positively to landscaping of wide boulevards on a corridor which was recently reconstructed, and the general feedback was that future corridors should be designed similarly.

This compilation of ROW data and recommendation for ROW preservation of 150 feet went beyond the original scope of the project.

Cooperative Review Process

In the early stages of the project, it was thought that after the two land use maps had been compiled onto one map, a series of discussions would take place to address incompatible land use combinations, or land uses that were incompatible with future arterial roadways. However, as these discussions took place, it became obvious that although the committee could formulate a recommendation for correcting these situations, the elected leaders would not find it acceptable to modify existing land use plans through the adoption of this multi-jurisdictional study. Rather, they strongly viewed land use decisions as an area on which they would act independently, and would not easily change as a result of pressure from a neighboring jurisdiction. Therefore, any changes to address incompatible land use combinations would needed to be completed later, after local consideration of the recommendations of the fringe area study.

The Committee considered what action could be taken through this study to prevent future incompatible situations. The outcome was the development of an on-going cooperative review process agreeable to all jurisdictions. This process will be described in further detail later in this paper.

Map of Growth Tiers

Initially, the Committee was asked to consider estimating the future growth rates for the purpose of developing maps which showed the extent of urban expansion in five year increments. These projections were to be based on acreage consumption data of development that occurred over the past 10 years. Completion of this task was undesirable to local staff, who encountered obstacles such as inconsistent methods of gathering acreage information, and uncertainty of the direction of development even in the next five years. Due to uncertainty of a new elementary school location and the potential for the City of Fargo to establish

incentives for development in one area of the City, local planning staff was uncomfortable with mapping a five year growth ring which was so subject to change.

Due to these concerns, this effort was dropped from the scope of the project. After consultation with the elected officials, they suggested a 20 year growth estimate based on acreage consumption data. This effort was not as subject to the decisions close-at-hand which could have greatly influenced development in the next five years, and was completed as part of the project.

Different Approach

The order in which the land use and transportation elements of this study were carried out was somewhat unusual. The transportation planning aspect of the project was the most agreeable aspect of the study, and was therefore completed first. This was due to the fact that Metro COG had traditionally been responsible for transportation planning in the metropolitan area. The Transportation Plan for the metropolitan area as well as other past studies provided valuable data to begin the process of extending arterial and collector roadway planning farther into the fringes of the urban area and beyond. Local staff was comfortable allowing Metro COG to lead the coordination effort and the staff input into the transportation element of the project. This was not necessarily the case with the land use planning efforts. Therefore, filling in the extraterritorial area with land use guidance was completed after the arterial roadways had been agreed upon. This is a different approach for planners who are accustomed to preparing traffic impact studies.

Study Accomplishments

Despite the difficulty in settling on a project scope, the Study Review Committee remained open to input from the elected officials throughout the project. The efforts of the Committee and the input from the policy makers yielded a study with several important products for the metropolitan area. They are listed below:

Transportation

- Cooperatively identified and agreed upon arterial roadways (most on section lines) - Continuity issues needed to be discussed and resolved in several cases;

- Cooperatively developed a plan for collector streets in the first mile of fringe area development;

- Agreed that at least one continuous collector street was needed per section; more than one in intense commercial areas or within the first mile of an interstate highway, where the dependence upon continuous collectors is more significant due to limited access onto and over/under the interstate;

- Identified existing ROW and roadway surface;

- Identified future ROW needs for fringe area arterials (150 feet) and collectors (80-100 feet plus 15 feet if a bikeway is planned);

- Identified the need for future river and interstate bridge locations;

- Familiarized elected officials with options for preserving and acquiring ROW;

- Familiarized city, county, and township officials with the benefits of access management;

Land Use

- Prepared a map that combined the planned land uses of both jurisdictions in fringe areas - The map served to show the extent of extraterritorial area where land use planning was not carried out;

- Cooperatively developed a land use "plan", or guidance for the entire extraterritorial area, accounting for existing and future features such as arterial roadways, sewage lagoons, airports, possible leasing and development of NDSU land, floodway data, etc.

- Identified areas of potential land use incompatibility both across jurisdictional boundaries and across boundaries of the section-by-section plans within the City of Fargo's study area;

Early Steps of Growth Management

- Identified a likely first "tier" of URBAN growth (urban versus the rural subdivisions currently allowed to occur in the area);

- Developed a combined growth rate for the two cities (250 acres per year for the past 10 years, 525 acres per year for the past two years); (see Table 1 below)

Table 1
Estimated Development within the Next 20 Years, 1997-2017
Fargo/West Fargo Urbanized Area

Time Frame for Development	20 Year Urban Development Tier			20 Year Urban Development Tier Plus Planning Tier		
	Acres Developed Inside Existing City Limits	Acres Developed Outside Existing City Limits	Total Acres	Acres Developed Inside Existing City Limits	Acres Developed Outside Existing City Limits	Total Acres
	Percent/ Acres	Percent/ Acres		Percent/ Acres	Percent/ Acres	
1-5 Years	80% / 1000 Acres	20% / 250 Acres	1250 Acres	50% / 1375 Acres	50% / 1375 Acres	2750 Acres
6-10 Years	50% / 625 Ac.	50% / 625 Ac.	1250 Acres	25% / 690 Ac.	75% / 2060 Acres	2750 Acres
11-20 Years	25% / 625 Ac.	75% / 1875 Acres	2500 Acres	10 % / 550 Acres	90% / 4950 Acres	5500 Acres
Total Acreage	**45% / 2250 Acres**	**55% / 2750* Acres**	**5000 Acres**	**24% / 2615 Acres**	**76% / 8385** Acres**	**11000 Acres**

** Equivalent to 4.3 sections of land* *** Equivalent to 13.1 sections of land*

- Used the lower growth rate to identify a 20 year growth tier, and the higher growth rate to identify a "planning tier" to demonstrate the need to increase planning efforts in these areas; and

- Developed assumptions regarding the percentage of urban growth that would occur inside and outside existing (1997) city limits in 10 year increments.

These were the accomplishments directly related to transportation, land use, and growth management. Perhaps the most important, on-going result of the study was the development of the Cooperative Review Process. It is discussed separately in the next section of the paper.

Development of a Cooperative Review Process

The most significant result of this project was the development of a Cooperative Review Process. The inclusion of this process in the recommendations of the study was also the most controversial aspect of the adoption of the project. The process was formed out of a desire to use the land use and transportation guidance developed in the study. It was also supported by staff as an opportunity to work with other local planners, and have increased opportunity to seek the input of

other professionals during the planning process. On a less positive note, it was also formed as a result of a lack of trust between jurisdictions.

The process is described below:

> Proposals of any kind that involve a land use or transportation issue are checked for consistency with the land use guidance in the fringe plan. If an inconsistency is noted, the Study Review Committee is reconvened. The Study Review Committee determines if it should support the change, based on whether or not the proposal appears consistent with the land use and transportation features agreed to in the Fringe Land Use Guide and Transportation Plan. It also determines what other changes might be needed to recreate a compatible situation if the proposal is approved.
>
> Written input is provided to the Planning Commission of the jurisdiction considering the project. This allows the Planning Commission to consider the point of view of the Committee who developed the Fringe Land Use Guide and Transportation Plan. Through this written input, the Planning Commission can consider the project from more of a "big picture" point of view, taking the joint recommendations of planners from neighboring jurisdictions into consideration.
>
> If a change is approved which creates an unharmonious land use or transportation combination, the Study Review Committee is reconvened to revise the land use guidance or transportation planning element.
>
> Another agreed upon feature of the process is that the land use guidance and transportation planning in the study are to be updated at least annually.

Useful Applications in other Cities and MPOs

Several lessons were learned throughout the development of this project that could be applied in other cities and metropolitan planning organizations. They are described below.

Allow for the evolution of project goals - When local planners are asked to participate in a project that is not necessarily suggested by them or desired by them, patience is required to allow for the development of trust between the participants. During this time, the participants can begin to see possible benefits of carrying out a cooperative planning effort.

Right-of-Way information for arterial and collector roadways - In situations where ROW information is not readily available and corridor preservation efforts are extremely important to the future of the transportation system, having a compilation of existing and future ROW information can help to prevent lost opportunities for obtaining the necessary future ROW. In addition, the inclusion of future ROW needs in this data base is equally as valuable as data regarding the existing ROW.

Concept of establishing a land use "guide" combined with a transportation planning element - In a situation where an area is seriously lacking in land use planning, the establishment of a "guide" can serve as a first step. This step may help policy makers to become more comfortable with making future land use decisions in future growth areas rather than allowing the market to dictate future land use decisions.

Use of Growth Rate Information - In situations where planners and policy makers are uncomfortable guiding or estimating short term growth, starting with a long range growth estimate is a good starting point. In this case a 20 year growth tier was established. A more recent, higher growth rate from past two years was used to establish another larger ring of growth, which was identified as a "planning tier". The establishment of the planning tier was helpful as it assists the public in understanding the purpose of future planning efforts being carried out miles from existing city boundaries.

Cooperative Review Process - Establishment of a review process agreed to by all participating jurisdictions does not resolve existing land use inconsistencies, but it does set the stage for more cooperative planning and review of development proposals in the future. In addition, it provides the Planning Commissions and elected officials with a broader base of input both geographically and professionally.

Educating Rural Townships - Through the public involvement process, property owners and elected officials were educated about how their decisions are related to future urban issues. Subdivision design, access management, results of increased traffic, and blending rural developments into urban settings were some of the subjects covered at these meetings, which were well received by property owners and township supervisors.

Mapping Multi Jurisdictional Land Uses and Transportation Systems - The simple step of placing the future land use plans and transportation systems of all participating jurisdictions on one map provided an invaluable tool for furthering discussion of the land use and transportation issues. In addition, it helped participants in the project to move toward the goal of viewing the study area as one metropolitan growth area, versus individual jurisdictions pushing toward independent city boundary lines.

Conclusion

This project was an example of how a metropolitan planning organization can help bring about improved coordination and cooperation between jurisdictions within its study area. By consistently bringing this multi-jurisdictional Committee together to discuss the needs of the project, some of the resistance to working together was eliminated. Participation in the project also initiated discussions on several subjects that have become follow-up projects, such as a comparative study of subdivision regulations, a south side Red River bridge crossing corridor preservation study, and further efforts to establish growth management methods in the extraterritorial area.

Session #5

Fort Ord Redevelopment: Coordinating Transportation and Land Use Planning

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ABSTRACT

The closure of military bases and conversion to civilian land uses is a challenging task faced by many small communities throughout the nation. Fort Ord is located in Monterey County, California and encompasses 28,000 acres of reprogrammed property. The twenty-year plan for the former military base involves replacement of 20,400 jobs and 12,800 barracks with 18,000 civilian jobs, over 13,500 residential units and a new state university for 25,000 students. The Fort Ord redevelopment plans were developed concurrently with a regional transportation study resulting in two important documents, the *Fort Ord Reuse Plan/Environmental Impact Report* and the *Fort Ord Regional Transportation Study*. This paper highlights how these two documents examined the transportation needs of the former base in context with the proposed regional transportation system. The planning process for Fort Ord redevelopment was generally considered a success in terms of forging a general consensus. The Fort Ord Reuse Plan received the American Planning Association's *1997 Outstanding Planning Award for Comprehensive Planning in a Small Jurisdiction.*

These plans incorporated several multimodal elements that balanced optimistic mode shifts with historical auto use. Land use and development patterns were identified as important factors contributing to the use of alternative modes of transportation. By employing concurrent planning strategies, the base reuse plan was able to explore opportunities for coordinating land use and transportation planning. The concepts of jobs-housing balance, mixed-use development, and higher density land uses were successfully employed as a means of reducing potential impacts and minimizing infrastructure costs. To ensure coordination throughout the redevelopment process, the land use guidelines promoted transit and pedestrian oriented development while the roadway design standards incorporated pedestrian and bicycle facilities. The early phases of development on the former military base are centrally located along a corridor that can best utilize transit and the existing infrastructure. This multimodal corridor serves the area's most pedestrian- and transit-oriented projects, the California State University of Monterey Bay and the University of California's Monterey Bay Environmental, Science and Technology Center.

Potential funding strategies for the proposed transportation improvements were also addressed. To support the possible implementation of a development-related financing mechanism, a nexus analysis of the proposed transportation improvements was conducted. The purpose of this analysis was to identify the "fair share" of each improvement that could be allocated to future development, both within the base and off-site. The resulting multimodal transportation plan and

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financing strategies were designed to give local planners and policy makers the information needed to build a new community where development will not outpace the infrastructure.

Fort Ord Redevelopment: Coordinating Transportation and Land Use Planning

1. BACKGROUND

Fort Ord is located in Monterey County, California adjacent to the Monterey Bay. It is in the County unincorporated area within the spheres of influence of the following cities: Marina, Seaside, Del Rey Oaks, and Monterey (see Figure 1). The effort was therefore multi-jurisdictional and involved several regional agencies creating a challenging political climate. For example, a simple relocation of a proposed shopping center to mitigate impacts meant transferring anticipated sales tax revenues and mitigation measures from one jurisdiction to another. The planning effort was further complicated because a national marine sanctuary to the west and prime agricultural land to the east border the former military base.

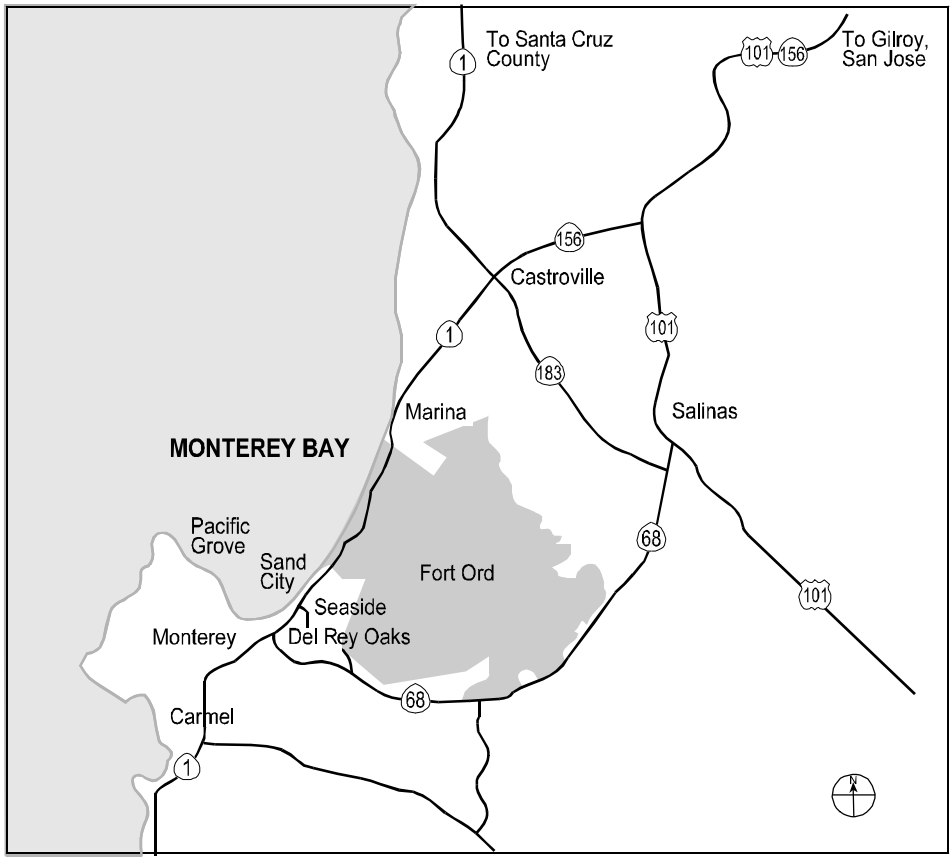

Figure 1
Fort Ord and Surrounding Area

Prior to closure, Fort Ord maintained 12,800 housing units and supported 20,400 military and civilian jobs. The Reuse Plan calls for 13,500 housing units and 18,000 new civilian jobs and a state university for 25,000 students. To put this planning effort into perspective, former Fort Ord represented approximately thirty percent of the combined population for the neighboring Monterey Peninsula and over ten percent of the entire county's population. The economic impact

of the base, in terms of annual money spent (e.g., payrolls, construction, contracts and local purchases) was estimated at $538 million including a payroll over $447 million.
This paper reports on the results of two planning efforts conducted simultaneously, the *Fort Ord Reuse Plan* undertaken by the Fort Ord Reuse Authority (FORA), and the *Fort Ord Transportation Study* managed by the Transportation Agency for Monterey County (TAMC). The FORA Reuse Plan includes a base-wide land-use plan, proposed General Plan amendments for each affected jurisdiction, business plan, public facilities improvement plan, and an environmental impact report (EIR). The traffic circulation element of the FORA Reuse Plan focussed on on-site transportation projects and land uses that best supported proposed development within the former military base. The Fort Ord Transportation Study forecasted regional transportation needs, designed a multi-modal transportation system for the Monterey County region, and quantified the financial burden of proposed development on and off the base.

A critical aspect of these two reports was the need to assess traffic impacts without being critical of the plan or interfering with the jurisdictions' land use authority. It was important to use a regional perspective so that Fort Ord development was not singled out as the only development creating the need for the proposed transportation improvements. Several regional transportation facilities were critical to redeveloping the former military base, therefore the financial plan relied on a Fort Ord development fee and a regional traffic impact fee to produce a balanced and feasible financial plan that did not over-burden development on or off the base. The resulting developer fees were compared to anticipated land values, and revisions were made to the land uses, mitigation measures and phasing of the project until the plan was economical.

The Fort Ord Reuse Plan had to use inventive measures that promoted alternative modes of transportation, while acknowledging that most of Monterey County residents currently drive in single-occupancy vehicles. The early phases of development are centrally located to best utilize the existing infrastructure and a multimodal corridor designed to serve the area's most pedestrian and transit oriented projects, the California State University of Monterey Bay and the University of California's Monterey Bay Environmental, Science and Technology Center. The local jurisdictions will greatly benefit if alternative modes are used by early development because the service life of the existing roadway system will be extended and costly capacity increasing roadway projects can be delayed or even eliminated.

2. A CONCURRENT, ITERATIVE PLANNING APPROACH

Planning for the redevelopment of an area as large as Fort Ord involved a large number of stakeholders and a variety of technical considerations. Stakeholders involved in the process included jurisdictions/institutions expected to receive land on former Fort Ord, neighboring jurisdictions expected to be impacted by the redevelopment, regional/state agencies, and the general public. Technical considerations included environmental constraints related to coastal and agricultural concerns, water resources, and a limited existing infrastructure. In addition, over 70% of the base was conveyed to such agencies as the California State University, University of California, California State Parks District and numerous homeless shelters and social service agencies before either the land use or infrastructure plan were completed.

The comprehensive and concurrent method used in the Fort Ord planning process was an important reason for its success. This approach featured the simultaneous development of the Fort Ord Reuse Plan and the Regional Transportation Study as well as a new approach in using various technical and economic factors in the development of the land use plan. In the typical planning process, illustrated in Figure 2, land use or development proposals are primarily a desire recognized by the project sponsor. The development plan is almost finalized before the impacts and related mitigation measures are determined. The mitigation measures, including transportation improvements, are almost viewed simply as "a cost of doing business". This was largely the process used in the previous planning efforts for Fort Ord. These preliminary land use plans were a collection of long-range visions and reflected the individual expectations of the local jurisdictions. This initial plan included a disproportionate share of higher tax-generating uses with relatively few residential units. The impacts and related costs were considered late in the process and used to identify significant constraints to the optimistic initial plan and ultimately lead to the realization that a more reasonable plan was needed that minimized mitigation costs.

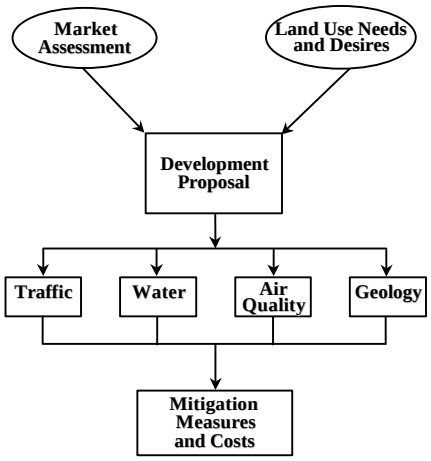

Figure 2
Typical "Cost-of-Doing-Business" Approach

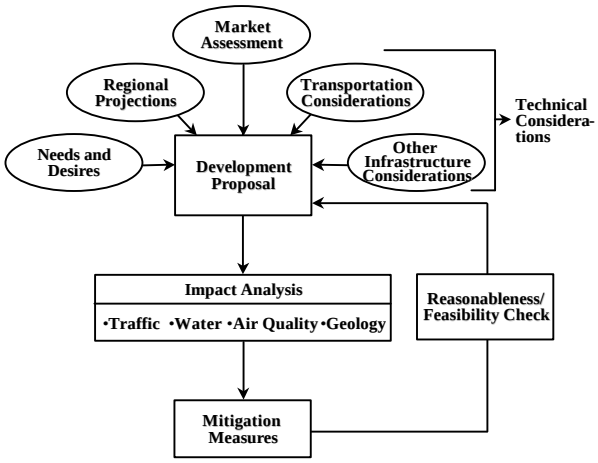

Figure 3
Concurrent / Iterative Process

With this knowledge, the FORA Reuse Plan effort was initiated. This time a more comprehensive approach was undertaken. This approach, as illustrated in Figure 3, included the following features that contributed to the success of the Fort Ord effort:

- Early consideration of technical factors - Land use planners worked with transportation, environmental, market analysis, economic, infrastructure and resource professionals to develop the reuse plan in an interactive and concurrent manner. This was achieved through a series of meetings at the outset of the project where all team members put forth their ideas, described constraints related to their technical filed, and commented on the initial proposals. From a transportation perspective, this provided an opportunity to incorporate several transportation-based strategies that could minimize the vehicular-travel impacts and to establish development patterns that were more conducive to non-auto modes of travel such as transit, bicycle and walking.

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- Concurrent assessment of impacts – Once a preliminary land use element was established, each technical group assessed the impacts relative to their field of expertise and proposed the mitigation measures. Once again, several meetings were held to discuss intermediate results and potential revisions to the land use element that may reduce significant negative impacts. This ensured that all team members used the most current data and were properly informed of changes.

- Iterative process - The FORA Reuse Plan incorporated a feedback between the mitigation assessment and the land use plan development. In this way alternative scenarios and refinements were tested to ensure that the resulting impacts fell within the constraints identified earlier. For example, the initial traffic impact analysis led to revisions in land use patterns to make better use of existing infrastructure and to reduce mitigation costs. Overall, this iterative process resulted in numerous revisions in the scale and/or pattern of land use, and especially the phasing of the redevelopment.

As noted earlier, another important characteristic of the Fort Ord planning effort was the simultaneous performance of the Reuse Plan and Regional Transportation Study activities. This ensured that both local and regional concerns were addressed and that the analysis in both cases was based upon the same inputs and assumptions. Finally, this provided an opportunity for regional issues and impacts to be addressed not only through proposed mitigation measures but also through refinements to the Reuse Plan's land use element.

3. KEY FEATURES OF THE REUSE PLAN

The transportation system developed as part of the Reuse Plan and the Regional Transportation Study defines the long-term vision for a comprehensive circulation network within, through and around Fort Ord. This system includes freeway, arterial, bus and rail transit, and bicycle and pedestrian components brought together to provide the most effective design possible while enhancing the community and protecting the environment. It is important to note the strong relationship between land use and transportation, and the coordination that occurred in developing the land use and transportation plans for the former Fort Ord. The jobs/housing balance, land use densities, and urban form all played a significant role in the design of the transportation system.

The transportation-land use relationship was used effectively with the objective of minimizing the impacts and costs related to the proposed development in two key ways: by encouraging the use of alternative modes and by maximizing the number of trips captured completely within the boundaries of the former fort. The following key concepts were employed in the preparation of the land use element of the Reuse Plan:

- Jobs/Housing Balance: The Reuse Plan attempts to maximize the number of trips captured completely within the project boundaries by encouraging quality employers to locate near residential sites and add affordable housing near commercial employment centers. The initial land use plans had more jobs than the proposed housing could support, and this created a disproportional number of morning commuters entering Fort Ord from the surrounding areas.

The roadway system, in turn, had to be designed to serve a relatively large in-commute while traffic in the reverse direction was below capacity. The revised land use element improved the jobs/housing balance resulting in an even commute flow to and from the former military base, which in turn provided a better utilization of the roadway network. This reduced the average commute length, minimized the number of lanes on the major arterials, and potentially decreased transit costs by promoting equal ridership in each direction of service.

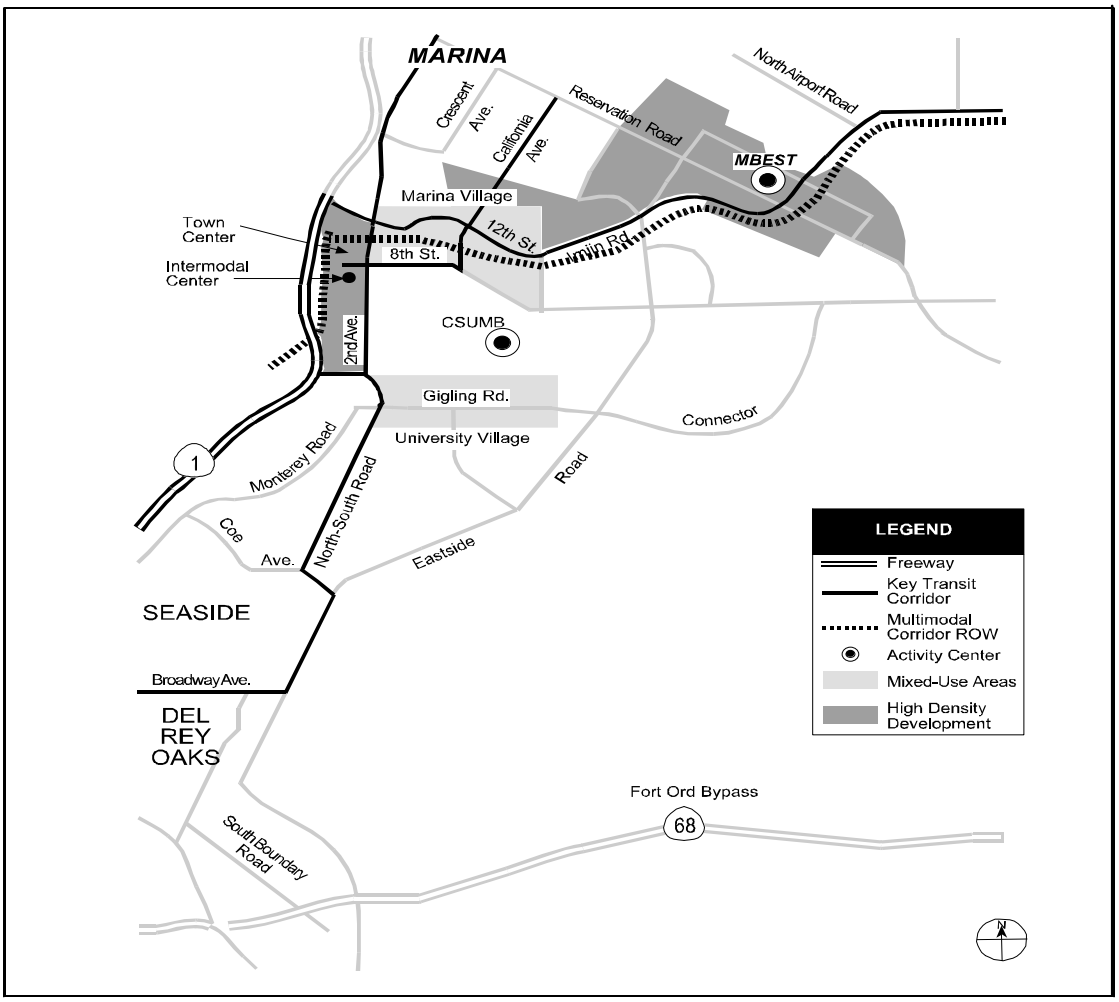

Figure 4
Key Land Use Elements

- Mixed-Use "Villages:" In a mixed-use development, residents of the area can patronize the local commercial uses without using their auto and employees can eat lunch at the local eateries. The Reuse Plan includes two mixed-use villages adjacent to the CSUMB campus (see Figure 4) comprised of commercial, office and residential auxiliary uses. These villages are located near the proposed transit corridor and are primarily intended to provide services to the students and university employees.

- Higher Density Areas Adjacent to Major Corridors: It was recognized early on that there are few, natural major transportation corridors through Fort Ord. These were identified based upon topography, existing infrastructure, and current connections to the regional system. It was natural to make these corridors the focus of proposed transit services. In turn, to help support the effectiveness of transit, higher density development was prescribed for these corridors (see Figure 4). Having these higher density areas allows for achieving the desired levels of overall development, but helps to minimize the transportation impacts of that development. Higher densities in the mixed-use areas result in a decrease in the distances between uses, further encouraging walking and reducing vehicle travel. In single-use developments, higher densities can mean greater opportunities for carpooling and transit service.

- Transit- and Pedestrian-Oriented Development (POD/TOD) Design: – In addition to land use patterns, the design of individual developments can impact the use of alternative modes. Providing convenient walkways and access to transit facilities can encourage use of these modes. The Reuse Plan includes guidelines that promote transit-oriented and pedestrian-oriented designs. To help support the effectiveness of transit, higher density development was prescribed along these corridors (see Figure 4). In single-use developments, higher densities can mean greater opportunities for carpooling and transit service.

The next step was to develop a multi-modal transportation system that incorporated these land-use-based strategies. Streets and roads form the basic component of the transportation system, but the strategies discussed above were used to minimize traffic mitigation costs in the following transportation elements:

- Roadway Element: The Fort Ord planning effort included the definition of an internal arterial network and the identification of regional roadway improvements needed to achieve acceptable levels of service. A total of $838 million in roadway improvements were identified, including $74 million for roadways within Fort Ord, $59 million for arterials outside the base, and $705 million for state highways. To support multimodal travel, the street cross-section design standards include right-of-way for bicycle and pedestrian facilities.

- Transit Element: Although transit historically accounts for only a small percentage of all trips in Monterey County, it was felt that Fort Ord redevelopment provided an opportunity to establish more transit-friendly communities. A key to achieving this goal was developing land use patterns that are more likely to support transit use, are easier to serve, and provide ridership in each direction of service throughout the day. This, in turn reduces transit subsidies as more of the costs are recovered through the fairbox. The transit element includes expanded bus service, a long-term rail corridor to Salinas, construction of transit-related facilities (an Intermodal Center and two park-and-ride lots), and the purchase of new transit vehicles. Initially, the expanded transit service focuses on the higher density corridors near the CSUMB campus.

- Pedestrian Element: A critical factor in promoting pedestrian activity is to have land uses that permit trips that can be easily and safely walked. Thus, the Reuse Plan includes requirements for sidewalks on all urban roadways, sidewalks and pedestrian walkways in major new developments and public facilities, and crosswalks at all signalized intersections and other

major intersections where warranted. The reuse plan includes several scenic paths near the campus where a high percentage of trips are expected by pedestrians and bicyclists.

- Bicycle Element: To promote bicycle travel, the Reuse Plan includes the designation of a base-wide bicycle network that includes both commuter routes and recreational trails. The bicycle plan includes Class 1 bikeways on all urban arterials with lower class facilities on other roadways, and the provision of secure bicycle parking at centers of public and private activity. Once again, the land use pattern is critical in achieving a community that facilitates bicycle travel, especially near the college.

4. FINANCING STRATEGY

A basic constraint to the implementation of the proposed system is the ability to fund these improvements. The financial plan required three steps:

1. Estimate the costs for each proposed project and summarize them into general funding categories;
2. Identify existing funds and estimate future local, state and federal funding allocations for each funding category; and
3. Propose potential funding sources for each funding category and determine if the expected shortfall can be reasonably financed.

Table 1 breaks down the estimated transportation costs and indicates that the price tag to implement the proposed regional capital and operational improvements approached one billion dollars. Capital improvements account for nearly 88% of the total transportation costs associated with the proposed transportation system with the largest share needed for state highway improvements. Once the transportation system was defined and a cost estimate was completed, expected funding sources were identified to establish the estimated financial shortfall.

Table 1
BREAKDOWN OF ESTIMATED COSTS BY IMPROVEMENT TYPE

Improvement Type	Estimated Cost	Percent Share
Total Capital Costs	**$857 million**	**88%**
Highway Capital Improvements	$705 million	73%
Regional Arterial Capital Improvements	$59 million	6%
On-Fort Ord Arterial Improvements	$74 million	8%
Transit Capital Improvements	$19 million	2%
Transit Service Expansion (Operations and Maintenance)	**$112 million**	**12%**
Service Expansion for Fort Ord	$56 million	6%
Service Expansion for Other Growth Areas	$56 million	6%
Total Transportation Costs	**$ 969 million**	**100%**

Table 2 highlights costs, expected funds, and anticipated shortfall by funding category. This table illustrates the key conclusion that existing sources are not expected to provide sufficient funding necessary for future improvements and new funding sources will therefore be essential to finance

the proposed improvements. In response to the anticipated funding shortfall, this study explored a number of options for funding the estimated $724 million shortfall in necessary transportation improvements.

Because some funding sources are constrained with respect to the types of projects that may be funded, a main purpose of this report was to provide direction for financing the suggested improvements. One of the biggest challenges was to assign the costs without alienating the stakeholders. The potential funding sources focussed on development-related financing, but also included current state and federal funding allocations, tax increment financing, local-option taxes, and toll roads. Development-related financing is limited in that the amount contributed must be proportional to the impact of the new development, and in most cases developer fees are limited to capital costs only (i.e., transit operating costs are difficult to extract). To support the possible implementation of a development-related financing mechanism, a preliminary nexus analysis of the proposed improvements was conducted. The purpose of this analysis was to identify the "fair share" of each proposed improvement that could be allocated to future development. As part of this process, dedicated or expected funding for each improvement was identified, and the remaining balance distributed between Fort Ord development, non-Fort Ord development and public shares. These shares were determined based upon the projected relative contribution to the demand for an improvement.

Table 2
ESTIMATED COSTS, EXPECTED FUNDING AND SHORTFALLS

Improvement Type	Costs/ Expected Funding
ROADWAY CAPITAL	
Total Estimated Costs	$838.0 million
Expected Sources:	$209.0 million
Shortfall	$629.0 million
TRANSIT CAPITAL	
Total Estimated Costs	$19.0 million
Expected Sources:	$ 0 million
Shortfall	$19.0 million
TRANSIT OPERATIONS	
Total Estimated Costs	$131.0 million
Expected Sources:	$ 36.0 million
Shortfall	$ 95.0 million
ALL IMPROVEMENTS	
Total Estimated Costs	$969.0 million
Total Funding from Expected Sources	$245.0 million
Total Anticipated Shortfall	$724.0 million

For each roadway improvement, the nexus analysis involved the identification of the Fort Ord and non-Fort Ord contributions to the volume increase while the current congestion was assigned to the “public share” (to be financed by a proposed sales tax). For example, the former Fort Ord’s contribution to added trips is equal to the percent of growth (new trips) with one trip end in the

former Fort Ord. For financing purposes, a trip with only one end in the former Fort Ord was assigned 50 percent of the impact. Public shares were determined based on the need to correct existing deficiencies. Costs were also allocated to the public share where conditions suggested that a true nexus for development-related financing may not apply (e.g., a significant portion of trips on a segment having ends outside the study area). For transit service improvements and intermodal facilities, where numerical forecasts of use or demand were not available, the allocation of costs was based primarily on the geographic location of the proposed improvement. The results of the preliminary nexus analysis for individual projects are presented in Table 3.

As indicated in Table 1, transit capital improvements represent a relatively small amount of the cost for new service while anticipated increases in operational and maintenance expenses represent the largest costs for providing transit service. With respect to transit operations and maintenance, expected funds for service improvements include those derived from the population-based Local Transit Fund (LTF) program, and from farebox revenues. It was assumed that the per capita transit funding from LTF will remain constant at $22. Therefore the LTF funds generated by Fort Ord population growth to the year 2015 is forecast to be $703,736, while that generated by off-site growth is $1,793,540. It was also assumed that a farebox recovery of 30% would be achieved and used to reduce funding needs for transit operating costs. At this level, farebox revenues are expected to cover $33.6 million of the estimated $112 million in service improvement costs. The estimated increase in operating funds still left a sizable shortfall that is expected to be funded by local contributions.

Table 3
SUMMARY OF PRELIMINARY NEXUS ANALYSIS
TOTAL COST SHARE ALLOCATION BY IMPROVEMENT TYPE

Share	Roadway and Transit Capital Improvements	Transit Operation and Maintenance Improvements	Total
Dedicated or Expected Funding	$209.0	$36.0	$245.0
Fort Ord Development	$117.0	$38.5	$155.5
Non-Fort Ord Development	$252.0	$37.5	$289.5
Unfunded Public Share	$279.0	$0	$279.0
Total	$857.0	$112.0	$969.0

The capital cost data from Table 3 is reorganized in Table 4 and used to estimate the developer fees on and off the base. All development was converted to “equivalent dwelling units”, or EDU’s, based on the number of daily auto trips generated. That is, if a drug store generates 5 times as many daily trips as an average household, it is converted to 5 EDU’s. The proportion of traffic improvement costs allocated to Fort Ord development was divided by the forecasted EDU’s on the former military base to get a fee per equivalent dwelling unit. The Fort Ord Traffic

Fee was approximately $8,200 per EDU, while the Regional Traffic Fee approached $3,000 per EDU.

The data from table 4 served as a reality check by identifying where the proposed funding sources will go in terms of projects. Current funding is primarily allocated to state highway projects, which remains significantly underfunded and will require traffic fees on and off the base and a proposed ½-cent sales tax to completely finance. The traffic fees on and off Fort Ord indicate the magnitude of the traffic impacts expected from proposed development. Of particular interest is the relatively balanced distribution of the proposed Fort Ord traffic fees. That is, the central location and land use plan on the former military base evenly distributes its impacts to the different transportation improvement categories and will require all types of transportation improvements to fully mitigate the assessed traffic impacts. Considering the magnitude of the Fort Ord Reuse Plan, it is important to note that its traffic impacts represent over half of the mitigation costs of all other development planned in Monterey County over the next twenty years.

Table 4
SUMMARY OF PRELIMINARY NEXUS ANALYSIS
CAPITAL COST SHARE ALLOCATION BY FUNDING SOURCE

FACILITY	Current Funding	Fort Ord Traffic Fees	Regional Traffic Fees	New Funds/ Sales Tax
State Highways ($704M)	143.0	60.0	210.5	291.1
Off-Site Arterial Improvements ($59M)	0.0	31.9	21.2	1.7
On-Base Road Improvements ($74M)	9.8	53.1	15.1	0.1
Transit Capital Improvements ($19M)	0	8.8	5.0	5.0
FUNDING SOURCE TOTAL	152.8	153.8	251.8	297.9

The team members from each discipline of this planning effort conducted a similar financial analysis for each type of mitigation. Preliminary results indicate that the mitigation costs for all types of environmental impacts on Fort Ord equate to approximately $60,000 per EDU. Unlike most development where the cost of land is negotiated before the mitigation measures are known, the land on former Fort Ord will be transferred from the Army to the Fort Ord Reuse Authority (FORA) and the price is currently being negotiated. The financial information generated from both reports was vital in these negotiations, as FORA can support its claim that the land value should be reduced by $60,000 per EDU. The financial analyst for this project concluded that the estimated fees should leave a residual land value after FORA pays the Army for the land. That is, the final base reuse plan resulted in reasonable land uses that are economically achievable and that a competitive market value for the land will remain to attract developers.

5. CONCLUSIONS

A key feature of the Fort Ord Reuse Plan was the proposed phasing of development in terms of both density and location. This comprehensive phasing plan was developed to match development needs and impacts with the existing infrastructure and several near-term improvements. This approach allows time to secure the funding for major improvements that will

be needed as development spreads to areas lacking infrastructure and promotes increases in intensity creating greater demand to use existing facilities. One of the biggest benefits of this approach is that surburban sprawl is limited.

Several bold assumptions were made as part of the financial plan used in both reports. The implementation of the regional impact fee and passage of a ½-cent sales tax appear to be overly optimistic. However, the overall effort led to a financially feasible FORA Reuse Plan that requires the implementation of an on-base traffic financing mechanism to insure mitigation measures are implemented. As some of the local jurisdictions begin to pay into the on-base fee program, which promotes more development, its benefits will hopefully spread and the regional impact will become a reality.

The resulting regional impact fee is relatively small compared to existing fees in neighboring counties. This conclusion was expected to be well received by the policy makers and form the basis for the regional transportation plan over the next 20 years. However, several of the policy makers in Monterey County were not ready to support any regional traffic impact fee. The lack of support was mainly the result of the misinterpretation that traffic fees obstruct development and that the proposed projects over the 20-Year planning horizon were overly ambitious. Subsequent work will be required before the regional impact fee can be implemented. For example, policy makers should identify a subset of the transportation improvement projects determined to be vital for the region's short-term economic development. This list could then be used to institute a short-term regional impact fee program that is more palatable.

A primary goal of the TAMC Study was to assure that the general public would not have to finance development on the former military base. Most of the funds from the proposed sales tax would fund state highway improvements currently needed to ease existing congestion. As a reality check, the transportation costs allocated to the public sector is consistent with the funding expected to be generated from a countywide ½-cent sales tax over a ten-year period. The passage of any sales tax is difficult, and would be much more difficult had the public been given the impression that the tax would help finance development, or improve roads that aren't already heavily congested.

Although not without difficulties or disagreements, the Fort Ord reuse planning effort was largely a critical success. Indeed, the Fort Ord Reuse Plan received the American Planning Association's *1997 Outstanding Planning Award for Comprehensive Planning in a Small Jurisdiction*. From a transportation perspective, there were several keys to this success:

- Ensure that transportation considerations are an input to the development of the land use element. Consideration of potential traffic impacts early in the development of the land use plan is valuable in minimizing their magnitude and the costs for mitigation.

- Educate stakeholders about the potential impacts and costs of development early in the planning process. It was easier to promote the concepts of multi-modalism and land use/transportation integration once policy-makers were shown the cost savings of this approach.

- Interact with other professionals. Foster communication, let ideas and concerns flow between disciplines, address problems quickly, tailor strategies to the situation, and be creative.

Session # 5

ABSTRACT

Priority Technique for General Aviation Airport Investments in Tennessee

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One issue state departments of transportation must address is the allocation of funds among competing general aviation airport projects. For example, the Tennessee Aeronautics Division administers an annual program for funding projects at airports throughout the state. Although the annual funding available from state and federal funds for the program is currently almost $12 million, the demand for projects far exceeds the available monies. Further, continued reductions in the Federal Airport Improvement Program (AIP) funding for small airports has increased the competition for funding. For many years, general aviation airport projects in Tennessee were awarded on a first requested, first funded basis. With the increase in requests and the reductions in funding, a rational system for project selection was needed. Accordingly, the Division developed a scoring system to rank and prioritize projects. The system considers a variety of factors for each project, including safety, economic impact of the airport, and usage.

The State Transportation Equity Fund, created in 1986 by act of the General Assembly, is the principal source of state funding for airport improvement. Taxes on the sale of aviation fuel are collected by the fund and allocated to the Department of Transportation for use in the airport program. The program received about $11.1 million from the Equity Fund during 1997. Using these funds, the Department makes statewide grants to Tennessee air carrier and general aviation airports to support safety, airport improvements, and landside improvements. The Department will cover up to 75 percent of the total cost, depending upon the type of project.

The Aeronautics Division also serves as the administrator in Tennessee for grant applications to the Federal Aviation Administration's (FAA) AIP for all airports except primary commercial service. Since over 90 percent of the state's 78 general aviation airports are located in small or medium sized communities, the prioritization technique has extensive implications on the economic development associated with airport investments for these communities.

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The paper describes the prioritization technique developed for the Tennessee Aeronautics Division. Point scores are awarded in relation to project objectives, type of improvement, airsides versus landside functions, airport usage, and sponsor responsibility. Discussed are the advantages and disadvantages of using a formal prioritization technique and how the benefits and costs of projects were considered along with issues of providing equity among airports of different sizes and economic development potential.

Priority Technique for General Aviation Airport Investments in Tennessee

Overview

General aviation (GA) facilities comprise the vast majority of the nation's civilian airports. In contrast, commercial service airports having regularly scheduled passenger service are a relatively small percentage of the airport population; these primarily serve large and medium sized population centers. GA airports vary widely in terms of intended function, services, aircraft rating, intensity of usage, and support facilities. However, in common they exist to serve the non-commercial segment of the aviation industry. This includes a diversity of users, among them recreational aircraft owners, agricultural pesticide applicators, cargo and passenger charter operators, and corporate aircraft. Some airports cater to a single market segment, while others serve elements of several of these groups. Typically, GA airports are limited by runway characteristics to the smaller propeller driven and jet aircraft, although a few have the capability to handle the largest jets used in passenger and cargo service.

General aviation airports are frequently associated with specific communities. While common, by no means is municipal ownership or control the norm. Ownership by county governments or independent airport authorities also occurs frequently, with state government and private sector GA airport ownership less common. Regardless of ownership, however, the primary markets for most GA airports are the urban areas within reasonable proximity, typically as measured in driving time.

Most small and medium sized communities view their associated GA airports as important assets in the quest for economic development. This is especially true when the community either has no commercial service airport or is poorly served by one. Industrial recruiters consider the lack of a suitable GA airport to be a major detriment in enticing industries to locate in an area without commercial service. Many corporations use business aircraft to transport executives to remote plant sites. In addition, they may use charter air cargo operators or corporate business aircraft to bring high priority shipments of critical components or raw materials to a factory site or to make emergency deliveries from plants to key customers. Such companies are felt not to be likely to locate in areas without a suitable GA airport. Besides business uses, GA airports may also provide economic benefits from usage by the recreational aircraft community, including both based aircraft and itinerant operations. In some cases, tourism is an important segment of such usage.

Many states have an agency charged with promoting aviation, setting aviation policy, ensuring coordination with federal funding agencies, and providing grants for airport construction and maintenance. Typically, the state department of transportation (DOT) performs these roles. One important issue state DOTs must address is the allocation of funds among competing GA airport projects. For example, the Tennessee Department of Transportation (TDOT) Aeronautics Division administers an annual program for funding projects at airports throughout the state. Although the annual funding available from state and federal funds for the program is currently almost $9 million, the demand for projects exceeds the available monies. Further, continued reductions in the Federal Aviation Administration (FAA) Airport Improvement Program (AIP) funding for small airports have increased the competition for funding. Many other states grapple

with similar problems. To address airport funding distribution, Tennessee and other states have developed project priority ranking systems which attempt to score projects based up a specified formula and set of criteria. A major issue with such systems is the balance between the state perspective and the interests of the local community served by the airport. As a state agency, a DOT must, of necessity, balance the statewide role of the airport system against the local issues associated with each individual facility.

This paper describes the prioritization approach developed for the TDOT Aeronautics Division. For many years, GA airport projects in Tennessee were awarded on a first requested, first funded basis. With the increase in requests and the reductions in funding, a more formal system for project selection was needed. Accordingly, the Division developed a scoring system to rank and prioritize projects. The system considers a variety of factors for each project, including safety, economic impact of the airport, and usage. Point scores are awarded in relation to project objectives, type of improvement, airsides versus landside functions, airport usage, and sponsor responsibility. Discussed are the advantages and disadvantages of using a formal prioritization technique, how the benefits and costs of projects were considered, and issues of providing equity among airports of different sizes and economic development potential. Also discussed is how the prioritization technique is an element integrated with long-range planning and the capital improvement program.

Background

The State of Tennessee has a long history of involvement in aviation. Tennessee's policy is that every community of 2,500 or more in population will be no farther than 30 minutes driving time from an airport. With minor exceptions, this goal has been fulfilled. The state's approach has been to encourage the development of GA facilities by local interests, with state and federal grant monies made available to aid construction. Only one of the 78 GA airports in Tennessee is state owned—a rural facility serving Reelfoot Lake in the northwest corner of the state. Most of the remainder of the airports are owned by county or municipal governments, although eight are privately owned, public use facilities. Fixed base operators run the publicly owned airports.

The Tennessee State Transportation Equity Fund, created in 1986 by act of the General Assembly, is the principal source of state funding for airport improvement. Vendors of aviation fuel in Tennessee report annual sales to TDOT, which then requests an appropriate share of the collected taxes from the state's Department of Revenue. The Fund generated about $11.1 million during 1997. The annual total fluctuates because of variations in amount of aviation activity, though in general it has been on an upward trend.

Because fuel tax revenues are generated by both commercial and GA aircraft operations, the Equity Fund is not devoted strictly to the GA airport system. The current disbursement program allocates 50% of the Fund revenues to commercial service airports for use as the required local match on FAA funded projects. Forty percent of the revenues are then earmarked for the GA airport program, with the remaining 10 percent available for discretionary purposes. In 1997, the Fund provided slightly in excess of $4.4 million for GA airport improvements in Tennessee.

Using Equity Fund monies, TDOT makes grants to GA airports statewide to support safety, airport improvements, and landside improvements. The Aeronautics Division is responsible for awarding and administering these grants. Grants will cover up to 75 percent of the total cost, depending upon the type of project. Airports are required to provide a local match for the remainder of the required project funds.

For all except primary commercial service airports, the Aeronautics Division also serves as the state administrator for grant applications to the federal AIP. This program is awarded by the FAA to TDOT on a block grant basis. In 1997, $4.5 million was available, with no local match required. The AIP does have eligibility requirements, however, which must be met by applicants.

In summary, Tennessee has available some $9 million annually for investment in the GA airport system. These monies provide the major funding base for all capital improvements to the publicly owned GA airports in Tennessee. Few of the cities and towns served by GA facilities would be able to bear the complete cost of such improvements. Thus, the state provided funding is essential to the system. However, the demand for funding greatly exceeds the available money. Since only a portion of the requested projects can be funded, the issue of equitable distribution of funds to meet both state and local goals has been of great concern.

Planning Framework

The TDOT Aeronautics Division plays an active role in helping to promote and maintain the GA system. As a state agency, TDOT must approach its activities with a statewide perspective. This introduces the potential for conflict between local interests and state interests, which of necessity are much broader. To minimize such problems, and to promote objectivity, the concept of prioritization has been firmly integrated into TDOT's aviation planning process. Prioritization is supported by long range planning, functional classification, capital improvement planning, and by a formal project priority ranking procedure. Figure 1 shows the overall relationships of these elements.

Policy and Oversight

The Tennessee Aeronautics Commission consists of members appointed by the Governor to represent aviation interests across the state. Theoretically, the Commission ensures that the state's aviation activities do reflect local issues and concerns. Commission members provide policy guidance to Division staff reviewing grant applications. The Commission also votes to approve all major grant applications, thus imposing an implicit prioritization on projects. However, Commission decisions are actually advisory recommendations to the TDOT Commissioner. Since the Commissioner is free to make the binding decision, ultimate approval resides within the DOT. In practice, the Commission is rarely overruled, but the possibility exists.

Long Range Planning

The Aeronautics Division performs the statewide planning process for aviation, with one product of this being the long range Tennessee Airport System Plan. Elements of the planning process are

done on a regional level within the state. Note that while these regions focus upon areas of the state, they do overlap the state's boundaries to reflect actual aviation markets. For each region, planners consider regional economic forecasts, aircraft activity forecasts, the existing airport infrastructure, and the economic impacts of airports. In assembling the regional evaluations into a comprehensive plan, TDOT considers statewide goals for service availability, development strategies, growth expectations, and economic activity forecasts. A statewide systems analysis is performed to develop recommendations for improvement and funding programs to meet state goals and objectives. The final system plan is the result of an iterative process that, when complete, provides a budget, maintenance, and developmental programs to guide state aviation activities for a multi-year period. The plan is the first step in an overall prioritization process for aviation improvements.

As part of the overall planning process, the Aeronautics Division has developed a functional classification system for GA airports. Each such airport in the state has been assigned to one of the following classes: GA Business Service; GA Community Service; GA Limited Service; GA Local Service; or Private, Public-use. The functional classification of each airport, updated as part of the long-range plan, defines the role of that airport and thus the state's interest in its infrastructure investment. Higher functional classifications represent airports with greater levels of activity, potential for growth, and regional economic significance. Typically, higher classed airports have infrastructure to support larger aircraft and to handle higher volumes of operations. This is not always the case, however, because some airports have deficiencies to be remedied by capital investment.

Short Range Planning

The second level in the TDOT's planning process is the airport Capital Improvement Plan (CIP). The purpose of the CIP is to help the Aeronautics Division budget for future needs while allowing owners to plan for airport maintenance and development. Owners are charged with evaluating pavements, facilities, and standards issues and annually submitting a list of potential projects to TDOT. Aeronautics Division staff select projects for inclusion in the CIP based upon goals in the long-range plan, budget projections, and scores generated by the priority ranking system described below. While the CIP is updated annually, it contains a three-year horizon of potential projects. Thus, the CIP is oriented towards the short term.

A key aspect of the CIP process is that it requires airport owners to submit project proposals, other than for emergency repairs, on a periodic basis, rather than the ad hoc fashion of previous years. Thus, all project proposals arrive at the same time and can be evaluated together. If a project falls in a CIP out-year, a project grant proposal must be submitted during that year and the project re-evaluated. Note that projects not on the CIP can be requested, but they will receive a lower priority for consideration.

The initial call for candidate projects to be considered in the CIP resulted in 540 projects, with a total value of $170 million. The difference between the requested amount and the $9 million available per year underscores the need for a prioritization process.

Project Scoring and Ranking

The third level in the planning process is the Airport Project Ranking System (APRS), TDOT's procedure for ranking proposed projects at GA airports. APRS is both a procedure for ranking airport projects and a computer software package which implements the procedure and allows groups of projects to be ranked. By evaluating the relative scores of projects, TDOT planners can determine which projects should receive priority in funding. Projects that do not score in the upper portion of the range for the current CIP cycle are unlikely to be selected. Since over 90 percent of the state's GA airports are located in small or medium sized communities, the prioritization technique has extensive implications on the economic development associated with airport investments for these communities. The role of APRS in the project selection process is a focus of the next section of the paper.

Project Ranking Procedure

This section describes the implementation and structure of APRS.

In APRS, projects are categorized by their location within the airport, e.g. runway, taxiway, terminal, etc. There is an implicit hierarchy of locations with airside locations (runway, taxiway) having an overall higher priority than landside locations (terminal, hangar, etc.). Each location has one or more project types that might be performed to improve the airport. Project types, for example, might include runway lengthening, navigational aid installation, hangar construction, or paving an access road. In general, the project types represent generic activities performed commonly among the airports within the system.

The APRS software implementation is a Windows application for Intel-based personal computers. Like most Windows programs, APRS employs a graphic user interface employing menus and forms to control program execution. Using the computerized ranking procedure, a complete set of projects can be viewed or printed in order of descending score.

APRS creates and/or maintains information in a number of databases. The main working data set is the project database, which contains a list of projects for which a ranking is to be established. Users may create one or more project databases, depending upon needs, project categories, etc. Project information includes airport, project type and location, estimated cost, request date, and disposition. The project rank is determined according to a set of criteria described further below. APRS interfaces with the Aeronautics Division's Airport Information Management System (AIMS) to obtain necessary information on facility characteristics and operations levels.

Scoring Formula

Project scores in APRS are computed according to the following formula:

$$S_t = S_{pt} + S_{aa} + S_{sr}$$

Where:

S_t = Total project score
S_{pt} = Project type score (max. 50 pts.)
S_{aa} = Airport activity score (max. 30 pts.)
S_{sr} = Sponsor score (max. 20 pts.)

The scoring formula permits a maximum project score of 100 points.

Project Type

The project type score is assigned based upon the nature and location of the project within the airport. In general, project types having a pure safety function score highest, with maintenance next highest, then upgrading followed by capacity. For example, the system assigns 49 points to a project that corrects unsafe runway surface failures, but only 19 to a project to increase runway dimensions or strengthen pavement to handle larger critical aircraft.

Airport Activity

The airport activity score accounts for various factors relating to the amount of activity at the airport. Busier airports should receive a higher score than lightly used ones. All other things being equal, the scoring formula allots slightly higher scores to airports having high levels of activity. Airports with a higher functional classification also receive slightly higher scores to reflect their importance to the system.

The composite score for airport activity is:

$$S_{aa} = S_{io} + S_{ba} + S_{fc}$$

Where:

S_{aa} = Total airport activity score
S_{io} = Annual itinerant operations score (max. 15 pts.)
S_{ba} = Airport based aircraft score (max. 10 pts.)
S_{fc} = Airport functional class score (max. 5 pts.)

The formula allocates 30 total points for airport activity. APRS obtains data on the airport class and operational levels from files in AIMS. Current values are always used in scoring.

Sponsor Responsibility

This scoring category reflects the degree to which the sponsor takes proactive measures to operate and maintain the facility in a highly professional manner and in compliance with applicable guidelines and licensing criteria. These categories include:

- publication of an airport operations manual,
- overall maintenance of facility,
- implementation of a pavement management system,
- implementation of hazard restriction zoning around the airport,
- implementation of land use zoning around the airport,
- compliance with state licensing requirements, and
- participation in the capital improvement planning process.

Compliance with all categories reflects a well-managed airport and gains increased points for projects for that airport. The CIP process gains airports points for participation and for submitting a request for a project in the current CIP. To help equitably distribute projects, however, airports with several ongoing projects may have points deducted from a project score.

The composite score for sponsor compliance is:

$$S_{sr} = S_{lc} + S_{mt} + S_{oo} + S_{om} + S_{hz} + S_{lz} + S_{cp} + S_{pm}$$

Where:

S_{sr} = Total sponsor responsibility score
S_{lc} = Licensing compliance score (max. 5 pts.)
S_{mt} = Maintenance quality (max. 4 pts.)
S_{oo} = Outstanding obligations score (max. 0 pts., min. -5 pts.)
S_{om} = Operations manual score (max. 2 pts.)
S_{hz} = Hazard zoning score (max. 2 pts.)
S_{lz} = Land use control score (max. 2 pts.)
S_{cp} = Capital improvement plan score (max. 3 pts.)
S_{pm} = Pavement management system score (max. 2 pts.)

The total number of points available for the composite score is 20.

Implications of the Priority Ranking Approach

The ranking procedure insures that all projects are put on a competitive basis. Objectivity is provided for by the allocation of scarce resources among communities. Projects are placed on a uniform funding cycle so that comparisons can be easily made.

An essential aspect of APRS is the functional classification plan. The smallest airports with little use will have investment limited to essential safety improvements. Other facilities in the lower functional classes will not be likely to have capacity or upgrade projects selected. This may make the owners of these facilities uncomfortable, but from a statewide perspective, it makes sense

when resources are scarce. However, with the emergence of specific development proposals, functional classification can be altered.

Despite the impact of functional classification on the score, airport owners have a chance to gain some offsetting points in the sponsor responsibility category. This rewards owners who protect their investment by complying with state guidelines and best industry practices. It also provides some equity in project distribution by deducting several points from the score of airports with multiple ongoing projects.

The priority ranking score reflects existing conditions and provides no direct recognition for development. This was deliberate. GA airports can stimulate economic development and serve as a catalyst to attract industry. There are specific examples where airport improvements were necessary to attract a specific industry. However, this is not predictable and a good GA facility is a necessary, but not sufficient condition for industrial recruitment. Rather than projecting or predicting development, the priority ranking system focuses on existing goals—enhancing safety, emphasizing projects of regional or statewide significance, and providing a good return on investment by ensuring utilization. Certainly, however, a proposal related to a firm development opportunity will receive special considerations and may have the priority altered. Rather than considering economic development explicitly in the priority ranking system, TDOT considers economic development potential for an airport in the long-range planning process and the functional classification.

Project scores do not consider the magnitude of funding required. The ranking process is strictly to determine the relative importance of projects according to benefit. Explicit tradeoffs between budget and project costs are made in the CIP. Project cost is really impractical to include in the formula because many projects are still in the conceptual state when submitted and lack detailed cost estimates.

The ranking process does not mean that a project will never be funded. It is simply a means for prioritizing a current year's proposed projects to determine which should receive limited funds. Projects with high scores will be placed in the CIP, for programming either in the current year or in an out year. Non-qualifying projects may always be revised and resubmitted in a later year. It should be noted that the ranking system is a tool, and, under extraordinary circumstances, a project may always be selected regardless of rank.

A review of the prioritization formula used for 1998 projects indicates that critical (safety, maintenance) projects in airports with high utilization rank highest. However, good projects in airports with lower usage levels will be in the upper tier. The scoring formula has been calibrated to provide reasonable tradeoffs. The same is true for lower tier projects. Non-critical projects in high utilization airports do fall into the lower tier and are unlikely to be selected. Thus, the system seems to be performing as intended. It is fully expected that, as more experience is gained or circumstances change, the formula weights will need to be adjusted or new factors added. However, initial indications are that the ranking process is meeting state goals.

An additional indication that the system is working is its acceptance by the airport owners. The priority ranking system provides a "level playing field" for airports seeking grants. An owner

clearly knows how projects are ranked, and what the chance for a particular project's funding is. The feeling that politics are involved in the selection process—formerly a major concern—is largely alleviated. If a project can be demonstrated to have economic development implications, it may be approved regardless of the score, but such cases are expected to be extraordinary.

Conclusions

GA airports in Tennessee, while owned at the local level, depend upon federal and state grant money for needed capital improvements. Tennessee annually has about $9 million available to support such projects—an amount far less than that required. Accordingly, some method is required to prioritize projects so that the most critical ones receive funding.

At issue with GA airport funding is the conflict between local and state interests. These airports are frequently viewed by their owners as critical assets for industrial recruitment. At the local level, frequently all projects are considered to be critical, since each owner sees its facility as the universe. The DOT, however, must consider regional or statewide interests, and the state perception of an airport project's criticality may be far different than the local owner's.

The development of a statewide planning process which is sensitive to the role of GA airports in promoting and sustaining economic development is essential to meeting both local and state goals. TDOT has implemented a comprehensive planning process that seems in spirit to meet these goals. This process involves the following elements:

- An Aeronautics Commission representing local interests to provide policy guidance and approve projects;
- Implementation of a long-range planning process which assembles regional analyses including aviation activity, economic forecasts, and economic impacts of airports into a plan that specifies budget, maintenance, and developmental programs to meet state goals and objectives;
- Development of a functional classification system in which GA airports are classified according to their role in the statewide system;
- Implementation of a short-term capital improvement planning process which, in compliance with the long-range plan, identifies specific high priority capital and maintenance projects and allocates budget resources to them; and
- Development of a system for objectively scoring projects according to a specified set of criteria and ranking them by score.

Prioritization is inherent in each step of this overall process. The prioritization process, which considers both state and local interests, brings objectivity to the programming of airport improvements. With a clearly defined set of priorities, TDOT can maximize the effectiveness of the airport grant program by funding those projects that make the greatest contribution to the system.

Functional classification is an important element of prioritization. By functionally classifying an airport, TDOT implicitly ranks that airport in terms of its importance to the state system. Classification is determined through the long-range planning process; the CIP and project ranking process explicitly consider the functional classification in ranking projects by importance and in programming them for implementation.

To perform the initial ranking of candidate projects, TDOT uses APRS. Projects receive an objective score based upon project type, airport activity, and sponsor responsibility, with the airport and sponsor categories being composite totals that consider a number of factors. Airport owners have the opportunity to earn project points by complying with a set of best practices and state guidelines. The set of ranked projects can then be evaluated for inclusion in the capital program for the current or subsequent years. Thus far, APRS has been well received by both state and local aviation officials.

The rational approach to investing in GA airports in Tennessee has put economic development on an objective basis. Rather than relying on vague references to economic development in the programming process, reliance will be placed on long-range planning and functional classification to adequately assess the economic development potential of an airport.

Session #5

State/Tribal Transportation Planning Relations and Strategies

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Abstract

Both ISTEA and the creation of Regional Transportation Organizations, growth management legislation, have resulted in a greatly increased need to coordinate transportation planning with Native American Tribes. Some of the problems encountered are lack of coordination between tribal transportation plans and state and regional transportation plans. This lack of coordination in many ways has hindered the ability to construct a seamless multimodal transportation network in some areas of the state.

Washington State has responded to this challenge by joining with the tribal nations to hold an annual Tribal/WSDOT Transportation meeting. Since 1994, the two groups have met annually to discuss mutually agreed upon issues. At the conclusion of each meeting, advisory groups have been formed, with membership from both the tribes and WSDOT, to work on identified issues. Before the next annual meeting the advisory groups meet and formalize recommendations and solutions to the issues. These recommendations are then brought forward to the entire group at the next annual meeting.. Some of the issues that have been addressed so far:

Issue	**Solution**
Tribal knowledge of ISTEA	Transportation Guidebook for Tribal Governments
Tribal Representation on RTPOs	Many Tribes are now represented on RTPO advisory and policy boards
Tribal Representation on Transportation Commission	Pending

Some of the lessons learned in this process are: that tribal nations are sovereign nations and each tribe deals with transportation issues differently; you must develop relationships with tribal nations before you can solve the problem; you must go slow--- the Tribal timeline is not the same as WSDOT's timeline.

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Relations and Strategies

In this paper I will to give the reader some background information on governance in Washington, identify some key transportation planning issues, describe how transportation planning is accomplished in Washington, describe some lessons learned in working with the tribal nations in Washington and outline some real successes.

To begin, the state of Washington has 27 federally recognized tribes in the state. Each tribe is a unique sovereign nation. When I first began working with tribal governments it became obvious they take their sovereignty very serious. For example at a tribal conference a tribal chair explained his position as being equal to the President of the United States but he would "stoop as low as the governor's office if he had to." In addition there are 39 counties, 277 incorporated cities and towns, 8 Metropolitan Planning Organizations (MPOs) and 14 Regional Transportation Planning Organizations (RTPOs) in the state. Each of these governments is unique and has specific transportation planning requirements and issues that they must deal with. Due to the variety of governments and issue's coordination is at best difficult.

The importance of Tribal Sovereignty was strengthened when then Governor Booth Gardner signed the Governors Accord in 1989. The Accord is a document that reinforced the fact that each tribal government is an independent sovereign nation and each department within the state must initiate policies and strategies to work with each tribal government. In 1993 the Washington State Department of Transportation (WSDOT) responded to the Governor's Accord by joining with the Tribal nations in a Tribal/State Transportation Meeting in Olympia. During this one day meeting the state tried to respond to transportation issues. During the meeting the Tribes indicated that they were not as familiar with ISTEA as the State. At the conclusion of this first meeting, WSDOT, with tribal assistance, agreed to write a manual to assist the tribal governments in working with the State in implementing ISTEA. The result is the **Guide to Tribal Transportation Planning in Washington State.** A copy of this document was provided to each tribal nation.

Key Issues

When dealing with tribal nations it is important to keep in mind that each one is unique. Each tribe has a separate council and each tribe only speaks for themselves. They are fiercely independent. Each tribe has different priorities, and may or may not have the resources to staff planning organizations within their structure. One thing that is universal throughout the state is that the transportation needs for tribes far exceeds the transportation revenues that are currently available in the state. In addition, planning funds that are available to tribes through the Bureau of Indian Affairs is insufficient. Although construction funds available to the tribes can also be used for developing transportation plans for their reservations few take advantage of it since those funds would be substituted for capital improvements which are also very much needed.

Transportation Planning in Washington State

In 1990, Washington State passed the Growth Management Act (GMA). The law requires that the fastest growing communities in the state to develop comprehensive plans that link land use with transportation facilities. Twenty-nine of the 39 counties and their cities and towns are currently planning under the GMA. Tribal governments although impacted by growth, cannot be required to plan under GMA.

The GMA can be characterized by the **4 C's:** Consistent, Coordinated, Comprehensive and Concurrency.

Consistent-The GMA requires that each city or county required to plan under the act must develop a plan whose planning elements are internally consistent. This means that the data used for the land use assumptions must be the same that are used to develop the transportation, water, sewer, park, school and other municipal capital facilities' plans. The counties and cities are also required to develop development regulations that are consistent with the plan.

Coordinated-The GMA requires that each adjacent jurisdiction coordinate with each other to insure coordinated development of capital facilities and land use patterns. At first this was a difficult task since many jurisdictions did not coordinate with their neighboring jurisdictions and unincorporated county areas.

Comprehensive-The GMA requires that each jurisdiction cover the same areas such as land use, transportation, housing, environmentally sensitive areas, water, sewer, schools, parks and recreation to name a few. The comprehensive plan is to cover a 20 year planning horizon. Each jurisdiction must determine where they anticipate the growth will occur and where new capital facilities will be required to serve the growth.

Concurrency-Providing the facilities as growth occurs is a cornerstone of the act. Specifically for transportation facilities there must be a funding mechanism to pay for new facilities within 6 years of the growth activity that needs it. The GMA allows for concurrency for other capital facilities to accommodate growth but it **requires** it for transportation impacts caused by growth.

Unfortunately, tribal nations are not required to plan under the GMA. Coordination and cooperation between cities and counties are therefore hampered as a result.

Regional Transportation Planning Organizations were also authorized by the GMA. RTPOs are made up of a county or counties and their cities and towns comprising a minimum population of 100,000. Jurisdictions comprising 75% of the population must agree to form an RTPO. The State Legislature funds the RTPOs. The major duties of the RTPOs are to: develop a Regional Transportation Plan (RTP); Develop a 6 Year Regional Transportation Improvement Plan to implement (RTIP) the RTP and to review the transportation element of local comprehensive plans and certify that they are consistent with the RTP. ISTEA enhancement projects were also prioritized through the RTPOs.

RTPOs are voluntary organizations. They are very similar to MPOs except that they look at both rural and urban transportation needs. All but one county belongs to an RTPO. San Juan county in the northwest corner of the state has no regional facilities other than the Washington State Ferry System that serves the islands. Although tribes are not required to belong to an RTPO many do voluntarily. In fact some RTPOs have included tribal membership on their policy boards. Many tribes have successfully competed for ISTEA enhancement funds through the RTPO process. In addition many transportation facilities that are important to tribal lands have been included in the RTPs and RTIPs.

Prior to ISTEA Washington State began developing a 20 year Multimodal Transportation Plan. The plan identifies the current state owned and state interest transportation facilities. Those areas included in the state owned are aviation, state and interstate highway facilities and the ferry system. Bike, pedestrian transit, freight and intercity rail facilities are included in the state interest plan. The plan is fiscally constrained. The plan identifies funding sources and strategies to meet the identified service objectives for each mode. The Washington Transportation Commission prioritizes the state program and projects based on the plan. The Plan satisfies both state and federal law.

The 14 RTPOs work in coordination with the state to develop the plan. A comprehensive outreach and public involvement plan are used to insure that all of the state's stakeholders are included in the development of the plan. The RTPOs include tribal participation in this effort.

Lessons Learned

Tribal governments are very protective of their sovereignty and they are very independent. It is very important to develop a relationship with each tribe before proceeding with a plan or program that may impact them. Like local governments one tribal council does not speak for a successive one. Local agencies must be very patient when working with tribes. In some case a tribe has been working on the same issue for many years. Local and state agencies must involve tribes very early in the process to be successful. When addressing a tribal council, silence does not mean concurrence. In many cases councils will want to fully digest what it is that you are proposing. In summary to be successful in working with tribes, learn their culture and show respect for it and always keep in mind that Indian time is different than yours.

Successes

Since 1993 WSDOT and the tribes have met annually. At each meeting participants have focused on previously agreed issues. Formal joint committees have been formed each year to develop policies regarding these issues. For example, to meet the needs of the tribal governments in understanding how transportation planning was accomplished in Washington state, the **Guide to Tribal Transportation Planning in Washington State** developed by a joint committee. As a result of another annual meeting a group was formed to develop a model memorandum of understanding stating how WSDOT would coordinate with tribal governments on construction projects.

In addition, there has been an increase awareness of and respect for tribal sovereignty. As a result WSDOT/Tribal relations have improved in many areas. Prior to holding these annual meetings tribal participation in RTPOs was low. Today, approximately 75% of the tribes participate in the RTPO process.

In closing, although Tribal/WSDOT relations are not perfect in Washington state, there is a process that is working to some degree. In Washington State we have a Governor and Secretary of Transportation that are committed to improving how state government agencies work with our tribal partners.

Introduction

Purpose of This Guidebook

This guide is meant to serve as a tool to assist agencies and Indian tribal governments in understanding transportation related funding, planning, rules and regulations, and processes. This guide is especially oriented towards issues and concerns of Indian tribal governments as related to transportation.

Scope and Limitations

This guidebook is just that — a guide, no more or less. The reader should refer to materials referenced in this guide for more details on a specific subject. For example, the ISTEA Application Handbook for Local Governments dated March 1993 provides a more complete description of the funding programs and the processes to obtain them. Similarly, the report: Washington State STIP — ISTEA Handbook for the Statewide Transportation Improvement Program, dated August 1993, provides details on the Transportation Improvement Program and the State Transportation Improvement Program (STIP).

Implementation of projects is only covered briefly as the TransAid document, the *Local Agency Guidelines* (LAG) manual, is the guide for this purpose for federally funded projects. Similarly, individual state programs each have their own procedural requirements which are cross-referenced in this application guide for Indian tribal governments.

Additional Sources of Information

For the reader, a reference source is provided of materials, agencies, and others that can help when questions arise on various aspects of transportation that are not covered in this brief guide.

Acronyms and definitions in transportation are listed to assist the reader in understanding some of the terms commonly used by transportation planners, engineers, and by government officials in general. These are included in the appendix.

Of particular note is a guide developed by the Association of Washington Cities entitled State Agency Assistance for Local Governments. This catalog of available funding sources for various state and federal funds also includes hints on writing proposals for funding projects and programs. The “catalog” covers more than transportation funding sources.

Additional Sources for Help

Following is a listing of people who can be contacted for particular questions on transportation:

Washington State Indian Tribes.c. (Federally Recognized)

Chehalis Tribe

Tribal Planner
Chehalis Business Council
PO Box 536
Oakville, WA 98568

(360) 273-5911, Olympia 753-3213, Fax (360) 273-5914

Colville Confederated Tribes

Tribal Planner
Colville Business Council
PO Box 150
Nespelem, WA 99155

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Nooksack Tribe

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Port Gamble S'Klallam Tribe

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Stillaguamish Tribe

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WSDOT's Regional TransAid Contacts

Additional assistance is available for your ISTEA funded projects. Contact TransAid's Regional Engineers and their staff at one of the six WSDOT Regions in your area.

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	Sam Richard	(206) 440-4736
	Harry Haslam	(206) 440-4737
North Central	Stan Delzer	(509) 663-9657 SCAN 565-9657
	David Orange	(509) 663-3147 SCAN 565-3147
Olympic	Bob Holcomb	(360) 357-2666 SCAN 357-2666
	Jim Werle	(360) 357-2609 SCAN 357-2609
	Dick Egolf	(360) 357-2631 SCAN 357-2631
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	Tom Swafford	(360) 905-2216
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	Dick Krouse	(509) 575-2581 SCAN 558-2581
Eastern	Brent Rasmussen	(509) 456-3058 SCAN 545-3058
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Chapter 1.c. *Background*

Foreword

The federal government recognizes 26 tribal governments in Washington State. Twenty-two of these are in Western Washington and four in the eastern part of the state.

There are also 26 Indian reservations within Washington State as shown on the map. Many were formed following a series of treaties in the mid-1850s known as the "Stevens Treaties" after the Territorial Governor, Isaac Stevens. Subsequent to these treaties, reservations of a number of treaty tribes were modified or enlarged by statute or executive order.

Together, the reservations comprise more than eight percent of Washington's land base. The tribes also reserve certain rights to natural resources — specifically, the right to fish, to hunt, and to gather shellfish, roots, berries, and other foods. These are treaty-protected rights, under the U.S. Constitution.

Tribal governments are not subdivisions of the state, but political entities, predating the U.S. Constitution and the colonization of this continent. Determined through early case law to be "domestic dependent nations," subject to the plenary powers of Congress, tribes have retained inherent sovereign powers and are recognized as distinct, independent, political communities.

Sources of Tribal Government Authority

The source of tribal government authority is different from that of state and local governments, which derive their power from the Constitution, state enabling legislation and administrative codes. In the case of tribes, each tribe derives its authority from its own internal laws. Virtually every one of these is the subject of one or more federal treaties or statutes that deal with it in individualized terms. Some tribes operate under their own constitutions, which are adopted by their membership and approved by the federal government pursuant to the Indian Reorganization Act of 1934. Other tribes operate under constitutions not related to the Act, and still others have no constitution at all.

Functions of Tribal Governments

Not only do tribal governments differ from state and local governments with regard to their source of power, they also differ with regard to their purpose. In addition to standard governmental functions as regulating, taxing and delivering services, tribal governments act to preserve and protect tribal culture, the tribal community and off-reservation treaty rights. As major landowners, tribal governments are also responsible for the development, management and operation of tribal economic enterprises.

Tribal governments functions include:

- Executive actions (similar to those taken by the governor of a state or the president of the United States).
- Legislative actions (similar to those taken by the state legislature or the U.S. Congress).
- General government administration (personnel management, budgeting, capital programming, intergovernmental affairs).
- Public safety (police protection, tribal courts and prosecution, other legal services, fire suppression, emergency medical response).
- Health care (mental health counseling, medical services, dental services, environmental health).
- Public works/engineering/infrastructure development (roads, sewers, water, cable television, facilities management etc.).
- Planning and community development (comprehensive planning, zoning, and land development regulation, environmental protection).
- Education (Headstart, K-12 schooling, remedial schooling and GED testing, vocational schooling, college schooling, scholarship support).
- Social service provision (daycare services, recreation services, youth and elderly services, child welfare and protective services).

The Indian Tribes of Washington

Confederated Tribes of the Chehalis Reservation

Located in Grays Harbor County the reservation was created by executive order in 1864. Made up of the Chehalis and Kwaiailk tribes, the reservation population is 308 Indians with 183 non-Indian. Land area of the reservation is 4,225 acres made up of 2,067 Indian lands and 2,158 acres on non-Indian land. Enrolled membership in the Confederated tribes is 500 people.

Constitution and bylaws were approved by the Commissioner of Indian Affairs in 1939. The reservation's chief governing body, the Chehalis Community Council, is composed of all qualified voters on tribal rolls. The Council elects a five-member Business Council that manages the tribe's property and assets, administers tribal funds and programs, and enforces ordinances. Each council member serves two-year terms. The Confederated Tribes of the Chehalis are a non-treaty tribe, but have water rights.

Confederated Tribes of the Colville Reservation

Located in Eastern Washington, this confederation includes the following tribes: Colville, Entiat, Methow, Nespelem, Nez Perce, Sinkaietk, Palouse, Sanpoil, Senijextee, Sinkiuse, and Wenatchee. Enrolled members are 7,400 in number. The reservation population is 6,957 (3,788 Indian and 3,169 non-Indian). Land area of the reservation is 1.4 million acres of which 1,120,000 is Indian land.

The reservation was established by executive order in 1872. Constitution and bylaws of the Confederation were approved by referendum in 1938. The Colville Business Council, the chief governing body of the reservation, manages the tribe's property and assets, administers tribal funds and programs, and enforces ordinances. Composed of 14 members elected by tribal enrollees for two-year terms, the Council chooses an executive committee from within its ranks.

The Hoh Indian Tribe

Located in Jefferson County, the Hoh Tribe has 120 enrolled members. Reservation population is 96 of which 74 are Indian and includes 443 acres which is all Indian owned.

The Tribe approved the 1934 Indian Reorganization Act and adopted a constitution in 1969. The Hoh Tribal Business Committee, chosen biennially, is the tribe's governing body. Composed of our members, it manages tribal property and assets, administers funds, and enforces ordinances. The Hoh retained treaty fishing rights and are a member of the Northwest Indian Fisheries Commission.

Jamestown S'Kllalam Indian Tribe

The reservation of 210 acres is all Indian owned. Enrolled membership in the tribe is 240 people whereas the reservation population is 22 (4 Indian and 18 non-Indian).

Officially recognized by the United States in 1981, the treaty fishing rights and other privileges were restored to the Jamestown S'Klallam. They became a sovereign political entity capable of government-to-government relationships with the United States. Their governing Business Council consists of five members elected to three-year terms. The Jamestown S'Klallam joined the Port Gamble and Lower Elwha S'Klallams and Skokomishes in 1981 to form the Point-No-Point Treaty Council, which makes fishery management decisions. They are also represented on the Northwest Indian Fisheries Commission.

Kalispel Indian Community

This 4,600 acre 100 percent Indian land community is located in Pend Oreille County and has a reservation population of 91 Indian and 9 non-Indian. It was established by executive order in 1914. The tribe is the Lower Kalispel Tribe.

The Kalispel accepted the 1934 Indian Reorganization Act and chartered a constitution in 1939. Revised in 1967, it provides for the Kalispel Indian Council to be the tribal governing body. The five council members are each elected to three-year terms.

The Lower Elwah Tribal Community

Located in Clallam County on the Olympic Peninsula, the reservation of 500 Indian owned acres has a population of 137 people (130 Indian and seven non-Indian). Members of the tribe number 530 and belong to the Lower Elwah S'Klallam tribe.

Reservation land was purchased on behalf of the tribe by the United States government in 1936 under the 1934 Indian Reorganization Act. A constitution was approved in 1968 that established the Lower Elwah Tribal Community Council, a sovereign political unit composed of the community's qualified voters. The council elects members to a five-member Business Council or one-year terms to manage the tribe's property and assets, administer tribal funds and programs, and enforce ordinances. The Lower Elwah possess treaty fishing rights and participate in both the Point-No-Point Treaty Council and the Northwest Indian Fisheries Commission.

The Lummi Nation

Approximately 3,200 members are enrolled in this tribe. Reservation population is 3,147 of which 1,594 are Indian and 1,553 are non-Indian. The reservation in Whatcom County has 13,600 acres and 7,500 acres of tidelands. Indian people own 7,600 acres of the 13,600 acres.

The reservation was established in 1859 by the Point Elliot Treaty and was enlarged by executive order in 1873. Tribes are the Lummi, Nooksak, and the Samish.

A constitution adopted in 1970 gives broad powers to the Business Council. Elected to three-year terms, the eleven members of the Council elect tribal officers from within their numbers. The council administers funds and social programs, oversees tribal businesses, and enforces ordinances. The Lummis

have treaty fishing rights and are a member of the Northwest Indian Fisheries Commission.

Makah Reservation, Makah Tribe

Located in Clallam County, the Makah reservation includes 28,112 acres of which all but 366 acres are Indian lands. Enrolled members are 1,600 while reservation population is 940 Indian and 274 non-Indian.

The reservation was established by treaty in 1855 and enlarged by executive order in 1872 and in 1873.

The Makahs voted to accept the Indian Reorganization Act of 1934 and approved a constitution in 1936. The five-member Makah Tribal Council is elected to serve staggered three-year terms. The Council administers tribal assets, resources, funds, social programs, and ordinances. The Makah have treaty fishing rights and are a member of the Northwest Indian Fisheries Commission.

Muckleshoot Tribe

Located in King County, near Auburn, 850 members belong to this tribe made up of Bukshul, Skopahmish, and Smulkamish Indians. The reservation of 3,850 acres (1,580 Indian land) includes 3,841 people of which 864 are Indian.

The reservation was established in 1857 by executive order based upon a 1854 treaty.

The Muckleshoot Tribe approved a constitution establishing the Muckleshoot Indian Tribal Council as a sovereign political entity in 1936. The Council consists of nine members elected for three-year terms in groups of three. It levies taxes, oversees businesses, and enforces tribal ordinances. The Muckleshoot have treaty fishing rights and are members of the Northwest Indian Fisheries Commission.

Nisqually Indian Tribe

Straddling Pierce and Thurston Counties along the Nisqually River, the reservation has a population of 578 people of which 365 are Indian. Four hundred and twenty-five members belong to the tribe. The reservation is 4,700 acres of which 1,007 are Indian owned and 3,693 non-Indian.

The reservation was established by the Medicine Creek Treaty in 1854, enlarged by executive order in 1857 and reduced in 1917.

The Nisqually tribe organized under the provisions of the 1934 Indian Reorganization Act and approved a constitution in 1946. The Nisqually Council is a sovereign political entity and the primary governing body of the reservation. Its seven members manage tribal assets, administer tribal funds and programs and enforce ordinances. Each member is elected for a two-year term. The Nisqually have treaty fishing rights and are represented on the Northwest Indian Fisheries Commission.

Nooksack Indian Tribe

Located in Whatcom County, the Nooksack Indian Tribe reservation covers 10 acres plus 2,900 in fragmented allotments. Reservation population is 556 of which 442 are Indian. Enrolled membership to the Nooksack tribe is 1,060 people.

The Nooksack received federal recognition in 1973 and established a reservation of approximately nine-tenths of an acre that they have slowly increased. After the tribe was federally recognized in 1973, they established the Tribal Council of the Nooksack. The eight-member Council conducts tribal business affairs. Each council member is elected to a four-year term. The Nooksack have treaty fishing rights and participate in the Northwest Indian Fisheries Commission.

Suquamish Tribe of the Port Madison Reservation

Over 850 members belong to the Suquamish Tribe. The reservation population is 4,834, of which 500 are enrolled Suquamish Tribal members. The land area over which the Tribe has jurisdiction is 8,012 acres of which 2,849 are trust lands. The reservation, which is named "The Port Madison Indian Reservation" was established by the 1855 Point Elliot Treaty and enlarged by Act of Congress in 1964. The Suquamish Tribe approved a constitution in 1965 that created a sovereign, seven-member council to enforce ordinances and govern the Tribe's assets, programs, and business including a salmon hatchery. Each council member serves a three-year term. The Suquamish have treaty fishing rights and are a member of the Northwest Indian Fisheries Commission.

Puyallup Tribe

Located in the urban areas of Pierce County near Tacoma, the Puyallup tribe has a membership of 1,800 enrolled members. The reservation of 18,062 acres is primarily non-Indian land with only 90 acres owned by Indians. Reservation population is 32,406 of which 937 are Indian.

The reservation was established by the Medicine Creek Treaty of 1854 and enlarged by executive orders in 1857 and 1873. The Puyallup Tribal Council is a sovereign political entity formed under a tribal constitution adopted in 1936. The Council is composed of five elected members serving three-year terms. It manages tribal assets and businesses, and enforces ordinances. The Puyallup tribe was at the forefront of the struggle to retain treaty fishing rights and is a member of the Northwest Indian Fisheries Commission.

Quileute Tribe

The tribe has 740 enrolled members. The reservation, located in Clallum County has 884 acres, all Indian lands. Reservation population of 381 includes 303 Indian people.

The reservation was established by executive order in 1889. The Quileute Tribe adopted a constitution in 1936 based on the Indian Reorganization Act. It provided for the Quileute Tribal Council to choose principal tribal officials and represent the tribe as a sovereign political entity. The Council consists of

five members elected to three-year terms. It manages tribal land and assets, levies taxes, provides law enforcement and enforces ordinances. Quileute lands remained unallotted, and the tribe has treaty fishing rights. The Quileutes are members of the Northwest Indian Fisheries Commission.

Quinault Indian Nation

Located in Jefferson and Grays Harbor counties, the reservation of 208,150 acres (145,705 acres Indian land) has a population of 1,216 of which 943 are Indian. Tribes of the Nation include Quinault, Queet, Hoh, Ozette, Chehalis, Chinook, and Cowlitz.

The reservation was established by the Quinault River Treaty in 1856 and enlarged by executive order in 1873.

The Quinault General Council is a sovereign political entity composed of all tribe members, but has delegated legislative authority to an eleven-member Quinault Business Committee. The members of the Business Committee serve three-year terms and also constitute the Quinault Nation Executive Office, which manages tribal lands and assets, provides social services, and enforces tribal ordinances. The Quinault Tribe has treaty fishing rights and participates in the Northwest Indian Fisheries Commission.

Sauk-Suiattle Tribe

The reservation population is 124 people of which 69 are Indian. Enrolled members in the tribe number 210. The reservation has 23 acres of land — all Indian owned.

The reservation was established by 1913 Congressional appropriation. The Sauk-Suiattle became a separate tribal entity from the upper Skagits in 1946. They received federal recognition in 1973 and approved a constitution in 1975. Tribal affairs are governed by a sovereign seven-member Business Council with each member serving three-year terms. The Sauk-Suiattle have treaty fishing rights and participate in the Skagit System Cooperative and Northwest Indian Fisheries Commission.

Shoalwater Bay Tribe

Located in Pacific County, the reservation of 640 acres (335 Indian) also has 395 acres of tidelands. The Willopah tribe has 66 people of the 131 reservation population. Enrolled membership in the tribe is 140.

The reservation was established by executive order in 1866. The Shoalwater Bay Tribe rejected the 1934 Indian Reorganization Act and adopted a constitution in 1971. The Shoalwater Bay Tribal Council is a sovereign political unit that handles tribal affairs. It is composed of five members who serve two-year terms. They have been actively trying to regain treaty fishing rights.

Port Gamble S'Klallam Indian Community

Eight hundred and sixty (860) are enrolled members. The reservation which is located in Kitsap County has 552 people of which 377 are Indian. The land area of the reservation is 1,341 acres, all Indian owned.

The reservation was established in 1935 when land was purchased by the federal government on behalf of the Port Gamble S'Klallam under the 1934 Indian Reorganization Act.

A constitution establishing a six-member Business Council as the tribe's governing body was approved in 1939. Members serve two-year terms. The Council is a sovereign entity that manages tribal assets and businesses, oversees funds and programs, and enforces ordinances. The Port Gamble Indian Community possesses treaty fishing rights and is a member of the Point-No-Point Treaty Council and the Northwest Indian Fisheries Commission.

Skokomish Tribe

In Mason County, the Skokomish Tribe has a reservation population of 614 of which 431 are Indian. The land area is 4,987 acres of which 3,039 acres are Indian owned. Tribes of the Skokomish include Twana, S'Klallam, Chimakum, Squaxin, and Sahewamish. The reservation was established by 1855 Treaty of Point-No-Point, and enlarged by executive order in 1874.

The Skokomish Tribe accepted the 1934 Indian Reorganization Act and approved a constitution in 1938. The Skokomish Tribal Council is a sovereign governing body that administers tribal assets and programs, and enforces ordinances. It is composed of seven members who serve four-year terms. The Skokomish have treaty fishing rights and are represented on the Northwest Indian Fisheries Commission.

Spokane Tribe

Enrolled members include 2,100 people. The reservation is located in Stevens County and has 133,344 acres of which 133,179 are Indian lands. Population of the reservation is 1,502 with 1,229 Indian and 273 non-Indian.

The reservation was established by executive order in 1881.

The Spokane Tribe approved the 1934 Indian Reorganization Act and adopted a constitution in 1951. A sovereign entity, the Tribe's Business Council administers assets, social and economic programs, and enforces ordinances. The Council is composed of five elected members who serve three-year terms.

Squaxin Island Tribe

Located in Thurston County, the Squaxins reservation is 2,175 acres (1,088 Indian and 1,087 non-Indian). Reservation population is 157 of which 127 are Indian. Enrolled membership in the tribe is 374.

The reservation was established by the 1854 Medicine Creek Treaty.

Squaxin Island Tribe accepted the 1934 Indian Reorganization Act and approved a tribal constitution in 1965. The sovereign governmental body of the tribe, the Squaxin Island Tribal Council, is composed of five members elected to three-year terms. It manages tribal assets and businesses and enforces ordinances. The Squaxin Island Tribe has treaty fishing rights and is a member of the Northwest Indian Fisheries Commission.

The Stillaguamish Tribe

Enrolled members to this tribe total 500. The reservation population is 113 including 96 Indian peoples. The size of the reservation is 21 acres.

Despite having no land base, the Stillaguamish were able to receive federal recognition in 1976. They have purchased land since then. The six-member Stillaguamish Tribal Council administers tribal affairs, including a fish hatchery. Each council member serves a three-year term. The Stillaguamish have treaty fishing rights and are a member of the Northwest Indian Fisheries Commission.

Swinomish Indian Tribal Community

The reservation was established by the 1855 Point Elliot Treaty and expanded by executive order in 1873. Tribes include the Swinomish, Suquamish, Kikiallus, Skagit, and Samish. Enrolled members equal 650. The reservation is 7,449 acres of which 3,611 acres are Indian land. Reservation population is 2,282 (585 Indian and 1,697 non-Indian).

The Swinomish Indian Tribal Community is a sovereign unit that operates under a constitution ratified in 1936. The Swinomish accepted the 1934 Indian Reorganization Act. The governing body consists of eleven members elected for five-year terms. The Swinomish Indian Senate, and principal tribal officers are elected from within Senate ranks. The Senate oversees tribal assets, businesses, programs, and enforces ordinances. It takes an active role in land use and environmental planning. The Community has treaty fishing rights and is a member of the Northwest Indian Fisheries Commission. The Tribal Community is a member of the Skagit System Cooperative, which regulates and enhances fishing in the surrounding watershed.

Tulalip Tribes

The reservation in Snohomish County of 22,490 acres of which 10,570 are Indian lands, has a population of 7,103 people. Indian people make up 1,204 persons on the reservation. Enrolled members to the tribe include 2,300 people. The Tulalip Tribes include Snohomish, Stillaguamish, Snoqualmie, Skyomish, Skagit, and Samish Indians.

The reservation was established by the 1855 Point Elliot Treaty and enlarged by executive order in 1873.

The Tulalip Tribes operate under a constitution approved in 1936. It provides for tribal affairs to be managed by a seven-member Board of Directors, which in turn employs other officials, including a business manager. Each member of the board serves a three-year term. The Tribes are a sovereign political entity, and administer tribal lands, funds, education, water, and resources. The Tulalip Tribes have treaty fishing rights and are a member of the Northwest Indian Fisheries Commission.

Upper Skagit Tribe

Located in Skagit County, the reservation population is 180 of which 162 are Indian. The land area of the reservation is 130 acres — all Indian ownership. Enrolled members number 510 people.

The reservation was established in 1913 by Congressional appropriation and expanded by federal grant program 1977 to 1982.

The Upper Skagit Tribe operates under a constitution approved in 1974. The seven-member Upper Skagit Tribal Council is the Tribe's sovereign governing body, and it includes a chairperson elected annually by popular vote. Other council members are elected to three-year terms. The tribe is a member of the Skagit System Collective, which enhances and regulates fishing in the Skagit River system. The Upper Skagits also possess treaty fishing rights and are a member of the Northwest Indian Fisheries Commission.

Confederated Tribes of the Yakama Indian Nation

Located on 1,372,000 acres (1,125,000 Indian) in Yakima and Klickitat counties, the reservation has a population of 27,668 of which 6,307 are Indian peoples. Tribes include the Yakama, Klickitat, and 12 other confederated tribes. Enrolled members are 8,000 people.

The reservation was established by the Yakama Treaty of 1855 and later by legislative and judicial action.

The Yakama rejected the 1934 Indian Reorganization Act, and formally organized their government in 1935. The Business Council of the Confederated Tribes of the Yakama Reservation is composed of 14 members serving four-year terms, each member representing one of the peoples who signed the Yakama treaty. Every tribal enrollee over 18 years of age is also included in a closely associated general council. The Confederated Tribes are a sovereign political entity and manage tribal property and assets, administer funds and programs and enforce ordinances. The Tribes have treaty fishing and water rights which they actively protect, and participate in the Columbia River Inter-Tribal Fish Commission.

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Chapter 2 *Key Transportation Issues of Indian Tribal Governments*

ISTEA's Relationship to American Indian Tribal Governments

ISTEA recognizes the unique and special status of Indian Tribal Governments and special provisions have been made to ensure that federal-tribal trust obligations are met. Trust obligations to meet the needs of tribes

remain even though ISTEA funding may be administered by State Transportation Agencies. The Doctrine of Federal Trust Responsibility requires the Federal Government to upgrade Tribal infrastructures systems up to a level comparable to non-Indian transportation systems. Tribes in Washington State are eligible to apply for State ISTEA program funds. Tribes also have set aside funding available through the Indian Reservation Roads (IRR) program administered by the Bureau of Indian Affairs (BIA).

Washington State's Office of the Governor and the Tribal Governments within the State have entered into an agreement called the Centennial Accord which establishes a government to government relationship between the State and the Tribes, by recognizing the sovereignty of the Tribal Governments. ISTEA also mandates tribal involvement in statewide ISTEA planning processes. Many Indian reservations contain state and local highways within their exterior borders. It is a state responsibility to ensure adequate tribal input for these roads.

The Bureau of Indian Affairs Indian Reservation Roads (IRR) program has special funds for BIA roads from the Highway Trust Fund. Annual nationwide IRR allocations for the fiscal years of 1994 to 1997 will be $191 million for the over 500 federally recognized Tribal Governments. At present funding levels, it may take 20 years to meet existing road needs, which does not include new growth and economic development projects. These funds are distributed by administrative formula to regional BIA Area Offices. The Portland Area Office administers IRR funds for Tribal Governments in Washington state. The BIA is responsible for IRR road inventories and ISTEA planning and implementation for Tribal Governments with regard to BIA roads. There are provisions under PL 93-638 Indian Self-determination Act, which allows Tribal Government to contract for these IRR funds, allowing tribes to administer and implement ISTEA projects. Eligible projects under IRR include 20,000 miles of BIA public roads and 25,000 miles of State/local public roads within or providing access to Indian lands and tribally controlled post-secondary vocational school roads. Transportation planning, including tourism and recreation planning are eligible. Other IRR project related items include: program and preliminary engineering, adjacent vehicular parking, interpretive signage, acquisitions of necessary scenic of historic sites, provision for pedestrians and bicycles, construction and reconstruction of roadside rest areas including sanitary and water facilities, and other appropriate public road facilities such as visitor centers. Prioritization of projects is done through implementation of tribally-based transportation plans. Two percent of IRR funds have been set aside for transportation planning to develop Tribal Transportation Improvement Programs (TIPs). Tribes may contract for 2 percent planning under 638 provisions. Tribal TIPs are incorporated into State Transportation Improvement Programs (STlPs).

ISTEA Employment Issue

Tribal Governments in Washington have identified employment as a key issue due to the general depressed economic conditions on most reservations and the resultant high unemployment which typically ranges from 25 percent

to 75 percent. Most tribes in Washington have implemented Tribal Employment Rights Ordinances (TERO) to give hiring preference to federally recognized tribal members. Indian preference employment provisions may also apply to some roads near reservations. Many tribes also have information on labor force availability and information regarding Indian-owned contractors and suppliers. The state also has special programs for minority contractors. The tribes suggest that these existing programs be utilized to address minority business contracting, and employment issues.

Government to Government Relationship Issue

The relationship between Tribal Governments and Regional Transportation Planning Organizations (RTPOs) is another key issue. The Governor's Accord, as drafted in the Centennial Accord, recognizes the sovereign status of tribes and decrees that tribes shall be accorded the respect of government to government relations. This policy needs to be carried out in state ISTEA implementation plans and processes. Requiring tribes to participate at the local level, as another local unit of government, may not be consistent with the state recognition of the sovereign status of tribes according to some tribal members. Instead, tribes have been invited to participate in State ISTEA planning through the RTPO level and are treated as a separate governmental unit. Some tribes have done so. Other tribes view this as a violation of the Centennial Accord and therefore view this as an infringement on Tribal Sovereignty. Under this opposing view, some Tribal Governments would like to see involvement at a higher level in the state.

State Set-aside Funding for Tribes Issue

State set aside funding for Tribal Governments has been suggested by some as a solution to meet the state's requirement to include tribes in ISTEA planning. Many tribes were not involved in state ISTEA planning and participation by tribes often has been limited. In many cases, tribal relations with local governments has not been good. Many tribes do not believe that Regional Transportation Planning Organizations (RTPOs) will provide fair treatment for tribes. There is also a problem of tribal governmental capacity, because some tribes lack the resources to participate in RTPO processes

RTPO Designation for Tribes Issue

Some tribal members have suggested that the state designate a statewide RTPO which would include all Indian governments within the state, to ensure that tribal input is not lost at the RTPO levels.

Involvement of Tribes in State ISTEA Planning Issue

The lack of communication between state, local governments, and tribal governments is a key issue. Some tribes may not have the resources in place to receive ISTEA information and participate in planning. Other tribes would like to get more information about ISTEA. In some situations, relationships between tribes and local governments have been adversarial in the past and communication may need improvement. It has been suggested that a Tribal Circuit Rider Program be established at the Northwest Tribal LTAP Center

at Eastern Washington University. This program would improve linkage between tribal governments, the state DOT, RTPOs, and local governments.

State — Tribal Policy Development Issue

Further policy development may be needed. The purpose of this handbook is to document existing state ISTEA policies, however, there are policy issues which go beyond the mission of this handbook. Defining the needs of tribes, the mechanisms for tribal involvement, and the delivery of programs to tribes, are issues that need to be addressed. One solution may be the state appointment of a Tribal Transportation Task Force composed of State and Tribal policy makers and staff to deal with issues in a comprehensive and systematic manner in order to address the short- and long-term needs of all parties.

Chapter 3 An Overview of Federal, State, and Other Transportation Programs

The Federal Funding Process

How Funding is Authorized by Congress

The federal government periodically passes a surface transportation act, which provides funding for transportation programs. Surface transportation acts were passed in 1979, 1982, 1987, and most recently in 1991. The 1991 Act — the Intermodal Surface Transportation Efficiency Act of 1991, or "ISTEA" — authorized federal surface transportation programs for six years (FFYs 1992-1997). Surface transportation acts generally do the following: Add, eliminate, or modify transportation programs; set authorization levels that define the maximum amount of money that can be expended for surface transportation programs; make special requests, such as or studies and demonstration projects; and provide direction to the U.S. Secretary of Transportation for the allocation of discretionary funds.

Intermodal Surface Transportation Efficiency Act of 1991 — ISTEA

The Intermodal Surface Transportation Efficiency Act of 1991 — ISTEA — is the current authorizing vehicle for federal aid to state and local governments for surface transportation programs. This legislation contains eight titles covering federal-aid highways; recreational trails, mass transportation; highway safety; motor carrier provisions; intermodal transportation; research programs, studies and activities; intelligent vehicle systems; advanced transportation systems; air transportation; and the extension of highway-related taxes and the Highway Trust Fund.

Compared to the previous 1987 act, ISTEA did a major restructuring of federal programs. ISTEA modified federal-aid programs by eliminating certain programs, combining others and creating new ones. Summarized below are the major structural changes ISTEA put into effect:

Programs Eliminated Under ISTEA

- Federal-Aid Primary (FAP)
- Federal-Aid Secondary (FAS)
- Federal-Aid Urban (FAUS)

New Programs Under ISTEA

- National Highway System (NHS)
- Surface Transportation Program (STP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Scenic Byways Program
- Ferry Boat and Facilities Construction Program
- Intelligent Vehicle Highway Systems Corridors Program (IVHS)

Programs With Major Modifications Under ISTEA

- Interstate Construction (terminated after four years)
- Interstate 4R (now Interstate Maintenance, with reconstruction excluded)
- Federal Land Programs (programs consolidated and formula changes)

Highway programs of ISTEA are financed primarily from the Highway Account of the Federal Highway Trust and, with some small federal General Fund resources used for specific, identified projects and programs. Transit programs are enacted from both the Federal General Fund and the Mass Transit Account of the Highway Trust fund. The Highway Trust fund receives most of its revenue from taxes on gasoline and diesel fuels — currently at rates of 14.1 cents and 20.1 cents per gallon, respectively. Federal taxes on tires, trucks and trailers and interest earnings provide the remainder of the Trust Fund revenues. Since 1956, Washington State has received back from the federal government an average of $1.67 for every dollar Washington taxpayers have contributed to the Highway Trust Fund. This favorable rate of return will decline over the term of ISTEA as we approach the completion of Washington's Interstate Highway System. The decline will not be as dramatic as previously thought, however, as Congress included in ISTEA certain provisions that will guarantee that the state will continue to receive approximately the same percentage share of highway funds as it did during the period FFY 1987-1991. However, with the required designation of the National Highway System in FY 1995, Congress will have the opportunity to review the federal funding formulas in ISTEA and to make modifications in those formulas that could more dramatically decrease the state's share of federal aid.

Transferability of Federal Funds

One of the most significant changes made in ISTEA, aside from the program structure changes, was the increase in the flexible use of federal highway and transit funds. While the previous surface transportation act (1987) allowed some transfers of funds between programs, ISTEA greatly expands this

ability and eases restrictions on transfers. The intent of Congress was to allow states and local jurisdictions greater flexibility in determining how federal trust funds would be used.

Since the process used for determining funding levels for highway and mass transit programs differ, each is addressed in turn below.

Federal Highway Administration (FHWA) Funding

Based on authorization established in the surface transportation act, the FHWA uses the authorized maximum levels of funding for each program and formulas established by law to determine the apportionment each state receives. These apportionments are determined by statutory formula, after certain deductions. States are then notified of the annual apportionments by program after October 1 of each year (the start of the Federal Fiscal Year, or FFY). During the course of the FFY, each state may receive additional allocations of federal funds through various discretionary programs, usually upon application to the FHWA.

Apportionments represent the amount that can be obligated by a state during a fiscal year, rather than the amount of cash that the state will actually be reimbursed for projects undertaken with federal assistance. Reimbursements takes place only after the state has paid for a project and sent a request for reimbursement to the FHWA. Federal control over the amounts of cash that the FHWA will have to ultimately send to states to reimburse them for project costs is exercised thought the establishment of the annual "limitation on obligations" as a part of the federal budget process. Each year in the U.S. Department of Transportation Appropriations Act, Congress establishes an upper limit (the limitation on obligations) on the amount of obligation that all states can incur. This limit may or may not be equal to the apportionment level set in the authorization bill, and in fact can vary widely from that level. In FFY 1992, or example, the obligation limitation was set at over 99 percent of the authorization in ISTEA. In FY 1993, however, the obligation limitation was set at about 82 percent of the authorization. Apportionment that cannot be used in the year in which they are received can be carried over to future years as unobligated apportionments. Generally these apportionments can be used for a period of four years. If they have not been used at the end of four years, they "lapse" (expire) and are no longer available to the state.

The state can receive additional obligation authority through a process called "redistributed obligation authority." Each fiscal year (FY), towards the end of the FY, FHWA surveys all states to determine whether they will use all of the obligation authority they have received and whether they could use additional obligation authority by the end of the FFY if it were made available. States that are not able to use their obligation authority return it to FHWA and FHWA "redistributes" it to states that can use it. Washington has had an excellent record in being able to not only use all of its annual obligation authority, but also in getting and using redistributed obligation authority.

Federal Transit Administration (FTA) Funding

Unlike funding for the Federal Highway Administration (FHWA), Federal Transit Administration (FTA) programs are appropriated budget authority programs. This means that while the federal authorization for the program may set any level of annual funding, funds must be appropriated each year through the federal budget process. The annual appropriations acts become critical in determining how much will be available for distribution each year, and the amounts appropriated may or may not be equal to the amounts authorized in the authorization act. FHWA funding, on the other hand, is based on a contract authorization process, wherein the multi-year authorization act (ISTEA, for example) sets the annual amounts apportioned or allocated and the annual appropriations act sets the amounts which may be obligated during that year — not the amounts which are apportioned. This difference is critical. While ISTEA sets the annual authorization for FTA at $5.235 billion for FY 1993, Congress only appropriated approximately $3.8 billion for the year.

Notwithstanding this difference between FHWA and FTA funding procedures, the formulas for FTA funding in ISTEA do affect the amounts of funds available annually for the various FTA programs. The FTA funding formulas are summarized below.

Funding for Section 3 Discretionary and Formula Grants

Authorizations for FTA Section 3 Discretionary and Formula Grants are set in ISTEA. Section 3 Grants receive both a Federal General Fund appropriation and an appropriation from the Mass Transit Account of the Highway Trust fund. Section 3 authorizations are not subject to set asides for other FTA programs. In FFY 1993, ISTEA authorized $1.725 billion in Mass Transit Account funds and $0.305 billion in General Funds, or a total of $2.030 billion for Section 3 grants. Under ISTEA, 40 percent of these funds are available for fixed guideway modernization by formula, 40 percent for new fixed guideways and extensions (discretionary), and 20 percent for buses (discretionary).

Funding for Section 9, 11, 12, 16, 18, 23, and 26 Formula Grant Programs

As with the authorizations for FTA Section 3 grants, the authorizations for all other FTA programs are set in ISTEA. Unlike Section 3, however, the authorizations for all other programs are established first through an appropriation of federal General Fund and Mass Transit Account funds and then by formula which determines how much of this total appropriation is set aside for each formula grant program.

Federal Funding for Aviation

The state also receives funding from the Federal Airport and Airway Trust fund. Taxes on aviation fuel, air freight, and passenger tickets provide revenue for the fund. Aviation revenue is primarily used to fund grants-in-aid to local airports and for facilities and equipment programs.

Note: The description of financial programs which follows for transportation or transportation related activities does not include all possible sources. An attempt was made to list the most common state and federal funding programs. The references list in this guide should be consulted for more detailed information on any of the funding programs listed. Of particular usefulness are the following three publications:

- ***Local Agency Guidelines (LAG) Manual, May 1994, WSDOT TransAid Service Center.***
- ***ISTEA Application Handbook for Local Governments, March 1993, WSDOT TransAid Service Center.***
- ***A Guide to Federal Aid Programs, Projects, and Other Uses of Highway Funds, FHWA-PD-92-018, September 1992.***

Northwest Tribal Local Technical Assistance Program (LTAP)

The American Indian Tribal Government LTAP Centers Program was created by the 1991 ISTEA. Four centers were established in the USA to serve Indian tribal governments. The Northwest Tribal Local Technical Assistance Program serves the northwestern states, including Washington.

The new centers for Native Americans are jointly funded and administered by the Washington, D.C. FHWA headquarters and the Bureau of Indian Affairs. They transfer highway technology to tribal governments via materials and training, publish a newsletter, improve the flow of information among the FHWA, the BIA, the state DOT's, and tribal governments. They also encourage the use of new cost-effective technology by tribal governments.

Along with the educational and technical assistance responsibilities, the American Indian Tribal LTAP Centers are to promote tourism as an economic development strategy. In summary, these centers do the following:

- Provide training workshops to tribes.
- Publish quarterly newsletters.
- Maintain mailing lists.
- Serve as a clearinghouse for publications, video tapes, field guides.
- Provide information on new and exiting technology.
- Perform self-evaluations of their programs.

The Northwest Tribal LTAP Center is located at Eastern Washington University and can be reached at (509) 359-7948. Contact Mike Marchand at:

NW Tribal LTAP
Eastern Washington University
Department of Urban and Regional Planning
MS-50 Isle Hall
Cheney, WA 99004

Federal Lands Highway Program — Indian Reservation Road (IRR) Program

Description

The Indian Reservation Road (IRR) Program was established by Congress within the Surface Transportation Assistance Act of 1982 (PL 97-424). The Bureau of Indian Affairs and the Federal Highway Administration executed a Memorandum of Agreement (MOA) in May 1983 which was amended in 1992 to include the Highway Bridge Replacement and Rehabilitation (HBRR) Program. The memorandum of agreement defines the roles and responsibilities of the agencies for both the IRR and the HBRP programs.

The Indian Reservation Road Program is administered by both the Federal Lands Highway Office of FHWA and by the Division of Transportation of the Bureau of Indian Affairs of the Department of the Interior. The program is 100 percent federally funded. Five of the 12 BIA areas of the country are under Certification Acceptance pursuant to Title 23 United States Code Section 117. In other BIA areas the FHWA Federal-aid Division Office located in each state, provides assistance or oversight of the IRR program.

Section 1003 of the 1991 ISTEA authorizes about $1.1 billion to be appropriated out of the Highway Trust Fund over a six-year period for Indian Reservation Roads ($159 million for FY 1992 and $191 million for each of FYs 1993-1997).

Up to 2 percent of the funds made available each fiscal year for Indian Reservation Roads must be allocated to Indian tribal governments applying for transportation planning pursuant to the provisions of the Indian Self-Determination and Education Assistance Act. The Indian tribal government, in cooperation with the BIA, and, as may be appropriate, with a state, local government, RTPO, or metropolitan planning organization, must develop a transportation improvement program for funding. Projects must be selected by the Indian tribal government for the transportation improvement program and are subject to the approval of the BIA and FHWA.

In addition to the IRR funds, not less than 1 percent of the amount of HBRRP funds to be apportioned to each state which has an Indian reservation within its boundaries will be transferred to the Secretary of the Interior to carry out this program.

Funds allocated for Indian reservation roads may be used for the purpose of funding road projects on roads of tribally controlled postsecondary vocational institutions.

Eligible Projects

Indian Reservation Roads funds may be used on eligible IRR roads as discussed below and defined in 23 USC 101 for the following purposes:

- Road and bridge improvements;
- Planning, research, engineering, and construction;

- Road sealing (using up to 15 percent of HTF funds apportioned for IRR);
- Indian technical LTAP centers;
- Transportation planning for programs to enhance tourism and recreational development;
- Adjacent vehicular parking areas;
- Interpretative signage;
- Acquisition of necessary scenic easements of scenic or historic sites;
- Provision for pedestrians and bicycles;
- Construction and reconstruction of roadside rest areas, including sanitary, and water facilities; and
- Other appropriate facilities such as visitor centers.

Process

Indian tribal governments working with the BIA have the responsibility for selecting projects to be funded under the IRR program (Title 23 United States Code, Section 204). The relationships and roles of the FHWA, BIA, and Indian tribal governments for the IRR program are summarized in Table 3-1. Pursuant to the BIA/FHWA Memorandum of Understanding, the BIA may request FHWA's assistance in performing transportation planning, engineering, construction administration, and research.

Pursuant to the Indian Self-Determination Act, Indian tribal governments can perform some of the activities of the IRR and the HBRRP programs under a public law (PL) 93-638 contract or an amendment to PL 93-638 compact. These areas are highlighted on Table 3-1 with a footnote.

Additional Information

Additional information may be obtained from the Federal Lands Highway Office in Vancouver, Washington, or from the Bureau of Indian Affairs in Portland.

Table 3-1

Division of Responsibilities for the Indian Reservation Road Program and the Highway Bridge Rehabilitation and Replacement Program. [1]

Activity	FHWA	IRR Responsibility BIA	Tribal Government
Report to Congress	x		
Oversee the programs	x	x	
Conduct program reviews of work		x	x
Administer the programs	x	x	
Develop and revise interagency agreements		x	x
Develop regulations and guidelines		x	x
Develop highway design, construction, maintenance, and safety standards	x	x	
Ensure adequate road maintenance and safety standards		x	x
Implement provisions of law providing for Indian preference in employment minority business set aside, preferential Indian subcontracting, and training and assistance to minority contractors	x	x	A
Perform Federal government trust responsibilities for Indian lands	x		
Determine respective responsibility for execution of the approved program	x	x	
Designate the BIA road system		x	
Develop certification acceptance plans for BIA areas		x	
Approve BIA area Certification Acceptance Plans		x	x
Establish Codes and Transfer IRR and HBRRP funds, liquidating cash, and obligation limitation to BIA		x	
Develop IRR fund allocation formulas		x	
Allocate IRR and HBRRP funds		C	x
Perform transportation planning including studies		B	x	A
Develop transportation plans for Indian tribes		B	x	A
Coordinate with state and metropolitan planning organizations	x	x	B
Develop transportation improvement programs		x	x
Approve transportation improvement programs		x	

Activity	FHWA	IRR Responsibility BIA	Tribal Government
Select projects for IRR funding		x	x
Approve IRR and HBRRP funding for projects selected by Indian tribal governments	x	x	
Perform preliminary engineering, public notification, conduct public hearings	B	x	A
Prepare environmental documents as per NEPA	B	x	A
Approve environmental documents	B	x	
Prepare plans, specifications, and detailed cost estimates (PS&E)	x	A	B
Approve PS&E in BIA areas not under CA	x		
Approve PS&E in BIA areas under CA		x	
Acquire right-of-way, obtain railroad agreements, and utility adjustments	B	x	A
Advertise, award, and administer construction contracts	B	x	A
Perform construction using force account		x	A
Approve change orders	B	x	
Prepare status reports for projects	B	x	A
Conduct project inspections	B	x	A
Make payments to contractors or state or civil subdivision for services provided on projects	B	x	A
Recommend acceptance of project to FHWA	B	x	
Conduct field inspection and accept project	x	x	
Develop a final construction report and as-constructed plans	A	B	x
Exchange information on contract claims or litigation on a project	x	A	x
Develop written request for FHWA assistance		x	x
Conduct research	x	x	A
Furnish highway statistical data on capital outlay and maintenance to FHWA	x	x	x
Furnish reports on obligations and project expenditure to FHWA	B	x	A
Ensure that BIA bridges are included in the state bridge inventory and NBI	x		

Inspect BIA owned bridges B	x	A	
Identify HBRR funds to be set aside for IRR bridges	x		
Issue instructions to states for submitting candidate IRR bridges for replacement or rehabilitation	x		
Prepare list of IRR bridges that require replacement or rehabilitation	x	A	
Select IRR bridges for HBRR funding		x	x
Perform final inspection on bridges funded with HBRP funds	x		B
Return unneeded HBRRP funds to state after consultation with BIA and Indian tribal governments	x		

[A]Under a PL 93-638 contract or amendment to a compact

[B]On a project by project basis upon request by BIA or a tribe

[(1)]Pursuant to Title 23 United States Code and the Indian Self Determination Act (PL 93-638) as amended.

Federal Lands Highway Program — Parkways and Park Highways

Description

Section 126 of the Surface Transportation Assistance Act of 1982 (1982 STAA, Public Law 97-424) established a coordinated Federal Lands Highways Program (FLHP) consisting of forest highways, public lands highways, parkways and park roads, and Indian reservation roads. The Surface Transportation and Uniform Relocation Assistance Act of 1987 (1987 STURAA, Public Law 10017) continued the FLHP with the same four funding categories. Section 1032 of the Intermodal Surface Transportation Efficiency Act of 1991 (1991 ISTEA, Public Law 102-240) also continued the FLHP, but reduced the funding categories from four to three by incorporating forest highways into public lands highways.

Park roads are owned by the National Park Service. Parkways are authorized by Congress. The FHWA's Federal Lands Highway Office administers the Parkways and Park Highways Program in cooperation with the National Park Service (NPS).

Section 1003 of the 1991 ISTEA authorizes $486 million to be appropriated out of the Highway Trust Fund over a six-year period for parkways and park highways ($69 million for FY 1992, $83 million for each of FY's 1993-1995, and $84 million for each of FY's 1996-1997). Additional funding for specific parkways and park highways projects is sometimes provided in DOT and DOI appropriations acts. Also several specific projects received funding under Sections 1104, 1105, and 1107 of the 1991 ISTEA. Federal participation is 100 percent for all projects.

Eligibility

Parkways and Park Highways funds may be used on eligible roads as defined in 23 USC 101 for the following purposes:

- Roadway and bridge improvements;
- Planning, research, engineering, and construction;
- Transportation planning for programs to enhance tourism and recreational development;
- Adjacent vehicular parking areas;
- Interpretative signage;
- Acquisition of necessary scenic easements and scenic or historic sites;
- Provisions for pedestrians and bicycles;
- Construction and reconstruction of roadside rest areas, including sanitary and water facilities; and
- Other appropriate facilities such as visitor center.

Additional Information

Additional information may be obtained from the Federal Lands Highway Office in Vancouver, Washington.

Federal Lands Highway Program — Public Land Highways

Description

The Federal Lands Program in ISTEA authorizes funds on (1) Indian reservation roads, (2) parkways and park roads, and (3) public lands highways, which incorporates the previous Forest Highways Programs. Programs for the first two are administered by the Department of the Interior. The Public Lands Highways Program is administered through the Western Federal Lands Highway Division of the FHWA which is located in Vancouver, Washington.

(There is no matching requirement as the federal share is 100 percent for federal lands programs.) Counties are generally expected to acquire any needed rights of way for selected projects.

Total funding for federal lands nationwide is $2.6 billion for the FFY 1992-1997. The funds are allocated on the basis of collective needs. The Forest Highways portion of Public Lands Highways and the Indian Reservation Roads authorizations are allocated by federal administrative formula.

The Forest Highway funds under ISTEA have doubled to about $8 million per year in Washington.

Types of Eligible Projects

Although ISTEA has dropped the term Forest Highway Program, it will continue to be used for now. The intent of the Forest Highway Program remains the same as before — to improve state and county roads that benefit national forest lands and uses.

In addition to the traditional project improvement proposals, transportation enhancements are also an eligible activity. These funds can be used for enhancement of parking areas, interpretation signage, acquisition of scenic easements or scenic or historic sites, provisions for pedestrians or bicycles, construction and reconstruction of roadside rest areas, and other facilities as determined by FHWA. Rural development is also a concern that may be helped with transportation improvements. An area's economic development council should be contacted for their local rural development plans to see if forest highway improvement needs are part of the plan. Project proposals must be jointly supported and prepared by the county or WSDOT region and the forest engineers of the respective national forest.

Process for Local Agencies (Forest Highway Funds)

A forest highway system has been established and the following counties are eligible to apply for forest highway funds:

Asotin	Ferry	Lewis	Skamania
Chelan	Garfield	Mason	Snohomish
Clallam	Jefferson	Okanogan	Stevens
Clark	King	Pend Oreille	Walla Walla
Columbia	Kittitas	Pierce	Whatcom
Cowlitz	Klickitat	Skagit	Yakima

- The Tri-Agency Group — comprised of representatives from FHWA, WSDOT, and the USFS — periodically request submittal of projects for the Forest Highway Program.
- If a proposed project is not on a system route, both a forest highway **route** proposal and the forest highway **project** proposal are submitted.
- Agencies having projects within the boundary of an MPO need to work with that organization to incorporate their project into the MPO's TIP.
- Federal Lands FHWA provides their six-year program to the Local Programs Division for forwarding to MPOs for incorporation into their TIPs and also for incorporation into the STIP for areas outside of MPOs.
- Proposed projects are evaluated and prioritized by the Tri-Agency Forest Highway Group using specific evaluation criteria and a point system. The Tri-Agency Group is composed of representatives from the Federal Highway Division of FHWA, United States Forest Service, and WSDOT TransAid Service Center.

The National Highway System

Description

The ISTEA of 1991 established a major new federal aid system, the National Highway System (NHS), which according to FHWA, "is the centerpiece of the newly structured federal aid highway program." The Secretary of Transportation of USDOT is directed by Congress to develop the NHS in cooperation with the states and local areas. The NHS will include the interstate system; other routes identified for their strategic defense characteristics; routes providing access to major ports, airports, public transportation, and intermodal transportation facilities; and principal arterials that provide regional service.

The proposed NHS has been developed by the states in cooperation with local and regional officials based on guidelines established by the Secretary of Transportation and on the functional reclassification. The states and the MPOs, as well as other local officials, have the flexibility to propose routes if they are consistent with the objectives of the NHS. This cooperative designation process has been completed.

The proposed system was submitted to Congress, and Congress is to take action on approving the system by September 30, 1995. Until then, the NHS in Washington will include all highways classified as principal arterials, including the interstate system. There are approximately 4,000 miles of roadways now eligible for NHS funds. It is expected that the NHS in Washington will be about 3,000 miles.

Although a part of the NHS, the Interstate System retains its separate identity and receives separate funding. The three interstate programs are:

- Interstate construction,
- Interstate substitute highway projects (not applicable in Washington), and
- An Interstate maintenance program.

The formulas for the three interstate programs are basically the same as in previous law. Interstate construction and interstate substitute are based on an estimate of cost to complete. The factors used for interstate maintenance, like the previous interstate resurfacing, restoration, rehabilitation, and reconstruction, (4R) programs, are lane miles and vehicle miles traveled.

Types of Eligible Projects

Construction, rehabilitation, resurfacing, restoration, and operational improvements for highways, highway safety improvements, highway-related technology transfer activities, and carpool and vanpool projects.

Interstate Maintenance (IM) funds, however, may not be used for new travel lanes, other than high occupancy vehicle lanes or auxiliary lanes or reconstruction. Also, Interstate Completion funds can only be used for projects identified in the Interstate Cost Estimate (ICE).

Process for Local Agency Projects

Note: Local agencies have very few miles on the NHS system. Local agencies have swapped NHS funds for STP funds

The Surface Transportation Program (STP)

Description

The STP funds may be used by the states and localities for any roads (including those on the NHS) that are of a higher federal functional classification than local access or rural minor collectors. These roads are now collectively referred to as federal aid roads. Bridge projects using STP funds however, are not restricted to federal aid roads but may be used on any public road.

The STP replaces several previous federal programs: federal aid urban systems (FAUS), federal aid secondary (FAS), rail/highway crossing, hazard elimination, and part of the old federal aid primary system. In addition, transit projects, car and vanpool facilities, bicycle facilities and pedestrian walkways, and a variety of other activities can be funded with STP funds. Over the six-year lifetime of ISTEA, Washington is authorized to receive over $635 million under STP.

The program differs from previous FHWA programs in several ways:

- Funds are eligible for a wider array of activities than the programs it replaces.
- Funds are eligible for activities and facilities rather than on specific federal aid systems.
- Funds must be made available to TMAs (MPOs with over 200,000 population) on the basis of population.
- Areas without urbanized areas under 5,000 population must receive at least 110 percent of the FFY 1991 federal aid secondary funds each FFY.

Federal guidance regarding the state planning process discourages the previous practice of formula suballocation of funds to local jurisdictions. Instead, it places the emphasis on a project identification approach that requires the integration of planning and programming processes by greatly increasing the responsibilities of MPOs and regional decision making for STP project selection.

The total STP funding nationally over the six years is $23.9 billion. The formula for distribution of funds is based on each state's FY 1987-1991 share of total national funding with appropriate adjustments for Interstate Maintenance and Bridge apportionments.

Once the funds are distributed to the states, each state must set aside nominally 10 percent for safety construction activities (i.e., hazard elimination and rail-highway crossings) and nominally 10 percent for transportation enhancements (which encompass a broad range of activities).

Each state must divide 50 percent of the funds by population between each of its areas over 200,000 and the remaining areas of the state. The remaining 30 percent can be used in any area of the state. The Act guarantees that rural

areas and towns of less than 5,000 population will receive annually no less than 110 percent of the FY 1991 federal aid secondary funds.

Process for Local Agencies Projects

(See the materials which follow on the various subparts of the STP including: STP Transportation Enhancement, STP Safety Construction, STP Regional Allocation Projected, and STP Statewide Competition Projects. Additional questions should be directed to the Regional TransAid Engineers and their staff on page xvi of this guide.)

STP — Transportation Enhancements

Description

ISTEA requires that nominally 10 percent of a portion of the STP funds be set aside for transportation enhancements, which encompass a broad range of activities. An Enhancement Advisory Committee (EAC) has developed statewide selection criteria for projects.

Types of Eligible Projects

Enhancements are defined in Section 101(a) USC Title 23 as follows:

> "The term 'transportation enhancement activities' means, with respect to any project or the area to be served by the project, provision of facilities for pedestrians and bicycles, acquisition of scenic easements and scenic or historic sites, scenic or historic highway programs, landscaping and other scenic beautification, historic preservation, rehabilitation and operation of historic transportation buildings, structures, or facilities (including historic railroad facilities and canals), preservation of abandoned railway corridors (including the conversion and use thereof for pedestrian or bicycle trails), control and removal of outdoor advertising, archaeological planning and research, and mitigation of water pollution due to highway runoff."

Funds Matching Requirements

Basic 80 percent/20 percent adjusted due to federal lands to 86.5 percent federal and 13.5 percent local. Pedestrian and bicycle facilities remain unadjusted at 80 percent federal and 20 percent local.

Process for Local Agency Projects

- Application requirements are established annually by an Enhancement Advisory Committee (EAC).
- All MPOs/RTPOs and WSDOT sponsor Transportation Enhancement Workshops statewide early each year (January through February) to inform the public of the program and the process for applying for funding.
- MPOs/RTPOs define a schedule for submitting projects. Agencies contact their MPO or RTPO to define the schedule requirements.
- Each MPO/RTPO establishes their own criteria for prioritizing projects and rank projects collected in their respective areas.
- Each MPO/RTPO submits their prioritized projects to WSDOT TransAid Service Center.
- The EAC reviews the projects' proposals and recommends funding for projects, giving equal consideration to:
  - Local priorities as established by the MPO/RTPO.
  - Diversity of projects.

- Statewide distribution of funding.

- The EAC submits their recommendations to the WSDOT Secretary of Transportation towards the end of May.
- The Secretary of Transportation reviews and approves the proposed funded enhancement projects submitted by the EAC.
- TransAid staff informs the applicant of their approved projects.
- Local agencies initiate their projects following the procedures in the *Local Agency Guidelines* (LAG) manual.

Note: As with all ISTEA funded projects, transportation enhancement projects must be included in the TIP/STIP.

STP — Safety Construction

Description

ISTEA requires that nominally 10 percent of the STP funds be set aside for safety construction activities, for example, hazard elimination projects and railroad crossing safety improvements. The railroad grade crossing program has two basic objectives: (1) to reduce the accident frequency and severity at at-grade crossings, and (2) to improve operation efficiency.

Types of Eligible Projects

- Railroad crossing improvements including installation of signs, markings, and cross-bucks.
- Installation of railroad warning devices, gates, etc.
- Repair, rehabilitation, or new railroad crossing surfaces.
- Intersection safety improvements.
- Minor highway alignment improvements.
- Guardrail and other protective devices installations.
- Elimination of roadside hazards.

Matching Requirements

Eighty percent federal and 20 percent local with certain safety projects at a higher federal match up to 100 percent.

Process for Local Agency Projects

- WSDOT TransAid Service Center defines the criteria. Projects are prioritized on the basis of a benefit cost ratio and a history of accidents and substandard conditions.
- TransAid staff solicits projects from local agencies and tribes in March.
- Local agencies submit projects for consideration.
- Staff of TransAid reviews and prioritizes the proposed projects based upon selection criteria.
- The TransAid informs the local agencies of the status of their projects.
- Local agencies process approved projects using the *Local Agency Guidelines* (LAG) manual.

STP — Regional/Allocation Projects

Description

Construction of improvements to roads, bridges, transit facilities, and other modes.

Type of Eligible Projects

Projects must be on federally functional classified roads, higher than local access or rural minor collectors. (Eligible projects include those for the STP in general.)

Matching Requirements

Basic 80 percent/20 percent adjusted due to federal lands to 86.5 percent federal and 13.5 percent local. Pedestrian and bicycle facilities remain at 80 percent federal and 20 percent local with no adjustment.

Process for Local Agency Projects

- The notice of funding allocation for the regional competition is distributed by the TransAid as follows for project selection:
  - TMAs for areas with an urban population over 200,000.
  - MPOs for urban areas over 50,000 population.
  - County areas/regional organizations for areas with an urban population under 50,000. (County areas may develop and use a project programming process only within the county, along with adjacent counties, or use the RTPO.)
- Application requirements are established by the administering agency (TMAs, MPOs, county regions). The funds are available to cities, counties, tribes, transit, and other public agencies.
- The TMAs, MPOs, and county regions select and prioritize the projects.
- The selected projects are added to the TIP.
- Local agencies initiate their projects following the procedures in the *Local Agency Guidelines* (LAG) manual.

STP — Statewide Competitive Program

Description

Statewide STP Competitive funds are available for specific transportation programs and projects. The goal of the program is to fund projects and programs that develop, improve, and/or preserve an integrated transportation system that encourages multimodal choices to the public.

Type of Eligible Projects

Projects must be on federally functional classified roads, higher than local access or rural minor collectors. (Refer to STP descriptions.)

Funds Matching Requirements

Basic 80 percent/20 percent adjusted due to federal lands to 86.5 percent federal and 13.5 percent local. Pedestrian and bicycle facilities remain at 80 percent federal and 20 percent local with no adjustment.

Process for Local Agency Projects

- Application requirements established each year by the Multimodal Transportation Programs and Projects Selection Committee.
- Notices are sent out by the TransAid Service Center soliciting projects from local agencies, ports, transit, tribes, and other public agencies.
- Agencies submit proposals to WSDOT TransAid Service Center in March. TransAid makes copies and forwards to the selection committee.
- The selection committee selects projects for funding based primarily on the prioritization method it establishes.
- TransAid staff informs the local agencies of the selection committee's approval.
- Local agencies initiate projects following the procedures in the LAG manual.

Note: These projects as well as any others funded with ISTEA funds must be included in the TIP/STIP.

Congestion Mitigation and Air Quality Improvement Program

Description

The CM/AQ Program was established under the ISTEA Section 1009. The purpose of the program is to fund transportation projects and programs that will contribute to attainment of National Ambient Air Quality Standards (NAAQS). Although the primary emphasis is on ozone and CO levels in nonattainment areas, some transportation projects and programs addressing air pollution with particulate matter greater than 10 microns (PM-10) may be eligible under certain conditions. The primary intent is for these projects and programs to result in tangible reductions in ozone precursor and CO emissions within a timeframe to allow attainment as provided in the Clean Air Assistant Act (CAAA) of 1990. It is important to note that the Clean Air Act requires highest priority be given to the implementation of the transportation portions of applicable SIPs and TCMs from applicable SIPs.

Eligible Projects

All projects eligible for CM/AQ funds must be included in a conforming transportation plan and TIP, and conform to the requirements of the Clean Air Act. They must also meet the National Environmental Policy Act (NEPA) and be a part of the STIP.

Projects that are eligible for CM/AQ funds include the following. Other projects and programs may also be considered for funding if the activities are innovative and based on promising technologies and feasible approaches which will improve air quality.

- Transportation activities in an approved State Implementation Plan (SIP).
- Transportation control measures (TCMs).
- Bicycle and pedestrian facilities and programs.
- Management systems.
- Traffic monitoring, management, and control operations.
- Emission inspection/maintenance programs.
- Transit projects.
- Highway and transit maintenance and reconstruction projects.
- Planning and air quality monitoring projects.
- Public/private initiatives.

Matching Requirements

Federal participation for most CM/AQ projects is 80 percent which is increased to 86.50 percent due to public lands adjustments. It can be 90 percent for some activities that are on the Interstate system. Certain activities may be federally funded at 100 percent if they meet the conditions presented in Section 120(c) of Title 23. These activities include such work as

traffic control signalization and commuter carpooling/vanpooling. Pedestrian and bicycle activities are limited to 80 percent federal participation.

Over the life of the act, Congress has authorized $6 billion for the national CM/AQ Program. It is anticipated that the state of Washington will receive $91.6 million for the six-year period from FFY 92 through FFY 97, an average of approximately $15.7 million per federal fiscal year to be used in three nonattainment areas. The three MPOs receiving these funds are Puget Sound Regional Council (PSRC), Southwest Washington Regional Transportation Council (SWRTC), and the Spokane Regional Council (SRC).

Process for Local Agencies

These funds are allocated to the three Washington State air quality nonattainment areas in the Central Puget Sound, Vancouver, and Spokane areas. Projects are selected and prioritized by the TMAs for these regions. The CM/AQ project process is:

- The Transportation Management Areas (TMA) publishes a request for projects with specific criteria. This is done typically each year. Project criteria will vary between regions.
- The agency submits candidate projects to the TMA in response to the TMA request. An estimate of the reduction in emissions from the proposed project is required with the project submittal.
- The TMA prioritizes the submitted projects. Projects that implement the State Implementation Plan (SIP) for air quality will receive highest priority.
- Projects are selected by the TMA based upon the priorities and available funds for inclusion in the TIP and STIP.

For more information, contact the TMA in your region:

- Central Puget Sound Area — Puget Sound Regional Council (PSRC) Telephone (206) 464-7515
- Spokane Area — Spokane Regional Council (SRC) Telephone (509) 625-6370
- Vancouver Area — Southwest Washington Regional Transportation Council (SWRTC) Telephone (360) 737-6067

Bridge Replacement and Rehabilitation Program

Description

ISTEA continues the existing Bridge Replacement and Rehabilitation Program (BRRP) of the previous law which provides assistance for any bridge on a public road. ISTEA added additional eligible activities like bridge painting, seismic retrofitting, and calcium magnesium acetate applications. A bridge discretionary program is continued with a new timber bridge component.

Washington has 6,938 bridges which are open to travel by the public. Of these, 2,187 or 32 percent are considered deficient either structurally or functionally. These deficient bridges determine Washington's share of BRRP funds.

The state must spend between 15 and 35percent of its BRRP funds for projects on public roads classified as local or rural minor collectors.

Types of Eligible Projects

Any bridge which is structurally deficient or functionally obsolete and has a sufficiency rating of 50 or less is considered eligible for replacement funding. Any bridge which is structurally deficient or functionally obsolete and has a sufficiency rating of 80 or less is considered eligible for rehabilitation funding. Eligible projects for BRRP funds include:

- Structurally deficient bridges.
- Functionally deficient bridges.
- Bridge painting.
- Seismic retrofitting.
- Application of calcium magnesium acetate.

Funds Matching Requirements

BRRP is funded 80 percent federal/20 percent local. There is no adjustment for federal lands in the state.

Estimated Washington Apportionment

Although the exact amounts apportioned to the state have changed yearly, Washington has historically received an average of $30 to $35 million per year through the BRRP. With ISTEA, Washington will receive nearly double the amount received in the past. The distribution of these funds to individual bridge replacement projects for local agencies is governed by policies established by the Bridge Replacement Advisory Committee (BRAC).

Presently, federal funds are split equally (50/50) between WSDOT and local bridge projects. Forty percent of a state's bridge funds may be transferred to the NHS or the STP; the transferred amounts are not subject to the STP set-asides and sub-state distribution requirements of ISTEA.

Process for Local Bridges

(See the WSDOT's *Local Agency Bridge Inspection Manual* for details.)

The selection and funding of bridge projects is facilitated by BRAC and its subcommittee, the Technical Committee. The WSDOT Bridge Condition Unit provides necessary technical support. BRAC has adopted policies on the use of these funds for various categories of projects.

- Each year, bridge candidates for replacement or rehabilitation are evaluated by a review team from the Bridge Condition Unit. A field inspection is made by this team the first year the bridge becomes eligible. The bridge is inspected every three years thereafter until a decision is made on the disposition of the bridge.
- The Bridge Condition Unit presents their evaluations of bridge candidates to the Technical Committee.
- The Technical Committee, made up of three professionalstructural engineers (one engineer from WSDOT, one county engineer, and one city engineer), review and arbitrate any differences between the sufficiency ratings as originally calculated and as revised by the Bridge Condition Unit team. The Technical Committee develops a matrix of information for BRAC's considerations of whether a bridge should be rehabilitated or replaced.
- The nine-member BRAC (three city, three county, and three WSDOT people) reviews the recommendations of the Technical Committee. Successful candidates for a recommended funding by BRAC fall into two groups — on-system and off-system bridges. They are arranged by their sufficiency ratings.

  BRAC discusses the relative merit of each bridge condition and makes one of the following recommendations to the Assistant Secretary for TransAid:

  - The bridge should be funded for replacement or for rehabilitation.
  - The bridge should not be funded.
  - A field review (C3R) should be made to determine the project scope and approximate costs. (***Note:*** As of this writing, all bridges receive a C3R unless there is a reason not to.)
- The Assistant Secretary for the TransAid of WSDOT selects the final bridge replacement candidates based upon the recommendations of BRAC.
- TransAid notifies local agencies by letter of any bridges chosen in their jurisdiction.
- The local agency then proceeds with the projectfollowing the procedures in the *Local Agency Guidelines* manual.

Emergency Relief Programs

Description

When an emergency exceeds the capability of state and local government, federal assistance can be requested from two sources, the FHWA and the Federal Emergency Management Agency (FEMA).

Under U.S. Code Title 23, Section 125, FHWA can provide funds for the restoration of damaged roads and bridges on federal aid highways.

Pursuant to Public Law 93-288, "Robert T. Stafford Disaster Relief and Emergency Assistance Act of November 1988, funds are available through FEMA for restoration of damaged roads and bridges off of the eligible federal aid classified roads and streets.

Process

(The WSDOT publication, Local Agency Guidelines" Chapter 33 explains in detail the process to follow for obtaining and using these funds.)

The initial starting point is a local Emergency Management Office, immediately after the disaster, notifying the Washington State Department of Community Development via the fastest means possible. Ultimately the Governor must declare an emergency and the FHWA and/or FEMA must approve the funding. Intergovernmental review is necessary. Contact the TransAid engineers in each WSDOT region.

Community Development Block Grants

Description

This program administered by the Washington State Department of Community Development, provides assistance to Indian tribes if assistance is sponsored by an eligible city or county. Cities must have less than 50,000 population and counties must be nonurban.

The program was authorized by Public Law PL 93-383 (42 USC 5301-5317).

The maximum grant awarded to local governments is $500,000 for a one-year program. Local match is not required but exploration of all available funding sources is encouraged. The estimated 1994 federal allocation statewide for small cities is $9,000,000. Call the program contact for 1995 financial information.

Types of Eligible Projects

The Washington State Community Development Block Grant Program provides funding for local housing, economic development, community facilities, and comprehensive projects which principally benefit low- and moderate-income households, eliminate or prevent slums or blight, or resolve problems which pose an immediate threat to public health and safety.

Process

Applications will be accepted once each year during a formalized application cycle. For additional information contact Charmaine Mortensen, Program Manager, Department of Community Development, Ninth and Columbia Building, PO Box 48300, Olympia, Washington 98504-8300, (360) 753-4900.

Community Development Block Grant Program — Imminent Threat

Description

This program is administered by the Washington State Department of Community Development. It provides assistance to Indian tribes if the application is sponsored by eligible nonurban city or county.

The program was authorized by Public Law 93-383 (42 USC 5301-5317).

A total of $200,000 is available annually statewide. Grant awards are made dependent upon emergency need. No local match is required. However, an exploration of all available funding sources is encouraged. A CDBG general purpose grant recipient may apply for an Imminent Threat Grant from the same federal fiscal year allocation.

Types of Eligible Projects

The Imminent Threat Grant Program addresses unanticipated and unique emergency needs that poise a serious threat to the health or safety of a community. In most cases, urgent problems will not be evident during the regular application cycle, so applications will be considered year round on a case-by-case basis. Examples of eligible imminent threat projects would include: broken water transmission lines, well cave-ins, collapsed storm sewers, and contaminated water supplies.

Process

Contact the Department of Community Development staff for application procedures. Contact Karen Roe, Community Development Specialist, Department of Community Development, Ninth and Columbia Building, PO Box 48300, Olympia, Washington, 98504-8300, (360) 753-4900.

Community Development Block Grant Program — Planning Only

Description

Administered by the Washington State Department of Community Development, the grant program is available to Indian tribes if the applicable is sponsored by a eligible city or county. Eligible cities have less than 50,000 people and eligible counties are nonurban. Authorizing legislation is PL 93-383 (42 USC 5301-5317).

The maximum grant amount for each application is $24,000 for a single jurisdiction and $40,000 for regional or multijurisdictional applications. Applicants must provide a 25 percent cash or in-kind match. Jurisdictions may apply for planning funds, general purpose funds, and imminent threat grants from the same federal fiscal year allocation.

Types of Eligible Projects

The CDBG Program has established a $300,000 annual fund for the purpose of providing Planning-Only Grants to eligible jurisdictions on a competitive basis. Planning-Only Grants may be used to conduct basic community development and low- and moderate-income needs assessment activities; and perform advance planning activities for projects which, if implemented, would principally benefit low- and moderate-income persons. The grants provide an opportunity to thoroughly assess community development needs, to develop options for addressing those needs, and to formulate work plans leading to well-conceived, successful projects that are appropriate for the jurisdiction.

Process

Application packets are available by calling the program's contact person. There are two application cycles each year. Contact Charmaine Mortensen, Program Manager, Department of Community Development, Ninth and Columbia Building, PO Box 48300, Olympia, Washington, 98504-8300, (360) 753-4900.

Short Course on Local Planning (Technical Assistance)

Description

This program is administered by the Washington State Department of Community Development, Local Government Services Division. Assistance is available to cities, counties, service agencies, special agencies, special districts and Indian tribes. Authorized by RCW 43.63A.030.

The Short Course on Local Planning was developed by the Planning Association of Washington (PAW) and the Washington State Department of Community Development (DCD) to educate planning commissions, board of adjustments, local elected officials, and the general public on the processes and products of local land use planning.

The course is a three-hour evening event. Experienced practicing professionals make presentations and respond to questions from the audience. Topical areas vary according to community needs, but often include the legal basis of planning, the comprehensive planning process, and plan implementation. Local needs determine both the evening's agenda and the professionals invited to speak. For instance, recent Short Course have featured speakers on planning for economic development, budget development, Indian tribal planning, commission roles an procedures, urban design strategies, and growth management.

Once a date for the course is set, the coordinator locates speakers and provides materials, while the host is responsible for obtaining a room, publicizing the course, and providing refreshments.

Process

Year round assistance is available for particular planning questions. Requests for Short Courses may be made by telephone or mail. Governing body authorization is not necessary. Contact Ted Gage, Planning Services Coordinator, Department of Community Development, 906 Columbia Street SW, PO Box 48300, Olympia, Washington 98504-8300, (360) 586-8971.

National Scenic Byways Programs

Description

Authorized by Section 1047 of the 1991 ISTEA, the interim Scenic Byways Grant Program is funded nationally at $30 million to allow states to undertake scenic byways projects. In addition to the interim program, grant funds totaling $50 million are authorized for the planning, design, and development of State Scenic Byway programs. Also, Scenic Byways may be funded through the 10 percent set-aside of STP for enhancement activities.

The Governor has named WSDOT the state's scenic byways agency and the legislature in 1993 directed WSDOT to place a high priority on obtaining the funds for "further development of a scenic and recreational highway program, including highway heritage project …, [and] consider the use of the designated system by bicycles and pedestrian …" Further, the WSDOT was instructed to consult with other agencies, commissions, and affected local jurisdictions, RTPOs and other interested parties in developing the program.

The WSDOT Scenic and Recreational Highways Program and the WSDOT Heritage Program were combined in December 1993 to create the "Heritage Corridors Program."

Process

Contact the Highways and Local Roadways Division of WSDOT, Judy Lorenzo at (360) 705-7274.

Federal Transit Administration's Section 3 Grant Program

Description

The FTA Section 3 Capital Grants Program consists of three separate parts:

- Formula apportionments for fixed guideway modernization.
- Discretionary grants for the construction of new fixed guideway systems and extensions to existing systems.
- Discretionary grants for buses.

Types of Eligible Projects

Under the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, formula apportionments for fixed guideway modernization and discretionary allocations for the construction of new fixed guideway systems and extensions to existing systems are each allocated 40 percent of available Section 3 funds, and discretionary allocations for the replacement, rehabilitation, and purchase of buses and related equipment is allocated 20 percent. At least $5^1/2$ percent of the bus funds must be made available for areas other than urbanized areas.

Matching Requirements

The federal share of any project financed under Section 3 is 80 percent of the "net project cost." "Net project cost" is defined as the portion of the cost of a project which can not reasonably be financed from revenues.

Process for Obtaining Funds

Distributions of funds are pursuant to a formula in ISTEA for the fixed guideway modernization funds. Distributions are discretionary with Congress for new fixed guideway systems and extensions to existing systems and replacement, rehabilitation, and purchase of buses and related equipment.

Contact

FTA (Seattle Office) (206) 220-7954

Federal Transit Administration's Section 9

Description

Section 9 of the Federal Transit Act is a formula grant program available only in urbanized areas for public transportation. Individual apportionments for urbanized areas over 200,000 population and the Bremerton urbanized area are set by formula; those for urbanized areas of 50,000 to 200,000 population (1990 federal census) are determined cooperatively by WSDOT.

Types of Eligible Projects

Funds can be used for operating and nonoperating (planning, capital equipment, or administration) expenses. An "operating limitation" is placed on Section 9 funds. The operating limitation represents the maximum amount of the total apportionment that can be spent on operating expenses.

Matching Requirements

The match for nonoperating expenses is 80 percent federal/20 percent local. For operating expenses, the match is 50 percent federal/50 percent local.

Process for Obtaining Funds

- Identify and define program need.
- Include project in local Transit Development and Financial Program (TDFP).
- Small urban systems: Annual meeting to develop three-year list of projects. First year covers project selection, remaining years are planned. Local system responsible for placing project in local TIP.
- Large urban systems: Local transit system responsible for placing project in local TIP. Local TIP process varies from MPO to MPO.
- Small urban systems: Applicant system prepares FTA grant and submits to WSDOT. Application is forwarded from WSDOT to FTA.
- Large urban systems: Applicant system prepares FTA grant and submits directly to FTA.

Contact

Cathy Silins, Public Transportation and Rail Division, (360) 705-7919, Fax (360) 705-6820.

Federal Transit Administration's Section 18

Description

FTA Section 18 includes the following categories: (1) Capital and/or Operations Assistance, (2) Planning Assistance, (3) Intercity Bus Program, and (4) Rural Transit Assistance Program.

Eligible applicants include public entities, private for profit organizations who provide transportation services (capital and/or operations assistance only), Indian tribal governments, and private nonprofit agencies (operations assistance only).

The following is an overview of the process for obtaining capital and/or operations assistance. For information on the other programs, or more detailed information on the programs described here, please call one of the contacts listed.

Types of Eligible Projects

Eligible projects must provide service to people in small urban and rural areas. Separate applications are required for capital and operations assistance.

Capital Projects

- Passenger vehicles — Must be accessible under the Americans with Disabilities Act.
- Shelters — Must be accessible under the Americans with Disabilities Act.
- Modifications to vehicles to enhance passenger use and access.
- Other equipment such as mobile radios and dispatching systems.

Operations Assistance

- Support existing service to small urban and rural areas.
- Expand service to cover new areas who are not yet served by a public transportation provider such as a transit.
- If the organization is a nonprofit agency, this must be done in coordination with a public transportation provider unless there are no existing providers who serve their area.

Matching Requirements

Capital Assistance — 20 percent local cash match (no in-kind contributions allowed and federal funds are not eligible for match).

Operations Assistance — 65 percent local match (50 percent of which must be from non-federal sources).

Process for Obtaining Funds

- Application availability announced each year in April.

- Request an application from the department.
- Submit application(s) to the department prior to the deadline.
- Public hearings scheduled (capital assistance only).
- Applications are reviewed by the evaluation panel.
- Notification is sent to advise the applicant whether or not an award is to be made. If an award is made, the applicant will be instructed on what types of assurances and certifications are required.
- Grant agreements are sent as soon as the applicant has completed the necessary assurances and the federal agreement is received by the department.

Contact

Barb Aufang, Public Transportation and Rail Divison, (360) 705-7926,
Fax (360) 705-7926

Washington State's Rural Mobility Grant Program

Description

The Washington State Legislature, in response to the Washington State Department of Transportation (WSDOT), appropriated $1.5 million for "rural mobility" in the 1993-95 Transportation Budget Act. In 1993, Secretary Morrison appointed a nine-member Rural Mobility Committee to:

- Establish the policies/criteria governing the expenditure of these funds.
- Review all submitted applications.
- Select projects.

The Rural Mobility Committee developed the following criteria for the use and distribution of the funds:

- Planning, operating, and/or capital activities that serve rural residents.
- Providing rural residents access to basic services (medical, educational, employment, recreational).
- Demonstrating benefit to rural communities.
- Forming partnerships.

Types of Eligible Projects

Planning, operating, capital, or some combination of these for public transportation services.

Matching Requirements

No local matching funds are required, however, applicants could provide a voluntary local match ("cost sharing") worth a maximum 2 points (100 points total).

Process for Obtaining Funds

- Submit application (will vary each year).
- Applications are reviewed and scored by the Rural Mobility Committee.
- Projects are selected and agreements are signed between the lead agencies listed on awarded applications and WSDOT. Quarterly progress reports are required of the grant receiver.

Contact

Barb Aufang, Public Transportation and Rail Division, (360) 705-7926

Northwest Technology Transfer Center

The Northwest T^2 Center is one of a national network of transportation T^2 centers which are part of the Federal Highway Administration's Local Technical Assistance Program (LTAP). Housed in the TransAid Service Center of the Washington State Department of Transportation, its mission is to help local agencies use existing resources more efficiently and to cope with their transportation problems by increasing their expertise through technical and management materials, training, and advice.

The Center is linked with the T^2 Center network in the USA and Puerto Rico. In fact, networking and daily communication and coordination with numerous associations and groups representing the public, academia, and private sector is a key role of the Center's staff in order that its services and products are timely and in tune to the needs of the local governments.

Basic Services and Products of the Center

Newsletters

The quarterly publication, the "Bulletin," provides brief articles on technical and management items of interest in design, construction, maintenance, and management. The newsletter is free to requestors.

Technical Materials and Advice

Staff obtain, advertise, and distribute various technical reports and other publications obtained through governmental and private sources. Other materials are created in response to need for brief, easy to read information. Staff also provides advice or else relays the request for advice to others for response.

Training

Various workshops are sponsored and/or supported by the Center. Staff maximizes the availability of workshops and conferences by coordinating efforts with governmental, educational, and private groups. The Center also provides free traveling "road shows" which takes training directly to the agencies. Most training is free or at low cost to the attendees. Our Training Coordinator works with various public and private training providers in satisfying the training needs of local agencies. This one-stop training resource service started in the fall of 1994. The T^2 Training Coordinator matches needs for training with training providers and serves as a clearinghouse for transportation training of local governments and Indian tribes.

Video Loans

The videos used in the "T^2 road shows" are made available for loan to governmental agencies at no cost.

Electronic Bulletin Board

Agencies and tribes have access to this computer which has various transportation related items including WSDOT's amendments to the Standard Specifications and General Special Provisions, and listings of educational opportunities.

Library Access

The WSDOT Library is available for use by other public agencies. Services are free.

Contact: George D. Crommes, P.E. Director
NWT2 Center, WSDOT-TransAid Service Center
P.O. Box 47390
Olympia, WA 98504-7390
Telephone (360) 705-7390

Chapter 4 Transportation Planning in Washington

Introduction

Community based planning and decision making is a long standing tradition in Washington. The people that make-up the diverse rural areas, cities and towns, and tribal areas throughout the state have made their own decision on community development and land-use. There are several common threads that bind communities together throughout the state — transportation is one of those. Transportation facilities are owned and operated by numerous jurisdictions. Like most public services and facilities, planning has traditionally been done at the local level. Transportation, however, connects people from their own community to other places, close and far away, making it essential that the transportation system function as one interconnected and coordinated system.

Transportation planning is done to solve important problems — problems we do not solve will mean that our economy and quality of life will suffer. Transportation planning should be done proactively to take advantage of opportunities that will shape our future and create the transportation system and preserve the quality of life we all desire. Transportation planning helps us to invest our transportation resources wisely. Transportation facility and service investments are expensive, take a long time to deliver, and provide service for many years. Because we have limited revenue available, transportation planning helps decision makers target investments that best serve the transportation customers needs and meet our social, economic and environmental goals. While transportation plans usually have a future component, the purpose is not to limit future decisions, but to lay out the future implications of today's decisions. Since decision making is an ongoing process, transportation planning also needs to be ongoing, reflecting the changing values and conditions of our state and world.

Growth Management in Washington

Throughout the 1980s, Washington experienced explosive population growth — 17 percent growth statewide with concentrated growth in the Central Puget Sound Region. In 1990, to begin managing this growth, the Washington state legislature enacted the state's Growth Management Act (GMA). Although GMA is not directly applicable to the Tribal Nations in Washington, it is important for Tribes to understand the context of transportation planning under GMA for all other governments in Washington. In 1990, the legislature found that …

> *"Uncoordinated and unplanned growth, together with a lack of common goals expressing the public's interest in the conservation and the wide use of our lands, pose a threat to the environment, sustainable economic development, and the health, safety, and high quality of life enjoyed by residents of this state. It is in the publics interest that citizens, communities, local governments and the private sector cooperate and coordinate with one another in comprehensive land use planning …"*

The Washington State Department of Transportation recognizes that in many instances tribes work directly with city and county governments on transportation issues. The department also recognizes that tribes are sovereign, and as such, do not necessarily agree with the philosophies or requirements of the state's GMA. Some tribes may find some aspects of GMA applicable and useful in their own planning. Below is a short discussion of the state's GMA and how it affects cities and counties that are required to plan under the act throughout the state.

Concepts of Growth Management

Communities that are required to plan under the state's GMA are those cities and counties which experience tremendous growth in a given timeframe. Counties with a population base of 50,000 or more are required to plan if the population within the county boundaries grows by more than 10 percent in a decade. In all parts of the state (which includes even the smallest counties), if population grows by more than 20 percent in a decade, the county and cities within its boundaries are required to plan. Cities and counties can also choose to plan under growth management even if these population thresholds are not met. Presently 29 counties and many cities are planning under growth management.

Cities and counties planning under GMA are required to develop a local comprehensive plan within four years of being required or choosing to plan. State law requires that certain items be included in the plan:

Mandatory Elements	***Optional Elements***
• Land Use	• Conservation
• Housing	• Solar Energy
• Capital Facilities	• Recreation
• Utilities	

- Rural areas (counties only)
- Transportation

In developing local comprehensive plans, cities and counties must incorporate the following concepts (known as the 4Cs of GMA).

1. The plan must be Comprehensive: All mandatory elements must be included.
2. The plan must be Consistent: The plan must be internally consistent. For example, the Transportation element must use the same assumptions as reflected in the Land Use element.
3. The plan must be Coordinated: The plan must be externally consistent, too. This takes coordination. A city's local comprehensive plan must be consistent with adjacent cities' or the county's plans.
4. The plan must have Concurrency: Once a plan is adopted cities and counties must do this fourth C: Ordinances must be adopted and enforced by cities and counties which ensure that transportation facilities and services will not fall below desired levels of services as described in the plan. Transportation strategies or improvements are to be put in place at the time of development or a financial commitment should be made so the strategies or improvements are accomplished within six years. Concurrency only applies to the transportation element, however local jurisdictions are choosing to apply concurrency to other elements of the plan also.

Throughout the planning process, cities and counties must involve citizens. Planning decisions made today, can only be implemented if communities agree with the vision for growth and development.

Statewide Transportation Planning

Transportation planning helps to identify the important transportation problems facing us and possible solutions to the important transportation issues we have now as well as those that we think will face us in the future. It determines what services transportation customers (citizens and business) want, balanced with competing demands, into a common vision for the entire transportation system. The process identifies current and future investment needs to achieve the vision, and makes trade-offs between needs to produce a plan that is financially feasible. It is a process that supports investment decisions.

Transportation planning in Washington State reflects the decentralized and diverse ownership of the transportation system. A key mission of these various transportation planning efforts is coordination between jurisdictions so that the transportation facilities and services, although under separate ownership, operate as a total system. Transportation users do not particularly care who's system they are using, only that they can get to their destination safely and efficiently.

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) — has, changed the way states and local agencies do transportation planning in a revolutionary way. Rather than providing a specific list of regulations, the Act delineates a list of "guidelines" that must be followed, but without specifics as to what compliance "looks like" and how compliance with these guidelines is to be achieved. ISTEA provides new flexibility and decision making at the lowest level. This is a major shift from previous ways of doing business. States are now required to implement and impart this new concept of decentralized participation. The state and the Metropolitan Planning Organizations are putting in place a planning process that takes into account a wide range of data and analysis, involves the public early, and creates close linkages among the, required management systems, the 20-year transportation plan, and the annual transportation improvement program.

RCW 47.06, enacted by the 1993 Legislature as ESHB 1007, requires the WSDOT to prepare a Statewide Multimodal Transportation Systems Plan for the Transportation Commission. The legislature recognized that the ownership and operation of Washington's transportation system is spread among federal, state, and local government agencies, regional transit agencies, port districts, and the private sector. Transportation planning authority is shared on the local, regional and state levels, and this planning must be coordinated and comprehensive in nature.

State law, RCW 36.70a, the state's Growth Management Act (discussed in detail before) requires cities and counties with significant population growth to prepare Comprehensive Plans composed of six elements including a Transportation Element. The Transportation Element must document the 20-year transportation infrastructure needs that are consistent with the other plan elements. The jurisdiction must show how it will pay for the level of service it is providing and any new facilities or service must be concurrent with when they are needed.

The Clean Air Act (CAA) of 1990 and the Clear Air Washington Act (CAW) of 1991 also influence the Washington State Department of Transportation's planning process. The Clean Air Act is a federal regulation that directs Washington to outline State Implementation Plans (SIPs). These plans will assist jurisdictions to attain air quality goals regarding carbon monoxide, ozone, and particle matter. To meet air quality goals, Washington State adopted the Clear Air Washington Act of 1991 to provide legislative authority over air pollution sources, provide programs to enhance Washington's air quality, and to devise SIPs as mandated by the Clean Air Act.

Transportation plans being developed at the local, regional, and state levels include the following:

Local Comprehensive Plans

Local Comprehensive Plans, under the State's Growth Management Act, serve as basic building blocks for transportation planning by defining land uses and the transportation system needed to support those land uses. Local comprehensive plans must include six elements as stated earlier. The

transportation element of the plan should integrate land use assumptions through identifying and developing the following:

- An inventory of land, water and air transportation facilities;
- Analysis of impacts on other jurisdictions, and a feedback loop to reassess land uses that cannot be served with available funding;
- Service level standards;
- Current and future transportation needs; and
- Realistic funding analysis.

Another key component are plans developed by special transportation districts, such as transit agencies and port districts. These plans define the needs and services to carry out these special purpose governments' missions.

Regional Transportation Plans

Regional transportation plans (also known as metropolitan transportation plans in eight urbanized areas for federal purposes), are developed by Regional Transportation Planning Organizations (RTPOs). An RTPO is created through the voluntary association of local governments within a region. Member jurisdictions within an RTPO determine their own structures to ensure equitable representation among local governments and to allow flexibility across the state.

RTPO Membership and Designation — Membership in each RTPO must include a minimum of one county, and a population of at least 100,000. Regions may be formed in areas with less than 100,000 population if a minimum of three geographically contiguous counties are linked. Member jurisdictions of an RTPO must include all counties in the region, and at least 60 percent of the cities and towns representing at least 75 percent of the population of the city and towns.

In areas where there are Metropolitan Planning Organizations (MPOs) as required by the federal government, the RTPO and MPO must be the same organization. The Department of Transportation verifies the designation of each RTPO to ensure that all state requirements are met.

Each RTPO must establish a Transportation Policy Board whose membership includes, but is not limited to: representatives from the member counties, cities and towns; major employers; the WSDOT; transit providers; and port districts within the region. Technical Advisory Committees are encouraged in RTPOs.

Lead Planning Agency — The RTPO is required to designate a lead planning agency which may be a regional council, county, city, town agency, or a WSDOT regional office. Of the fourteen RTPOs that have formed or are in the process of forming, eight of the lead planning agencies are regional councils, two are economic development councils/districts, three are Department of Transportation regional offices, and one is a county public works department. The key role of the lead planning agency is to provide

staff support to the RTPO and to coordinate the development of the Regional Transportation Plan.

Developing the Regional Transportation Plan — The RTPO is a formal mechanism used by local governments and the State to coordinate the planning of regional transportation facilities and services. A key function of the RTPO is to develop a Regional Transportation Strategy which addresses alternative transportation modes, and transportation demand management in regional corridors, and recommended preferred transportation policies to implement growth strategies. The Regional Transportation Strategy serves as a guide, along with countywide planning polices, guidelines and principles, for the development of the Regional Transportation Plan, also a responsibility of the RTPO. RTPOs are also required to developed in cooperation with WSDOT, public transit operators, and local jurisdictions, regional transportation improvement programs based on the plan. Improvement programs are to propose regionally significant transportation projects and programs and transportation demand management measures.

Statewide Multimodal Transportation Plan

While the state role in transportation planning was previously limited to state-owned transportation facilities and services (highways, ferries, and state-owned airports), the state has broader interests in all types of transportation modes. This broader interest is reflected in both state and federal law. In 1993, the state legislature expanded the state's concern to include transportation facilities and services that the state does not own, but are critical to the economic and social well-being of the state. These state interests include aviation, public transportation, intercity passenger rail, freight rail, marine ports and navigation, and bicycle and pedestrian transportation. The Statewide Multimodal Transportation Plan defines objectives for these state-owned and state-interest facilities and services including intermodal connections, determines current and future deficiencies, and proposes programs, strategies and specific solutions that should be pursued to protect the state interest, consistently and in cooperation with regional and local transportation plans.

Transportation Improvement Program and State Transportation Improvement Program

Programming and project selection under ISTEA have changed significantly from previous practice. This section highlights important issues related to programming and project selection.

Transportation Improvement Programs (TIPs)

ISTEA requires Transportation Improvement Programs to be prepared by the Washington State Department of Transportation (WSDOT) and the Metropolitan Planning Organizations. The Statewide Transportation Improvement Program encompasses all projects in Washington funded with ISTEA funds.

Transportation Improvement Programs prepared by transportation management areas or metropolitan planning organizations include all

federally funded projects in the region (including projects on native lands). Projects for the Transportation Improvement Program are selected based on the long-range plan, need, priority rating defined by a clear set of criteria, and the availability of funds. Transpor-tation Improvement Programs usually are prepared annually and provide a three-year "window" projects at both the regional and the statewide levels. They must be prepared at least every two years.

In air quality nonattainment areas, projects funded with state or local funds must be included in the Transportation Improvement Program as well. This is to ensure that Washington's Transportation Improvement Programs reflect all important changes to the transportation system with potential air quality impacts.

The most important issues related to the preparation of a Transportation Improvement Program are listed in the following.

Project Selection Authority

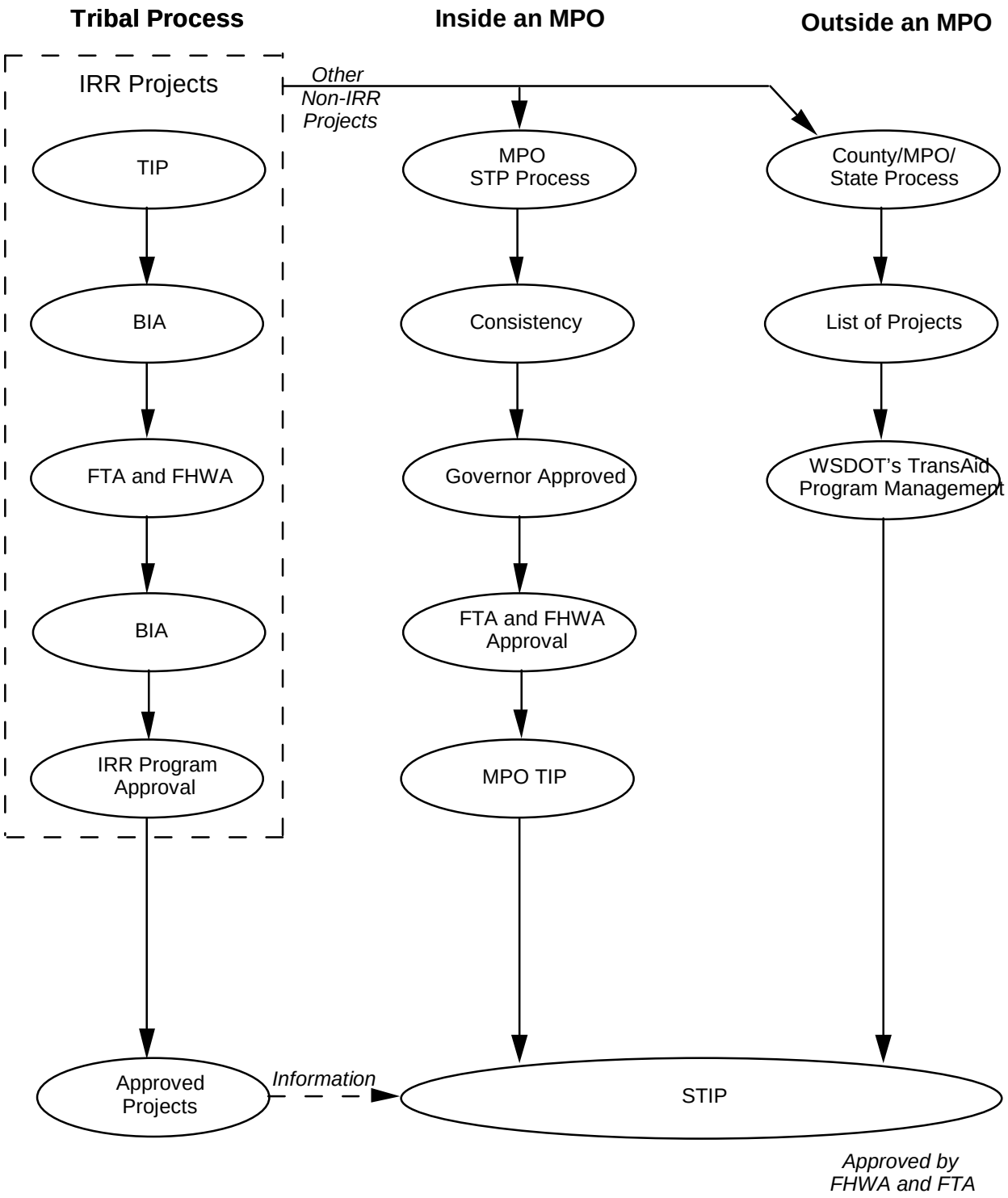
Under ISTEA, Transportation Management Areas (Metropolitan Planning Organizations for metropolitan areas with populations over 200,000) for the first time have not only planning but also programming authority. In Washington, there are three Transportation Management Areas: Seattle/Tacoma, Spokane, and Vancouver. They select projects in consultation with WSDOT. This means that WSDOT only advises them on project selection. In smaller urban areas Metropolitan Planning Organizations, and in rural areas county area lead agencies or Regional Transportation Planning Organizations are to select projects in cooperation with WSDOT. This means that WSDOT and regional and local officials jointly decide on the projects that will become part of the Transportation Improvement Program and prioritize them together. Tribal governments are invited to participate in this process.

Washington State has gone one step further in its implementation of ISTEA. In addition to Transportation Management Areas, it gives Metropolitan and Regional Transportation Planning Organizations, or designated county area lead agencies, the responsibility for project selection for some funds under the Surface Transportation Program. The intent of this provision is to facilitate an integrated, regional approach to planning and programming of transportation facilities. The project selection process at the regional level, provides opportunities for projects from all transportation modes, and tribal governments to be considered on the basis of regional needs and priorities.

Prioritizing Projects

In Washington, all regional planning organizations and WSDOT are given maximum flexibility to create the prioritization criteria that best address regional needs. They are also charged with developing prioritization methods to carry out the process. The only exceptions are projects competing on a statewide basis (for example, in the Enhancements Program). Here, consistent statewide project selection criteria and priorities are established by advisory committees.

The TIP/STIP Process



MPO/RTPO Directory

May 13, 1999

RTPO	*Counties*		*Lead Agency*
Benton-Franklin Region Council (BFRC) 99352 943-9185 6756 Morton, Executive Director Transportation Program	Benton Franklin Walla Walla	*	BFRC PO Box 217 Richland, WA Public (509) Fax (509) 943- Donald P. Mark Kushner, Manager
Island/Skagit Northwest Region Avenue North 98133-9710 Administrator Manager of Planning Coordination NB-82 (123) or 440-4802	Island Skagit		WSDOT- 15700 Dayton PO Box 330310 Seattle, WA Ron Anderson, Bob Josephson, Local (206) 440-4711, Fax 440-4801
North Central Central Region Wenatchee Avenue 98801-1156 1674 Honsinger, Transportation Planner 1504 Public (509) 662-0504	Chelan Douglas Okanogan		WSDOT-North 1551 North PO Box 98 Wenatchee, WA Fax SCAN 565- Dave SCAN 565-
Palouse Economic Development Council	Asotin Columbia		Palouse Northeast 1345

			Terre View Drive
	Garfield		Pullman, WA 99163
			Public (509) 334-3579
			Fax (509) 332-6991
			Jack Thompson, Executive Director
Peninsula Olympic Region	Clallam		WSDOT-
	Jefferson		5720 Capitol Boulevard, MS 7440
	Kitsap		PO Box 47440
	Mason		Olympia, WA 98507-7440
			Fax (360) 357-2601
			Gary Demich, Administrator
			Toby Rickman, Transportation Planning Engineer
			Public (360) 357-2630
Puget Sound Region Council (PSRC)	King	*	PSRC
	Kitsap		1011 Western Avenue, Suite 500
	Pierce		Seattle, WA 98104-1035
	Snohomish		Public (206) 464-7515
			Fax (206) 587-4825
			Mary McCumber, Executive Director
			King Cushman, Director Transportation
			Public (206) 464-6174
Quad County Public Works	Adams		Adams County
	Lincoln		210 West Alder
	Grant		Ritzville, WA 99169
	Kittitas		Public (509) 659-4236

Fax (509) 659-0301

Walt R. Olsen, P.E., County Engineer

Southwest Washington Region Transportation Council (SWRTC) Clark * SWRTC Klickitat Skamania 1351 Officers Row Vancouver, WA 98661

Public (360) 737-6067

Fax (360) 696-1847

Dean Lookingbill, Transportation Director

Southwest Washington (SWW) Cowlitz * Cowlitz-Wahkiakum Grays Harbor Lewis Pacific Wahkiakum Council of Governments 207 Fourth Avenue North, Admin. Annex Kelso, WA 98626

Public (360) 577-3041

Fax (360) 423-9986

Steve Harvey, Director

Spokane Regional Transportation Council (SRTC) Spokane * SRTC Whitman Sixth Floor Municipal Building West 808 Spokane Falls Boulevard Spokane, WA 99201-3333

Public (509) 625-6370

Fax (509) 625-6988

Glenn Miles, Transportation Manager

San Juan County San Juan San Juan County 350 Court Street

			Friday Harbor, WA 98250 Public (360) 378-2114 Ron Loewen, Director
Thurston Regional Planning Council	Thurston	*	TRPC 2404-B Heritage Court SW Olympia, WA 98502 Public (360) 786-5480 Harold Robertson, Director
Whatcom County Council of Governments	Whatcom	*	WCCOG 2011 Young Street Bellingham, WA 98225 Public (360) 676-6974 Mark Challender, Director
Tri-County RTPO	Ferry		Tri-County RTPO
	Stevens		TRICO Economic Development District
	Pend Oreille		347 West Second, Suite A Colville, WA 99114 Public (509) 684-4571 Brent Grening, Director
Yakima Valley Council of Governments	Yakima	*	YVCOG 6 South Second Street, Suite 605 Yakima, WA 98901 Public (509) 575-4372 Lon Wyrick, Director

*Indicates also an MPO.

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Chapter 5 Implementation of Programs and Projects

Foreword

Under the federal Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) each state must assemble a Statewide Transportation Improvement Program (STIP). Metropolitan Planning Organizations in the country's most highly urbanized areas must assemble a similar program known as a Transportation Improvement Program (TIP).

Transportation Improvement Programs (TIPs)

ISTEA provides an opportunity for the MPOs to focus and direct transportation funding in a way that will enhance communities throughout the MPO area. The federal act provided a new strengthened regional planning role for local governments to coordinate transportation and growth management strategies through MPOs and each MPO has lead responsibility for the TIP process in their area.

ISTEA builds on past statutes to require stronger decision-making partnerships among local governments, transit agencies, MPOs, and the WSDOT and other affect public and private interests. The legislation requires MPOs to develop a program that identifies, prioritizes, and makes decisions regarding funding of transportation projects that are consistent with the Metropolitan Transportation Plan.

The overall transportation program document containing transportation projects selected though the regional decision process is officially called a Regional Transportation Improvement Program, or TIP. A TIP document must be a three-year program of projects and it must be updated at least every two years, though it will be updated annually in most regions.

Federal guidance requires that all transportation projects in the region requesting federal transportation funding under Title 23 CER or the Federal Transit Act be including a regionally adopted TIP.

Before such projects can be including the final TIP, the region must ensure that all projects have met the following conditions:

- The projects must be evaluated and found to be consistent with the Metropolitan Transportation Plan;
- The projects must be prioritized by year and listed in a "financially feasible" TIP that shows how reasonable expectations of specific financial resources will be available to implement the included projects;
- The projects that could affect air quality must be evaluated and found to demonstrate conformity with national air quality standards. The program of projects collectively must show overall improved air quality and

support the region's ability to achieve national air quality standards by the dates established by Congress;

- The list of projects included it the TIP must be developed in cooperation with tribal governments, local governments, transit agencies, and the WSDOT; and
- The projects can be included in the final, adopted TIP only if reasonable notice is given to the public and an opportunity is provided for the public to comment on the list of proposed TIP projects. Specifically, ISTEA requires that the public involvement process be an "early, continuous, and meaningful" one.

State Transportation Improvement Program (STIP)

The STIP is the result of the statewide and regional planning and selection processes. At a minimum, it includes all federally funded (Title 23) transportation projects for a three-year period

ISTEA states: "The process for developing such plans and programs shall provide for consideration of all modes of transportation and shall be continuing, cooperative, and comprehensive to the degree appropriate, based on the complexity of the transportation problems." The STIP development process in Washington has some regional variation based on complexity.

In developing the STIP local agencies, Regional Transportation Planning Organizations (RTPOs) and Metropolitan Planning Organizations (MPOs), transit agencies, the Governor's Office, and the tribes should all be involved.

With a federal requirement for a STIP, a state process to assure its timely completion is very important. If it is delayed, the programming process for the local agencies and the state are delayed. The result could mean more than delay — a project could be terminated or prevented from proceeding.

The STIP is a summary list of the selected transportation projects throughout the state. It is reviewed by the Federal Highway Administration and the Federal Transit Administration to assure the following

- It identifies all proposed highway and transit projects in the state, funded under title 23 USC and the Federal Transit Act, including Federal Lands projects;
- It is consistent with the long-range, statewide transportation plan;
- It is consistent with the metropolitan transportation programs (TIPs) approved by the MPOs;
- In CO ozone or PM-10 nonattainment areas, it includes projects that conform with the State Implementation Plan (SIP) for air quality (also required by the federal government);
- It is consistent with expected available funding; and
- It identifies project selection priorities developed with appropriate consultation and/or coordination with local jurisdictions, metropolitan planning organizations, and federal land agencies.

ISTEA requires an update of the STIP at least on a biennial basis. Washington has chosen to update the TIP annually. First the vast majority of agencies involved in the process use a calendar year budgeting process. In addition, the premise of planning under ISTEA, coupled with the desirability for air quality conformity, is that projects be delivered on the time schedule planned.

While programs generally proceed in an orderly fashion, program delivery is subject to factors that simply cannot be planned to the desired level. Such items as disputed right of way acquisitions, environmental challengers, and emergency situations often delay or redirect projects. This redirection requires continuous updating of the plan and changes in delivery of that plan.

Finally, WSDOT programming is subject to legislative review and approval with biennial budgets. The combination of influences on the process leads us to the conclusion that an annual update will not only better serve the requirements of ISTEA and the public, but will provide for a smoother flow of necessary planning and programming adjustments.

Implementing Projects

Foreword

In May 1994, an update of the *Local Agency Guidelines* (LAG) was issued. This updated LAG manual was revised to reflect the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, the subsequent procedures by the Federal Highway Administration (FHWA) and suggestions by the Local Agency Guidelines Committee.

The LAG manual was produced to provide Washington's local agencies with statewide standards and procedures to follow when using federal funds for transportation projects. The manual is also a source book with references given for those seeking additional information and assistance. The guide has been structured in the same order as the development of a project. Through the LAG manual the Regional TransAid Engineers and their staff can assist local agencies and Indian tribes in developing, funding, and implementing transportation projects. The guide provides numerous checklists which help to ensure that items are not forgotten during a project's development. Local agencies and tribal governments, through use of the LAG manual, a handbook, can follow the necessary steps for implementing their transportation projects.

The reader should refer to the LAG manual for the details in developing projects. An overview of the project development process as outlined in LAG follows.

An Overview of Developing projects Using the Local Agency Guidelines (LAG)

Once transportation improvements proposal has been through the planning process and included in the Transportation Improvement Program (TIP) for the regional planning organization (MPO or RTPO), the next step is to start the actions necessary to implement the proposal.

As outlined in the *Local Agency Guidelines*, requests for funds are made along with appropriate initial paperwork for federal participation. Upon approval of funding and authorization to proceed, design work begins including necessary environmental documentations. Following local, state, and federal laws, contract plans are prepared. About the same time, monies are requested for various activities, e.g., right of way purchases and construction of the facility. Contracts are advertised and awarded. Construction begins with directions and oversight by the responsible agency or tribe. Upon completion of work to the satisfaction of the contracting agency, the final paperwork including final payments and awards are completed and the facility is opened to traffic.

The LAG manual includes all the details and the key forms needed to process local federally funded projects. In addition, Regional TransAid Engineers and their staff are available to assist local agencies and tribes with their federal-aided projects.

Contact names and phone numbers are listed in the front of this guidebook for the Regional TransAid Engineers as well as the various tribal planners.

Appendix A References

"A Summary — Intermodal Surfaces Transportation Efficiency Act of 1991 Prepared for Washington" FHWA 1992.

"A Summary — Opportunities for Local Governments Under the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991" FHWA 1992.

"A Summary — Bicycle and Pedestrian Provisions Under the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991" FHWA 1992.

"A Summary — Design and Construction of Highway Projects Under the Intermodal Surfaces Transportation Efficiency Act of 1991" FHWA 1992.

"ISTEA News Issues No. 1 through 19, Northwest T^2 Center, WSDOT Local Programs Division.

"ISTEA Handbook" Washington Transportation Policy Institute; Dye Management Group, Inc. 1992.

Washington's Regional Transportation Planning Organization, WSDOT, November 1993.

Proceedings — Washington State — Tribal Transportation Meeting (ISTEA), WSDOT and Governor's Office of Indian Affairs, December 17,1993.

ISTEA Application Handbook for Local Governments, WSDOT, Local Programs, NWT^2 Center, March 1993.

Washington State STIP — ISTEA Handbook for the Statewide Transportation Improvement Program, WSDOT, Program Development Division, August 1993.

Local Agencies Guidelines (LAG), WSDOT — TransAid Service Center, May 1994.

State Agency Assistance for Local Governments, Association of Washington Cities (AWC), 1994-1995.

"Your Community's Transportation System" — A Transportation Element Guidebook. Washington State Department of Community Development, June 1993.

A Guide to Federal-Aid Programs, Projects, and Other Uses of Highway Funds, FHWA, Publication No. FHWA-PD-92-018, September 1992.

Appendix B
ISTEA Acronyms (Abbreviated List)

This list only spells out acronyms commonly used in discussions of ISTEA. It does not provide definitions.

ADA	Americans with Disabilities Act	
BFW	Bicycle Federation of Washington	
CM/AQ	Congestion Mitigation/Air Quality	
EAC	Enhancements Advisory Committee	
FAP	Federal Aid Primary (obsolete under ISTEA)	
FAS	Federal Aid Secondary (obsolete under ISTEA)	
FAU	Federal Aid Urban (obsolete under ISTEA)	
FHWA	Federal Highway Administration	
FTA	Federal Transit Administration (formerly UMTA)	
GMA	Growth Management Act (State)	
IISC	Institute ISTEA Steering Committee	
IM	Interstate Maintenance	
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991	
MPO	Metropolitan Planning Organization	
	BFGC*	Benton-Franklin Governmental Council
	CWGC	Cowlitz-Wahkiakum Governmental Conference
	IRC*	Intergovernmental Resource Council

	PSRC*	Puget Sound Regional Council formerly PSCOG)
	SRC*	Spokane Regional Council
	TRPC*	Thurston Regional Planning Council
	WCCOG*	Whatcom County Council of Governments
	WCOG*	Yakima Valley Conference of Governments
NHS	National Highway System	

* (Designated as RTPOs also)

OA	Obligation Authority
RTPO	Regional Transportation Planning Organization Island/Skagit North Central Palouse Peninsula Quad-County Southwest Washington Tri-County
Section 3	Capital Only Rail/Transit Discretionary Program
Section 8	MPO Planning for Transit
Section 9	Transit Capital and Operations Program
Section 1 6b2	Elderly and Disabled Transit Program
Section 18	Small Urban/Rural Transit Capital and Operations Program
Section 26a2	Transit Planning and Research
STIP	Statewide Transportation Improvement Program
STP	Surface Transportation Program
STPP	Surface Transportation Policy Project (Washington, D.C.)
T^2	Technology Transfer
TIP	Transportation Improvement Program
TMA	Transportation Management Area
WTPI	Washington Transportation Policy Institute
WSDOT	Washington State Department of Transportation

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Appendix C
Glossary of Terms

AASHTO — American Association of State Highway and Transportation Officials.

Action Strategy— Describes the action necessary to implement the community vision. This includes new transportation facilities and services to be provided and funding sources.

Adequate Facilities Ordinance— An ordinance that requires a determination that there will be adequate public facilities available to support a development before the development is approved.

Americans with Disabilities Act (ADA)— Federal legislation requiring the provision of facilities to individuals with disabilities that will assure accessibility to all transportation facilities both public and private. ADA guarantees equal opportunity for individuals with disabilities in employment, public accommodations, transportation, state and local government services, and telecommunications.

Arterial — A major street carrying the traffic of local and collector streets to and from freeways and other major streets. Arterials generally have traffic signals at intersections and may have limits on driveway spacing and street intersection spacing. Arterials are most likely to be designated as "roadways of regional significance."

Built-Out — Having no remaining vacant land; fully developed to the maximum permitted by adopted plans and zoning.

C3R — Close, repair, rehabilitate, or replace (part of WSDOT's Bridge Program).

Capacity Accounting Procedure— A procedure followed by a city or county to account for the accumulated requests for capacity from developments that have received development approval. The procedure assures that transportation capacity is set aside so that it is available when the development is complete.

Capital Facilities Element— The capital facilities element of the comprehensive plan includes: an inventory of existing capital facilities owned by public entities, showing the locations and capabilities of the capital facilities; a forecast to the future needs for such capital facilities; and the proposed locations and capacity of expanded or new capital facilities.

Capital Facilities— The physical structures which serve urban development.

Census Transportation Planning Package (CIPP)— Package formed by the U.S Census Bureau CTPP contains census data, such as population and employment information, and is broken down by Traffic Analysis Zones (TAZs) for use in urban travel demand forecasting models.

Census Transportation Planning Package (CTPP)— Package formed by the U.S. Census Bureau. CTPP contains census data, such as population and employment information, and is broken down by Traffic Analysis Zones (TAZs) for use in urban travel demand forecasting models.

Clean Air Act Amendments of 1990— Federal and state mandated legislation that requires adherence to National Ambient Air Quality Standards (NAAQS) in areas of urban and transportation development. Non-attainment of the required air quality levels results in restricted ability to acquire federal funds for additional road building projects.

CMS — Congestion Management Systems. Large metropolitan areas (200,000) population or more) and states are required to develop management plans which make new and existing transportation facilities

more effective through the use of travel demand management and operational management strategies.

COG — Council of Governments is a voluntary consortium of local government representatives, from contiguous communities, meeting on a regular basis and formed to cooperate on common planning and to solve common development problems of their area.

Collector — A street for traffic moving between major or arterial streets and local streets. Collectors generally provide direct access to properties, although they may have limitations on driveway spacing. Collectors are generally considered not "regionally significant."

Collectors (Rural) — Rural collector roads are subclassified as major collectors and minor collectors. These routes generally serve travel of primarily intra-county rather than statewide importance and constitute those routes on which (regardless of traffic volume) predominant travel distances are shorter than on arterial routes. Consequently more moderate speeds may be typical. Rural collectors both major and minor, generally constitute 20 to 25 percent of the rural road miles.

> Rural major collectors provide service to any county seat not on an arterial route; to larger towns not directly served by an arterial and to other traffic generators of equivalent intra-county importance such as consolidated schools shipping points parks important agricultural areas etc. Major collectors link these places with nearby larger towns or cities, or with routes of higher classification and serve the more important intra-county travel corridors.
>
> Rural minor collectors should be spaced at intervals, consistent with population density, to collect traffic from local roads and bring all developed areas within a reasonable distance of a collector road. Furthermore, minor collectors provide service to the remaining smaller communities and also link the locally important traffic generators with their rural hinterland. Rural minor collectors are generally not eligible for federal funding of road improvements; however, bridge improvement projects are fundable.

Collectors (Urban) — Urban collectors provide for land access and traffic circulation within residential neighborhoods and commercial and industrial areas. They distribute traffic movements from such areas to the arterial system. Half-mile spacings are common in developed areas. Collectors do not handle long through trips and are not continuous for any great length. They generally account for 5 to 10 percent of the total street system.

Comprehensive Plan— A document consisting of maps, charts, and text which contains the adopting city or county's policies regarding long-term development. A comprehensive plan is a legal document required of each local government by the State of Washington. The required content of the comprehensive plan is described in RCW 36.70A.

Concurrency — A requirement in the Growth Management Act (GMA) that public facilities and services be provided concurrent with new development.

Concurrency is the key link between land use and transportation. The State's Growth Management Program very specifically defines "concurrent with development" for transportation as meaning that "improvements or strategies are in place at the time of development, or that a financial commitment is in place to complete the improvements or strategies within six years."

Cost Estimates — Cost of new facilities or services necessary to compare the transportation needs with the available revenues. Costs must be estimated for:

- Maintenance and operation of the existing and proposed transportation system.
- Costs of designing and building new, expanded, or replacement facilities.
- Cost of acquiring new transit vehicles or ferry vessels and related capital costs.
- Program costs for operating transportation services such as transit or ridesharing.
- General costs associated with administering, planning, and operating the transportation system.

CRAB — County Road Administration Board.

Critical Areas — As a key part in managing growth in Washington, the Growth Management Program requires that every county and city classify and designate critical areas: wetlands, aquifer recharge areas, fish and wildlife habitat, frequently flooded areas, geologically hazardous areas, and rare/endangered plant habitat.

CTR — The Commute Trip Reduction legislation which require major employers in the eight most populated counties in the state to take measures to reduce the number of single occupant vehicle (SOV) trips and the number of vehicle miles traveled (VMT) by their employees.

Density — For residential development, density means the number of housing units per acre. For population, density means the number of people per acre or square mile.

Developable Land — Land that is suitable as a location for structures because it is free of hazards (flood, fire, geological, etc.), has access to services (water, sewer, storm drainage, and transportation), and will not disrupt or adversely affect natural resource areas.

Element — A component or chapter of the comprehensive plan. State law requires each city comprehensive plan to include six elements. Counties must also prepare a Rural Element. In addition, elements addressing recreation, conservation, and solar energy may be included at local option.

FHWA — Federal Highway Administration.

Finance Element— The finance element of the transportation plan assures the recommended improvements and financially feasible to implement. It includes:

- An analysis of funding capability.
- A multi-year financing plan.
- If probable funding falls short of meeting identified needs, a discussion of how additional funding will be raised, or how land use assumptions will be reassessed to endure that level of service standards will be met.

Financing— A series of actions to be taken which will result in a system of projects and services being provided based on the identification of needs, cost estimates, assessment of the ability to pay, the development of financial policies and financing schedule, the establishment of forecasted cash flow and priorities to govern management of the system.

FTA — Federal Transit Administration (formerly the Urban Mass Transit Administration, UMTA).

Functional Classification— ISTEA modified the federal aid systems approach that has covered our program since the 1920s. The federal aid primary, secondary, and urban systems are history. Now, all public roads in the nation, except those functionally classified as rural minor arterial or local roads, are called federal aid highways and are eligible for improvement under a broad category called the Surface Transportation Program (STP).

By federal mandate, each state was required to revise the functional classifications of all public roads. The resultant system was to be reported to the federal Congress by September 1993. Criteria was set forth in the March 1989 version of "Highway Functional Classification-Concepts, Criteria and Procedures," as modified by Attachment 3 to FHWA memorandum dated February 10, 1992.

To provide a balanced system, the criteria set forth percentages of roads for each classification level. As much as possible, the percentages are to be adhered to. Justification is required for not doing so. Particular attention is required to assure uniformity across state and local boundaries.

The process consisted of classifying highways, roads, and streets, into groups having similar characteristics for providing mobility and/or land access. The highest classifications, the arterials, provide for the greatest degree of mobility of large volumes of long-distance traffic, with little or no access to abutting properties. The next general classification the collectors, generally provide equal emphasis upon mobility and land use accessibility. The last category, local access, emphasizes abutting property needs and essentially discourages long-distance travel.

Geographic Information System (GIS)— A computer-operated data storage device. GIS allows the assignment of multiple "layers" of data sets to the map of a given area. In transportation planning, these diverse bits of data can be called up for any one given location and used to display database information for that area.

Growth Management Act (GMA)— 1990 state legislation that declares it to be "in the public interest that citizens, communities, local governments,

and the private sector cooperate and coordinate with one another in comprehensive land use planning." GMA relates land use, transportation, capital facilities, housing, public utilities, and environmental protection in its requirements.

Highway Transit Assignment— The fifth and final step in travel forecasting A forecast of the highway route or transit route a trip will traverse. Highway/transit assignment simulates the traffic volumes and transit ridership on the highway and transit system.

Highway/Transit Assignment— The fifth and final step in travel forecasting. A forecast of the highway route or transit route a trip will traverse. Highway/transit assignment simulates the traffic volumes and transit ridership on the highway and transit system.

Home-Based Trip — A trip with one end at the residence of the trip-maker.

Home-Based Work — A trip, for the purpose of work, with one end at the residence of the trip-maker.

Impact Fee — A fee levied on the developer of a project by a city, county, or special district as compensation for the expected effects of that development. The Growth Management Act authorizes imposition of impact fees on new development and sets the conditions under which they may be imposed.

Implementation Measure— An action, procedure, program or technique that carries out comprehensive plan policy.

Infrastructure Capacity Monitoring System— A system established by a local government, either manual or automated, to maintain current capacity information for all public facilities for which level of a service standards are established. This system needs to include all reservations of capacity issued to date through the development permitting process in order to ensure concurrency.

Intergovernmental Coordination— Efforts include an assessment of the impact of the transportation plan and land use assumptions on the transportation systems of adjacent jurisdictions and within a given region. Section 10 of the Growth Management Act requires intergovernmental coordination. "The comprehensive plan of each county or city that is adopted pursuant to Section 4 of this Act shall be coordinated with, and consistent with, the comprehensive plans adopted pursuant to Section 4 of this Act of other counties or cities with which the county or city has, in part, common borders or related regional issues." Section 7 (6)(d) requires intergovernmental coordination as a part of the transportation element of comprehensive plans.

Interlocal Agreement— An agreement among the jurisdictions within a Regional Transportation Planning Organization (RTPO) that establishes the organization and defines duties and relationships for member counties. The agreement governs RTPO operations and is submitted as part of the RTPO's designation package.

Intermodal Surface Transportation Efficiency Act (ISTEA)— Federal statute providing significant additional funding for highway and transit programs and facilities. ISTEA authorizes new planning requirements for MPOs and RTPOs and mandates a comprehensive approach to planning by providing incentives for congestion management, highway safety, and cleaner air.

Land Use Assumptions— The proposed and existing land uses, i.e., retail, various residential densities, office manufacturing, etc. used in developing travel forecasts. These land uses are represented by population and employment numbers in the travel forecasting process.

Land Use Element— The land use element of the comprehensive plan designates the proposed general distribution and general location and extent of the uses of the land. Land uses include, but not limited to the following, where appropriate: agriculture, timber production, housing, commerce, industry, recreation, open spaces, public utilities, public facilities. The land use element includes population densities, building intensities, and estimates of future population growth.

Land Use Strategies— An action that addresses the relationship between land uses to reduce the number of vehicular trips generated and/or reduce the length of trips.

Lead Planning Agency— The agency in a Regional Transportation Planning Organization (RTPO) that is responsible for staffing and for assuming the lead in achieving intergovernmental coordination of the Regional Transportation Planning Program. The Lead Planning Agency is also the designated recipient of Regional Transportation Planning grants from the Washington State Department of Transportation (WSDOT). The Lead Planning Agency may be a regional council, a county, a city or town agency, or a WSDOT Regional Office.

Level of Service Standards (LOS)— A qualitative measure describing operational conditions within a traffic stream in terms of speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety.

Level of Service — A method of measuring and defining the type and quality of particular public service such as transportation, fire protection, police protection, library service, schools/education, etc. The county and cities must cooperatively develop standards for level of service for public services and infrastructure as a part of the policies governing growth management

Local Streets and Roads (Urban and Rural)— All public streets and roads, not otherwise classified as arterials or collectors, comprise the local access system. These roadways primarily serve local needs for access to adjacent lands, travel over relatively short distances, and connections to collectors or other higher systems. Local urban streets offer the lowest level of mobility and usually contain no bus routes. Service to through traffic movement is deliberately discouraged. Local streets usually account for 65 to

80 percent of the urban system. In rural areas the local roads generally comprise 65 to 75 percent of the road miles. Similar to rural minor collectors, the urban and rural local systems are ineligible for federal roadway funds; but, do qualify for bridge funding.

LRP — Long-Range Plan is a two-year forecast plan. now required at both the metropolitan and state levels, which must consider a wide range of social, environmental. energy, and economic factors in determining overall regional goals and how transportation can best meet these goals.

Minor Arterial (Urban and Rural)— Minor arterials collect and distribute traffic from principal arterials to lesser classified streets or allow for traffic to directly access their destinations. In urban areas they serve secondary traffic generators such as community business centers neighborhood shopping centers multiple residence areas and traffic from neighborhood to neighborhood within a community. Urban bus routes generally follow these facilities. Access to land use activities is generally permitted. Such facilities are usually spaced under two miles apart in urban fringes and in core areas can be spaced at 1/8 to 1/2 mile apart. In sparsely populated areas of our rural counties minor arterials may be wisely disbursed or nonexistent. Rural minor arterials in conjunction with rural principal arterials are spaced at such intervals that all developed areas of the state are within a reasonable distance of an arterial highway. Rural minor arterials are expected to provide for relatively high overall travel speeds with minimal interference to through movement. Rural minor arterials generally comprise 4 to 8 percent of the system; whereas in urban areas they generally comprise 10 to 15 percent.

Mode of Travel — Means of travel such as auto driver, vehicle passenger, transit passenger, bicyclist, or pedestrian.

Mode Split — The fourth step in forecasting travel is determining what mode of transportation (automobile, transit, carpool) will be used to make a trip.

Model — A mathematical formula that expresses the actions and interactions of the elements of a system in such a manner that the system may be evaluated under any given set of conditions, i.e., land use, economic, socioeconomic, characteristics.

MPO — Metropolitan Planning Organization is the agency designated by the Governor (or governors in multistate areas) to administer the federally required transportation planning in a metropolitan area. An MPO must be in place in every urbanized area over 50,000 population. The MPO is responsible for the long-range plans and the transportation improvement program. The official name for an MPO may also be Council of Governments, Planning Association, Planning Authority, Regional or Area Planning Council, Regional or Area Planning Commission.

MSA and CMSA — Metropolitan Statistical Area is the census classifications for areas having a population over 50,000. The MSA may contain several urbanized areas, but counts one or more central city or cities.

When the commuting patterns of two MSAs have caused them to merge, the result is a Consolidated Metropolitan Statistical Area (CMSA).

Multimodal Transportation Systems— Buses, ferries, cars, and bicycles are all examples of modes of travel. In a multimodal transportation system, each of these components is factored in so that service can be delivered efficiently. For example, the waterfront trolley which conveys ferry passengers to a bus terminal might be considered an interdependent multimodal transportation system.

NAAQS — National Ambient Air Quality Standards were set by the Environmental Protection Agency to define air pollution. EPS established NAAQS measures for six pollutants: carbon monoxide, ozone, particulate matter, lead, sulfur dioxide. and nitrous oxide.

NHS — The National Highway System, natural resource lands are agricultural, forest, and mineral resource lands which have long-term commercial significance.

Nonhome-Based Trip— A trip that takes place between two points, neither of which is the home end of the trip maker.

Obligation Authority (OA)— Under ISTEA, it is vested with WSDOT except for STP funded projects within TMA boundaries.

Open Space — Any parcel or area of land or water that is essentially unimproved and devoted to an open space use such as preservation of natural resources, outdoor recreation not requiring development of play fields or structures, or public health and safety (flood control).

Operational Conditions— Description of the transportation facility or service. Includes pavement width, number of lanes, access points, etc., for roads and transit vehicle capacity, service frequency, transit stop convenience, and safety for transit service.

Pedestrian Friendly Development— Development designs that encourage walking by providing site amenities for pedestrians. Pedestrian friendly environments reduce auto dependence and may encourage the use of public transportation.

Performance Monitoring System— Monitoring the performance of the program is an integral part of the regional transportation plan. It determines how well the plan is being implemented and whether the system improvements and/or applied system demand strategies are having the desired effect. Each RTPO must implement and describe the performance monitoring system they have adopted.

Planning Commission— A group of people appointed by the City Council or County Commission to administer planning and land use regulations for the jurisdiction.

Principal Arterial (Urban and Rural) — Principal arterials permit traffic flow through and between our cities and towns and between major elements of the urban areas. They are of great importance in the regional

transportation system as they interconnect major traffic generators, such as central business districts and regional shopping centers, to other major activity centers and carry a high proportion of the total area travel on a minimum of roadway mileage. Principal arterials frequently carry important intraurban as well as intercity bus routes.

Public Facilities— Includes streets, roads, highway, sidewalks, street and road lighting systems, traffic signals, domestic water systems, storm and sanitary sewer, parks and recreation facilities, and schools.

Public Services— Includes fire protection and suppression, law enforcement, public health, education, recreation, environmental protection, and other governmental services.

Public Transportation Benefit Area (PTBA)— The most commonly used authority for the operation of public transportation in the state. Currently, 14 PTBAs exist in Washington. Designation of a PTBA can cover a county, less than a county, or multiple counties, but only one PTBA can exist in each of these jurisdictions. PTBA funding options include a 0.1 to 0.6 percent sales tax, a household tax up to $1 per month, a business and occupations tax, a utilities tax, and a Motor Vehicle Tax (MVET) match.

Queue — A line, as of people or vehicles, waiting a turn.

Regional Transportation Plan (RTP)— The product of the Regional Transportation Planning process. It addresses existing and future regional transportation system facility and service needs and formulates a funding plan to meet these needs. The Plan proposed by the RTPO and is due three years from the date the RTPO was designated.

Regional Transportation Planning Organization (RTPO)— A voluntary association of local governments within a region, to achieve coordination in transportation planning. Regions are determined by local governments who have transportation concerns which extend beyond their individual boundaries and a desire and need to work together to address those concerns. The Growth Management Act (GMA) authorizes RTPOs to develop a Regional Transportation Plan (RTP).

> The Regional Transportation Planning Program (RTPP) extends transportation planning to area currently not covered by the Federal MPO program. WSDOT administers both the MPO and RTPO programs jointly, without duplication.

Regional Transportation Planning Program— By the 1990 Legislature as part of the State Growth Management Act (GMA), the Regional Transportation Planning Program offers a formal mechanism for local governments and the state to coordinate transportation planning for regional transportation facilities.

Regional Transportation System (RTS)— The Regional Transportation System includes all facilities and services within the boundaries of a Regional Transportation Planning Organization (RTPO). Identified by the

RTPO, the system forms the basis for later transportation needs inventories and eventually, the development of the Regional Transportation Plan (RTP).

Single Occupancy Vehicle (SOV)— Vehicles that carry one occupant, usually a private automobile.

State Environmental Protection Act (SEPA)— Act which requires consideration of alternatives and mitigation of environmental impacts for major projects and programs both public and private.

State Implementation Plan (SIP)— The Federal Clean Air Act authorizes the State Implementation Plan, which, through efforts from the Washington State Departments of Ecology and Transportation, provides policies for improving air quality. Specifically, the SIP requires that all projects planned for a nonattainment area must be shown to not cause an increase in that area's levels of carbon dioxide (CO), ozone, or particulate matter (PM10).

Systems Plan — A draft document that carries into implementation some of the goals and policy recommendations of the Transportation Policy Plan. This new WSDOT planning effort will recommend performance measurements for the state owned portion of the transportation system, analyze the system to identify deficiencies, and propose solutions for addressing some of the state's critical transportation needs.

T^2 — Technology Transfer.

Technical Advisory Committee (TAC)— The Technical Advisory Committee, comprised of member jurisdictions and Transportation Policy Board (TPB) members, provides technical expertise to the Regional Transportation Planning Organization (RTPO) in the development and maintenance of the Region Transportation Plan (RTP). RTPOs are encouraged to establish a Technical Advisory Committee for this purpose.

TMA — Transportation Management Areas. Any area over 200,000 population is automatically a Transportation Management Area, which subjects it to additional planning requirements but also entitles it to earmarked funds for large, urbanized areas under the Surface Transportation Program.

Traffic Analysis Zone (TAZ)— A tool used to conduct transportation analyses. Usually, Traffic Analysis Zone Designations coincide with U.S. Census Blocks and are used in conjunction with population and employment data for that particular area.

Transfer of Development Rights (TDR)— A program that permits a property owner or developer to relocate development potential from areas where proposed land use or environmental impacts are considered undesirable to another site which can accommodate increased development beyond that for which it was zoned.

Transportation Demand Management (TDM)— Action intended to modify travel behavior, usually to avoid more costly expansion of the transportation system. TDM addressees traffic congestion by focusing on reducing travel demand rather than increasing transportation supply to boost

transportation efficiency TDM policies, which are intended to reduce air pollution, energy consumption, and traffic congestion, may include: ridesharing, parking management, bicycling, road pricing, telecommuting, and staggered work hours.

Transportation Policy Board (TPB)— The Transportation Policy Board (TPB) provides policy advice to the Regional Transportation Planning Organization (RTPO) and is a required component of the Regional Transportation Planning Program (RTPP). The Board consists of diverse members, including representatives from the member counties, cities and towns, major employers, the State Department of Transportation, transit providers, and port districts.

The TPB offers a means of formal participation in the development of the Regional Transportation Plan (RTP) for those not a member of the RTPO, but who have a major stake in regional transportation facilities.

Trip Distribution— The third step in forecasting travel is where trips begin and where they end. This is done for different trip purposes on trip types. Common examples are home to work, home to school, home to other, and nonhome-based (trips that do not begin or end at home).

Trip Generation— The second step in forecasting travel is forecasting the number of trips generated by the forecasted land use; the number of trips made to and from each type of land use by day. Trip generation provides the linkage between land use and travel. Trip generated at the home are generally termed "Production." Trips generated by business are generally termed "Attractions."

Trip Length — The length of a trip measured in miles;may be airline distance or over-the-road distance.

Trip Purpose — The reason for making a trip. Each trip may have a purpose at each end; for example, home to work.

Trip — A one direction movement which begins at the origin and ends at the destination. For example, a trip movement from a residence to a work place is a trip from home to work.

Unified Planning Work Program (UPWP)—This is the Scope of Work in the agreement that each Regional Transportation Planning Organization (RTPO) enters into with the State Department of Transportation (WSDOT). Each Work Program covers a fiscal year. It describes the work methods and anticipated products that the MPO and RTPO will utilize in its planning work.

Urban Growth Areas— Areas where urban growth will be encouraged. Counties and cities must cooperatively establish the urban growth areas and cities must be located inside urban growth areas. Once established, cities cannot annex land outside the urban growth area. Growth outside of urban growth areas must be rural in character.

Urban Growth— Refers to growth that makes intensive use of land for the location of buildings, structures, and impermeable surfaces to such a degree

as to be incompatible with the primary use of such lands for the production of food, other agricultural products, or fiber, or the extraction of mineral resources. When allowed to spread over wide areas, urban growth typically requires urban governmental services.

USDOT — United States Department of Transportation.

Vehicle Miles Traveled Estimate (VMT)— A quantitive regional estimation that describes the number of vehicles which travel across a given location in a one-year period. VMT is calculated by multiplying the traffic volume by the number of miles that comprise the length of the distance to be measured.

Volume/Capacity (V/C)— As a planning tool used to conduct regional transportation analyses, volume over capacity measures current volumes of traffic for a given length of road and expresses this as a percentage of road capacity for that same given length

WSDOT — Washington State Department of Transportation.

Zoning — A map and ordinance text which divides a city or county into land use "zones" and specifies the land uses and size restrictions for buildings within that zone.

Appendix D
Fundamentals of Transportation Planning

Getting Started — Defining Your Community's Vision for the Future

To plan a comprehensive transportation system communities must first define their values. Values related to livability, safety, mobility, and stewardship of the land could have a major influence on the transportation system that is best suited to a particular jurisdiction. For example, if a community wants to create a vibrant, pedestrian-oriented downtown, improvements to mobility for pedestrians, bicyclists, and transit riders should take precedence over moving cars rapidly through the downtown area.

Issues related to transportation and community character are complex, with many differing viewpoints. By visualizing the future of your community and drawing broad goals from this view, you will be able to make informed decisions about the individual choices your community faces.

How do you begin to plan for the transportation improvements that will help to achieve your vision for the future? First, take a fresh look at your comprehensive plan. We have become accustomed to viewing the comprehensive plan as simply a land use map that designates where to put the elements of our community — homes, businesses, schools, parks, etc. But, from a different perspective, consider how the plan relates to mobility.

If you begin with the big picture, the issues related to mobility become clearer. Sample questions include:

- How will your community move freight and people about from place to place?
- What destinations will people be attracted to?
- How will people get to and from these areas?
- Are there alternative ways of moving people?
- Which destinations require good truck access?
- Are there alternative ways of moving freight?
- How will your plan fit with regional plans?

There are several common elements of most transportation plans. In this appendix, these elements will be explored and explained. The transportation planning process described herein is similar to processes that many local and regional governments are using as they prepare their transportation plans under the state's Growth Management Act and ISTEA.

The level and types of transportation needs of a community are directly tied to its land use patterns and level of development. To develop a long-range transportation plan, current and future land use patterns and densities need to be described and projected. Next, level of service standards should be agreed to by the community. Together, the land-use assumptions and Level of Service (LOS) standards provide the needed information to identify current and future transportation system deficiencies. Improvements concepts and financing strategies to meet these deficiencies can then be analyzed. Ordinances can be adopted which prohibit development if the development cause the LOS to decline below adopted standards.

In transportation planning concurrency and intergovernment coordination are also important. In this appendix, these two concepts are defined and strategies to achieve concurrency and the importance of coordination of community transportation planning are discussed.

Key Steps in Developing The Transportation Plan

The development of transportation plan has eight key steps:

1. Agreeing on land use assumptions.
2. Adopting level of service standards.
3. Inventoring existing services and facilities.
4. Determining current and future deficiencies.
5. Analyzing financing to meet deficiencies.
6. Reassessing the plan for concurrency.
7. Developing an action strategy.
8. Coordinating with neighboring governments.

Land Use Assumptions

Existing and proposed land uses are an integral component of transportation planning. Determination of existing and future transportation needs requires an inventory of existing land uses to determine current demand for travel and whether such demand can be met by existing transportation facilities. Land use activities proposed to take place during the planning time frame should be analyzed and mapped to determine future transportation demands on existing facilities. Future land use also determines the need of siting of new facilities.

Land use assumptions for developing a transportation plan would include:

- Analysis of the location of present land uses, i.e., various residential densities, retail, highway strip commercial, office, warehouse, etc.;
- Analysis of population, employment, and trips per day generated in each land use areas;
- 10- to 20-year projections of anticipated population growth for each of these areas;
- Desired location of future land uses; and
- Location of future transportation facilities not only to relieve current transportation pressures, but can also to guide the location of future growth and the type of development occurring around the facility.

Level of Service Standards

Level of service standards establish a gauge for evaluating the performance of the existing transportation system and planning for the system to meet future needs. Essentially, level of service is defined as a qualitative measure describing operational conditions within the traffic stream or on the transit system, and the perception by motorists and/or passengers. Level of service standards and measures generally describe these conditions in terms of such factors as speed and travel times, freedom to maneuver, traffic interruptions, comfort and convenience, and safety.

Traditional roadway level of service measures follow a grading scheme similar to a school report card. The measures are A through F, with A describing a safe uncongested roadway, and F describing gridlock. The following table gives a more in-depth description of these levels of service:

Level of Service	Description
A	Describes a condition of free flow with low volumes and high speeds. Freedom to select desired speeds and to maneuver within the traffic stream is extremely high. On freeways, average travel speeds near 60 mph generally prevail.
B	Zone stable flow, with operating speeds beginning to be restricted somewhat by traffic conditions. Drivers still have reasonable freedom to select their speed. On freeways, speeds of over 57 mph are maintained.

C Still in the zone of stable flow, but speeds and maneuverability are more closely controlled by the higher volumes. The selection of speed is now affected by the presence of others and maneuvering within the traffic stream requires substantial vigilance on the part of the user. Average travel speeds on freeways are still over 54 mph.

D Approaches unstable flow. Speed and freedom to maneuver are severely restricted. Still, increases in traffic flow will generally cause operational problems at this level. Average travel speeds on freeway are 46mph.

E_____Represents operating conditions at or near the capacity of the highway. Freedom to maneuver within the traffic stream is extremely difficult. Any incident can be expected to produce a serious breakdown with extensive queuing. Average travel speeds on freeways are approximately 30 mph.

F_____Describes forced flow operation at low speeds, where volumes are above theoretical capacity. Operations within a queue are characterized by stop-and-go waves and are extremely unstable. Vehicles may progress at reasonable speeds for several hundred feet or more, then be required to stop in cyclic fashion.

These standards by transportation planners and traffic engineers can serve as the basis for establishing road and highway levels of service, but should not be used in the absence of land use considerations. In order to concentrate development into a community center or downtown areas, it may be desirable for the local community to establish a method for measuring level of service that considers all roads within the area together rather than separately. This could involve the use of different measuring technologies appropriate for the size of the community.

Once existing levels of service are determined, a plan for eliminating current deficiencies can be established. Level of service standards are also used as a measure to ensure transportation facilities meet future demands. Future facilities can be designed to ensure that demand on facilities does not exceed agreed to level of service standards. To achieve the vision of a long-range plan, provision of future transportation improvements can be based upon maintaining accepted levels of service standards.

Inventorying Existing Services and Facilities

Preparing an inventory of existing transportation services and facilities is the first step in determining the existing level of service standard for each part of the transportation system

An inventory or air, water, and land transportation facilities and services, including transit routes, is required to define existing capital facilities, transportation services, and travel levels as a basis for future planning. An assessment of existing conditions should include analysis of the current capacity and demand on each system. An inventory might include current average daily trips for roadways, and routes, schedule and ridership

information for transit services. Typically, an inventory includes a map showing where existing roads are located, the number of lanes, plus a discussion of deficiencies or problems.

Determining Current and Future Deficiencies

After the inventory of existing services and facilities is completed, the degree to which the existing level of service of each facility meets the locally established level of service standard can be determined. This is through comparison of the actual use if the system with the community's level of service goals. The determination of the level of service for each facility or service indicates whether each system can accommodate current demand. Where existing facilities cannot meet current demand, a plan for eliminating those deficiencies can then be developed.

Using population projections and the proposed future land use map, forecasts of traffic for at least ten years should be undertaken to determine location, timing, and capacity needs of future growth. The plan for improvements to existing systems should consist of system expansion (adding road lanes, pedestrian facilities, or public transportation services) and transportation system management (traffic control devices) needs to meet current and future demand in accordance with established level of service standards.

Analyzing Financing to Meet Deficiencies

After current and future needs to meet system deficiencies are determined, analysis of the funding capabilities must be undertaken to compare needed improvements against probable funding resources. Analysis of financing capabilities must include a multi-year financing plan based on the needs identified earlier in the planning process. If probable funding falls short of meeting identified needs, the plan should include a discussion of the means for raising additional funding or a reassessment of land uses (which may result in fewer future transportation needs as transportation and land-use assumptions are interrelated).

Reassessing for Concurrency

At this point in the planning process, the community has reached an important milestone which requires action. Communities should adapt and enforce ordinances which prohibit development approval if the development causes the level of service on a transportation facility to decline below the standard adopted in the plan, unless transportation improvements or strategies to accommodate impacts of development are made<u>concurrent</u> with development.

Concurrency means that improvements and strategies must be in place at the time of development, or that a financial commitment is in place to complete the improvements or strategies within an agreed amount of time. Strategies to ensure concurrency may include: increased public transportation services, ridesharing programs, demand management, and other transportation systems management strategies. Where financial commitments cannot meet identified needs for transportation improvements, reassessment of land uses and revisions to the transportation plan should be made. The future land use

plan must be revised to ensure that location, intensity and density of proposed future land uses will not cause demand on transportation facilities and services to exceed established level of service standards.

Other options to revise the transportation plan include:

- Reassessing standards or reconsidering what is an appropriate level of service for the given system;
- Reassessing financing or other budgetary priorities; or
- Reassessing transportation service, i.e., is the proposed facility appropriate for the economy in the region.

Developing an Action Strategy

The transportation plan should include an action strategy for bringing into compliance any existing facilities or services that are below established level of service standards, and provide for expansion of facilities and services to meet future needs at established level of service standards. The strategy must be financially sound and planned needs should be financially feasible. The future land use plan should be consistent with this action plan and future growth should not cause facilities to fall below the established level of service standards.

Providing Intergovernmental Coordination

Coordination with adjacent communities often is necessary throughout the planning process. The plan of each community should be coordinated and consistent with the plans of other communities that share common borders or related regional issues.

Where possible, communities should mutually define level of service standards for shared transportation facilities and services. The transportation plan should also include an assessment of the impacts of the transportation plan and land use assumptions on the transportation systems of adjacent communities. Land use assumptions of one community may impact the transportation needs of another. It is therefore essential that communities coordinate their planning, particularly during the analysis of current and future deficiencies, reassessment and concurrency, and development of the action strategy. Further, coordination is often necessary during development of the future land use assumptions. Future land use patterns need to be coordinated on a regional basis to increase the efficiency of the regionwide transportation system.

Land Uses and Transportation Linkages

Land use decisions should not be made without consideration of transportation needs and impacts. Both the location of land use and the type of land use itself affect transportation demand. Different types of land use generate different traffic volumes; for example, commercial activities generate more travel trips than residential activities. Further, locating shopping and work opportunities in close proximity to residential development increases the likelihood of bicycling and pedestrian travel. A

longer travel distance between home and work generally increases reliance on the automobile rather than the use of other alternatives, thus increasing demand on roadway networks.

Transportation decisions also require consideration of impacts on land use. Transportation access allows the development of land that was previously inaccessible; such lands become subject to increased market demand for highway oriented and other types of urban development. A primary consideration in deciding on the location of a new home or business is access to the transportation system. When access to outer lying areas is improved, development pressure in the surrounding area is increased. There is a direct relationship between improved highway access and the development pressures.

The transportation planning process involves guiding, directing, and regulating growth to meet local planning objectives. Therefore, development of future land use plans requires consideration for enhancing the efficiency of the transportation system. Strategies to increase efficiency include:

1. Increased employment density.
2. Provision of employment and housing balance.
3. Development caps.
4. Regionally consistent site designs.

Employment Density

Mixed use centers can make transit and other rideshare alternatives both economically viable and attractive to the user, thus reducing automobile traffic. It is extremely difficult to accommodate commuter trips if they are generated by low density, scattered office developments. The single-occupant vehicle is the only mode of transportation which can effectively be utilized in such areas. Therefore, low density office development in outlying areas will aggravate a community's transportation problem.

Promotion and protection of land uses which reduce the commute distance between the home and place of employment, and between home and public transportation services and facilities should be emphasized. It is important to recognize the linkage between land use and transportation, and to establish land use policies that will be effective in helping to solve urban/suburban transportation problems.

Employment and Housing Balance

The employment and housing balance refers to the availability of an adequate supply of housing close to employment centers, and also the potential for reducing automobile traffic. From a transportation planning perspective, lack of housing opportunities in a community and surrounding areas creates a major problem. For example, as a community's employment opportunity base increases, a shortage of housing opportunities in the area will "force" those people working in the community center to choose a house outside of the area. This situation will increase the commuter's travel

distance, and therefore increase potential transportation, energy, and air quality problems.

Development Caps

Development caps refer to shifting of household or employment growth away from those areas that are already congested to areas that can accommodate the increase in travel demand. This strategy is the opposite of concentrating growth, but also can have applicability. If there is no acceptable solution to a transportation deficiency (transit, demand management, construction, or changing the desired level of service), it may be necessary to deny new development requests. The impact of denial is to shift growth to another area. However, this type of action must be coordinated regionally or it will not result in the desired transportation service.

There are many examples of limits on development shifting growth to an adjacent community that is on the same highway facility. The result is the same number of cars traveling the same highway, only over longer distances. The impact to the community denying the development is the same as if it had accepted the development. The impact to the region is greatly increased traffic because of the longer commute.

Regionally Consistent Design

Regionally consistent design refers to the development and implementation of community standards which promote transit and pedestrian accessibility rather than automobile accessibility. In order to be effective, these policies need to be consistent within specified transit corridors in which transit service is identified as the priority.

The following site design policies would promote transit use in suburban employment centers. Paved, covered walkways and adequate lighting should be provided between building and nearest transit stops, and paved covered passenger standing areas with good visibility should be provided at all transit stop locations. Development should be sited to invite pedestrian access among and between buildings and transit service. This can be done through narrowing of setbacks and orientation of buildings toward bus stops and approaches rather than parking lots. Office developments should provide a central focus for surrounding development that promotes people-oriented activities such as restaurants and shops. Routing of transit should be through the center of the development to provide short walking distances to transit stops to as many people as possible. The number of parking spaces should be reduced and located peripherally to the center. Transit pullouts or parking of ride-shared vehicles should be given preferential location.

These site design policies would also be appropriate for residential development, with the following additions: provisions of sidewalks and a safe, attractive pedestrian environment; minimizing the area devoted to streets; and locating higher density housing along streets serviced by transit or near transit stations.

Applications to Link Land Use and Transportation

Current approaches interface transportation and land use in the following three ways: (1) zoning policies, (2) transportation policies related to development decisions, and (3) Transportation Demand Management.

1. Zoning Policies

   Examples: high-density residential zones located on arterials, the routing of through traffic around residential areas, and buffers between residential zones and arterial.

2. Transportation Policies Related to Development Decisions

   One of the primary considerations in deciding on the location of a new home or business is access to the transportation system. Decisions to widen a road, add a stoplight to improve traffic flow, or build new roads in outlying areas, improve the access and increase the development pressure in the surrounding area. The relationship between improved highway access and development pressure is direct and profound. Therefore, one consideration in recommending transportation access improvements is the desirability of increasing development pressure.

3. Implementation Conditions Imposed on Development

   Transportation Demand Management (TMD) and Transportation System Management (TSM) are used more frequently in communities with large population densities. A variety of implementation conditions can be imposed on development. Examples of administrative TDM measures are: bus pass subsidies, ride match, and flex time. Examples of constructed TSM measures are bus pullouts and shelters.

Environmental Considerations

The role of communities in meeting environmental consideration in transportation planning is important.

Threats that are jeopardizing the sustainability of our environment and our quality of life have been identified by many. Comprehensive action agenda has been aimed at protecting our environment and natural resources. The following list should be considered in the transportation planning process:

1. Protect natural resource lands critical areas.
2. Improve air quality.
3. Improve water quality.
4. Reduce noise conflicts.
5. Manage open space and scenic views.

Protecting Natural Resource Lands and Critical Areas

Natural resource lands are agricultural, forest and mineral resource lands which have long-term commercial significance. Protection of natural resource lands can be accomplished by developing access primarily for movement of products and goods, discouraging increased public access of

natural resource lands, and avoiding decision or separation of resource lands that presently operate as an ecological community or unit.

As a key part in transportation planning communities classify and designate critical areas. After classifying and designating these areas, communities should adopt and enforce regulations to protect these areas and preclude incompatible land uses. Critical areas include:

- Wetlands.
- Aquifer recharge areas.
- Fish and wildlife habitat conservation areas.
- Frequently flooded areas.
- Geologically hazardous areas.

Wetlands — Wetlands provide valuable functions necessary for maintaining a good quality of life, such as flood storage, wildlife habitat, water quality improvement, fish breeding and spawning areas for commercial and recreational fisheries, and recreational opportunities. Transportation design and construction practices must consider protection of wetlands. New transportation corridors and ferry facilities should avoid disturbing and dividing wetlands. Where incidental damage is unavoidable, mitigation efforts should restore the wetlands or replacement wetlands. Constructed natural drainage corridors should not be altered by development or highway construction. Highway water runoff should be treated to remove sediments and other pollutants prior to discharge onto water bodies or wetlands.

Aquifer Recharge Area— Aquifers are major sources of drinking water for many communities. Aquifer recharge areas should be protected to replenish water supplies and maintain surface water levels. Protection should include: avoiding transportation construction in critical aquifer recharge areas, wherever possible; avoiding penetration of aquifers with support structures; providing spill containment measures, where necessary; and routing storm water to aquifer recharge areas only when it has been adequately filtered or treated.

Fish and Wildlife Habitat Conservation Areas— Fish and wildlife are important natural resources. Fish and wildlife habitat conservation areas are extremely sensitive to human encroachment. Therefore, planning of transportation facilities should consider: preserving wildlife movement corridors; avoiding breeding, nesting, and feeding sites; preserving stream flows and water quality for fish runs; and preserving riparian habitat areas supporting rare and endangered wildlife and plant species.

Frequently Flooded Areas— Floodplains generally provide storage capacity during major storm events. Flood storage capacity should be maintained to prevent flooding of adjacent developed areas. Transportation facilities should be located outside floodplains, or if that is unavoidable, above floodplains, and designed for closure during major floods; consider high water in design; discourage new development in frequently flooded

areas by limiting access; and ensure adequate design and maintenance of pipes and storm water management devices.

Geologically Hazardous Areas— Geologically hazardous areas include steep slopes, landslide areas, seismic areas, and areas of high erosion potential. In addition to public safety, the location and design of transportation facilities in these areas should consider impacts on water quality and the deposition of sediments into water bodies and wetlands. Public access and inappropriate land uses should be discouraged.

Improve Air Quality

Research has found that vehicle traffic is a major source of air contaminants, which affect public health and urban vegetation. Transportation sources contribute to total air pollution as shown in the following table.

Air Contaminant	State	National
CO	49%	66%
TSP	43%	21%
PM10	——	25%
SO2	6%	5%
NOx	50%	40%
VOC	36%	35%
Pb	——	31%

(***Source:*** Washington State Department of Transportation)

Two major considerations for improving air quality and vehicle related pollution include: reducing driving and reduce driving related pollution.

To reduce driving, transportation planning should consider establishment of employer-based incentive/disincentive programs that discourage, rather than encourage, employees commuting to work alone. Other considerations include:

- Expansion of efforts to develop transit opportunities and other alternatives to single occupancy vehicles;
- Planning mixed use zones that increase housing near employment centers and reduce the need for transportation; and
- Increasing public education/awareness of the effect of personal driving habits on the environment.

To reduce driving-related pollution, the following considerations are recommended:

- Control gasoline vapors at the fueling source;
- Encourage transitions to cleaner fuels and more fuel-efficient vehicles;
- Expand the vehicle emission inspection and maintenance program; and

- Promote federal initiatives to explore and develop approaches for controlling emissions from diesel-powered vehicles.

Improve Water Quality

Storm water runoff contaminants constitute a significant percentage of the water pollution. Contributors include: runoff from urban streets and parking lots; increased erosion from construction activities; and air contaminants dissolved by rainwater. Transportation considerations for controlling these sources include establishing local storm water management programs, in accordance with programs being developed by the Department of Ecology. These may include filtration devices, buffers, and reduction of impermeable surfaces.

Improved water quality can also be accomplished by fitting new vehicles with oil drip and leak collection devices. This and other methods can reduce incidental contamination deposits on the roadways.

Reduce Noise Conflicts

A three-tier approach for reducing noise conflicts involves:

- Establishing design and location standards for transportation facilities to ensure compatibility with adjacent land uses;
- Controlling of land uses adjacent to transportation facilities to guide the future use of vacant or undeveloped lands and reduce the impact of noise on existing land use activities; and
- Reducing noise source emissions through establishment and enforcement of noise ordinances. A noise reduction program includes both physical and administrative techniques.

Administrative techniques to reduce noise conflicts in sensitive areas may include zoning to exclude incompatible uses and building heights limits, and requiring construction of buffer strips, noise barriers, and sound insulating construction. Other legal restrictions, such as subdivision laws and building and health codes, could require acoustical site planning or insulating berms and barriers; specify acoustic insulation and sealed windows; and establish certain indoor noise limits to be achieved through various physical techniques.

Public ownership or control of the land is another technique for reducing noise conflicts and could include municipal land acquisition or easements and conservation trusts. Other techniques include tax incentives for compatible use, and educational and advisory services.

Open Space and Scenic Views

Transportation has a major impact on the appearances, as well as the accessibility, to the diverse natural and scenic elements which characterize a region. The challenge is to preserve these elements while supporting the needs of the growing population.

The views from Washington’s transportation facilities is a catalyst for the state’s fourth largest industry, tourism. Preserving scenic, recreational, and

cultural resources should be an interactive process between the state, tribes, local agencies, and local land owners, to identify these resources and develop management practices to enhance the view from the road, as well as from the scenic area. Federal, state, and communities may consider acquiring or regulating adjacent land use or to use other controls such as scenic easements and tax incentives to allow visually compatible land uses to continue. The goals of the transportation plan should reflect the community vision with respect to scenic view preservation.

Making the Transportation System More Effective

Historically, increases traffic congestion has resulted in expansion of the transportation system. Problems include:

- Travel demand grows faster than the system can be expanded;
- Construction of new strategies to address congestion roadways become more difficult to sustain due to increased cost of new construction and the increased cost of maintenance on existing roads; and
- Social and environmental impacts prevent construction.

Following are three approaches to making the transportation system more effective:

1. Use Transportation Demand Management (TDM)

   The art of modifying travel behavior, usually to avoid the more costly expansion of transportation system.

2. Use Transportation Management System (TSM)

   Encompasses an array of actions that can be taken to increase the carrying capacity of roadways.

3. Developed Land Use Strategies

   Address the relationship between land uses to reduce the number of vehicle trips generated and/or reduce the length of trips.

Transportation Demand Management

Transportation Demand Management addresses traffic congestion by focusing on reducing travel demand rather than increasing transportation supply to increase transportation efficiency. Travel demand is reduced by measures which either eliminate trip making or accommodate person trips in fewer vehicles. These techniques generally address the commuter. Implementation of TDM alternatives therefore requires employer/public agency cooperation.

Transportation Demand Management alternatives include:

- Ridesharing.
- Transit service improvements.
- Parking subsidy removal/pricing.
- Parking supply limits.

- Transit/rideshare incentives.
- Ride home guarantees.
- Telecommuting.
- Flextime.
- Compressed work week to reduce driving days.
- Walking/bicycling.
- Road pricing.

Ridesharing— Ridesharing includes carpooling and vanpooling. A carpool is any passenger vehicle with a minimum of two people who commute on a regular basis. A vanpool is a passenger van used by seven to fifteen commuters. Programs to encourage ridesharing include carpool matching; preferential parking for carpools and vanpools; distribution or posting of information on ridesharing and transit services and other activities designed to introduce commuters to prospective carpool partners; and fleetpool programs which allow employees to use the employer's automobile fleet during nonwork periods for employee-operated carpools.

Transit Service Improvements— Transit service levels are measured by the accessibility and distribution of transit. Strategies to improve service levels focus of reducing the time between transit vehicles, extending the hours of service, increasing the geographical area providing service, and increasing the accessibility of transit to all residents.

Parking Subsidy Removal/Pricing— This strategy has two related components: the removal of employer-based parking subsidies at employment sites where parking charges currently exist (typically Central City areas) and/or instituting employee-paid parking charges at employment sites where parking charges do not currently exist (typically suburban areas). Growing evidence suggests instituting paid parking and/or removal of employer subsidized parking has been most effective in converting automobile commuters to transit or carpools. This approach is acceptable, however, only if other approaches without a monetary impact on the employee are not sufficient.

Parking Supply Limits— Parking supply can be limited through development controls or land use codes. Parking supply is typically limited through the use of maximum limits on the overall supply in an area. The technique is most applicable to big city centers. Some cities allow a reduction in parking in exchange for a developer's commitment to conduct an on-site transportation demand management program. Another technique for parking reduction for new development is to require a portion of site be set aside and held in reserve in case future additional parking is needed. Limiting the parking supply will generally result in increased parking cost.

Transit/Rideshare Incentives— As an incentive to use transit or rideshare, the employer may subsidize partially or fully, the out-of-pocket cost of an employee work trip. Subsidy options can include transit passes, carpooling

parking fees, vanpool fares and guaranteed rides home in an emergency or after normal transit hours.

Ride Home Guarantees— Ride home guarantees can also be provided by a public agency. A guaranteed ride home program provides subsidized rides home, usually by taxi, for those commuters who are not able to use their normal transit and rideshare commute mode due to a personal emergency or work obligation. For some commuters, a ride home guarantee is necessary to encourage the use of ridesharing or transit.

Telecommuting— Telecommuting refers to the use of telecommunications technology for certain employees to work from a remote site or their home. Telecommuting can be an effective TDM strategy by shortening or eliminating peak-period commute trips to primary office sites. However, telecommuting from a remote office site does not eliminate the entire commute trip and will add traffic to the road system near the remote site.

Flextime — Generally, any system that gives employees some control over their own starting and ending times is considered flextime. Flextime does not necessarily change the number of days in the work week. Flextime can reduce traffic congestion at peak hours and facilitate use of ridesharing or transit. The range of possible hours within which an employee may choose to work is extended beyond the usual stating and quitting times. Employees are usually required to be at work during core time (e.g., 9:30 a.m. to 3:00 p.m.) and have a choice as to when to begin and end the day, provided they work the necessary eight hours.

Compressed Work Week — This technique "compresses" the typical five-day, 40-hour work week into a fewer number of days. The most typical schedule is four, ten-hour days resulting in a reduction of driving days and commute miles per week.

Walking/Bicycling— Measures which give equal consideration or priority to pedestrian or bicycle access over vehicular access are also TDM measures. Examples range from individual building design review to assure that doors are near transit routes to regional plans for safe bicycle routes.

Road Pricing — This strategy includes a range of pricing alternatives which might be applied to congested bridges, freeways, or arterial streets. It could include tolls for single occupant vehicles or for highway users during peak periods.

There is no experience in the United States with pricing on a regional network of highways and arterials for purposes of reducing trips. There is some experience with price changes on tunnels and bridges and the potential effect of road pricing. The results suggest an increase of $2 to $3 on peak-period highway users may reduce peak travel by 15 to 25 percent. Issues would include concerns abut impacts on the placing tolls on federally funded facilities.

Implementation of TDM measures which are constraint (such as road pricing) must be concurrent with viable options. If not, the desired result may

not occur, i.e., extra cost will be absorbed or avoided by relocating the business. The traffic problem could then become worse.

Implementation of TDM Techniques

Gaining acceptance and use of TDM requires marketing to both the business community and the user. The active support of employers, businesses, and developers is needed. The program must trigger business enlightened self-interest and may involve negotiated public private agreements. The commuting public may perceive TDM alternatives as requiring significant adjustment in personal comfort, preference, and habits. People need to be told the benefits to them personally as well as the benefits to the community.

It is important to understand that each TDM measure is applicable to a different segment of the population. Unlike roads which are intended to serve the entire traveling public, TDM measures are tailored to specific segments of the travel market. There are different alternatives to the automobile for different people, and different TDM strategies for different employers. Establishing a successful TDM program requires as much marketing data and market understanding about the companies and commuters as possible. The personal automobile is a strong competitor.

Each person, department, and employment site is unique. What works well for some may not work well for others. Locally, measured effectiveness should be used to determine local actions. National experience identifies these examples of TDM application options:

Walking — Works well for those who live close to work where the climate is mild (or there is weather protection) and the area is well-lighted, is fairly secure, and has sidewalks.

Bicycling — Works best for those who live within five miles of work where the terrain is fairly flat and the climate is mild.

Public Transit — Works best for those who live within 20 miles of work and work in concentrated areas. Transit must stop near work site and home, and schedules and work shifts must be compatible. Alternatively, park and ride lots and express service to work site needs to be provided.

Carpools — Works well for those who commute ten miles or more and spend 40 minutes or more commuting, particularly in suburban work sites without transit where there are convenient employment groups.

Vanpools/Buspools — Works well for those who commute 15 miles or more and spend one hour or more commuting. Needs to be large group of employees who have same work schedule and live in same area.

Compressed Work Week — Change work schedules to work ten hour days, four days per week or nine days every two weeks can help reduce trip and vehicle miles traveled (VMT), but involves changing production and coverage schedules.

Telecommuting — Eliminates or shortens trip. Works for some employees but not production employees.

Flextime — Does not eliminate car usage but helps employees match bus schedules, vanpools and carpools, or to miss peak congestion times.

Transportation Demand Management in Rural Communities

In rural communities, the need for implementing transportation demand management techniques is based upon different reasons than those initiating urban application. Rural communities are characterized by limited or no traffic congestion, widely spaced commercial and employment centers, and widely distributed residents. Road quality and maintenance may be a problem, but congestion is of little significance. What congestion exists may be experienced for a very short duration, denoting a "peak five minutes" as opposed to a "peak hour" period. Modes of travel other than personal automobile are generally not available or not economically viable.

Transportation demand management techniques should still be considered but for different reasons. Providing increased access to employment sites from the surrounding area through transit and ridesharing programs, or facilitating second-job employment of agricultural workers through flextime, are demand management approaches that could have rural application. Also, many rural areas have tourist travel peaks that could lend themselves to parking controls combined with tourist transit service, or to traffic operational improvements.

Transportation System Management

Transportation System Management formally refers to an array of actions that coordinate transportation services and facilities to increase the carrying capacity of existing transportation system and facilities; for example, the use of high occupancy vehicles (HOV). These actions include:

- Management of traffic operations and traffic control systems to maximize utilization of available roadways.
- New transit or highway facilities that maximize the people carrying capacity of the transportation roadway, as compared to vehicular capacity.
- Implementation of TDM strategies.

Traffic Operations and Traffic Control Systems— Traffic operational analysis and the installation of state of the art control systems can increase the capacity of existing roadways. Examples include:

- Synchronized traffic control on major arterials.
- Ramp metering on freeways.
- Traffic surveillance and incident control on both major arterials and freeways.
- Increased length for turn lanes.
- Express lanes.
- Truck climbing lanes.

Access Control — Access control refers to the control of vehicular access to major roadways. A freeway represents complete access control as access is limited to interchanges and the freeway ramp design allows vehicles to enter the traffic stream without stopping. Where ramp metering is in place, stopping does occur. Partial access control on major arterials or state highways can also be provided by limiting or prohibiting driveway access, by limiting or prohibiting left turn movements, and by limiting or prohibiting cross traffic at intersections. These actions increase the capacity of the major arterial to carry through traffic without requiring additional lane construction.

High Occupancy Vehicle (HOV)— HOV priority refers to measures which create priority-based access and or exclusive access to freeways, arterials, ferries, and parking systems based on the number of occupants in the vehicle. HOV priority is an attempt to maximize the number of people (rather than vehicles) accommodated by the transportation system. For example, designating diamond lanes for exclusive use by carpools, vanpools, and transit vehicles is one means for providing HOV priority. Another example of HOV priority is a queue jump lane which allows carpools, etc. to move to the front of the line in getting on a crowded facility such as a ferry boat. Implementation of TSM measures is usually the responsibility of the state or local government. Large developments can be required to provide some TSM measures as a condition of development for those facilities that the development impacts.

Land Use Strategies

The number and arrangement of homes and businesses on land determines the number and length of trips and often determines whether the trip is made by automobile, transit, carpool, or walking. Land use strategies to manage transportation demand include:

- Employment concentration.
- Employment/housing balance.
- Development cap.
- Site design.
- Mixed use.

Employment Concentration— Concentrating jobs in mixed-use centers (similar to a traditional downtown) makes transit and ride sharing attractive.

Employment/Housing Balance— Providing an adequate supply of affordable housing near employment centers shortens trips, thereby reducing miles of automobile traffic. Bicycling and walking are also more attractive.

Development Cap— Shifting growth away from highly congested areas may prevent degradation of highway levels of service, but not always. Travelers may still pass through the cap area on their way to the alternate growth area.

Site Design — Promoting transit, bicycle, and pedestrian accessibility in new development design can reduce auto trips. Examples of this are permitting on-site services (i.e., day care, pharmacy, dry cleaners, etc.), at park and ride lots and employment centers, and by encouraging interaction between the streets and buildings at the street level.

Mixed Use — Mixing a variety of land uses in an area that is attractive for walking promotes use of walking for some trips. For example, providing restaurants near offices. Other approaches to mixed use may include: creating a neighborhood commercial district or allowing compatible convenience retail uses to locate within residential areas, allowing mixed compatible land uses, and increasing employment and housing densities in activity centers.

Land use strategies can be incorporated into the development review process as conditions of approval. This action should be one part of a broader transportation and land use strategy that includes growth management policies and revisions to general plans, subdivision regulation, and zoning to provide for community development patterns that help reduce overall auto use and vehicle miles traveled.

Trip Reduction Ordinance— A council regulation requiring developer or employer participation in providing incentives for building occupants or employees to use TDM alternatives is a trip reduction ordinance. The ordinance would require that a transportation management plan be prepared for each new development site or employment site. Program components might include shuttle service to transit stations, residential and commercial park-and-ride lots, guaranteed ride-home programs, pedestrian walkways, commuter rail easements, rent reductions for commuters who walk to work subsides for users of transit and vanpools, and mandatory parking providing strategies combined with significant parking supply limitations, etc. Generally, the ordinance would involve laying out requirements for projects in certain land use categories that meet minimum size thresholds. Flexibility can be provided within categories of actions required or by permitting developers to submit their own Transportation Management Program as alternative to the program required by the ordinance.

Administrative Guides— Guidelines are a means of providing staff policy backing to impose TDM, TSM, or land use strategy requirements. This ensures some consistency for case-by-case negotiation.

Interim Ordinances— These can be adopted for a temporary period until the community governing body decides on the terms of a permanent ordinance.

Zoning Techniques— The following are examples of presently available zoning techniques that can be used to implement TDM, TSM, or land use strategies:

1. Bonus or Incentive Zoning

Increased development rights (usually in form of higher densities) given to a developer when amenities deemed to be in the public interest are provided in the development (i.e., day care, retail, social services, etc.).

2. Overlay Zone

   A zoning ordinance overlays conventional zoning and covers specific parcels or a large area of land.

3. Planned Unit Development Zoning

   Encourages coordinated development of large tracts of land.

4. Special District Zoning

   Requires specific things to maintain a particular quality in the district (i.e., Pioneer Square, Pike Place Market).

Measuring Effectiveness

The overall goal of TDM, and the land use strategies discussed in this section is to increase the effectiveness of the total transportation system by reducing demand or maximizing existing capacity. Measuring effectiveness requires identifying factors that will measure changes in demand or capacity resulting from implementing the alternatives. This change in demand is projected in measurable terms. Then, baseline and periodic measurements are made to define change.

For example, for a carpool program in a target service area, the number of single person cars versus carpool commuters is determined by a survey at the beginning of the program. The amount of change is determined by periodic surveys. The measure of effectiveness is actual change versus projected change. Corrective action is taken if the stated goal is not met.

Both the local transportation plan and the regional transportation plan need to include identification of ways in which effectiveness will be measured. There is still a very small amount of actual data available by which to judge the actual effectiveness of TDM, TSM, or land use strategies.

Acknowledgments

This guide was developed in cooperation with various WSDOT offices, Indian tribal members, and the Governor’s Office of Indian Affairs.

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Special thanks go to the following committee members who provided comments, ideas, and suggestions since this project started in the summer of 1994.

The review team included:

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Our sincere appreciation is extended to the review team and to all others that contributed to this guide.

George D. Crommes, P.E.
Editor

Preface

On December 17, 1993, a Washington State-Tribal Transportation meeting was held in Olympia to discuss national Indian transportation issues and the ISTEA legislation as they pertain to tribes within the state of Washington. There were over 100 participants almost evenly divided between tribal and state/federal representatives. Their main purpose for coming together was to achieve a better understanding of each others problems and to develop some procedures or methods of how to work together to implement ISTEA programs. This will necessarily involve describing BIA programs, tribal priorities, and Indian-related federal programs such as the Local Training Assistance Program (LTAP).

It is interesting to note that this effort is an outgrowth of the Washington State Centennial ACCORD signed by 26 federally recognized tribes and Governor Booth Gardner on August 4, 1989. The purposes and objectives as stated in the ACCORD are:

"This ACCORD illustrates the commitment by the parties to implementation of the government-to-government relationship, a relationship reaffirmed as

state policy by gubernatorial proclamation January 3, 1989. This relationship respects the sovereign status of the parties, enhances and improves communications between them, and facilitates the resolution of issues.

The ACCORD is intended to build confidence among the parties in the government-to-government relationship by outlining the process for implementing the policy. Not only is this process intended to implement the relationship, but also it is intended to institutionalize it within the organizations represented by the parties. The parties will continue to strive for complete institutionalization of the government-to-government relationship by seeking an accord among all the tribes and all elements of state governments.

This ACCORD also commits the parties to the initial tasks that will translate the government-to-government relationship into more efficient improved and beneficial services to Indian and non-Indian people. This ACCORD encourages and provides the foundation and framework for specific agreements among the parties outlining specific tasks to address or resolve specific issues.

The parties recognize that implementation of this ACCORD will require a comprehensive educational effort to promote understanding of the government-to-government relationship within their own governmental organizations and with the public.

It is in this spirit that a Task Group was formed to develop, write and publish an ISTEA/Tribal Handbook. This handbook will serve the same purpose as the ISTEA Application Handbook for Local Governments with the additional purpose of including processes unique to tribal governments. Significant contribution has been made by tribal staffs, Indian LTAP Center at EWU, Intertribal Transportation Association, Federal Highway Administration, Washington State Department of Transportation, NWT2 Center, and the Governor's Office of Indian Affairs.

Sincerely,

Wendell George, President
Intertribal Transportation Association

Dennis B. Ingham
Assistant Secretary
TransAid Service Center
WSDOT

1:TA7

SESSION 6 - AIR QUALITY AND TRANSPORTATION: CURRENT ISSUES AND TECHNIQUES

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Panelists: Jerry Everett, Federal Highway Administration
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Richard Margiotta, Science Applications International Corportation
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Session #6

New Ambient Air Quality Standards
Analytic Challenges and Process Changes
An FHWA Perspective of the Impacts on Small and Medium Sized Areas

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ABSTRACT

Significant changes to standards and regulations that influence metropolitan transportation planning in many areas were made in 1997. Specifically, the U.S. EPA issued both a new set of National Ambient Air Quality Standards(NAAQS) and major revisions to the Conformity Rule. The impacts of the new standards and the conformity rule are interrelated. For example the current conformity regulations are based on the 1990 Clean Air Act Amendment nonattainment designations which in turn are based on the old NAAQS. Thus with new NAAQS one would expect new designations and a new set of conformity regulations. However, it will likely take EPA several years to collect the required monitoring data and make the new designations. Thus in the short term it appears that the new standards will have little impact. However, the medium to long term impacts of these changes on the planning processes and the analysis techniques employed by small-medium size areas is not yet clear. It does appear that the changes in the ozone and particulate matter standards will result in numerous new nonattainment areas, some of which will likely be considered small or medium-sized areas.

This paper will first provide background information on the new standards. Second, it will provide a review of some of the applicable transportation and air quality terminology. Third, the "current" air quality status of small and medium sized areas will be described and developing issues will be discussed. Finally, information will be provided which will assist small-medium sized areas in their preparations to meet the analysis requirements under the new standards and revised regulations.

Acknowledgments

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Introduction

The U.S. EPA issued new National Ambient Air Quality Standards(NAAQS) and revised the Transportation Conformity Rule in 1997. The focus on this paper will be on documenting the impacts to date and to the extent possible predicting the future impacts of these changes on transportation planning in small and medium-sized communities. However, before the impacts can be understood one must become familiar with some of the important aspects of these revisions.

New NAAQS

There are two types of NAAQS, primary standards which set limits to protect public health and secondary standards which are designed to protect public welfare. The U.S. EPA issues NAAQS for seven pollutants; Carbon monoxide (CO), Nitrogen Dioxide (NO2), Ozone (O3), Lead (Pb), Particulates <10 micrometers (PM_{10}), Particulates <2.5 micrometers ($PM_{2.5}$) and Sulfur Dioxide (SO2). On July 17, 1997 the standards for ground level ozone and particulate matter were revised. The previous 1-hour ozone standard is being phased out and replaced with a more stringent 8-hour standard. The PM_{10} 24-hour standard was updated and new standards for $PM_{2.5}$ were added.

Transportation Conformity Revisions

With the intent of simplifying the conformity process and providing much need flexibility in making conformity determinations the EPA in July 1997 finalized a third set of amendments to the transportation conformity rule. Included in those amendments were several changes that may affect transportation planning in small and medium-sized communities classified as maintenance or nonattainment. Under the revised rule the build/no-build test is eliminated once state implementation plan (SIP) budgets have been submitted. Newly submitted SIPs replace the build/no-build and other emission reduction tests after a 45-day adequacy review period by EPA. Network modeling is now only required in serious and above ozone and CO nonattainment areas with an urbanized population greater than 200,000. However, areas currently using network models must continue to use them. The specific modeling criteria were streamlined and clarified, and additional modeling guidance will be issued in the future. Rural areas now have flexibility to choose among several conformity tests when demonstrating conformity for years beyond the time frame of the attainment SIP or maintenance plan. Additionally, the consequences of EPA disapproval of a SIP are less severe. Following EPA disapproval of a SIP without a protective finding, projects from the first three years of the currently conforming transportation plan and TIP can proceed(1).

Defining the terms

Becoming familiar with the terminology of air quality and transportation planning is the first step in understanding the linkage between the two. This section is intended to remind the reader of the definitions of some of the key terms used in this paper.

A "nonattainment area" is a locality where air pollution levels persistently exceed the NAAQS. Maintenance areas are geographic regions that were designated nonattainment and have

subsequently been redesignated to attainment subject to the requirement to develop a plan that will assure the standards are maintained. Conformity, simply defined, refers to the requirements that in nonattainment and maintenance areas the transportation plans and programs must "conform" with the purpose of the applicable SIP.

The Census Bureau defined "urban" for the 1990 census as comprising all territory, population and housing units in urbanized areas and in places of 2,500 or more persons outside urbanized areas. Rural areas as defined by the Census Bureau are areas with under 2,500 in population(2). The Transportation Research Board (TRB) builds on the definition of urban to define small and medium-sized urban communities as those with maximum population of 250,000. There are about 125 urban areas in the United States with a population greater 250,000 and probably several thousand communities that fit the broad definition of a small or medium-sized urban area.

For many transportation planning purposes the terms "urbanized" and "metropolitan" are more important than urban. For example all urbanized areas are required by Federal law to have a Metropolitan Planning Organization (MPO). The MPOs are required to define a metropolitan area that encompasses the current urbanized area and the area expected to be urbanized during the 20 year forecast period. An urbanized area as defined by the Census Bureau comprises one or more places and the adjacent densely settled surrounding territory that together have a minimum of 50,000 persons(3). Nationally there are currently 339 MPOs of which approximately 225 are in urbanized areas with a population of 250,000 or less(4). These definitions are very important for integrating the air quality and transportation planning processes. Based on these definitions the geographic areas that are required to meet the various planning requirements and the people impacted by them can be identified.

Pollutants

Of the seven criteria pollutants only ozone, carbon monoxide and particulates are currently given significant consideration in transportation planning**.** It is important to understand both the source and characteristics of pollutants if one desires to comprehend the prospects for a region complying with the NAAQS. The following is a brief description of these three pollutants.

Ozone

Ozone is not emitted directly into the air, but is formed by gases called nitrogen oxides (NOx) and volatile organic compounds (VOCs) that in the presence of heat and sunlight react to form ozone. Ground-level ozone forms readily in the atmosphere, usually during hot weather. NOx is emitted from motor vehicles, power plants and other sources of combustion. VOCs are emitted from a variety of sources, including motor vehicles, chemical plants, refineries, factories, consumer and commercial products, and other industrial sources. Changing weather patterns contribute to yearly differences in ozone concentrations from city to city. Also, ozone and the pollutants that cause ozone can be carried to an area from pollution sources located hundreds of miles upwind.

CO

Carbon monoxide is a colorless, odorless, poisonous gas formed when carbon in fuels is not burned completely. It is a byproduct of highway vehicle exhaust, which contributes about 60

percent of CO emissions nationwide. Other sources of CO emissions include industrial processes and fuel combustion in sources such as boilers and incinerators.

PM

Particulate matter originates from a variety of sources, including diesel trucks, power plants, wood stoves and industrial processes. The chemical and physical composition of these various particles vary widely. While individual particles cannot be seen with the naked eye, collectively they can appear as black soot, dust clouds, or grey hazes. As noted earlier EPA now maintains standards focused on "coarse" particles less than 10 micrometers in diameter ("PM_{10}") and "fine" particles less than 2.5 micrometers in diameter ("$PM_{2.5}$"). Fine particles result from fuel combustion, residential fireplaces and wood stoves or they can be formed in the atmosphere from gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds. Coarse particles are generally emitted from sources such as vehicles traveling on unpaved roads, materials handling, and crushing and grinding operations, and even windblown dust.

Attainment Status

Overview

The situation regarding the nation's nonattainment areas is quite dynamic. Since by definition an area's nonattainment status is directly linked to the NAAQS, changes in the standards may result in a change in the attainment status of an area. Additionally, pollutant emissions levels and meteorological conditions vary over time in most regions of the country. Favorable meteorological conditions and/or reduced emissions may result in areas attaining the standards while growth in emissions and/or unfavorable meteorological conditions may result in violations of the standards. The general trend has been toward greatly improved air quality in the U.S. For the nation as a whole pollutant concentrations and the number of affected people have dropped steadily over the past 25 years.(5)

Due to the dynamic nature of the nation's air quality situation from both a scientific and regulatory perspective it is difficult to provide a status report with lasting value. It must be recognized that data provided at any point in time could be out-of-date very quickly. With this in mind a composite snap-shot of the first 8 months of 1998 was developed. As of January 17, 1998 there were a total of 150 geographic regions classified as nonattainment containing an estimated one hundred and seventeen million people. (6) About thirty of these regions were in nonattainment for more than one pollutant.

Small and Medium-Sized Areas

Table 1 is comprised of a subset of nonattainment areas that have a populations near or below the 250,000 threshold for small and medium-sized areas. These data indicate that as of January 27, 1998 there were 72 geographic regions in this category, nine of which were in nonattainment for more than one pollutant. At least 9 of these geographic regions and by some definitions 15 or more could be categorized as rural nonattainment areas.

Table 1: Small & Medium-Sized Nonattainment Communities (January 27, 1998)

#	State	Nonattainment Area	Number of Areas			Affected Pop.		
			O_3	CO	PM_{10}	O_3	CO	PM_{10}
1	AK	Anchorage		1	1		222	170
2	AK	Fairbanks		1			30	
3	AK	Juneau			1			12
4	AZ	Ajo			1			6
5	AZ	Bullhead City			1			5
6	AZ	Douglas			1			13
7	AZ	Miami-Hayden			1			3
8	AZ	Nogales			1			19
9	AZ	Paul Spur			1			1
10	AZ	Payson			1			8
11	AZ	Yuma			1			54
12	*CA*	*Chico*		*1*			*72*	
13	CA	Imperial Valley			1			92
14	*CA*	*Lake Tahoe South Shore*		*1*			*30*	
15	CA	Owens Valley			1			18
16	CA	Searles Valley			1			30
17	CO	Aspen			1			5
18	CO	Canon City			1			12
19	CO	Fort Collins		1			106	
20	CO	Lamar			1			8
21	CO	Longmont		1			52	
22	CO	Pagosa Springs			1			1
23	CO	Steamboat Springs			1			6
24	CO	Telluride			1			1
25	DE	Sussex Co	1			113		
26	ID	Boise			1			125
27	ID	Bonner Co (Sandpoint)			1			26
28	ID	Pocatello			1			46
29	ID	Shoshone Co			2			13
30	MD	Kent and Queen Anne Cos.	1			52		
31	ME	Knox and Lincoln Cos.	1			67		
32	ME	Lewiston-Auburn	1			221		
33	MI	Muskegon	1			159		
34	MT	Butte			1			33
35	MT	Kalispell			1			11
36	MT	Lame Deer			1			0
37	MT	Libby			1			2
38	MT	Missoula		1	1		43	43
39	MT	Polson			1			3
40	MT	Ronan			1			1
41	MT	Thompson Falls			1			1
42	MT	Whitefish			1			3
43	NH	Manchester	1			222		3
44	NH	Portsmouth-Dover-	1			183		

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#	State	Nonattainment Area	Number of Areas			Affected Pop.		
			O_3	CO	PM_{10}	O_3	CO	PM_{10}
45	NM	Anthony			1			1
46	NM	Sunland Park	1			8		
47	NV	Reno	1	1	1	255	134	254
48	NY	Essex Co.	1			1		
49	NY	Jefferson Co.	1			111		
50	NY	Poughkeepsie	1			259		
51	OH	Jefferson Co. (Steubenville)			1			4
52	OR	Grants Pass		1	1		17	17
53	OR	Klamath Falls		1	1		18	17
54	OR	LaGrande			1			11
55	OR	Lakeview			1			2
56	OR	Medford		1	1		62	63
57	OR	Oakridge			1			3
58	OR	Springfield-Eugene			1			3
59	PA	Altoona	1			131		
60	PA	Johnstown	1			241		
61	PR	Guaynabo Co.			1			85
62	UT	Ogden		1	1		63	63
63	UT	Utah County (Provo)		1	1		85	263
64	WA	Olympia-Tumwater-Lacey			1			63
65	WA	Spokane		1	1		279	177
66	WA	Wallula			1			47
67	WA	Yakima			1			54
68	WI	Door Co.	1			26		
69	WI	Manitowoc Co.	1			80		
70	WV	Follansbee			1			3
71	WV	Wier.-Butler-Clay			1			22
72	WY	Sheridan			1			13
		TOTALS	**16**	**14**	**53**	**2129**	**1213**	**1939**

Current Situation and Forecast for the Future

Tremendous progress has been made towards cleaning our nation's air in the past three decades. However, there is still work to be accomplished especially with regard to ozone and particulates. Though the full impacts of the revisions to the conformity regulations and NAAQS are still unknown this section provides a brief description regarding current conditions and what is anticipated.

Ozone

On May 27, 1998 EPA issued the final rule identifying areas where the old 1-hour standard for ozone no longer applies because there had been no current measured violation of the 1-hour standard. Nearly half of the areas reclassified as a result of this action were small and medium sized areas. After EPA's revocation of the old ozone standard the only small and medium-sized areas that remain in nonattainment for ozone are the six indicated by shading in Table 1 (7). However, twenty-two of the nation's forty-three ozone maintenance areas are either

small/medium-sized or rural.

The question for these areas now becomes "what next?". Estimates of the extent of the nation that would be classified as nonattainment under the new ozone standards range from about 20 areas up to two or three times that number. The current best guess based on the monitoring data available to date indicates that roughly 150 additional counties will be classified as nonattainment for ozone under the new standard(8)(9). Some of these counties will become part of existing nonattainment areas and others will comprise new nonattainment areas. However, EPA anticipates most of the new ozone nonattainment areas (at least in the northeastern U.S.) will not need to implement any transportation related measures. Their expectation is that most of these areas will reach attainment simply by complying with EPA's rule for regional NOx reductions(10). As indicated in Table 2 implementation of the new standard is expected to be a long process occurring over about 12 years.

Table 2: Important Dates on New Standards Implementation Time Line(11)

Date	Ozone	PM_{10} & $PM_{2.5}$
July 1997	New Standard Issued	New Standard Issued
May 1998	Old Standard Revoked	$PM_{2.5}$ monitoring program ongoing
Fall 1998	New EPA guidance and rules released	EPA will issue anti-backsliding rule & revoke old standard case-by-case
2000	Traditional area designations	PM_{10} designations and classifications
2002-2003	Transitional area attainment dates & Traditional area SIPs due	$PM_{2.5}$ designations begin as data becomes available
2005	Traditional area attainment dates set	Earliest $PM_{2.5}$ SIPs due date
2008-2010	Traditional area attainment dates	Last Year for $PM_{2.5}$ SIP submittal & $PM_{2.5}$ attainment dates begin

CO

Long-term improvements regarding CO pollution continued between 1986 and 1995. National average CO concentrations decreased 37 percent while CO emissions decreased 16 percent. Long-term air quality improvement in CO occurred despite a 31 percent increase in vehicle miles traveled in the U.S. during that period(12). Violations of the CO standard have been virtually eliminated over the past two decades. In fact recently 8 CO areas in California lost their nonattainment status reducing the national total of CO nonattainment areas to 20. Chico and Lake Tahoe South Shore shown in italics in Table 1 were reclassified to attainment as part of this action. Though 12 of the 20 current CO nonattainment areas and 10 of the 33 CO maintenance areas are in small and medium sized or rural areas few actually have a serious CO pollution problem.

PM

Approximately 53 of the 77 PM_{10} nonattainment areas and 4 of the 6 PM_{10} maintenance areas are small or medium-sized communities. The number of new $PM_{2.5}$ and new or expanded PM_{10} nonattainment areas is still not clear at this point in time. The EPA has estimated that at least

several hundred counties will be designated as nonattainment for particulate pollution. However, the new particulate standards were created with limited knowledge of emission sources. The current method for determining PM_{10} emission factors--based on silt loading--is inadequate and uncertain when determining $PM_{2.5}$ emission rates. Current EPA regulations call for regional and project-level modeling of particulates, but approved methodologies have not been established. EPA has stated that full implementation of the standards will be deferred until such methodology can be developed. Although there has been some fine particle monitoring in the past a more comprehensive network is needed to support state planning and control efforts. The first priority for the fine particle standard, therefore, is to establish a comprehensive $PM_{2.5}$ network to measure ambient concentration across the country. The monitoring network will indicate the areas that have significant $PM_{2.5}$ pollution problems and identify the major sources of $PM_{2.5}$ in various regions. The initial network, designed and deployed by EPA and the States, will consist of approximately 1500 monitors. Table 2 provides highlights of the anticipated implementation schedule.

Clarifying the Issues and Developing Solutions

Several efforts designed to better understand the perceived needs of urban areas with regard to transportation planning have been undertaken recently. These projects include NCHRP Synthesis 252 "Response of Small Urbanized Area MPO's to ISTEA", a survey of over 100 small to medium sized metro areas by the Texas Transportation Institute and a nationwide survey of state departments of transportation and MPOs on conformity issues conducted jointly by the American Association of State Highway Transportation Officials (AASHTO) and the National Association of Regional Councils (NARC). Information gleaned from these and related efforts indicate that only 20 to 25 percent of small and medium-sized areas perceive air quality as a major transportation planning issue in their area. However, in areas where air quality is a concern it was usually identified as one of the top two issues facing them. Indications are that the portion of small and medium-sized areas that are required to address air quality issues in their planning process will likely increase significantly in the next several years. A great deal of attention is being given to the issues related to this topic. The remainder of this paper will highlight some of these efforts.

TEA-21

On June 9, 1998, the Transportation Equity Act for the 21st Century (TEA-21) was signed into law. Several provisions of this new statute are likely to impact transportation and air quality planning in small and medium sized urban areas. The TEA-21 includes revisions to the Congestion Mitigation and Air Quality Improvement Program (CMAQ) apportionment formula to include "stand-alone" CO nonattainment and maintenance areas several of which are small and medium-size metropolitan areas. The option to tailor the planning process to fit the complexity of the problem in areas under the 200,000 population threshold was retained. Metropolitan boundaries may now be maintained as they reflected nonattainment areas, at the existing limits on the date of the enactment of TEA-21, or they may be extended to reflect increases in nonattainment area boundaries at the discretion of the state's Governor and the MPO. For new MPOs, the boundaries should reflect the nonattainment area boundaries based on agreements

between the Governor and local officials(13).

DOT Assistance

The FHWA and other DOT agencies are actively working to assist small and medium-sized urban areas in their transportation and air quality planning efforts. Much of this assistance is developed and provided cooperatively with the U.S. EPA and other Federal Agencies. The following are samples of the ongoing projects that will help small and medium-sized areas in this regard.

Handbook for Technical Information and Procedures

The objective of this research project is to develop a reference book of simplified analytical procedures for obtaining and refining technical information needed for transportation planning in small and medium sized urban areas. The handbook will provide examples of procedures to be used in various situations, guide users through the appropriate decisions and steps to complete a particular analysis and direct planners to related documentation in other sources. The draft handbook will be ready for review in February 1999 and the final product should be available in September 1999.

Public Information Initiative

The US DOT and EPA have launched pilot programs aimed at enhancing public involvement in voluntary behavioral changes to reduce congestion and improve air quality. The primary goal of the project is to build national and local coalitions of public and private organizations geared toward changing attitudes and behavior related to transportation and air quality. The program was pilot tested this summer in three areas including one medium-sized area, Dover, Delaware. The program may be expanded to as many as 12 cities in the 1999 ozone season depending on the evaluation of the pilot projects.

Basic Guide To Conformity

Transportation Conformity A Basic Guide for State and Local Officials as the title implies was not designed for planning agency staff. However, this 22 page document is a very good primer on transportation conformity issues and is well suited for folks who have not faced conformity issues in the past. Though is doesn't provide detail descriptions of the many nuances of the transportation conformity regulations is does define the key terms, list actions subject to conformity, explain roles and responsibilities and provides a cursory description of other basic conformity issues.

Conformity Reference Guide

The FHWA is developing a *Transportation Conformity Reference Guide* designed to facilitate compliance by State and local agencies with the transportation conformity requirements. The reference guide is not intended to be a "cookbook" on how to work through the transportation conformity process nor does it prescribe how to make a conformity determination. It is instead a manual that contains transportation conformity rules and relevant preamble language, questions and answers, and resource lists. Designed to be useful to both seasoned practitioners and conformity novices alike the guide is organized according to the transportation conformity provisions that apply to all nonattainment and maintenance areas followed by requirements

specific to certain pollutants or designations. It is anticipated that the guide will be available in late 1998.

Interagency Consultation: The Key Toward Collaborative Decision -Making

Based upon a review of interagency consultation processes from across the nation, the FHWA has compiled successful examples of state and local agencies and their efforts to improve the transportation conformity process. Findings of this report suggest that interagency consultation if performed early in the metropolitan planning process may result in better state and local decision-making at the regional level.

Research

A number of research efforts are either currently underway or will begin shortly that address various aspects of the air quality and transportation linkage. These projects range from basic research regarding the source and nature of particulate pollution to the specific analytic needs of small and medium-sized MPOs. The large number of related efforts prohibits inclusion of them all, however a select few of the most relevant are briefly described.

MOBILE Emission Factor Model

The EPA's highway vehicle emission factor model, MOBILE, provides average in-use fleet emission factors for VOCs, CO and NOx. It is used by States (except California) and other local and regional planning agencies in the development of emission inventories and control strategies for SIPs and in the development of environmental impact statements (EISs). The EPA is currently working on a major update to the model, MOBILE6, which is scheduled to be released late in 1999. Revisions to MOBILE6 include: Facility-based emission factor estimates (different average emissions for different roadway types, even at similar average speeds), "real-time" diurnal emission factors; updates on the effects of oxygenated fuels on CO emissions, separation of "start" and "running" emissions, to permit more precise temporal and spatial allocation of emissions; updates to many other parameters based on new data. It is likely that the development of the next version of EPA’s particulate emission factor model, PART5, will not begin until after the revisions to the MOBILE model are complete.

Quantification of Impacts of Seasonal and Episodic Public Education Programs

The cooperative agreement between FHWA, California Air Resources Board (CARB) and U.S. EPA seeks to gather the necessary information to develop emission reduction quantification guidelines for episodic and seasonal education programs. The project will provide sets of quantification methodologies, using both state-of-the-art tools and less costly approaches, to local jurisdictions involved in such programs. Development of such standard quantification techniques should remove the need for state and local governments to design their own unique methods for each program.

National Cooperative Highway Research Program (NCHRP)

An extensive list of NCHRP research projects related to the topic of transportation and air quality are in various stages of completion. One example is NCHRP Project 20-7 which has allocated $100,000 to track the evolution of the regulatory development associated with the new NAAQS for ozone and $PM_{2.5}$ and to keep the state departments of transportation informed. Other examples include the following: *NCHRP Report 394, NCHRP Project 25-15, NCHRP Project 25-11, NCHRP Project 25-14, NCHRP Project 25-17, NCHRP Project 25-18* and *NCHRP Project 8-33.*

Conclusions

EPA's overall strategy and time line for implementing the new ozone and PM standards thus far appears to be consistent with its billing as a "common sense" approach. However, we all recognize that the "devil is in the details" which with regard to these revised standards are yet to be developed. The best guidance available at this point for planners is to stay informed of the evolving regulatory process at the national level and proactively seek to be involved at the local level. If the recent past is a good indication then the bureaucratic and analytic burden will continue to increase on transportation planners as they contribute to efforts to solve the nation's air pollution problems.

It is premature to offer anything more than general expectations of the extent to which the new and revised standards will impact the number and size of nonattainment areas. However, it is instructive to note that the vast majority of the 16 small and medium-sized ozone nonattainment areas have a population in the tens of thousands or even 100's of thousands. However, the opposite is true of the PM_{10} nonattainment areas most have a population of less than 50,000. This agrees with other data that suggest that ozone has been predominately a large urban area problem and PM_{10} has had a greater impact in smaller urban and rural areas. These differences are primarily due to the nature of the emissions that cause the pollution problems. A large portion of PM_{10} emissions are from windblown dust and reentrained dust due to agricultural operations or driving on unpaved roads while ozone precursor emissions are often from the operation of engines and commercial establishments. Though the science is still lacking with regard to $PM_{2.5}$ some data indicate its impacts may be a "hybrid" of ozone and PM_{10} resulting in both large and small urban areas being designated as nonattainment for $PM_{2.5}$(14).

Finally, in the short term it appears that the new standards will have little impact. However, the medium to long term impacts of these changes on the planning processes and the analysis techniques employed by small-medium size areas is not yet clear. It does appear that the changes in the ozone and particulate matter standards will result in numerous new nonattainment areas, some of which will likely be small or medium-sized areas.

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Session #6

Rules, Roles, and Responsibilities in Transportation Planning and Air Quality: One State's View

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ABSTRACT

The Clean Air Act Amendments (CAAA) of 1990 and the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 are a pivotal moment in transportation planning in the United States. In 1997 the U.S. Environmental Protection Agency revised both the ozone standard and the small particulate matter standard to be more stringent. In 1998 congress is poised to reauthorize the ISTEA. The paper is written from the point of view of North Carolina which operates and maintains the largest state maintained highway system in the United States. North Carolina also has seven counties classified as maintenance for one or more criteria pollutants. The new ozone standard impacts North Carolina more heavily than any state, other than Ohio.

This paper examines the changes in transportation planning since 1990 and examines potential effects of recent changes to the ozone and fine particulate matter standard and what effect they might have on transportation planning. After discussing these issues the paper then presents a number of actions and strategies to allow States and MPOs to effectively deal with the new regulations. These strategies are based on experience in North Carolina since 1990.

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Rules Roles and Responsibilities for Transportation Planning Air Quality: One State's View

The Operating Environment of State and Local Transportation Agencies has changed dramatically since 1990. These changes resulted from passage of the Clean Air Act Amendments of 1990 (CAAA90) and the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). Transportation Planning is on the brink of more changes that will be as extensive as those that have taken place since 1990. By drawing on recent events this paper attempts to extrapolate from current events to the future and to develop some strategies for small and medium sized urban areas to utilize in coping with the new ozone standard and the new fine particulate matter standard.

The Rules: Setting the Stage

The Clean Air Act Amendments of 1990 and the Intermodal Surface Transportation Efficiency Act of 1991 reshaped the environment of transportation planning in the 1990's. The CAAA90 was a landmark in environmental legislation. A number of its provisions directly or indirectly affected transportation planning. One goal of CAAA90 was to ensure that transportation planners and Air quality planners worked together to meet health and mobility goals in nonattainment and maintenance areas. ISTEA was the first post Interstate highway transportation legislation. ISTEA reflects the belief that in many areas the transportation infrastructure is either fully in place or nearly so. ISTEA reflected this belief and placed emphasis on system connectivity, system completion, and financial flexibility between major funding categories. ISTEA also strengthened the relationship between transportation planning and Air quality planning.

The Clean Air Act Amendments of 1990

Several provisions of the CAAA90 directly or indirectly effect transportation planning. The three most important of these provisions were: classification of nonattainment areas, the requirement for 15% reduction in volatile organic compounds (VOCs) by 1996, and the conformity provision.

Congress realized that not all nonattainment areas had air quality problems of the same severity and that areas with more severe nonattainment problems required longer lead time to implement the controls needed to meet the standards. This led directly to the development of a multi-tier classification system with the severity of the problem ranging from marginal to moderate to serious to severe to extreme for ozone and from moderate to serious to severe for carbon monoxide. Deadlines ranged from 1993 for marginal ozone areas to 2020 for extreme ozone nonattainment areas.[1]

In light of the then current air quality control regime focusing on volatile organic compounds congress placed a requirement on all moderate and above ozone

[1]The Los Angeles area is the only area classified as extreme for ozone.

nonattainment areas to reduce emissions of VOCs by 15% between 1990 and 1996. This requirement specifically excluded emissions reductions resulting from the federal motor vehicle control program. A special state implementation plan (SIP), detailing the control VOC reduction control strategies, was to have been submitted by 1996.

Section 176(c) of the Clean Air Act, transportation conformity, was significantly strengthened in the CAAA90. Originally conformity had existed to ensure that any transportation control measures included in the state implementation plan were also included in transportation planning and transportation programming. Conformity was revised to require that agencies using federal funds could only implement projects consistent with the SIP in nonattainment or maintenance areas. The practical implications of this change only become evident when considered in the context of the regulations resulting from it. Metropolitan Planning Organizations are given the responsibility of determining whether or not transportation plans, programs, and projects conform to the intent of the SIP. To make a positive conformity finding the following things must be true:

(1) The MPO has used the latest planning assumptions,
(2) The MPO used the most recent emissions model in its analysis,
(3) The MPO has consulted with other agencies in an agreed upon manner,
(4) Any transportation control measures included in the SIP are being implemented on schedule,
(5) Estimated emissions from the transportation system are less than or equal to the emissions anticipated in the SIP.

If the MPO cannot make one or more of these statements it cannot make a conformity determination. If an MPO cannot make a conformity determination only two strictly limited classes of projects (previously conforming and exempt) may proceed. The MPO must make a conformity determination on its transportation plan at least every three years or every time the transportation plan is amended. A conformity determination and USDOT conformity finding is also required upon adoption or amendment of a local transportation improvement program and before a NEPA document is completed on a transportation project.

The conformity determination for the transportation plan also must cover the full twenty year design period of the fiscally constrained transportation plan while an attainment SIP or Air quality maintenance plan is only required to cover a ten year period. This SIP/Long Range Plan (LRP) mismatch causes significant problems because the LRP often includes ten or more years of population and employment growth not considered in developing the SIP. The motor vehicle emissions budgets in the SIP remain effective for the full twenty years of the transportation plan; however, additional emissions reductions or controls on motor vehicles only come from improving vehicles or improved travel efficiency. Additionally the MOBILE emissions model currently does not consider vehicle improvements beyond 2020. In order to comply with the federal requirement for 20 year transportation plans many MPOs are making population and employment projections to

2025.

The Intermodal Surface Transportation Efficiency Act

ISTEA also played a major role in shaping transportation planning in the 1990's. ISTEA shifted the balance of power between modes of transportation and between states and metropolitan planning organizations. ISTEA also began the shift from completing the interstate highway system to maintaining and managing the existing transportation infrastructure.

The 3-C (cooperative, comprehensive, and continuing) planning process has long been the cornerstone of urban transportation planning. ISTEA strengthened the requirements of the 3-C process and changed the dynamics of the relationship between metropolitan planning organizations and state transportation agencies. More responsibility and power were given to the MPOs. However, without adequate staffing or agreement with the state transportation agency this authority was difficult to exercise. Few small MPOs had the staff or budget needed to meet the planning requirements. Perhaps the four most important changes were: 1) imposition of fiscal constraint on long range transportation plans and local transportation improvement programs, 2) imposition of a mandatory 20 year design horizon for LRPs, 3) imposition of mandatory three or five year reviews of the LRP, and 4) a direct tie to section 176(c) of CAAA90. In addition to these items the metropolitan planning regulations developed from ISTEA required a substantial investment in public involvement procedures intended to solicit input from traditionally under served groups. ISTEA also required explicit consideration of 16 planning items.

Where are we and how did we get here?

In 1990 North Carolina had seven counties newly classified as nonattainment for one or more pollutants. However, the transportation planning community had little or no relevant experience dealing with either state air quality implementation plan development or with conformity. Transportation related air quality analysis of transportation projects consisted mostly of the carbon monoxide (CO) hot spot analysis required in the NEPA process. By 1998 all seven of North Carolinas nonattainment areas had been redesignated as maintenance for all pollutants. We also had a well developed but under-documented interagency consultation process. We are also suffering the effects of our earlier inexperience and inattention to Air quality related issues. The transportation planning community had been working almost continuously on conformity issues in the seven maintenance areas to the detriment of good transportation planning.

There are a number of things that we, in North Carolina, have done well since 1990. All of our nonattainment areas are now maintenance areas. We have a regular, routine, and growing interagency consultation process. This process is building bridges between agencies and bringing issues to light. We are also participating in policy debates as fully as time and staff permit. We routinely educate our staffs and our decision makers on air quality issues.

There are also a number of things that we need to do better. In our haste to get out from

under the pall of nonattainment we and the State Air agency excluded the MPOs from realistic input into the SIP process. We have had a number of conformity lapses. Most have resulted from administrative problems. However, Charlottes lapse is real, has lasted for over a year, and may continue for quite some time.

Charlotte's conformity lapse is related to our earlier inexperience with Air quality issues and the effects of the mismatch between the time frames of the SIP and the Long Range Transportation Plan. On December 15, 1994 North Carolina's Department of Environment and Natural Resources submitted an ozone maintenance demonstration for the Gaston-Mecklenburg ozone nonattainment area. That submission contained initial highway mobile source emissions budgets substantially higher than the highway mobile source emissions budgets submitted to USEPA on May 23 1995 and approved July 5, 1995. The change in emissions budgets resulted from NCDENR's desire to correct an error in the method they had used to estimate vehicle miles of travel in the earlier submission. We have been unable to effectively engage USEPA in our consultation process. Also our relationships with our FHWA and FTA regional offices have been poor for several years. At the same time, we and our MPOs are also struggling with our new, more equal, relationships.

The Revised Ozone Standard, the New Particulate Matter Standard, and TEA-21

The transportation planning community was not effectively engaged in the environmental changes that took place in the early 1990's. Recently a number of events have taken place that may cause even more changes in our work environment. East of the Mississippi the ozone transport assessment group (OTAG) has completed its work and EPA has issued a SIP call requiring NO_X reductions for member states based on the modeling done for OTAG. In 1997 President Clinton issued a presidential directive on new ozone and particulate matter standards. Finally Congress has just completed a new transportation bill entitled The Transportation Equity Act for the 21st Century (TEA-21). Each of these events will have some effect on transportation planning.

Regional Ozone Transport

The ozone transport assessment group (OTAG) was created as a response to assertions by states in the northeast that they could not meet the one-hour ozone standard because of transport into their areas from the Midwest and southeast. A total of 37 States and the District of Columbia participated in the OTAG modeling effort. The result of the OTAG process is a requirement for an average 22% reduction in NO_X from the 22 upwind states[2]. Generally, mobile source emissions are not a significant part of regional transport. However, state Air agencies have discretion as to which NO_X controls to implement. In

[2]Alabama, Connecticut, District of Columbia, Delaware, Georgia, Illinois, Indiana, Kentucky, Massachusetts, Maryland, Michigan, Missouri, North Carolina, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Virginia, Wisconsin, and West Virginia.

the past emissions control strategy has often meant that Air agencies depended upon emissions reductions provided by the federal motor vehicle control program rather than seeking new stationary source emission reductions. State and local transportation agencies, especially those in the East, must monitor this issue and participate in SIP development. Failure to monitor the OTAG SIP process may result in unanticipated and perhaps unrealistic measures to control transportation related emissions and unforeseen future problems.

The New Ozone Standard

USEPA began the process of revising the ozone standard in response to a lawsuit by the American Lung Association and others to force a reevaluation of the ozone standard based on new scientific data. Ultimately the debate over the new standard was resolved by President Clinton's July 16, 1997 Presidential directive on the new ozone and particulate matter standards[3]. The result was to develop an ozone standard based on the 8-hour average ozone value for a day. The standard is set at the fourth highest day of the year with a value of 0.08 parts per million. The design value will be taken as the fourth highest day during a three year period. The new ozone standard will affect between 250 and 350 counties nationwide. We can expect the number of people living in nonattainment areas in the United States to increase from approximately 75 million to approximately 120 million. USEPA is required to begin designations under the new ozone standard by 2000. The designations will be based on three years of data. After areas are designated as nonattainment they have until 2003 to submit SIPs demonstrating attainment.

Transitional Status

A significant innovation created by the new ozone standard is the transitional ozone area. Under some fairly broad guidelines a state can opt to declare its anticipated ozone nonattainment areas as transitional and submit SIPs for those areas before 2000. In exchange for providing early emissions reductions transitional areas conformity and new source review rules will be relaxed and simplified in transitional areas. However, these rules will not be complete until mid to late 1999 and SIPs for transitional areas will need to be approved by December 2000.

Transportation Conformity in Rural Areas

Conformity is coming for rural areas. The concept of nonattainment areas as being congruent with political jurisdictions is slowly eroding. Gradually this concept is being replaced by the concept of an area of violation and area of influence. An area of violation is an area in which a violation of the standard occurs. The area of influence is the area who's sources contribute to the violation of the standard. While the area of influence concept was not implemented in discussions of the new ozone standard the standard itself will bring nonattainment, and conformity, to a new class of area: the rural nonattainment

[3]Three States (Michigan, Ohio, and West Virginia) are suing USEPA over implementation of the new standards because the Clean Air Scientific Advisory Committee (CASAC) was split in its recommendation for a new ozone standard.

area. EPA's preliminary data for North Carolina shows approximately 20 counties that could be classified as nonattainment for ozone under the new standard. Of these 20 counties approximately half contain no major urban area. These areas pose a significant dilemma for transportation and Air quality planners. As yet no one has addressed the following issues: who is the responsible state or local authority, who performs the conformity analysis, what tools and methods will be used for conformity, and just what does conformity mean in a rural area.

Who is the responsible state or local authority?

In the past, Air quality problems were limited primarily to urban areas with populations greater than 50,000 and well established transportation planning processes. These processes were run under the umbrella of the MPO and the MPO policy board was given the responsibility for making the conformity determination with a USDOT concurrence required to ensure that all the requirements were met in a reasonable fashion. No similar process exists for rural areas. Because counties in North Carolina have no responsibility for providing transportation services this responsibility likely will fall to the Board of Transportation unless some new entity is required either by TEA-21 or by the revision of the conformity regulation necessitated by the creation of rural nonattainment areas. However, other states with county transportation departments will have to come to terms with this issue.

A new requirement in TEA-21 is that of a statewide transportation plan with a twenty year planning horizon. While the regulation for the statewide transportation plan has yet to be written it is likely that USDOT would require that the statewide transportation plan be fiscally constrained while USEPA will likely require that this plan be the basis for transportation conformity in rural areas[4].

What tools and methods will be used to prove conformity in rural areas?

The transportation activity side of conformity relies on the four step travel demand modeling process for the basis of its analytical rigor. While travel demand models work reasonably well for urban areas they may not work at all well, or be appropriate for rural areas. Their quality is secondary to the fact that most rural counties have neither a transportation planning process nor a travel demand model. USEPA and USDOT are looking at some alternatives in their proposal for transitional ozone areas. However, it is not certain that the benefits of becoming a transitional nonattainment area outweigh the risks associated in declaring oneself nonattainment earlier than necessary.

What does conformity mean in a rural area?

The concept of conformity in a rural area has to be defined. The current understanding of conformity is that in urban areas there is some trade-off between transportation modes. Conformity also assumes there is a direct relationship between mobile source emissions and violations of the NAAQS. These assumed relationships may or may not exist outside

[4]Staff Paper for Transportation Conformity in Transitional Ozone Areas. USEPA July 28

of urban areas.

The New Particulate Matter Standard

At the same time as the ozone standard was revised the particulate matter standard was changed in two ways. First, the PM_{10} standard was relaxed. Second, a new $PM_{2.5}$ standard was promulgated. The $PM_{2.5}$ standard is set at the lesser of a daily average of micrograms per cubic meter per year or a one-day maximum of 65 micrograms per cubic meter. USEPA will not begin designating $PM_{2.5}$ nonattainment areas until after a national $PM_{2.5}$ monitoring network is in place. This network is scheduled for completion by 2002. EPA will make $PM_{2.5}$ designations between 2002 and 2005 with PM SIPS due by 2008.

Fine particulate matter has traditionally been a problem in the West rather than the east. However, development of the new fine particulate matter standard of 2.5 microns may change that assessment. PM_{10}, the fine particulate matter benchmark, is often a product of incomplete combustion, or of mechanical action, or the re-entrainment of fine dust into the atmosphere. $PM_{2.5}$, the new standard, represents a particle smaller than a red blood cell. These particles are not the product of mechanical action but are aerosols formed by chemical combination. Little information on speciation or source apportionment is available for $PM_{2.5}$.

Until the $PM_{2.5}$ standard was promulgated in 1997 there was not a reliable reference monitoring method. The primary tool for estimating mobile source emissions of fine articulate matter is similar to the MOBILE series of emissions models. This model considers primarily the effects of diesel engines and re-entrained dust. Further, we do not really know the composition of $PM_{2.5}$. Before state Air agencies can effectively develop emissions inventories and control strategies they will need to develop an understanding of what the components of $PM_{2.5}$ are and where they come from.

TEA-21

The Transportation Equity Act for the 21st Century will bring a new series of regulations to replace existing regulations. While the authorization ceiling is much higher, the emphasis is shifting from completing the transportation system to managing the system in place.

Global Warming

The federal and state environmental agencies, and the environmental groups are looking beyond ozone and fine particulate matter to global warming. The Kyoto Conference of 1997 and the United Nations Report on global warming have given them a map to their next issue. The key provision of the Kyoto Treaty is to stabilize greenhouse emissions at or below 1990. While the United States Senate may not ratify the Kyotto Treaty there will be considerable pressure to implement its provisions. Transportation is a major user of energy. In North Carolina approximately 28 percent of greenhouse gases come from

the transportation sector[5]. Furthermore greenhouse gases are products of clean combustion as opposed to "traditional" pollutants that are caused by incomplete combustion. As a major use of fossil fuels the transportation sector will be asked to reduce its fuel use and emissions.

Strategies

Early in the 1990's the transportation planning community was caught napping by the Clean Air Act Amendments and by the Intermodal Surface Transportation Efficiency Act. We have been reacting to events ever since. Few areas have successfully integrated conformity and Air quality planning into transportation planning. We must do better in the future. We cannot react to events. We must anticipate events and act proactively. The following strategies are intended to allow us to be proactive. Table 1 provides an example of useful methods and the strategies to which they apply.

Educate

Transportation professionals must educate several groups. In no particular order we must: educate ourselves, our decision makers, environmental agencies, and the public.

Transportation planners need to become conversant with new aspects of public policy. It is not enough to understand the thirtieth highest hour, or the K and D factors, or how the funding process works, or the percentage of people that will use a new high occupant vehicle lane. How do these things effect air quality? How does the state Air agency put together the state implementation plan? What is the technical and scientific basis for Air quality standards, problems, and proposed solutions? When and who is going to be sitting at the table when new nonattainment areas are designated? Are you or your MPOs getting realistic input into the SIP development process? Are the MPOs taking the opportunity to provide input? Do they know something that you do not? It is a mistake for state agencies to cooperate amongst themselves to the exclusion of the MPOs.

Most decision makers are poorly prepared to deal with Air quality issues. Yet these are the same people who will be required to assess the information provided by technical staff and make a conformity determination. The environment is important to them; however, the mobility needs of the public are also important to them. They will look to transportation planners to provide reliable information on the issues. Air quality is so complex that more than one exposure is needed to assure understanding.

State Air agencies must also be educated. State Air agencies are primarily interested in maintaining public health by protecting Air quality. Transportation agencies are primarily concerned with maintaining the public's mobility and the economic vitality of the area. While Air quality planners may be engineers they are generally unaware of the limitations of transportation data or the political process of transportation planning. Even simple

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[5] *The North Carolina Greenhouse Gas Emissions Inventory for 1990.* Department of Geography and Planning Appalachian State University, Boone North Carolina. August 1996.

terms may have different meanings in the transportation planning context and the Air quality planning context. For example transportation planners tend to think of speed as either spot speed or corridor level speed while Air quality planners are concerned with average trip speed. Without defining terms communication is doomed to failure.

One tactic that we have found useful is for the State transportation agency and the State Air agency to develop a joint presentation explaining Air quality for the public and decision makers.

Research

We simply need to know more. USDOT's strategic goals statement for Air quality lists research as a need. One goal of the Clean Air Act Amendments of 1990 and the ISTEA was to force improved technology. The requirement to assess the Air quality effects of every project in the transportation plan is beyond the scope of most travel models and the EPA MOBILE emissions model used today. We need methods to assess the effects of transportation control measures, system operational improvements, and other projects that have been within the error (") of the models. We need to develop methods to better quantify the effects of travel demand measures. We need tools to model NO_X emissions. We need to improve the linkage between travel demand models, emissions models, and atmospheric dispersion models. We need significant amounts of research to determine transportation's share of $PM_{2.5}$.

Monitor

It is critical that transport agencies, at all levels, expend the effort to monitor Air quality related events. While this appears paranoid no other group will protect mobility interests. Activities performed by others have direct, and lasting, effect on our ability to meet the mobility and quality of travel needs of the public. The state Air agency develops emissions budgets apportioned to source categories. Ultimately these emissions budgets determine the activity levels of both stationary and mobile sources, and the stringency of controls placed on the source categories. The natural tendency of a state Air agency is to bank the emissions reductions that have traditionally come from mobile sources and not tackle new controls for significant existing and new stationary sources. The level of the emissions budgets and the stringency of controls ultimately determines the MPO's ability to make conformity.

Communicate

Communication is critical in making the conformity process work. The entire purpose of the interagency consultation process is to foster communications. It is important to develop both formal and informal channels of communications. Formal communications are needed to insure adequate information flow to reach decisions. Informal channels can build understanding and trust between agencies. Both aspects are needed. There are several distinct communities each of which has a distinct language and culture. The purpose of communications is to allow information to pass easily across the boundaries of these groups.

In North Carolina we have had reasonable success with our communications process by having face-to-face meetings on a regular basis. All MPOs with Air quality problems are invited, NCDOT staff, Division of Air Quality staff, FHWA Division Staff, and occasionally environmental organization staff attend. EPA staff, FHWA and FTA region staff and distant MPOs are encouraged to attend electronically. Meeting notes and a list of attendees are distributed to almost fifty people. Using this model, we are integrating our MPOs into to process of developing the interagency consultation process and conformity SIP.

With each other

Perhaps the most neglected aspect of communications is communicating with one another. Each of us knows what goes on in our own states or MPOs. However, most of us do not know much about what goes on in other states or in nearby MPOs. For example events in Atlanta significantly affect transportation planning and conformity throughout the southeast, and to a lesser extent throughout the nation. Yet few professionals outside Georgia have a clear understanding of the events that have transpired during their conformity lapse, or of the agreements affecting us that have been made to resolve Atlanta's conformity lapse and the dispute over previously conforming projects. For example, as a result of Atlanta's conformity lapse USDOT and USEPA intend to develop a memorandum of agreement on how to handle conformity lapses (including previously conforming projects and exempt projects). Such an agreement will probably give more control of the transportation planning process to USEPA .

With federal agencies

Communicating with federal agencies is very important but can be difficult. It is important because federal agencies have the responsibility to comment on and approve conformity findings. It is difficult because federal agencies are often located at some distance from events and do not have the same perspective or knowledge of events as state and local officials. Good relations and communications with one level of the agency does not guarantee good communications with other levels of the same agency. The diversity of federal agencies demands innovative techniques. It is important in some cases to approach upper levels management. Other times it is important to include people in meetings, even if only electronically. Because of limited travel budgets we have found federal agencies are comfortable with this concept.

With Air agencies

State and local Air agencies are our partners and counterparts in the transportation planning Air quality planning process. We must talk with them. Developing both formal and informal channels of communications is very important.

Table 1: Tools for Implementing Proactive Strategies

	Applicable Strategy			
Tool	Educate	Research	Monitor	Communicate
Telephone Trees	X			X
Internet Sites	X	X	X	X
Regular Meetings	X		X	X
Conference Calls			X	X
Written Procedures	X			X
Speakers Bureaus	X			X

With the public

Some consider communications with the public obligatory nuisance. However, the public is our ultimate customer. We need to provide them with as much information as possible so that they can understand the issue, and participate in the planning process.

Input Points

As noted earlier it is important to communicate with a number of groups in the air quality and transportation planning process. In order to effectively communicate transportation agencies also need to know when to voice opinions, concerns, and suggestions. This section discusses a number of places during the process at which transportation agencies should provide input.

USEPA is developing the conformity rule for transitional areas now. It is important that transportation agencies provide input in this process in hopes of developing a sensible easily implemented rule. Transportation agencies should also be involved in the decision to opt into transitional ozone nonattainment.

In 2000 and 2003 USEPA and state governors will be designating nonattainment areas for ozone and $PM_{2.5}$ respectively. Because of the significant effect on transportation agencies they should be involved in the designation process.

Transportation agencies should be as active as possible in development of emissions inventories and control strategies. Accurate inventories and projections are critical in development of appropriate control strategies. It is far easier to discuss what are appropriate strategies during their development than to try and change them at the eleventh hour immediately before or after USEPA approval.

Transportation agencies should also participate strongly in development of interagency consultation procedures and state conformity rule development. The interagency consultation procedures work to ensure communications between the agencies. The state conformity rule defines the framework in which state and locally funded projects will be considered.

Conclusion

Once again the world is changing for transportation agencies. Practitioners of

transportation planning need to look not only to the act of the play but to the act beyond that as well. We also need to utilize the lessons that we have learned at so much cost in the past few years.

First transportation agencies must develop in house expertise on significant new problems. In most cases, particularly at state DOT level, it is no longer acceptable for Air quality related policy issues to be handled on a part time basis or as a collateral duty. Second transportation agencies should develop lines of communications with state and local Air agencies. The goal is to become active participants in the SIP development process. Being an active participant requires more than simply providing information upon request. There is a significant opportunity for transportation agencies to improve their positions in the development of the interagency consultation SIPs that must be revised as a result of the Third set of conformity amendments. Third, transportation agencies need to learn from one another. Fourth transportation agencies should work to resolve the SIP Plan mismatch. Fifth, transportation agencies need to look ahead and develop policy analyses and policy positions on these issues.

Session #6

SPEED AND DELAY PREDICTION MODELS FOR PLANNING APPLICATIONS

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ABSTRACT

Estimation of vehicle speed and delay is fundamental to many forms of transportation planning analyses including air quality, long-range travel forecasting, major investment studies, and congestion management systems. However, existing planning-level techniques do a poor job of estimating the duration and extent of congestion. To improve the state of the practice, a simplified queuing-based model, QSIM, was developed. QSIM incorporates several features including: the use of temporal distributions as a basis for developing hourly traffic estimates; estimation of "peak spreading"; accounting for daily variation in traffic by allowing hourly traffic estimates to vary stochastically; for freeways, the inclusion of a capacity drop after flow has broken down (i.e., after the onset of queuing) to model the growth and dissipation of queues; for arterials, considering the effects of signal density and progression; separate functions to estimate speeds in queuing and free-flow conditions based on relationships developed with microscopic traffic simulation models; use of the concept of highway capacity to determine when traffic operates under free-flow and queuing conditions as well as a basis for estimating free-flow speeds and the extent of queuing on the test link; and estimating delay rather than speed as the predictive variable. (Speed is then developed as a function of delay and free-flow speed.) The model was used to develop a dataset from which a series of predictive equations were developed. The equations use only a few, readily available independent variables. Application of the new procedure shows that under congested conditions, it predicts substantially more delay than do traditional methods. Future work includes field validation of the models and extending them to cover a variety of bottleneck conditions.

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Introduction

Background

Estimating speeds for planning applications has become an important issue for transportation analysts to deal for a variety of reasons, including:

- **Long-Range Transportation Planning.** The foundation of long-range planning is the use of travel forecasting models which predict future traffic on a transportation network as a function of expected changes in land use and demographic patterns. Vehicle speeds on the network are used during the trip distribution and traffic assignment phases of the process.

- **Congestion Management Systems (CMS).** Performance measures are an integral part of a CMS and define the extent of congestion and permit the evaluation of the effectiveness of congestion reduction and mobility enhancement strategies. Thus, performance measures fall into two categories: those that relate to congestion (interference from traffic as it affects systems performance) and mobility (the ability to complete desired trips).

- **Major Investment Studies.** Major investment studies are in-depth investigations of large-scale transportation projects. They are an outgrowth of traditional benefit/cost (B/C) analyses conducted for highway projects but they are usually multimodal in nature. Also, the scope of a major investment study is larger and includes impacts beyond those that strictly accrue to the transportation system (e.g., financing and social issues). In both major investment studies and traditional B/C, determining vehicle speeds for each alternative is essential for:

  1. Estimating travel time savings, which can be half or more of the total transportation-related benefits of the project;

  2. Providing a basis for calculating vehicle operating costs; and

  3. Estimating the externalities of pollutant emissions and noise impacts.

- **Air Quality Planning.** For air quality planning, the MOBILE and EMFAC models require users to provide a variety of inputs, including vehicle speeds for the particular time period being analyzed. Much of the recent research activities in speed estimation techniques have been undertaken to improve the speed inputs to these models. These activities have used the post-processor approach, i.e., refining the speeds that are used to make assignments in travel forecasting models.

For undersaturated (i.e., uncongested) conditions on freeways, existing methods provide reasonable results. However, these methods deal with the consequences of oversaturated conditions by focusing only on specific links or highway segments for the peak hour only. Actually, the queue will not only affect speeds in the peak hour but it will also affect at least the next hour, and maybe more, depending on how long it takes to dissipate. Further, the queue may spill back onto upstream freeway sections that static analyses would indicate have V/C ratios less

than 1.0. In this situation, traditional speed estimation methods will predict higher speeds but in reality these upstream sections are influenced by the queue that has formed downstream of them.

The situation is exacerbated when travel forecasting (network) models are used as the basis for estimating speeds. Within the structure of network models, the basic problem is illustrated in Figure 1. Network models routinely predict volumes well in excess of link capacity due to the way in which the internal algorithms work. While some traffic will be diverted off of congested facilities during the assignment process, it is still common for assigned volumes to exceed link capacities, sometimes by 50 percent or more when future year forecasts are made. (This is shown in Figure 1 as the divergent solid lines.) By definition, it is never possible to observe volumes in excess of capacity in the field; traffic will grow up to the physical capacity at which point flow will break down and a queue will form upstream (backward) from this location. (This is shown at Point A in Figure 1.) If the link is a freeway, prior research has shown that volumes will actually drop to less than capacity after flow has "broken down". Traffic may again build back up on the link due to volumes from intersecting links, but when it hits the physical capacity, a queue will form once again (Points B through D). It is precisely this condition that the speed estimation procedure developed here addresses.

In addition to the recurring congestion problem, the effect of incidents on speeds has not been addressed in the preparation of emissions inventories. Nonrecurring congestion accounts for 40 to 70 percent of all congestion in urban areas (Ref. 1). However, no methods have been developed to estimate what effect nonrecurring congestion has on speeds for air quality purposes. Addressing nonrecurring congestion's effects on speeds is not within the scope of this paper.

Requirements of Speed Estimation Procedures for Planning Applications

Based on the preceding discussion, speed estimation procedures for transportation planning applications should have the following characteristics:

- **Ease of use.** The procedure should be able to be applied in a simple fashion and require only a few, easily obtainable input data items. Ideally, the data items should be generally available to planners or collected as part of routine planning studies.

- **Consideration of traffic variability.** Traffic demand on a facility varies substantially day-to-day. For strictly recurring congestion, this means that for facilities that *on average* operate close to capacity, some days will see demand volumes in excess of capacity while others will operate below capacity.

- **Consideration of saturated conditions.** Nearly all of the highway capacity research to date has focused on parameters (speed, flow, and density) for unsaturated traffic conditions (the so-called "stable flow regime"). However, a major concern of practicing engineers and planners is what occurs after oversaturation (i.e., standing queues)[1] has occurred.

- **Use of *HCM* concepts and methods as a foundation.** The *HCM* provides a useful starting point not only because it is widely accepted but the delineation of capacity

[1] For the purpose of this research, the terms "oversaturation" and "congestion" are used equivalently and indicate what traffic engineers call "forced flow", that is, the traffic flow that occurs after capacity is exceeded (Level of Service F).

divides the two flow regimes (stable and unstable). Also, because many factors go into the determination of capacity (e.g., lane width and truck mix), it can be used as a single surrogate for many other factors influencing speed.

- **Application to travel forecasting models.** Travel forecasting (network) models are used to develop data for air quality estimation as well as many other planning applications. Therefore, the information provided by travel forecasting models should be the basis for the speed prediction procedures.

Methodology

The research presented here is an extension of three Federal Highway Administration (FHWA) projects (Refs. 2, 3, and 4). These studies were concerned with estimating the cumulative effects of congestion on vehicle speeds over the course of an entire day. Because most analytical methods consider only the effects of peak hour congestion (such as V/C ratio), a new measurement of daily congestion was used: the Average Annual Daily Traffic-to-Capacity (AADT/C) ratio, where capacity is the two-way capacity. For reference, the AADT values that result from various AADT/C ratios for typical situations are provided in Table 1.

A simple macroscopic simulation model was developed to study the effects of queuing on speeds. This model, named QSIM, was developed to integrate results obtained from simulation runs for congested and uncongested conditions and to produce estimates of the overall effect of AADT/C on average delays due to congestion over the course of a year. QSIM analyzes the effects of temporal variations in traffic and queuing on an hour-by-hour basis for weekdays and for weekends/holidays. Weekday travel is analyzed separately in each direction--the "home-to-work" peak direction, for which the peak occurs in the morning, and the "work-to-home" direction, for which the peak occurs in the afternoon. Both freeways and signalized arterials are considered by QSIM. Unsignalized streets were also considered by the study, but were not modeled with QSIM. Figure 2 shows the operation of QSIM and the subsequent analysis that was performed.

Set Test Section Capacity

The procedure starts by defining a test section for QSIM to analyze. The capacity of the section is determined using *HCM* procedures. For the research reported herein, the following basic capacity values were used:

- Freeways – 2,300 pcphpl, based on the 1994 *HCM* for 6+ lane facilities; and

- Signalized Arterials – 900 pcphpl, based on the *HCM's* saturation flow rate of 1,800 pcphpl and a 50 percent green time.

The test section length is also set at this time; this is a key factor in QSIM as the speed and delay of vehicles are measured over the length of the section. For this study, segment length was fixed at 1.5 miles (7,920 feet) for freeways. For signalized arterials, the length of the segment is equal to the signal spacing. Setting a variable segment length for arterials is believed to capture the effect of queuing more realistically than a fixed one. Thus, high signal densities imply a shorter segment length, therefore, a higher percentage of the link will be consumed by queuing.

Temporal Distributions and Peak Spreading

Once the AADT/C level is set, AADT is determined by multiplying AADT/C by the (two-way) capacity. Average Weekday Daily Traffic (AWDT) and Average Weekend/ Holiday Daily Traffic (AWEDT) are determined by applying factors to AADT: 1.0757 for AWDT and 0.8393 for AWEDT (Ref. 3). From these daily volumes, temporal distributions are used to determine "target" volumes by hour (Table 2). Separate distributions exist for freeways and nonfreeways; three AADT/C ratios (AADT/C less than or equal to 7, AADT/C between 7 and 11, and AADT/C greater than 11); and peak direction (morning and afternoon). Direct application of these distributions would lead to problems for AADT/C ratios on the boundary values. For example, the high AADT/C range's distribution is flatter than the middle range; this could possibly lead to predicting congestion in an hour for the middle range while not predicting congestion in the same hour for the high range. Therefore, a smoothing procedure was used as described in Table 3. This procedure accounted for problems at the boundary values and further spread out traffic throughout the day as AADT/C ratios increased above 13. This additional peak spreading feature was deemed necessary since the data for developing the distributions (713 urban ATRs [Ref. 3]) did not have a large number of sites where AADT/C was greater than 13. The formula for smoothing the distributions of AADT/C ratios greater than or equal to 13 is basically a weighted average computation between the actual hourly percentage derived in Ref. 3 and a perfectly flat daily temporal distribution. The first term in the equation represents the weight applied to the actual percentage. The second term is the weight applied to a perfectly flat distribution, which has an hourly percentage equal to (1/48), since there are two directions being considered. An example will clarify the process. For an AADT/C of 14, the "weight" on the actual percentage is 10 and the weight on the "flat" percentage (1/48) is 2. For an AADT/C of 16, these weights are 8 and 4, respectively. Note that the procedure adds volumes to off-peak hours as it subtracts from peak hours. It should be pointed out that this procedure is not based on observed data but has been instituted as a purely mechanical procedure to account for two conditions: 1) counterintuitive results at the AADT/C boundaries of the original temporal distributions; and 2) excessive queuing that would result at very high AADT/C ratios if the temporal distributions were unaltered. This second condition is really the phenomenon of peak spreading.

Stochastic Variation in Traffic Volumes

In order to account for day-to-day variability in traffic flows, QSIM stochastically determines what the test volume in a given hour should be from the "target" hourly volume (determined above) and information on hourly variability (Table 4), where the "target" volumes are the mean of normal distribution and the variance is defined as:

$$\text{Variance} = (\text{Coeff. of Variation} * \text{Mean})^2 \qquad (1)$$

Random sampling is then used to select the test volume from this distribution.

Uncongested Speed Functions

If the test volume is less than the section's capacity, newly developed uncongested speed functions are applied. The uncongested speed functions were determined by running FRESIM and NETSIM in a series of experiments to gauge the effects of various highway and traffic conditions (Ref. 2). The results were then analyzed with multiple and nonlinear regression

analysis to develop equations that predict delay. (Speed was calculated as a function of delay, as described below.) The relationships used were as follows:

Freeways

$$d_{vc} = 4.46\ V/C - 1.55\ (V/C)2 - 0.05\ sff\ V/C + 0.044\ sff\ (V/C)2 \qquad (2)$$

Where: d_{vc} is delay due to congestion in vehicle-hours per 1,000 vehicle-miles; and

s_{ff} is free-flow speed in miles per hour.

Signalized Arterials

$$d_{sig} = (32.6 + 30.0\ (V/C)2)\ (1 - e\text{-}.3n) \qquad (3)$$

Where: d_{sig} is delay in vehicle-hours per 1,000 vehicle-miles; and

n is the number of signals per mile, assuming an "intermediate" signal progression case (see below).

In both of these formulations, delay is the additional travel time beyond that which would result if all vehicles could traverse the section at the free-flow speed. Delay includes not only the time spent sitting at traffic control devices, but also the time lost while decelerating to a stop and then accelerating back to the free-flow speed. The second term of the equation varies between 0 and 1 and is essentially an adjustment factor for the delay due to the V/C ratio; for high values of signals per mile the term is close to 1.

The NETSIM experiments conducted to produce Eq. (3) were based on assuming a "fixed time" scenario in a simple network of multiple signals where zero offsets in the signal timing were used. (All signals in the test network were also assumed to have the same volumes and capacities.) Since the signals were closely spaced, a degree of progression existed within the system. To gauge the effect of progression, a second set of NETSIM runs was made with the same network and data, but this time with "ideal" progression in the study direction. The results show that progression can have a substantial improvement in arterial speeds (Table 5). A method for incorporating progression effects into Eq. (3) is discussed in a later section.

Perform Queuing Analysis

1. **Determine percent of link under queuing**. If test volume exceeds capacity, a queue is assumed to form. For simplicity, the program assumes that the bottleneck point from which the queue builds is at the downstream end of the segment. The program accumulates total travel time on the segment. If the length of the queue exceeds the length of the segment, total delay due to the bottleneck will naturally exceed total delay on the segment itself. (This additional delay can be estimated by increasing segment length.) For freeways, once volumes exceed capacity, vehicles are assumed to move through the bottleneck point at a flow rate less than capacity. Therefore, two basic freeway capacity values are used: 2,300 pcphpl (the new *HCM* capacity for six or more lanes) for unsaturated conditions and 2,000 pcphpl for oversaturated conditions (Ref. 6).

   Queues are estimated for the beginning and ending of each hour. If the demand volume plus any leftover queue is greater than the capacity of the section, the queue at the end of the hour is calculated by:

$$Q2 = Q1 + V - C \quad (4)$$

Where:
- Q1 = queue at the beginning of the hour (vehicles);
- Q2 = queue at the end of the hour (vehicles);
- V = demand (test) volume for the hour (vehicles); and
- C = bottleneck capacity of the section (vehicles).

2. Calculate Queue Speed. For both freeways and signalized arterials, if the V/C ratio is greater than 1.0, queuing is assumed to take place. Queuing will also affect traffic if there is a standing queue at the end of the preceding hour. If travel in the hour under consideration is affected by queuing, the program analyzes the growth (or decline) in queue length over the hour. Vehicle-hours of travel are estimated separately for those portions of the segment that are affected by queuing and those that are not. The approach developed by Dowling and Skabardonis to combine speeds for queued and unqueued conditions was modified for use here (Ref. 3). Their formulation is:

$$\text{Link Speed} = [\text{Queue Speed} * (\text{Queue Length}/\text{Link Length})] + [\text{Nonqueue Speed} * (1 - \text{Queue Length}/\text{Link Length})] \quad (5)$$

In the current formulation, the speed on the segment is based on estimating total vehicle-hours of travel (VHT) and vehicle-miles of travel (VMT) first, then computing speeds as VMT/VHT; this avoids the computational problems of the Dowling and Skabardonis approach. VMT and VHT are tracked separately for queued and unqueued portions of the test segment:

$$VMT = \{(UQL * DVOL) + (AQL * CAP)\}/5280 \quad (6)$$

Where:
- UQL = length of the segment that is not queued, in feet;
- DVOL demand volume for this hour (determined stochasti-cally from the temporal distributions), in vehicles;
- AQL = average queue length during the hour, in feet; and
- CAP = the bottleneck capacity, in vehicles.

The first term counts the number of vehicles that are entering the segment at the back of the queue. When the entire segment is consumed by a queue, this term becomes zero. The second term counts the number of vehicles in the queue that are processed through the bottleneck. Queue length is found by multiplying the number of queued vehicles by the calculated queue spacing (Equation 8).

$$VHT = (UQL * DVOL * UQDEL) + (AQL/QSPACE) \quad (7)$$

Where:
- UQDEL = unqueued delay, in hours per vehicle-foot, calculated using the uncongested delay function; and
- QSPACE = spacing of vehicles in the queue, in feet per vehicle = Queue Speed/CAP. (8)

The first term is the number of vehicle-hours experienced by vehicles on the unqueued portion of the segment. The second term calculates the number of vehicles that (on average) are in the queue during the hour. Note that QSPACE depends on the assumed queue speed, which for freeways was determined empirically from freeway data to be 15.5 mph (Table 6). For arterials,

queue speed was determined analytically as capacity (vehicles per hour) times vehicle spacing (feet per vehicle) and is roughly 8-9 mph. The second term is equivalent to estimating queued VHT (QVHT) as a function of queued VMT (QVMT) and queue speed:

$$\text{QVHT} = \text{QVMT/Queue Speed} \tag{9}$$

Letting:

$$\text{QVMT} = \text{AQL} * \text{CAP (the second term in Equation (6)), and}$$
$$\text{Queue Speed} = \text{CAP} * \text{QSPACE},$$

produces:

$$\text{QVHT} = (\text{AQL} * \text{CAP})/(\text{CAP} * \text{QSPACE}) \tag{10}$$
$$= \text{AQL/QSPACE}.$$

Note that in the methodology, the traditional speed/flow/density relationships are used. There is some evidence that in the congested (unstable) traffic flow regime these relationships do not apply. Additional microscopic simulation carried out by the authors indicates that the *number of vehicle merging operations over a given space* significantly influences speed, flow, and density (Ref. 7). Vehicle merges are in turn a function of the type of bottleneck and traffic demand. The assumed freeway queue speed of 15.5 mph is felt to be representative of an on-ramp bottleneck, therefore, the current research applies to this situation only. (However, on-ramps are the most common form of bottlenecks in most areas.)

Hourly Speed Estimates

The strategy of predicting delay rather than speed was taken for two reasons. First, it is computationally more efficient because it avoids the calculation of average speeds weighted by volumes. Second, it allows the inclusion of multiple sources of delay (such as delay attributable to grades and curves) in the final speed estimation. Since delay is defined as the time that is experienced by vehicles in excess of what it would have been at the free-flow speed, the final speed on the segment can be computed as:

$$S = \frac{1}{\frac{1}{S_{ff}} + \frac{\text{Delay}}{1000}} \tag{11}$$

Where: S is overall average speed, reflecting the combined effects of all sources of delay;
Sff is free-flow speed; and
Delay is the sum of delay from all sources (including congestion) in hours per 1,000 vehicle-miles, as computed above.

QSIM *Output Data Set*

QSIM completes its analysis for each of 24 hours in a day for the weekday/inbound direction, weekday/outbound direction, and weekend/holiday with both directions combined. The results are stored in a data set and the process is repeated by again randomly determining test volumes for another "day." A total of 1,000 "days" were so treated. From these 1,000 observations, delays and volume-weighted speeds were computed for each hour and test direction. For some

AADT/C levels, the speeds in a particular hour represent a combination of "days" when queuing did and did not occur due to the stochastic determination of test volumes.

Curve Fitting

The data in the tables may be used directly by analysts if desired. However, equations were developed from the data in the tables to facilitate application of the procedure. The curve fitting process was as follows. First, three separate time periods were defined: peak hour, peak period, and daily. Second, three analysis periods were defined: weekday, weekend/holiday, and combined. All hours of a day were used in the daily analyses. The peak period for both freeways and arterials included three hours in the morning (7-10 a.m.) and three hours in the afternoon (4-7 p.m.). This choice is something of a compromise since for high AADT/C levels all six hours will be congested while for low AADT/C levels fewer hours will be congested. Consideration was given to varying the length of the peak period as a function of AADT/C but was dismissed in favor of consistency. From the QSIM output, the peak hour for freeways was between 4 p.m. and 5 p.m. for AADT/C <= 10 and between 5 p.m. and 6 p.m. for AADT/C > 10. For arterials, the peak hour was between 4 p.m. and 5 p.m. Due to the nature of the polynomial models used, *the equations are valid for AADT/C levels up to 18; higher AADT/C levels are very unlikely to occur in practice.*

2. Study Results

Field Validation

A limited amount of field validation was conducted. For uncongested conditions on freeways, comparisons of QSIM's speed function were made against data from the Denver and Orlando freeway surveillance systems. QSIM's uncongested freeway speed function was found to follow the field data closely. For V/C ratios below 0.80-0.85, QSIM has a slight tendency to underpredict speeds while at V/C levels between 0.85 and 1.00 it slightly overpredicts speed.

Validation under congested conditions is more difficult using freeway surveillance data alone. The problem is that QSIM (or any other analytical method) must use the demand volume as input, even if the volume is over capacity. Such conditions are not possible to observe directly in the field since under forced flow, observed volumes will be less than the ideal capacity. A larger problem with using the freeway surveillance data in this manner is the large amount of variation that exists in both speeds and the physical capacity of the section under study. Procedures in the *HCM* would indicate that capacity is fixed. However, several important factors are either not considered in the calculation of capacity or can not be distinguished from our data. In the latter category, the field data in hand do not break out the number of trucks in the traffic stream; only total vehicles are included. Use of a fixed percent trucks in the capacity calculation does not allow for the fact that the observed number of trucks in a given hour can vary. Therefore, even accepting that *HCM* procedures account for every factor influencing capacity, our data will naturally show that physical capacity varies from day-to-day because of the fluctuation in the truck mix. Beyond this, other factors not considered by the *HCM* also may affect capacity. Traffic engineers have observed that when traffic flow approaches the theoretical capacity, it becomes highly sensitive to external influences. Under extremely dense conditions, a single aberrant driver may be all that is needed to shift the traffic stream into forced flow. Other factors that may affect capacity include weather, light conditions, and pavement condition.

The determination of capacity is extremely important for the QSIM model because it uses capacity to determine whether traffic is operating in either the free-flow or forced flow regimes. However, given the problems with capacity noted above, comparisons between the field data (which in effect have a variable capacity) and QSIM results (based on a fixed capacity) are probably inappropriate. To get a more "fair" comparison, QSIM's capacity was allowed to vary stochastically. That is, for each hour of comparison, QSIM was run several times where the capacity value for a particular run was sampled from a normal distribution with a mean of 2,300 pcphpl with a standard deviation of 50 for Denver and 90 for Orlando. The mean value of 2,350 pcphpl was selected using the following procedure. First, daily capacity was assumed to vary both above and below the theoretical capacity. To capture those cases higher than the theoretical capacity, any hours where volume was greater than or equal to the theoretical capacity were identified. For those below, the V/C ratio had to be between 0.9 and 1.0 plus the density of vehicles had to be between 40 and 42 vehicles per lane-mile in order for the data to qualify. (This is the density at capacity suggested by the *HCM*.)

Speeds for each QSIM run were then averaged; these were used as the basis of comparison. On average, the hour-by-hour comparisons showed that QSIM overpredicted speeds by about seven percent. For entire peak periods, QSIM's performance improves: about four percent high on average. Overall, we believe that QSIM's predictions are in line with the field data.

Final Speed Equations

Freeways

Curve fitting for freeways was straightforward. Plots of the data indicated that polynomial forms of AADT/C could be easily fit to the data. The results appear in Table 7 and Figure 3. Not that the minimum speed is equal to the 15.5 mph queue speed used in QSIM. This speed is indicative of the type of bottleneck assumed, namely, an on-ramp. More onerous bottlenecks, such as lane drops and incident-caused lane blockages, would have lower speeds.

The dependent variable in these equations is weighted average hourly delay measured in hours per 1,000 vehicle-miles. For example, consider the Peak Period. The equation for predicting weekday delay (in hours per 1,000 vehicle-miles) is:

$$\text{Delay} = 0.0001732632 * (\text{AADT/C})^5 - 0.0000116968 * (\text{AADT/C})^6 + 0.0000001974 * (\text{AADT/C})^7.$$

Speed is calculated by using the formula:

$$\text{Speed} = \frac{1}{1/\text{FFS} + \text{Delay}/1000}$$

Where: FFS is the free-flow speed.

As a complete example, assume a six-lane freeway with a calculated one-way (*HCM*) capacity (based on three lanes in one direction) of 6,600 vphpl and a free-flow speed of 60 mph. Its AADT is 158,400 vpd; therefore, its AADT/C is: 158,400/(2 * 6,600) = 12.0. Delay for Weekday Peak Period is calculated using the above formula and is 15.2602 hours per 1,000 vehicle miles. Weekday Peak Period Speed (i.e., the weighted average speed for the six-hour period defined as the Peak Period) is:

$$\text{Speed} = \frac{1}{1/60 + 15.2602/1000}$$

$$= 31.32 \text{ mph.}$$

Signalized Arterials

Curve fitting for arterials was far more complex due to the extra influence of signal density, in addition to AADT/C. The same basic functional form was assumed as for the uncongested delay function as described previously. Two separate models were fit from the data with the cutoff point being an AADT/C value of seven (Table 8 and Figure 4).

AADT/C <= 7 (Arterials)

$$\text{Delay} = (1 - e\text{-}.3n) * (NOQ + Q)$$

Where: n = signals per mile;
NOQ = predicted value from the "no queue equations";
and
Q = predicted value from the "queue equations".

For example, consider the Peak Period. The equation for predicting weekday delay for an AADT/C value of 5, free-flow speed of 40 mph, and three signals per mile is:

$$\text{Delay} = (1 - e\text{-}.^{3*3}) * \{32.6326 + (0.27187282 * 5^2) - (0.01054104 * 5^3) + (0.0000288004 * 5^6) - (0.0000013948 * 5^7)$$

$$= (0.59343) * (38.4530)$$

$$= 22.819 \text{ hours per 1000 vehicle-miles.}$$

Speed is calculated by using the same formula as for freeways above, except that a different free-flow speed is used:

$$\text{Speed} = \frac{1}{1/40 + 22.819/1000}$$

$$= 20.9 \text{ mph.}$$

AADT/C > 7 (Arterials)

$$\text{Delay} = (EQ>_7) + \{(1 - e\text{-}.^{3n}) * (NOQ)\}$$

Where: $EQ>_7$ is the predicted value from the "AADT/C > 7" Equations.

For example, consider a segment where AADT/C = 12, free-flow speed = 40 mph, and signals per mile = 4. Delay for the peak period on weekdays is calculated as:

$$EQ>_7 = \{2.789265513 * (12 - 7)\} + \{0.259827 * (12 - 7)^2 * (1 - e\text{-}.^{3*4})\}$$

$$= 13.9463 + 4.5392$$

$$= 18.4855$$

$$NOQ = 32.6326 + (0.27187282 * 12^2) - (0.01054104 * 12^3)$$
$$= 53.5667$$

Therefore:

$$Delay = 18.4855 + \{(1 - e^{-.3*4}) * 53.5667\}$$
$$= 55.9182.$$

Speed is then calculated as:

$$Speed = \frac{1}{1/40 + 55.9182/1000}$$
$$= 12.4 \text{ mph.}$$

Adjustments for the Effects of Progression

All of the QSIM analysis – including its uncongested delay function and the final equations – are based on the NETSIM results for the no-progression case. (This was defined as zero offsets in the timing of the signals in the test networks.) However, as shown in Table 5, progression results in significantly higher arterial speeds. Based on these data, it was observed that progression effectively acts to "reduce" the signal density. That is, with signal progression, the system behaves as if signal density was actually lower. Therefore, the problem was to develop an adjustment factor to reduce signals per mile in the delay prediction equations. The first step in estimating the adjustment factor was to examine the data in Table 5. For each level of signals per mile (6 and 10) and V/C ratio (0.2, 0.4, 0.6, 0.75, 0.85, and 0.95), the uncongested delay function was used to predict speeds. The next step was to add a factor to the signals per mile variable in the $(1 - e^{-.3n})$ term of the delay function to see how close the predicted speed could get to the actual speed under progression. The adjustment factor was varied iteratively until the average percent error was minimized; the factor was found to be approximately 0.167. This value implies that with progression the signal density can be thought of as one-sixth the signal density for no progression. For the high signal densities on which the factor was developed (Table 5), this ratio makes sense. However, for lower signal densities, the authors thought that the ratio was too high. To compensate for this, several mathematical functions were tested to see if the ratio could be lowered for low signal densities while still using the empirical information tested above. The form finally selected was:

$$n' = \frac{2n}{n + 2} \qquad (12)$$

Where:

n' = signals per mile, adjusted for ideal progression
n = actual number of signals per mile.

This functional form produces more reasonable results. For example, at a signal density of 10 per mile, n' is 1.67 which corresponds to the empirical information and at low signal densities n' is also low. However, note that the NETSIM experiments on which the adjustment factor is based (Table 5) are for ideal progression conditions. Also, the original (fixed time) case assumes some degree of progression since signal spacing is relatively small and the timing offsets are zero. One way to think of the situation is to consider that the base models (fixed time) assume intersection arrival flows similar to the *HCM* Arrival Type 3 and the progression case arrival flows similar to

Arrival Type 6. It is left up to the analyst to decide which case is most appropriate for the particular situation being studied. If the analyst believes the progression situation to be less than the pure ideal, but more favorable than the base case, an intermediate value can be chosen. Therefore, the recommendation is to consider progression in some fashion when using any of the delay equations.

3.0 Application of the New Speed Estimation Methodology

Introduction

The new speed estimation methodology is applied to each segment individually. By comparison, many forms of transportation planning analyses are typically based on network (travel forecasting) models where many hundreds, sometimes thousands, of individual links exist. Speeds on these individual links are estimated during the traffic assignment process, usually with some variant of the Bureau of Public Roads (BPR) function. It is believed by many analysts that the speeds resulting from the final assignment are too crude for use in most analyses, especially air quality analysis; speeds are used to achieve realistic traffic assignments (link volumes) rather than to match any observed or theoretical norms. Therefore, many urban areas use a "post-processing" approach where the final assignments and basic link data are used to estimate speeds external to the travel forecasting process. Most areas base their post-processors on standard and well-known procedures, such as the *HCM*, and estimate speeds link-by-link. The purpose of this Section is to show how the new speed equations may be used as the basis for such post-processing of network model output.

Comparisons to Standard Practice

The new speed equations are based on roadway AADT because of its widespread availability. When the QSIM model is applied, AADT is converted to AWDT and Average Weekend/Holiday Daily Traffic (AHDT) depending on the case being studied. The final equations, however, relate AADT/C to speed so the effect of varying traffic on weekdays and weekends/holidays is automatically considered. Output from traffic forecasting models is almost always considered to be AWDT due to the way in which trip generation procedures are constructed. Therefore, analysts should first convert the models' predicted volumes (AWDT) to AADT values. The adjustment factor reported in Section 2 (i.e., the inverse of 1.0757) provides a default value in lieu of locally developed factors.

Freeways

Comparisons were made for both congested and uncongested links on a hypothetical urban freeway section as presented in Figure 5 and Table 8. The so-called "standard practice" scenario is based on applying the original BPR function for V/C < 1.0 and the modified BPR4 function for V/C >= 1.0 as post processors to travel forecasting network data.[2] The reasons for these choices

[2] Original BPR equation speed = $FFS/(1 + (0.15 * (V/C)^4))$

Modified BPR4 equation speed = $FFS/(1 + (V/C)^4)$

Where: FFS = free-flow speed; and
V/C = volume-to-capacity ratio.

are that the original BPR function closely follows the latest freeway speed/flow curves from the 1994 *HCM*, and the BPR4 curve shows a reasonable degradation of speeds for V/C ratios over 1.0. In practice, most agencies would probably use a single function so that the comparison is geared towards what is felt to be the best procedure.[3] The BPR functions and *HCM* procedures are applied on a hourly basis, usually the "peak hour for the peak direction." Because the new speed equations consider both directions simultaneously, the offpeak direction must be estimated separately for the standard practice case. Note that the hourly V/C ratio used for standard practice is based on the K- and D-factors rather than the temporal distributions on which the new speed equations are based. Note also that the volume differences along the hypothetical segment are large and probably would not be found in the field; the authors are using these for example purposes only. Because of the volume difference, two sets of K- and D-factors (derived from HPMS data) are used. The smaller K- and D-factors for the higher congestion case indicates that at least a small degree of peak spreading is accounted for, something that may not normally be done in practice unless states or local agencies also differentiate these factors as a function of volume/ congestion.

The results, as presented in Table 9, demonstrate the implications of using standard practice versus the new speed equations. Considering only the peak hour, the new equations predict lower speeds with the gap between the procedures widening as congestion builds. Additionally, the effect of stochastic variation in traffic from day-to-day is also apparent: for an AADT/C of 9.0, the standard practice peak direction has a V/C ratio of 0.99, right at the boundary between stable and forced flow. The BPR function predicts relatively high speeds because the V/C ratio indicates that speeds are always in the stable regime. In contrast, the new equations do not assume that volumes will be constant from day-to-day for the peak hour, but on some days volumes will be high enough to kick flow over into the unstable regime.

Although not directly compared, the peak period speeds predicted using the new equations are likely to be a lot lower than those predicted using standard practice, depending on how local agencies address other hours around the peak hour. If they assume that the peak period is six hours per day (as assumed by the new equations) and if they also assume that speeds in all of these six hours are equivalent to speeds in the peak hour, then their BPR-predicted peak period speeds will be close, but still consistently higher, than those predicted by the new equations. If they assume a shorter peak period, then the volume (VMT) "exposed" to low speeds is decreased, a potentially important fact for air quality analyses. If they assume lower volumes in hours around the peak, then predicted speeds will increase. Overall, even if state and local planners followed the absolute best practices, they would still predict higher speeds than speeds predicted by the new equations developed by this research.

Signalized Arterials

A similar comparison was conducted for signalized arterials (Table 10). Because the current research verified that signal density is an extremely important factor in determining arterial speeds, the *HCM* (Chapter 11) methodology was considered to be the most desirable "standard practice" for post-processing speeds from network model output. (The BPR4 equation was also applied since it depends solely on V/C ratio and is easier to apply on a network basis.) For the peak hour (both directions), both the *HCM* and the BPR4 equation predict higher speeds than the new

[3] Even if local agencies choose not to apply the new speed equations developed in this research, they should consider using these two post-processor functions for saturated and unsaturated conditions rather than a single function.

equations, although the *HCM* results are closer to the new equation results. At the highest congestion level compared (AADT/C = 13), the predicted speeds for the *HCM* and the new equations are closer due to the nonlinear nature of the *HCM* delay equations. The six-hour peak period speeds predicted by the new equations are very close to those of the (single) peak hour, indicating that speeds are relatively insensitive to signal V/C ratio for the ranges studied. The same observations made for freeways regarding speed prediction for hours around the peak also apply to arterials.

4. Summary of the Research

This research has developed a new procedure for estimating vehicle speeds. From a theoretical standpoint, it has several advantages over other planning methods now in use:

- It is based on predicting the effects of traffic over an entire day by taking each hour in sequence. Hourly volumes are developed using temporal distributions developed from a large (713) set of urban ATRs from around the country. The effects of peak spreading as congestion builds are explicitly accounted for in the distributions.

- Day-to-day variations in traffic are considered by the model. The ATR data were used to determine the variability in hourly volumes. This information was used to vary volumes stochastically within the QSIM model, resulting in a more reliable estimate of speeds than would be obtained if only averages were used. The reason for this is the nonlinear nature of the delay. Consider a volume very near to capacity; this is the average volume that might occur on the facility over the course of a year. Only a small increase in volume will kick the flow over into the unstable speed regime. This effect, which goes unnoticed if the average is used, is addressed by allowing volumes to vary stochastically.

- Uncongested speed functions based on applying the FRESIM and NETSIM microscopic simulation models were developed. The arterial speed function contains a term for signal density, a highly important determinant of arterial speeds. The positive effects of progression are also accounted for by the arterial equations.

- The effects of congestion are incorporated by combining queuing analysis with the hourly volume estimation discussed above. Queues are built and dispersed over time and their effects on speeds are computed. The model uses an assumed speed for queued vehicles on freeways based on extensive data from freeways in Orlando and Denver. Also, a freeway queue discharge rate lower than capacity is used to dissipate queues.

- Both tables and equations are developed that allow the user flexibility in how to apply the research. Equations are developed that predict speeds for both directions on a link for the peak hour (4-5 p.m. for AADT/C <= 10 and 5-6 p.m. for AADT/C > 10), the peak period (7-10 a.m. and 4-7 p.m.), and the entire day. If only one direction is required, the data tables in Reference 4 should be used. Separate equations were developed for weekdays, weekends/holidays, and all days combined, but most analyses will probably focus on the weekdays.

- Based on the above points, the main finding of the research is that under congested conditions (queuing), traditional methods of speed estimation overestimate speeds (i.e., produce higher speed estimates than should be obtained) by a substantial margin. This overestimation is directly related to the level of congestion. For extremely congested networks, such as those encountered when performing 20-year traffic forecasts, the speed overestimation by traditional methods can be inordinately large. Conversely, for uncongested facilities, speed estimation is much simpler and a variety of methods can be used, subject to the observations in Point 7 above. Finally, the overestimation of speeds in congested conditions has ramifications for air quality planning, congestion management, and other transportation planning applications. If speeds are predicted to be higher than observed in the field, CO and VOC estimates will be lower than they should be and NO_X emissions will (usually) be higher. Other implications of using higher-than-expected speed estimates include underestimating the extent of congestion in an urban area and underestimating the benefits of highway improvements and transportation control strategies.

Because project research resources were limited, only limited field validation of the models was accomplished. Also, extension of the work to cover additional types of bottlenecks besides on-ramps should be undertaken.

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4. COMSIS Corporation, et al., "Development of Diurnal Traffic Distribution and Daily, Peak, and Offpeak Vehicle Speed Estimation Procedures for Air Quality Planning," prepared for FHWA, Work Order B-94-06, April 1996.

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6. Hall, F.L. and K. Agyemang-Duah, "Freeway Capacity Drop and the Definition of Capacity", paper presented at the Transportation Research Board Annual Meeting, 1991.

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Table 1. AADT/C Levels and Corresponding AADT Values

	Freeways (10% Trucks)		
	4-Lanes[1]	6-Lanes[2]	4-Lane Signalized Arterials (8% Trucks)[3]
AADT/C	**AADT[4]**	**AADT[4]**	**AADT[4]**
9	72,000	113,000	30,000
10	80,000	126,000	33,000
11	88,000	138,000	37,000
12	96,000	151,000	40,000
13	104,000	163,000	43,000
14	112,000	176,000	47,000
15	120,000	188,000	50,000

[1]Ideal Capacity = 2,200 passenger cars per hour per late (pcphll)
[2]Ideal Capacity = 2,300 pcphpl
[3]Ideal Capacity = 900 pcphlp (based on a saturation flow rate of 1,800 pcphpl and 50 percent green time
[4]Rounded to nearest 1,000

Table 2. Weekday Temporal Distributio

Type of Facility: Freeway

	AADT/C								AADT/C	
	LE 7.0		7.1 - 11.0		GT 11.0		LE 7.0		7.1 - 11.	
	Peak Direction		Peak Direction		Peak Direction		Peak Direction		Peak Direct	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	
	Pct. of	Pct. of	Pct. of	Pct. of	Pct. of	Pct. of	Pct. of	Pct. of	Pct. of	Pct
Hour	Daily Volume	Daily Volume	Daily Volume	Daily Volume	Daily Volume	Daily Volume	Daily Volume	Daily Volume	Daily Volume	Da Vo
1	0.42	0.58	0.44	0.57	0.47	0.54	0.34	0.47	0.37	0
2	0.27	0.33	0.27	0.34	0.27	0.32	0.21	0.28	0.23	0
3	0.23	0.25	0.22	0.26	0.20	0.24	0.15	0.18	0.17	0
4	0.23	0.22	0.21	0.21	0.18	0.18	0.14	0.14	0.16	0
5	0.38	0.29	0.35	0.28	0.31	0.25	0.24	0.18	0.28	0
6	1.17	0.68	1.12	0.69	1.06	0.72	0.74	0.42	0.81	0
7	3.26	1.75	3.16	1.90	2.86	2.18	2.23	1.19	2.35	1
8	4.83	2.90	4.59	3.05	3.90	3.27	4.11	2.28	3.85	2
9	3.56	2.57	3.80	2.76	3.66	3.04	3.45	2.33	3.42	2
10	2.58	2.24	2.75	2.30	2.94	2.53	2.64	2.29	2.69	2
11	2.46	2.33	2.50	2.34	2.68	2.49	2.64	2.56	2.65	2
12	2.56	2.56	2.61	2.61	2.73	2.69	2.90	3.02	2.90	2
13	2.65	2.71	2.68	2.75	2.75	2.78	3.20	3.35	3.17	3
14	2.70	2.77	2.75	2.81	2.82	2.86	3.14	3.24	3.14	3
15	2.93	3.12	2.93	3.15	2.97	3.15	3.18	3.44	3.116	3
16	3.26	4.01	3.21	3.87	3.21	3.60	3.40	4.13	3.35	3
17	3.47	4.81	3.38	4.43	3.28	3.82	3.46	4.78	3.49	4
18	3.42	4.85	3.32	4.39	3.29	3.77	3.31	4.83	3.45	4
19	2.66	3.23	2.66	3.20	2.82	3.22	2.68	3.23	2.75	3
20	1.95	2.23	1.97	2.25	2.12	2.36	2.14	2.41	2.18	2
21	1.54	1.78	1.54	1.79	1.62	1.86	1.73	1.97	1.75	2
22	1.40	1.63	1.44	1.69	1.54	1.74	1.49	1.71	1.50	1
23	1.14	1.30	1.19	1.39	1.27	1.46	1.10	1.26	1.11	1
24	0.79	0.98	0.83	1.05	0.89	1.07	0.74	0.94	0.75	0
TOTAL	49.87	50.13	49.92	50.08	49.84	50.16	49.36	50.64	49.67	50

Source: Ref. 5.

Table 3. Peak Spreading Modification Procedures for Temporal Distributions

AADT/C Range	Modifications
1-7	None; low range used
8	(1/3 of low range) + (2/3 of middle range)
9	None; middle range used
10	(2/3 of middle range) + (1/3 of high range)
11	(1/3 of middle range) + (2/3 of high range)
12	None; high range used
13+	[{pct* (24 - AADT/C)} + (1/48) * (AADT/C - 12}]/12 where: pct = hourly distribution of traffic from (5)

Table 4. Average Coefficients of Variation from Urban ATR Sites

	Functional Class			
	Urban Freeway		Urban Principal Arterial	
	Day of Week		Day of Week	
	Weekend	Weekday	Weekend	Weekday
	Coeff.	Coeff.	Coeff.	Coeff.
Hour	VAR	VAR	VAR	VAR
1	26.83	26.78	28.59	33.37
2	27.32	27.34	31.79	39.77
3	26.82	25.63	33.95	42.66
4	28.59	23.29	37.59	41.05
5	34.54	22.01	42.47	34.57
6	44.64	19.12	47.37	25.77
7	51.23	14.59	50.03	17.42
8	54.66	11.85	53.36	14.42
9	41.18	11.37	41.54	13.12
10	29.77	11.71	31.63	13.08
11	25.05	12.69	28.80	13.86
12	22.18	13.14	26.52	13.74
13	18.56	13.07	21.27	13.40
14	17.47	13.05	20.23	13.62
15	17.68	12.69	20.01	13.34
16	18.89	11.75	21.01	12.62
17	20.40	11.44	21.89	12.28
18	21.20	12.48	22.62	13.35
19	21.01	16.15	23.74	16.79
20	22.29	19.66	25.78	20.32
21	23.96	20.05	28.19	22.55
22	25.38	19.94	31.49	24.18
23	29.58	23.96	36.04	29.40
24	36.33	29.32	43.51	36.35

Table 5. Effect of Progression on Vehicle Speeds

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Signals per Mile	Signalization	V/C					
		0.2	0.4	0.6	0.75	0.85	0.95
6	Progression	28.8	29.7	28.8	28.5	27.3	24.2
	Limited Progression	22.2	20.2	18.6	17.4	16.5	14.8
10	Progression	24.5	25.2	24.1	23.2	22.6	17.4
	Limited Progression	20.0	18.4	17.0	15.9	17.4	12.5

Table 6. Speeds in Queues from Freeway Field Data

City	No. 5-minute periods	Average Speed	Coefficient of Variation
Orlando (1-4)	**2,407**	**16.1 mph**	**30.3%**
Denver (1-25)	**1,263**	**15.0 mph**	**33.3%**

Source: Analysis of Freeway Management Center Data

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Table 7. Coefficients for Freeway Delay Equations

PEAK PERIOD

	Weekday	Weekend	Combined
AADT/C			
$AADT/C^2$			
$AADT/C^3$			0.0347966374
$AADT/C^4$			-.0122499794
$AADT/C^5$	0.0001732632	0.0000253342	0.0016577982
$AADT/C^6$	-.0000116968		-.0000862934
$AADT/C^7$	0.0000001974	-.0000000318	0.0000015096

PEAK HOUR

	Weekday	Weekend	Combined
AADT/C			
$AADT/C^2$			
$AADT/C^3$	0.1055828979		0.0824450974
$AADT/C^4$	-.0417711090		-.0316382045
$AADT/C^5$	0.0059009773	0.0000256501	0.0043851790
$AADT/C^6$	-.0003319769		-.0002436727
$AADT/C^7$	0.0000064684		0.0000047234

DAILY

	Weekday	Weekend	Combined
AADT/C			
$AADT/C^2$			
$AADT/C^3$	0.0551483782	0.0096559689	0.0461854203
$AADT/C^4$	-.0189486676	-.0023347525	-.0154380323
$AADT/C^5$	0.0023287974	0.0001925990	0.0018559670
$AADT/C^6$	-.0001133801	-.0000044347	-.0000887095
$AADT/C^7$	0.0000018954		0.0000014614

Note: The equations should be applied up to an AADT/C value of 18.

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Table 8. Coefficients for Arterial Delay Equations

PEAK PERIOD

NO QUEUE EQUATIONS

	Weekday	Weekend	Combined
INTERCEPT	32.6326	32.8082	32.6270
AADT/C			
$AADT/C^2$	0.27187282	0.10420309	0.23911219
$AADT/C^3$	-0.01054104		-0.00898736
$AADT/C^4$		-0.00012311	
$AADT/C^5$			
$AADT/C^6$			
$AADT/C^7$			

QUEUE EQUATIONS

	Weekday	Weekend	Combined
AADT/C			
$AADT/C^2$			
$AADT/C^3$			
$AADT/C^4$			
$AADT/C^5$			
$AADT/C^6$	0.0000288004	0.0000025067	0.0000225491
$AADT/C^7$	-0.0000013948		-0.0000010684

AADT/C > 7 EQUATIONS

	Weekday	Weekend	Combined
(AADT/C - 7)	2.789265513		
$(AADT/C - 7)^2$			0.265213232
$(AADT/C - 7)^3$		0.0142379985	
$(AADT/C - 7)(1 - e^{-.3n})$			1.445427904
$(AADT/C - 7)^2(1 - e^{-.3n})$	0.259827162	0.1060087507	
$(AADT/C - 7)^3(1 - e^{-.3n})$			

Note: n = signals per mile. The equations should be applied up to an AADT/C value of 18.

Table 8. (Continued)

PEAK HOUR

NO QUEUE EQUATIONS

	Weekday	Weekend	Combined
INTERCEPT	32.9859	32.6524	32.8591
AADT/C			
$AADT/C^2$	0.36235337	0.13826170	0.31492585
$AADT/C^3$	-0.01545356		-0.01297063
$AADT/C^4$		-0.00019683	
$AADT/C^5$			
$AADT/C^6$			
$AADT/C^7$			

QUEUE EQUATIONS

	Weekday	Weekend	Combined
AADT/C			
$AADT/C^2$			
$AADT/C^3$			
$AADT/C^4$			
$AADT/C^5$	0.0004278173	0.0000639922	0.0003209231
$AADT/C^6$	-0.0000010179		
$AADT/C^7$			-0.0000007210

AADT/C > 7 EQUATIONS

	Weekday	Weekend	Combined
(AADT/C - 7)	4.935624291		
$(AADT/C - 7)^2$			0.430066318
$(AADT/C - 7)^3$		0.0213118297	
$(AADT/C - 7)(1 - e^{-.3n})$			1.916741055
$(AADT/C - 7)^2(1 - e^{-.3n})$	0.191184548	0.1612475797	
$(AADT/C - 7)^3(1 - e^{-.3n})$			

Note: n = signals per mile. The equations should be applied up to an AADT/C value of 18.

Table 8. (Continued)

DAILY

NO QUEUE EQUATIONS

	Weekday	Weekend	Combined
INTERCEPT	32.9015	32.8089	32.5177
AADT/C			
$AADT/C^2$	0.15119788	0.10661207	0.19583856
$AADT/C^3$			-0.00728030
$AADT/C^4$		-0.00015241	
$AADT/C^5$			
$AADT/C^6$	-0.00000333		
$AADT/C^7$	0.00000014		

QUEUE EQUATIONS

	Weekday	Weekend	Combined
AADT/C			
$AADT/C^2$			
$AADT/C^3$			
$AADT/C^4$			0.0007935231
$AADT/C^5$		0.0000325589	
$AADT/C^6$	0.0000144058		
$AADT/C^7$	-0.0000006601		

AADT/C > 7 EQUATIONS

	Weekday	Weekend	Combined
(AADT/C - 7)			
$(AADT/C - 7)^2$	0.1852764500		0.1586415772
$(AADT/C - 7)^3$		0.0102536589	
$(AADT/C - 7)(1 - e^{-.3n})$			
$(AADT/C - 7)^2(1 - e^{-.3n})$	0.1346060360		0.1211710141
$(AADT/C - 7)^3(1 - e^{-.3n})$		0.0097281924	

Note: n = signals per mile. The equations should be applied up to an AADT/C value of 18.

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Table 9. Comparison of New Speed Equations to Standard Practice,

Link	AADT/C	Standard Practice: Weekday Peak Hour								
		Peak Direction			Offpeak Direction			Combined Directions		Pea Hou
		Volume	V/C	Speed[2]	Volume	V/C	Speed[2]	Volume	Speed	Spe
(1,2)	7.0	3,390	0.77	57.0	2,650	0.60	58.9	6,040	57.8	55.
(2,3)	8.0	3,870	0.88	55.0	3,030	0.69	58.0	6,900	56.3	51.
(3,4)	9.0	4,355	0.99	52.4	3,410	0.78	56.8	7,765	54.3	44.
(4,5)	11.0	4,440	1.01	29.4	3,690	0.84	55.8	8,130	41.4	29.
(5,6)	13.0	5,250	1.19	20.0	4,360	0.99	52.4	9,610	34.7	20.

AADT/C	K-factor[4]	D-Factor[4]
< 11	10.4%	58.7%
>= 11	8.1%	56.1%

[1]The new equations predict speeds for both directions simultaneously.
[2]Calculated using the original BPR function for V/C < 1.0; modified BPR4 for V/C >= 1.0 (see previous footnote)
[3]The peak period is from 7-10 a.m. and 4-7 p.m.; volumes are from the Appendix.
[4]K- and D-factors developed from 1993 HPMS data.

Table 10. Comparison of New Speed Equations to Standard Practice, Sigr

AADT/C	AADT	HCM Methodology								BPR Speed	
		Peak Direction			Offpeak Direction			Total Volume	Wtd Avg Speed		S
		Volume	V/C	Speed	Volume	V/C	Speed				
8.0	28,800	1,622	0.90	24.6	1,229	0.68	28.0	2,851	26.1	30.2	
9.0	32,400	1,825	1.01	19.1	1,382	0.77	27.1	3,208	22.6	26.6	
11.0	39,600	1,942	1.08	14.7	1,582	0.88	25.2	3,524	19.4	22.5	
13.0	46,800	2,295	1.20	8.7	1,870	1.04	17.4	4,165	12.6	16.8	

Arrival Type = 3 (minimal progression)
m = 16 (incremental delay factor)
C = 90 sec
g/C = 0.5
FFS = 40 mph
Sig/Mile = 2.0
Capacity = 1,800 (4-lane arterial)

AADT/C	K-factor	D-factor
< 11	9.9%	56.9%
>= 11	8.9%	55.1%

Note: K- and D-factors developed from 1993 HPMS data.

Figure 1. Forecasted Network Link Volumes vs. Reality

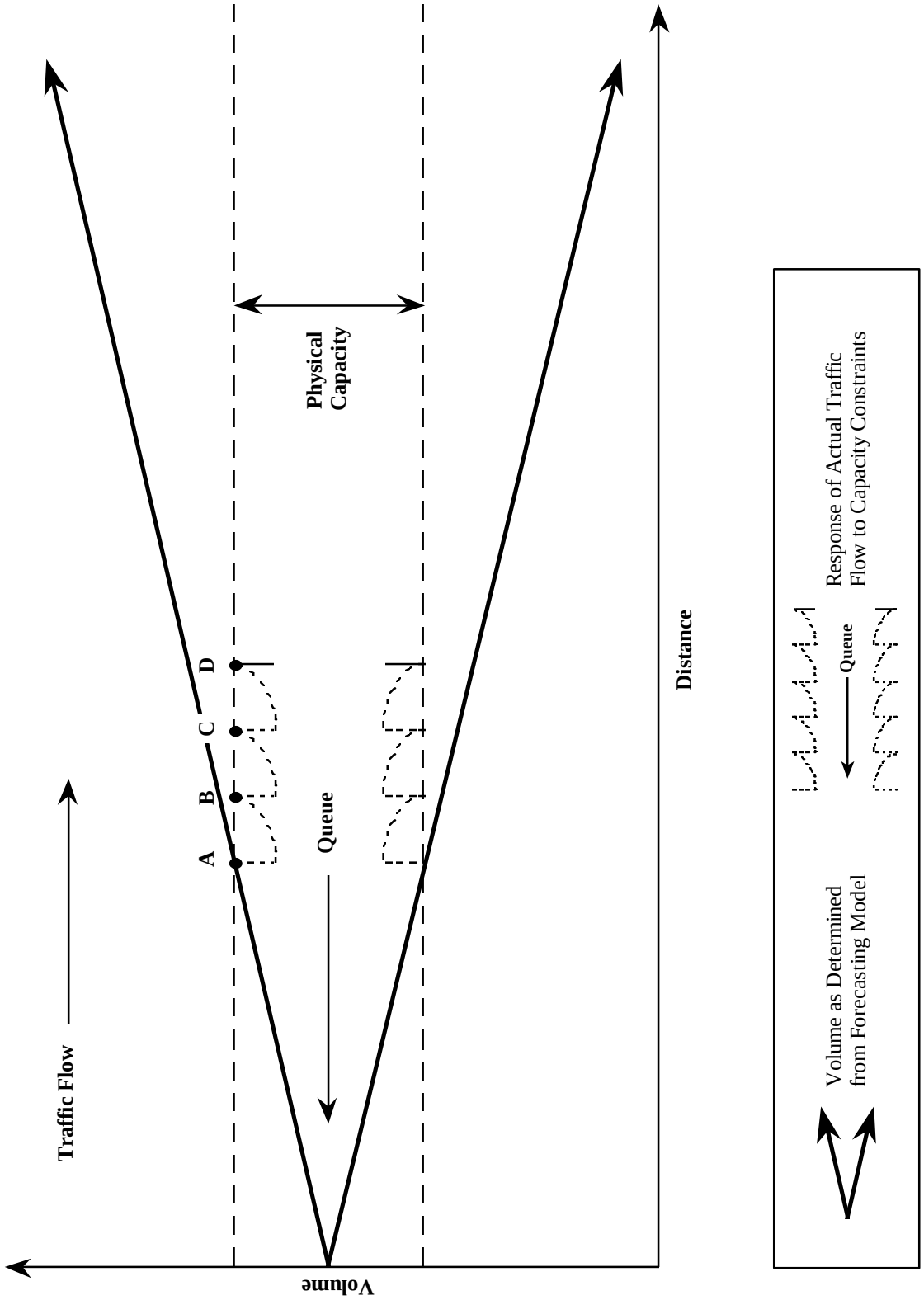


Figure 2. Overview of QSIM Methodology

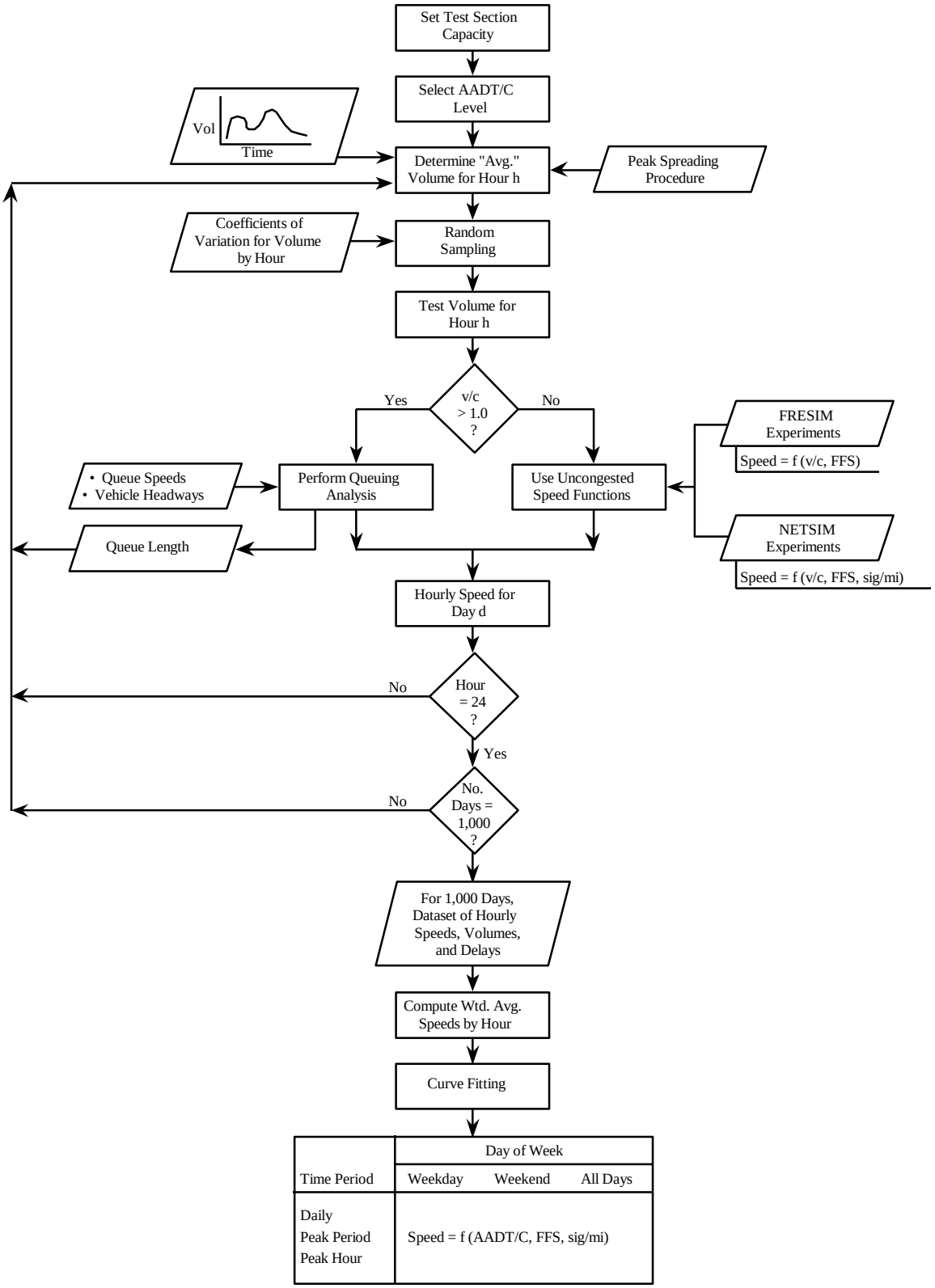
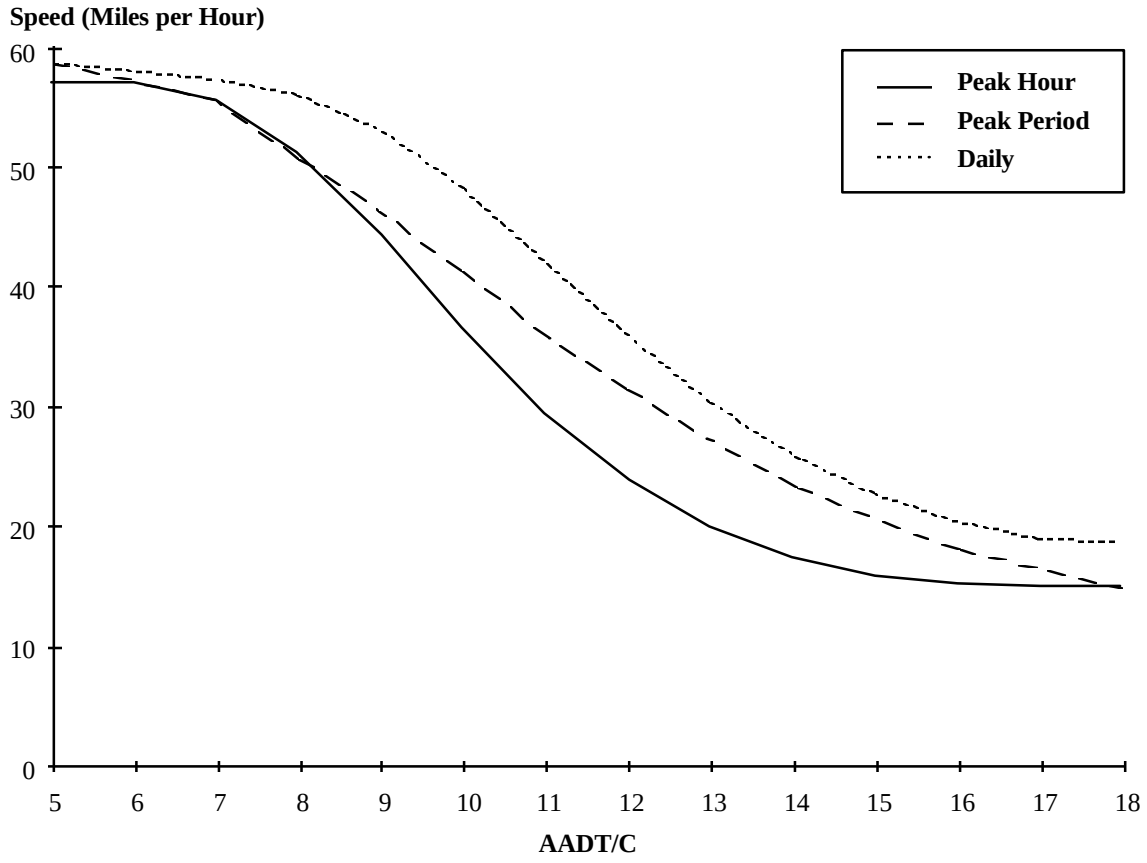


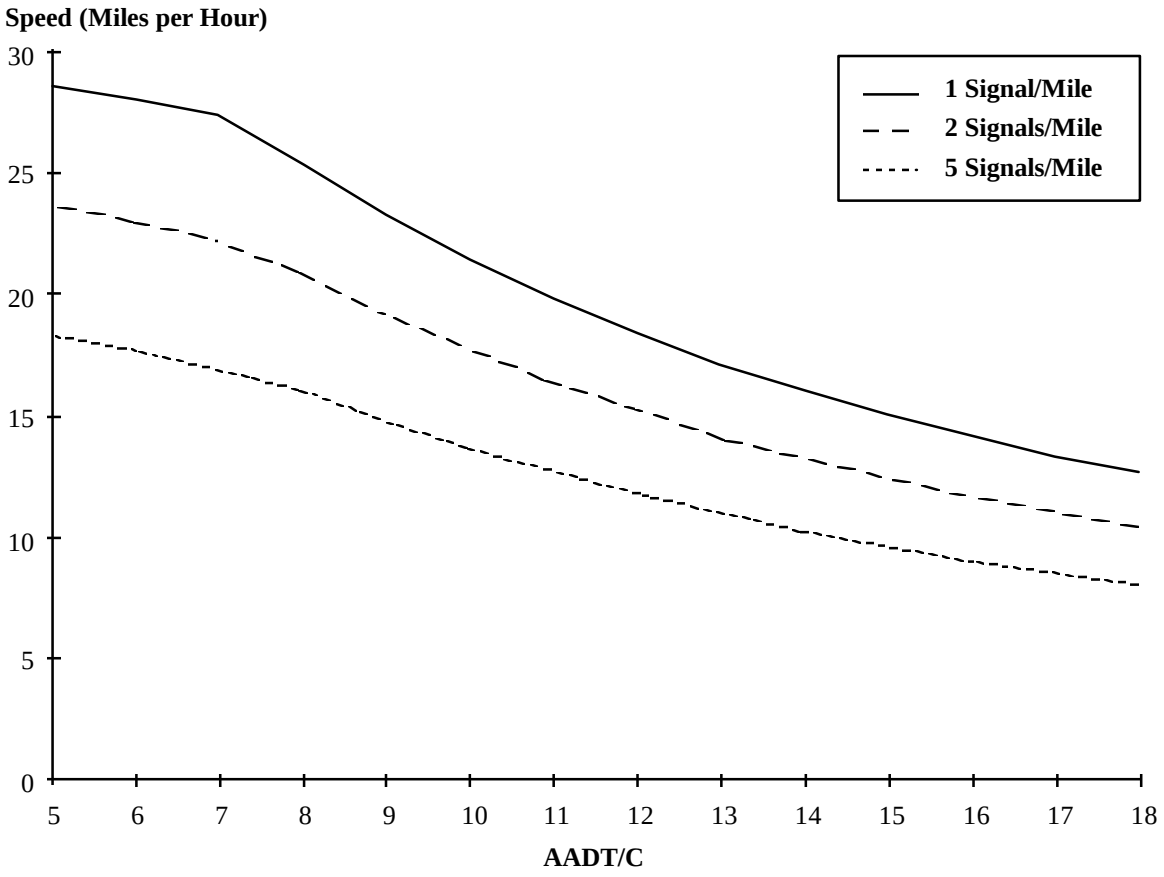
Figure 3. Speed Curves for Freeways
Weekdays



Note: FFS = 60 mph

Figure 4. Speed Curves for Arterials

Peak Period Weekdays



Note: FFS = 40 mph

Session #6

"Air Apparent: How the MPO Can Work With Air Quality"

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SIXTH ANNUAL
SMALL AND MEDIUM SIZED COMMUNITIES CONFERENCE

ABSTRACT

Metropolitan Planning Organizations (MPOs) were established with the intention of providing the oft-quoted "comprehensive, continuing, and coordinated" transportation planning in urban areas of over 50,000 people. In reality, each MPO is defined by its members, and their interests, environment, and history. Many MPOs in high-growth areas have continued conflicts with traditional highway-oriented planning that do not mesh well with the implied and direct regulatory requirements contained in the Clean Air Act Amendments and surface transportation legislation. To make matters worse, the standards for the most critical component of pollution in many areas - ground-level ozone – have been tightened, a move that will force many more MPOs into the arena of air quality planning.

This paper attempts to answer two questions: what is the ability of an MPO to address air quality issues now, and what steps should be taken to develop an air quality plank in the MPO's overall platform? *The key elements of a successful and cost-effective program to work with air quality are also presented*, and will be the main benefit of this paper to most readers. Each program contains action items, resource requirements, and suggested sources for customizing their own program. The three tiers of programs are sensitive to the abilities of the MPO, recent changes and interpretations in air quality legislation, and should satisfy the needs of MPO constituents at a given stage of the MPOs evolution relative to air quality.

The foundation for this paper is the recent experience of an MPO and its staff administrator (the author) thrust into air quality conformity issues. The Capital Area MPO is centered on Raleigh, North Carolina, a city of 280,000 people. The total population of CAMPO is currently estimated to be about 580,000 people. In March of 1997, CAMPO encountered a conformity lapse with almost no warning. The results of the subsequent experience are presented here to help other MPOs, both in North Carolina and around the country, deal with the issue of air quality.

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Air Apparent: How the MPO Can Work With Air Quality

The current relationship of metropolitan planning and air quality has a substantial history. A precedent had already been achieved for regional planning efforts by the mid-1950's. Section 701 of the Federal Housing Act of 1954 doled out federal grants for councils of governments to address regional problems. The real public impact of the 1954 Act, however, was reserved for the inclusion of federal programs to subsidize home ownership with financing and insurance programs. Concerns about open space and the "suburbanization" of rural lands prompted grants for transit and open space preservation in the Federal Housing Act of 1961. An even greater stride was achieved in the 1962 Highway Act, which gave federal aid to urban areas of greater than 50,000 population. The criteria needed to receive this funding was significant: a planning process that was continuing, comprehensive, and coordinated must be established and maintained.(*1*)

Of course, not all of the existing stakeholders were ecstatic to find these new regional agencies in their midst. The Bureau of Public Roads (BPR) was responsible for the implementation of the 1962 Highway Act. Deeply intertwined with state highway departments and road construction, BPR saw the new regional agencies as a "potentially disruptive innovative force," threatening established procedures and decision-making systems. Not surprising was the outcome of this perspective: for nearly three decades the MPOs were to be an adjunct to decision-making, often called upon to collect data, but seldom relied upon for meaningful input into the decision-making process. Not until the 1973 Highway Act was the moniker "MPO" used in federal legislation. The culmination of a year-long battle, the 1973 Highway Act was seen by some as the first real defeat of the powerful highway lobby and by others as a promise to guard against domineering state highway departments. During the 1980's, energy resource concerns, deregulation, and concerns over acid rain and other environmental campaigns each played a role in defining the responsibilities of the MPO.(*1*)

This synergy culminated in the Intermodal Surface Transportation Efficiency Act of 1991. ISTEA granted MPOs the much sought-after right to select projects from certain federal aid funding sources, and forced consensus with the state departments of transportation on the remaining programs. Many of these MPOs were not well-equipped to deal with the new responsibilities. The poor starting position, combined with reluctance of traditional decision-makers to part with authority, made for a slow enactment of many of ISTEA's grand promises of a more efficient, balanced, and publicly influenced transportation system.

Thus it should not seem surprising that many MPOs – charged with regional concerns, consensus-building, and cooperative and comprehensive planning – were not prepared to participate in matters of air quality. In reality, the entangling of the MPO in air quality via long-range planning requirements represented a proverbial "unfunded mandate," the nemesis of local governments in the 1980's and early 1990's. The Clean Air Act Amendments of 1990 (CAAA), painfully passed by the Bush Administration in a losing bid to win back the mantle of environmentalism for the Republican Party, did not get the attention it deserved from the transportation community at large. Now MPOs were faced with the ultimate responsibility of determining conformity on long-range plans and incorporating poorly-understood regulatory

requirements that have undergone nearly constant reinterpretation and revision by the Environmental Protection Agency (EPA) and Federal Highway Administration (FHWA). While the experience of the Capital Area MPO in Raleigh in partnering with FHWA local offices and the state departments of transportation and natural resources has been encouraging, there are still remaining problems to overcome. The regional nature of the offices of the Federal Transit Administration (FTA) and the EPA does not permit easy coordination. The former agency is partly responsible for "signing off" on conformity determinations, and the latter has a non-regulatory but still-powerful review role in the process. The local office of FHWA, while extremely helpful in many areas, is also painfully under-staffed and sometimes has a different perspective from its regional office.[1]

Any type of initiative would be difficult without a solid policy framework that could only arise from a high-quality partnership between state DOTs and MPOs, and to a lesser extent, the Federal Highway Administration. High-growth states driven primarily by economic policies on the local (land use) side, and state DOTs that are unable to accommodate even minor changes in policy directives, face considerable difficulties. Furthermore, the standards for the most critical component of pollution in many areas - ground-level ozone - were tightened in a Presidential Directive issued on July 16, 1997.(*2*) This is a move that will force many more MPOs into the arena of air quality planning(*3*), even though mobile source emissions have remained relatively stable even as vehicle miles of travel have doubled in the past 25 years(*4*).

The purpose of this paper is to provide the target audience (MPO staff and local planners) with a set of four descriptors that will categorize the MPO to determine which of three programs it should consider to deal with air quality planning. Elements of a successful and cost-effective program to work with air quality are also presented, and will be the main benefit of this paper to most readers. Each program contains action items and resource requirements. Suggested sources for continuing education are presented. The three tiers of programs are sensitive to the abilities of the MPO, recent changes and interpretations in air quality legislation, and should satisfy the needs of MPO constituents at any stage of air quality involvement.

This work is based largely on the recent, real-world experience of an MPO and its staff administrator (the author) thrust into air quality conformity issues. The Capital Area MPO is centered on Raleigh, North Carolina, a city of approximately 280,000 people. The total population of CAMPO is currently estimated to be 580,000. In March of 1997, CAMPO encountered a conformity lapse with almost no warning. The results of the subsequent experience are presented here to help other MPOs, both in North Carolina and around the country, work with the issue of air quality.

[1] The regional FHWA offices are consolidating into four "district" offices. This centralization will probably strain efforts at coordination even further.

The Level of Involvement: Matching Resources With Need

Metropolitan Planning Organizations exist in a variety of sizes and forms. Differing skill levels exist within the MPO staffs, and regulatory and political environments are also varied. It is therefore desirable to equate these abilities with a range of actions that the MPO may wish to undertake in their involvement with air quality. To this end, a set of four variables ("descriptors") that count towards a summary rating were developed. This summary rating is then matched to one of three air quality involvement programs described later in the paper.

The purpose of this rating system is to understand both the MPO's ability to undertake a particular set of actions, as well as the actual need to do so. Resource levels (staffing), staff abilities, the air quality status of the MPO, and its size in terms of number of representative members are presented as factors in the rating system. The higher the summary score (which is simply the sum of each score for every descriptor), the more advanced the air quality planning effort for that MPO. The purpose of this system is to provide a "launching point" in the evolution of the MPO's air quality planning program. It should also assist the user in understanding and addressing the abilities of an MPO for undertaking an air quality program.

Resource Level (Man-Hours/Week)		**Staff Ability (see Definition)**		**Air Quality Status (see Definition)**		**MPO Size (Policy Members)**	
Measure	***Score***	**Measure**	***Score***	**Measure**	***Score***	**Measure**	***Score***
<3	*1*	I	*1*	Always Attainment	*1*	<4	*1*
3 - 5	*2*	II	*2*	Maintenance	*2*	4 - 7	*2*
6>	*4*	III	*3*	Non-Attainment	*5*	8 - 12	*3*
						13>	*4*

Sum of All Four Scores: _____

Recommended Air Quality Program Level (Range of Summary Scores):

- Program A (4 - 7)
- Program B (8 - 11)
- Program C (12 - 16)

Figure 1. MPO Air Quality Program Descriptors.

Definition of Descriptive Measures

The four descriptive measures shown in Figure 1 can be used to identify which Air Quality Program is appropriate for your MPO. The definitions of the descriptive measures are shown below, and should be reviewed carefully to ensure that the intent of the descriptor is met. In other words, if the reader feels that there may be extenuating circumstances that would "kick" the rating for a particular measure into a different category, then this needs to be considered when developing the final score.

Resource Level (Man - Hours/Week)
This is simply the number of hours each week that a full-time staff member has to devote to air quality issues. If the agency is not currently involved in air quality, then this time will probably be "stolen" from other tasks and projects. An extenuating circumstance may be the employee that scores well on the Staff Ability descriptor that can get a task completed faster. Technical and clerical assistance should generally not be counted towards this measure, but the user may consider an adjustment (not to exceed one rating category) in the case of fairly advanced technical assistance being available.

Staff Ability (Index)
The level of ability of the staff person(s) working on air quality issues must be objectively considered. If the staff has a skill set that is compatible with carrying out air quality program initiatives, then a more advanced program becomes feasible. This measure should be developed for the same person(s) considered in the Resource Level descriptor above. Below is how the available staff should be rated. Consider the rating appropriate if any three of the following characteristics are met:

Rating	Characteristics
I	Less than two years of MPO experience, marginal writing skills, little graphics or technical communication ability, marginal analytical capability, weak policy background
II	Two to five years of MPO experience, good technical writer, knowledgeable of public outreach efforts, good analytical and policy analysis capabilities
III	More than five years of MPO experience (preferably dealing with DOT, FHWA, and state air quality monitoring agency officials during this time), strong technical communicator, good analysis capability with modeling experience, familiar with media relations

Figure 2. Ratings for Staff Ability Descriptor.

One example of an outside consideration may be where the MPO's primary air quality specialist can be assisted by someone else that has a characteristic that they lack, such as public outreach or marketing. A higher rating could then be achieved.

Air Quality Status
This descriptor is fairly self-explanatory, except for noting that it obeys a three-tiered classification system without further subdividing on the severity of non-attainment (e.g. moderate, serious, extreme). If an area has only recently been made attainment for either ozone or particulate matter, then it is suggested that the "Maintenance" category be selected for this descriptor. This is due to the anticipated consequences of tighter standards for these pollutants.

An obvious example of an extenuating circumstance that may make a difference on the selected score is where it is known that a "drop" in the MPO's attainment status is impending and unavoidable.

MPO Size (Number of Policy Members)

Metropolitan Planning Organizations must often work with a number of jurisdictions in their planning area. Each jurisdiction is represented on the policy-making board of the MPO. Additionally, transit agencies, governmental councils, and other transportation providers may also be represented on the policy board. The technical board usually has an even larger membership, representing not only the professional staffs, but also may have members that are advocates of bicycling, handicap access, freight, universities, or other transportation interests. Each additional member requires additional coordination to create an effective and integrated planning process[2]. Hence, for larger groups it is generally desirable to sponsor a more comprehensive air quality planning program[3].

Certainly, the ultimate score given on this descriptor may be influenced by the presence of a variety of jurisdictional sizes and policy positions. Smaller jurisdictions that have not experienced rapid growth may well have a different perspective on air quality issues and mitigation strategies than their larger counterparts. Bridging the gap between these perspectives can be expected to require an additional effort.

The Three Air Quality Planning Programs

The summary rating can be used to categorize the complexity and expense of a particular air quality planning program element. The content of each program is determined by (a) its cost in terms of time, labor and capital investment, and (b) the complexity of the element. An estimate of the resources required to undertake each measure is provided for budgeting purposes. Wage rates from the North Carolina Department of Transportation and City of Raleigh are used to convert hours into expenses. Wage rates vary by program due to the anticipated higher earnings of more experienced employees (see also the definition of the descriptor "Staff Ability" above). The user may adjust the wage rates to meet local conditions.

To facilitate comparisons, it was decided that every air quality planning program element should follow the same format for description (see Figure 3).

Name of Program Element	Hours	Staff ($)	Contracted ($)
• **Description of Program Element and Typical Actions** • **Resources/Funding**			
• **Goal(s) of the Program Element**			

Figure 3. Template for Air Quality Plan Element.

[2] As an example, the Capital Area MPO has 14 voting members on its Transportation Advisory Committee (TAC – the policy board), and 30 voting members on its Technical Coordinating Committee (TCC).

[3] The author recognizes that the opposite may be true; that is, higher membership in any organization places additional burdens on the support staff that may encourage a *reduced* effort for any given function. Nevertheless, the contention that the issue of air quality is a priority issue is a basic assumption in this report. Although the author believes that this assumption can be validated by federal regulatory requirements and the recent experiences of MPOs, like any new program, it should be tested and discussed between the board members and staff prior to commencement.

Note that both "Staff" and "Contracted" dollars are shown here, the primary difference being allowances for fringe benefits (i.e., longevity pay, health and life insurance, retirement benefits etc.) for in-house staff and a 10% administrative cost added to the contracted services, as well as a 154% overhead rate.

Figure 4 indicates the wages that were developed. Note that "Hours" of work (annual) are also shown so that adjustments can be made if either the wage rates or number of hours required to carry out each task are different for an organization. Such variability in cost can be ascribed to a number of external forces, such as employee longevity, regional wage differences, or the competition and availability of local consulting firms.

	In-House "Staff" ($/hour)	**"Contracted" Labor ($/hour)**
Planning	25	65
Public Involvement	28	75
Engineering	33	78
Graphics/CADD	18	50
Temporary	10	10
Overhead Rate (included)	30% Fringe Benefits + 10% (Administrative)	154% + 10% Oversight
Direct Costs		
1. Printing and Reproduction	8 cents/copy (B&W) 80 cents/copy (full color paper reproduction)	
2. Travel	0.325 cents/mile	

Figure 4. Implementation Costs.

The three programs described below can be viewed as a temporal evolution in air quality planning: staff education to policy board/planning actions to mitigation strategies. A small MPO that is just entering the arena of air quality planning could spend 6 to 18 months on Program A, and transition into the second and third programs. It is also expected that by the time a MPO enters Program C, numerous adjustments and additions could be made to expand and tailor an air quality planning program to the individual organizational needs. This is in fact highly desirable, and exchanges of information between MPOs then becomes very useful. Internet mailing lists, newsletters (e.g. Clean Air Transportation Report published by the National Association of Regional Councils), and professional associations should be encouraged to transition from high level information providers to more case studies of successful program elements. An important lesson is that no single program element can be successful on its own; it takes multiple passes and a varied program to get across the complex messages and tasks inherent in air quality issues.

Program A: Staff Education (total cost: $2,730)

Program A is intended to primarily educate and inform the staff about air quality matters, and to establish a flow of communication between the MPO staff, supervisor(s), and partners in air

quality planning. There are just two elements in the scope of work for Program A: Coordination and Research. These two elements will form a cornerstone of all the programs.

Education	**30**	**$1,400**	**--**
• Approximately 30 hours of staff time should be spent on educating the MPO staff on matters of air quality. There are now many sources of information available to the user, many of which were not even in existence when the CAAA passed in 1990. A sample of these sources are provided at the end of this paper. A portion of the thirty hours should be spent attending at least one professional conference addressing the subject of air quality. Teleconferences have also become popular and cost-effective ways of acquiring information, although they lose the value of personal interaction. • Most of the cost is associated with planning staff time and attending a conference. Minimal direct costs are assumed, with a moderate amount of travel involved.			
• Primary Goal: To educate the staff that will be working on air quality issues about the subject matter. Understand the State Implementation Plan (if available), interagency working agreements (coordination policies), pollutant thresholds and where each county in the MPO area stands in relation to them, and the requirements of a conformity analysis and conformity determination. • Secondary Goal: Identify and mark sources of information, develop a library of practices used in other areas to deal with all phases of air quality planning from public education and outreach to construction solutions.			

Coordination (AQ Specialists)	**50**	**$1,330**	**--**
• Approximately 50 hours of staff time will be required to prepare and meet with the state air quality agency (in North Carolina, this is the Department of Health and Natural Resources, Air Quality Division) and the state department of transportation. Two meetings with the regional (district) offices of EPA, FTA, and FHWA are also assumed, which may be combined or handled without face-to-face interaction. Written correspondence is occasional. It is not recommended that contractual labor be utilized due to the required level of personal communication necessary to achieve the desired level of coordination. • Almost all of the cost is accrued to planning. Minimal direct costs are assumed, with some travel involved.			
• Primary Goal: To establish a positive working relationship with the individuals who are the key players in developing staff-level actions in air quality. • Secondary Goal: To provide the MPO staff with additional information on the specific focus of the primary review agencies involved in air quality planning.			

Program B: Coordination and Dissemination (total cost: $28,080)

Although the education process should never stop, the MPO quickly finds itself in the position of acting on the information it has gathered. This mainly takes two forms: working with air quality modeling, particularly in the form of data collection and refinement of inputs, and second, the preparation of conforming transportation plans. Recent FHWA guidance on the latter suggests that MPOs must look ahead a minimum of 23 years and perform updates every

three years (non-attainment areas), or 25 years with five-year update cycles (attainment areas). What is often not stated is that it takes three-to-five years to develop and approve a transportation plan. Unable to accommodate these schedules, it is probable that many MPOs will turn to approving long-range transportation plans without prior approval by the individual agencies represented on their boards. To make the plan process work in such an environment requires an ever-increasing amount of coordination, not with the staffs involved only in air quality planning, but with the local municipalities.(*5*) The refinement of revenue projections, cost estimation techniques, strengthening public involvement, and addressing local needs in long-range plans must be undertaken in the same time frame.

Coordination (local staffs)	**100**	**$2,500**	**$6,565**
• At this level of coordination, several attempts at coordination with the municipal staffs and officials must be made. The establishment of a two-page, biennial newsletter to the members is a start. Agenda packages may contain one-page staff reports (preferably with slightly different letterheads to distinguish them immediately for the target audience) on breaking news or simply include copies of articles or professional association letters. If the MPO has not already done so, then participation in the Association of Metropolitan Planning Organizations (AMPO) is recommended. Coordination with the state air quality agency and state department of transportation will still be required. A review of the State Implementation Plan (SIP) and the coordination protocol is now being undertaken in North Carolina; MPOs in other areas should also participate in this process. Pushing for more involvement in the selection of transportation control measures (TCMs) in the SIP is a critical task. • Required resources lie primarily with planning labor costs, but there are also graphics and CADD costs. Direct costs for newsletters ($1,030/full color at 50 copies each) , AMPO membership (cost varies; approx. $800), and staff reports ($600 for three) must be added to moderate travel and reproduction expenses.			
• Primary Goal: To relate information to the primary customer base, the boards.			

Data Collection (Stage One)	**40 (+ temp)**	**$8,300**	**$9,815**
• Travel time (link speed) studies to improve the inputs to the air quality model are desirable to improve not only the accuracy of the emissions model, but also to move the MPO into a stronger partnership role. A sample of freight vehicle counts to determine vehicle mix is important, as heavy vehicles are major contributors of nitrogen oxides (NOx).(*6*) Vehicle occupancy counts will establish a baseline for high occupancy vehicle and other travel demand management actions that may be considered in future years. Both programs should be considered for a two- or three-year cycle, depending on the population and VMT growth. • Data collection activities can be assigned to temporary staff (interns at $10 per hour) with some supervision by planning staff. Automated travel speed/distance recovery hardware improves the collection process, but will add $400 to the cost. Travel costs may be significant if a personal vehicle is being used the during data collection.			
• Primary Goal: To improve the accuracy of emissions modeling.			
• Secondary Goal: Improve the partnership with the air quality agency.			

Planning Provisions	240	$6,000	$11,700
• Although the requirements for long-range plans have been known for some time, it may be necessary to revisit them, particularly with the passage of the new transportation authorization bill, TEA21. The 15 (made 16 in 1995) planning factors have been consolidated into seven functional areas. Funding levels are different, requiring new revenue projections and factors. Experience suggests that the strictness with which the planning regulations are upheld is dramatically increasing. Therefore, many areas that have yet to address the requirements completely must do so prior to the next certification review (self-certifying MPOs, those under 200,000 in population, may also be facing a higher level of inspection). Create a list of transportation projects that are threatened if the long-range plan is found to be non-conforming. Such a list will require the identification of exempt projects and those that have passed certain milestones in their development[4]. The establishment of an air quality-sensitive protocol for modifications to regionally-significant projects in plans and programs will also be required. The final, and perhaps most critical, work task may be to address the discrepancy in planning year horizons between the long-range plan requirements and the Clean Air Act (and 1990 Amendments). Both AMPO and numerous MPOs have been active in trying to get recognition of this issue, which may hold a long-range transportation plan to short-range emission budget levels. • Resources consist primarily of planning staff labor in the areas of research, agenda and presentation preparation.			
• Primary Goal: Prepare the MPO for tougher certification reviews, and ensure that the planning process does not threaten to hold up needed construction improvements.			

Program C: Implementation (total cost: $72,725)

The MPO will be held responsible for the timely implementation of action items, typically called TCMs, as outlined in the State Implementation Plan[5]. This will require involvement in modeling, both air quality and travel forecasting. In North Carolina, the state department of transportation has long assumed the primary responsibility for travel demand modeling, and is working with the state air quality agency to ensure the validity of air quality models. However, this state of affairs is rapidly changing. It is anticipated that the MPOs, or regional agglomerations of MPOs, will gradually shift into the role of providing travel demand modeling services. This is desirable from at least two standpoints: one, it will keep the agency that is responsible for conformity analyses (MPO) at the forefront; and two, it allows the state department of transportation to consolidate its holdings as a technical resource and implementing agency.

[4] In North Carolina, these milestones were: Record of Decision, final design, right-of-way acquisition, and project letting/construction. If three years had passed since any of these had occurred, then the project was considered vulnerable during a lapse of conformity.

[5] This is true even though the ultimate decision about which TCMs are approved does *not* reside with the MPO, but with the state legislature and the EPA.

Data Collection (Stage Two)	640	$9,225	$12,725
• One of the lingering problems with emissions modeling practice is the way in which roads are functionally classified. A classification system should take into account percent grade, signal spacing, driveway spacing, and other factors that may describe emissions potential.(*7*) The 12-category federal functional classification system does none of these, focusing instead on vehicle miles of travel and urban/rural differentiation. Local street systems, where the majority of cold starts and resulting high emission levels occur, are poorly modeled. An analysis of this problem followed by a data collection effort to enrich the current travel demand model would be required to rectify this problem. • The resources required to perform such an effort are substantial, and would probably consist of three months' intern work, possibly performed over one summer. Field work could be limited if adequate aerial photography is already available.			
• Primary Goal: To improve the validity of current emissions models.			

Mitigation/TCMs	800	$22,000	$60,000
• As the MPO gains more experience, it is probable that construction measures to offset increases in VMT-related emissions will be considered more thoroughly. These may include variable message signing, incident-detection programs, and HOV/HOT lanes.(*8, 9, 10*) The costs for preliminary planning, designing, and market research for even a single such project would result in costs such as those shown above. A lower-cost action would be the application of staff to grant writing for funding, such as the Mobile Source Emissions Grant or CMAQ funding (the application of which would most likely involve a grants-like process).(*11*) Another cost-effective action would be the establishment of both municipal and private programs for reducing air emissions. Mowing rights-of-way outside of the 9-2pm peak ozone-formation hours and sponsoring cafeteria lunch programs on ozone alert days are examples. • The consultant price tag seems more appropriate, since few MPOs can muster the range of expertise necessary to carry out this element. The primary source of costs is for engineering, although planning, public involvement/marketing (*12*), and CADD work is included. Obviously, cost-sharing with the private sector and the state department of transportation should be strongly considered.			
• Primary Goal: To mitigate emissions from mobile sources. • Secondary Goal: To achieve compliance with the SIP and emissions budgets.			

Summation and Resources

Space restrictions do not permit a detailed examination of all of the possible elements that might comprise an effective air quality planning strategy. For example, classroom education programs, air quality workshops, and web site development all would aid in education and dissemination, and none are mentioned. The establishment and broad acceptance of a set of solid performance objectives that include features of mobility *and* the environment are crucial to effectively using the MPOs' resources (*13, 14*). Even so, the local conditions, changing regulatory environments, and the variation among MPOs in their talents and resources would make such a list obsolete even before it could be distributed. It is much more appropriate to

get our MPOs on a track to locating resources that they can use to build on. Substantial staff and funding commitments are a result of air quality planning. Avoiding the ramifications of adhering to air quality regulations to make life easier for the MPO staff and boards is a short-range position at best, and one that doesn't preclude additional efforts to deal with the regulatory requirements. It seems likely that these requirements will continue close to their present form, and unlikely that they will be substantially repealed.

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North Carolina Department of Environment and Natural Resources, Division of Air Quality (NCDENR DAQ) - http://daq.state.nc.us.
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University of Tennessee: Environmental Reporting/Links – http://excellent.com.utk.edu/SCICOM/airqual.html

SESSION 7 - TRANSPORTATION TOOLS THAT MAKE COMMUNITIES LIVABLE

Moderator: John Edwards
The RBA Group, Georgia

Panelists: Greg Pates, Minnesota Department of Transportation
Todd Chase and Tom Litster, OTAK, Oregon
David Godfrey and Tony Mazzella, City of Kirkland, Washington

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Session #7

Improving Small City Highways; New Techniques for Improving Safety and Livability Through Technology Transfer

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ABSTRACT

Highways provide needed access to destinations in small cities in addition to allowing through travel to other places. Many small city highways are very wide and traffic speeds excessively high. Extensive paved areas, narrow sidewalks, and little greenery has resulted in a dangerous, unpleasant environment for residents and visitors. Increasing traffic volumes and resulting highway reconstruction often make problems worse. City residents recognize these problems and would like to see design solutions that improve the safety and livability of their communities.

These problems are not unique to the US. Scandinavia has similar problems. Traffic in small cities accounts for a relatively small amount of total traffic, but for a large share of accidents and fatalities. This is especially true for pedestrian and bicycle traffic.

The Danish Road Directorate, Norwegian Public Roads Administration, and Finnish National Road Administration have constructed "Environmentally Adapted Throughroad" pilot projects to address these problems. They have done research, published reports, and revised their highway design guidelines as a result. Designs focus on 1) moderating traffic speeds and fitting motor traffic into city land-use; 2) increasing the safety of pedestrian and bicycle traffic; 3) supporting the cityscape and livability with highway design; and 4) taking all community impacts into account when planning and reviewing proposed design alternatives. The planning technique of "roadway segmentation" is key in addressing these areas.

Positive results have occurred. Traffic speeds and accidents are down, and small city environments have improved. Residents are satisfied with the changes.

This paper presents the history, concepts, processes, and results of the Scandinavian activities. The information comes from reports and from interviews from an FHWA Study Tour that included myself. The reports include: a) "Danish Road Standards, Part 0, Road Planning in Urban Areas" -1991, b) "Danish Road Standards, Part 7, Speed Reducers" - 1991, c) the Danish "A Catalog of Ideas" -1993, d) Miljoprioriterede gennemfarter, Effekter i 21 byer, Rapport nr. 70, Danish Road Directorate" - 1996, e) Improvement of Small City Through Roads" -Finnish National Road Administration - 1993, f) "Summary from the Norwegian Street Enhancement Program" -1996, and other reports..

The paper includes a bibliography and contacts list.

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INTRODUCTION

Scandinavian Road Agencies, in cooperation with local governments, have constructed and researched "Environmentally Adapted Throughroads" in small towns. The roads are designed to balance traffic and environmental improvements. The Danes have a unique name for this process of conversions - "Traffiksanering' or "traffic made sounder."

The population of these pilot towns ranges up to 10,000 in Finland, with similar populations in Denmark and Norway. Experiences from the towns apply to stretches of highway between 470 and 2891 m long and longer in Denmark, between 400 and 750 meters long in Norway, and of similar lengths in Finland. ADTs typically range up to 16,500.

Why Throughroads?

Previous actions on residential roads along with differentiation of traffic resulted in many long and straight residential and distributor roads with excessive traffic speeds. Traffic roads, with resulting greater traffic and drivers with less respect for speed limits cause most serious safety and environmental problems.

Throughroads carry a small amount of total kilometers traveled but a significantly larger amount of personal injury or fatality accidents (PIF). In Finland in the early 1990's, throughroads accounted for about 6% of Public Roads length, 17%of overall kilometers traveled, and 27% of all PIF.

Throughroads are the "Main streets" of small towns; years of road construction for motorized traffic only (starting in 50's/60's) resulted in building removal, wide paved roads and parking, less greenery, etc. Residents of towns are unhappy with this condition.

History of Throughroad Improvements, Policy and Pilot Projects:

1960's - Traffic Differentiation created the separation of heavy, fast traffic from light (bicycle and ped) traffic, and slow traffic. Problems with inconsistent coordination of land use and traffic planning resulted in light traffic using paths and primary (arterial) and distributor (collector) roads not designed for such traffic. Residential and local distributor roads became long, with excessive speeds. Grade separations were expensive, and local road closures resulted in long detours.

<u>Denmark</u>

1970s - "Woonerven" improved residential roads and raised awareness of traffic calming. The Danish Road Traffic Act of 1976 (shared local roads), and "Silent Roads" (local), were successful in residential areas. There was reconstruction to remove black spots and other safety improvement on throughroads, but no real "traffic calming."

1980s - Danish Road Directorate (DRD) published "Highways through Towns - a Catalog of Ideas -1981" showing how car speeds could be reduced, bicycle and pedestrian service and safety improved, and environment improvement. Pilot projects constructed on arterial highways in three towns with ADTs of 3-4,000. Effects studied in the "EMIL-project" (Consequence evaluation of environmentally adapted throughroads). Most results positive: reduced speeds, improved safety, reduced environmental impacts, inhabitants and road users happy with changes. This resulted in

more pilot projects in towns with ADT's of up to 20,000.

1990s - Road Standards for Urban Areas - 1991, published by DRD, coordinates traffic planning based on speed differentiation with the definitions of traffic and local roads in the Danish Municipal Plan Act (1984). 1992-1994 saw planning and construction of conversions of throughroads in 25 Danish towns based on 1991 Road Standards, etc. Again, largely positive results have occurred.

Finland

1960s/70s - Sidewalks installed along thoroughfares of most Finnish built-up areas (BUA). Typical thoroughfare had extensive paved areas, wide roads, narrow sidewalks, poor safety for bicycle and pedestrian traffic.

1980s - Throughroad design and construction based on the "Design Directive for BUA Thoroughfares"(1984) by Finnish National Road Administration (FinnRA). Goals included taking the existing environment into account and improving it, clarifying traffic arrangements and safety, and improving the level of service for bicyclists and pedestrians.

1990s - "Throughroads built in the 1980s; Villagescape and Functionality Survey, published effects. Speed constraints were not used as design features; average travel speeds were close to the speed limit but the speed limit was often greatly exceeded. The environment or "villagescape" were not sufficiently taken into account resulting in the road dominating the environment. "Improvement of Small City Throughroads" published in 1993 to address previous shortcomings. Six case study towns were chosen to apply the new design principles and concepts. RFPs and competitions for designs were held. In 1995 the first follow-up study of the case towns published for Rantasalmi. Results include improved safety (esp bicycle/ped traffic), improved environment, improved access, and residents and drivers were pleased with the results.

Norway

1991-1995 - Environmental Priority Thoroughfare Program established by Norwegian Public Roads Administration (NPRA)constructs trial projects in five towns to obtain more information on the effect of re-designed streets and to generate more attention and interest in environment and traffic improvements. In 1992 the "Road and Street Design" manual was published by NPRA. Re-introduced the "street" as more than just an artery; also an urban design element and commercial/social arena. In 1995 the Hearing Draft for updated "Roads and Streets" was developed to deal with traffic construction in urban areas and cities. "City life - the Street as a Social Arena" R & D project of 27 streets and town squares was also started to acquire knowledge about urban social activities as a premise for street design.

1996 - "Street Enhancement: Summary from the Street Enhancement Programme" was published by NPRA, presenting a summary of experiences from the trial projects. A comprehensive report and individual reports are to follow. Effects include reduction in traffic speed, reduction is also expected in accidents, parking is more orderly, the visual environment improved and outdoor uses increased.

1997 - Four reports on the City Life R & D programme published by the NPRA.

APPROACHES TO SOLVING THROUGHROAD PROBLEMS:

A main thoroughfare through a town must serve several functions - through-traffic, bicycle and foot traffic, local traffic, shopping, and everyday use by the townspeople. These requirements involve numerous interests and services (sometimes viewed as conflicting), which can be addressed in different ways. Strategies are often categorized as:

A: Bypass Roads

A new road is built leading through-traffic outside the town center.

B: Main Thoroughfare with through-traffic priority

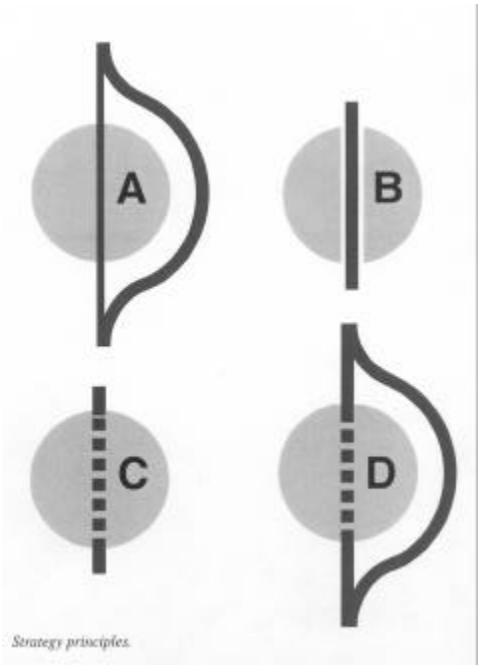
Traffic on the main thoroughfare has priority, employing e.g. medians, safety fences, guide rails, limited access, priority for through traffic and speed limits of 60 km/h (35-40 mph) or higher

C: Environmentally adapted throughroad main street

The thoroughfare gives priority to local functions and is adapted to the local environment. Bicycle and pedestrian traffic and local road traffic are provided with good accessibility, while through-traffic has somewhat lower priority.

D: Bypass and enhanced main street

A combination of Strategy A and C. This solution satisfies the requirement for environmental improvement of the old main road when a new bypass is built.



Strategy principles.

Environmentally adapted throughroads do not necessarily reduce the amount of traffic in a town. Bypasses can provide good results where there is a high volume of through traffic. However, environmentally adapted throughroads will often be quicker and cheaper to build than a bypass, conflicts arising from taking R/W for roads are avoided, and they will physically and socially improve the local environment.

THROUGHROAD DEVELOPMENT PRINCIPLES

The goals of Strategy C (and the old main road of Strategy D) are to improve traffic safety and services, and the local environment. The main development principles for traffic and land-use are very similar in all the countries and are:

A clear town plan and road network plan must be done for major investments, such as road conversion, in built-up areas.

Multi-disciplinary collaboration and cooperation between planners, engineers, architects, landscape architects, residents, property owners, road users, and sometimes artists, is required.

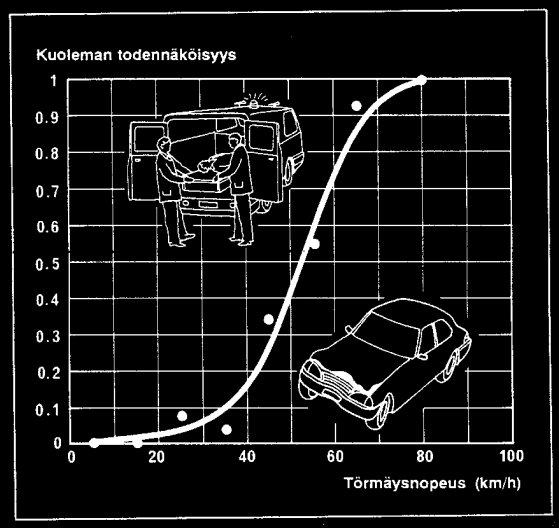
An open planning process is needed to search for common ground in values, to acknowledge

the significance of conflicting values, reach consensus about problems, environmental and traffic goals, and terms imposed by the environment.

Improving bicycle and pedestrian traffic service and safety, based on light traffic network needs and links, is of major importance.

The speed limit (and desired operating speed) on downtown roads or other sections must be reduced to 30 to 40 km/h (20-25 mph) to improve traffic safety. Research in Scandinavian (and other countries) shows that the probability of a pedestrian fatality increases exponentially when the motor vehicle impact speed is over 40 km/h (25 mph). Diagram 5/7, from Finland, illustrates this principle.

5/7. Probability (K) of a pedestrian fatality in an accident as the function of impact speed (Vt).



Throughroads should be developed as a **common space** to be used by all residents of the community, meeting the social needs of various user groups.

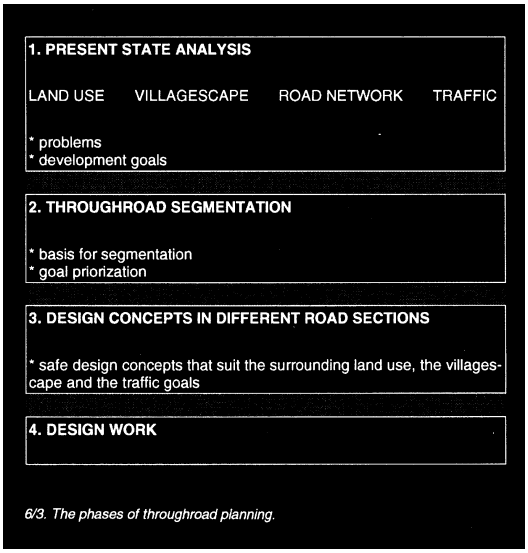
Changes in the community structure and environment should take into account along with construction, maintenance, and traffic costs.

Preserve or rediscover the small scale and richness of detail of the road and its environment. All existing building and trees should be preserved. Road surfacing materials, lights, street furniture, and other details should conform to the basic design and character of the area concerned.

Spatially limited and narrow road sections should be kept as is. Wide open thoroughfares can be sub-divided using parking, paths, sidewalks, green spaces, etc.

THROUGHROAD PLANNING PHASES

Throughroad improvement design begins with drawing up a schematic plan. In this plan, the different development alternatives are examined in parallel with land-use planning. All basic decisions on traffic arrangements, and any land-use solutions linked with them, are made in the schematic plan. Technical designs are examined only to check their feasibility and that their costs and other effects can be studied.



6/3. The phases of throughroad planning.

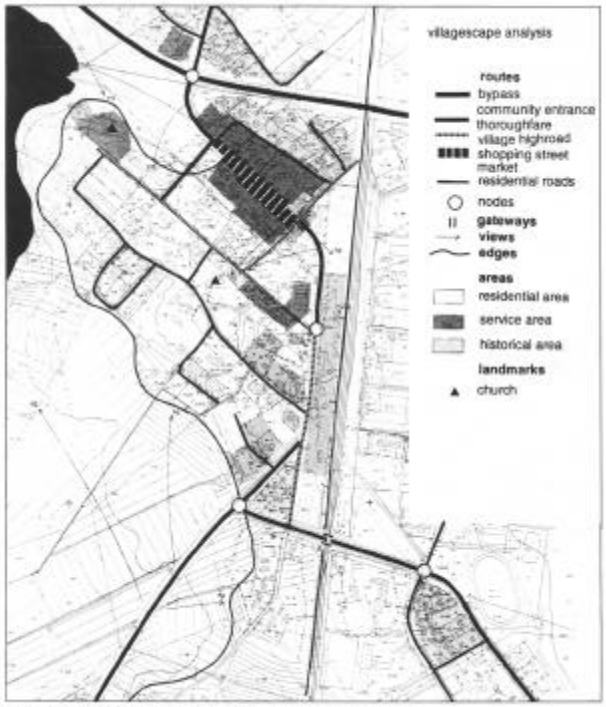
Throughroad design, from the "present-state analysis" to the details of individual design concepts, requires an open planning process with close cooperation between

land-use, villagescape, and traffic planning expertise. Residents, road users, focus groups, businesses, landowners, and others should involved to gain their opinions, experiences, and expertise. They may be involved through questionnaires, open houses, planning workshops and design charettes, and theme days, etc.

Formalized open meetings and work seminars involving general discussions of solutions should be held up to the detailed planning/design phase. It is important to include directly involved interests and individuals in the work. In many projects, information brochures were distributed to residents and businesses, and project material was exhibited.

Throughroad Analysis

The drafting of a schematic plan begins by preparing a comprehensive analysis of the present situation. This is used as the basis of throughroad segmentation and design. The analysis studies:

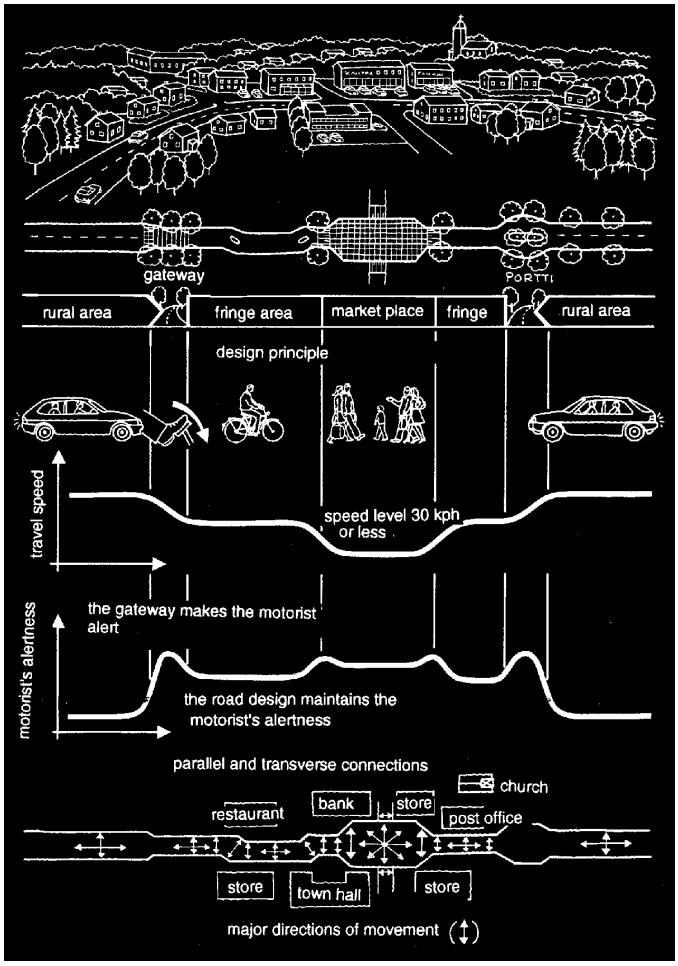


6/4. Example of a villagescape analysis in a small rural built-up area. Viharn.

- Land Use and the Functional Structure in the Built-up Area
    - -the present structure, functions, the need for links between them, and shortcomings
    - -center point of the built-up area
    - -realistic estimate of growth and the potential for change
- Villagescape
    - -originality and positive features of the environment
    - -problems requiring correction
    - -sites to be preserved, environment imposed constraints on land-use and road design
- Road Networks (including Light Traffic Networks)
    - -the status of the road in the national and area networks
    - -speed level goals in different parts of the road networks
    - -road network history and goals
- Traffic
    - -traffic function
    - -traffic safety situation
    - -functional goals

Throughroad Segmentation

A throughroad consists of separate, discrete sections. A section is a stretch of road in which problems and properties of the road and its environment are fairly constant. It begins with an approach section, often followed by a section where construction is denser before the shopping street section. The character of the traffic in each section is defined by the functions along the road and its' status in the road network.



Segmentation is used to make it easier to define the development goals for each road section and to find solutions to traffic problems while taking environmental factors into account.

Sections are defined at the goalsetting stage of design based on inventories and problem analysis. Both environmental and traffic properties are examined in a section of throughroad.

The design concepts used in a section of road should be based on its traffic goals and environmental properties. For instance, two shopping street sections in different towns, though similar in function and status, may differ greatly in spatial delimitation and scale. Particular care

must be taken with historically valuable and homogeneous environments.

Changes in the road environment and the reason for various road design features must be evident to road users. At the boundaries between sections, design work should make use of environmental features and technical means of traffic guidance.

Elements used to achieve main development principles

Many different types of geometric design, material, and visual elements are used to achieve development principles and section goals and designs.

Figure 17 from the Danish Road Guidelines addresses the appropriate application of main types of speed reducers. Types 1-8 are appropriate for throughroads (traffic road, desired speed < 40-50 km/h, and both ADT ranges).

Other elements include: medians, roundabouts low speed intersections, curbside parking, lighting, planting, and street furnishings,

Main Type	Road Class		Desired Speed (km/h)			Annual Day Traffic (ADT)	
	Traffic Road	Local Road	≥60	50	≤40	>3000	≤3000
1 Pre-warnings	x	x	x	x	x	x	x
2 Gates	x	x	x	x	x	x	x
3 2-lane raised areas	x	x		x	x	x	x
4 2-lane humps	x	x		x	x	x	x
5 Staggerings	x	x	x	x	x	x	x
6 Staggerings with raised area	x	x		x	x	x	x
7 2-lane narrowings from road centre	x	x		x	x	x	x
8 2-lane narrowings from roadside	x	x		x	x	x	x
9 Narrowings to 1 lane	(x)	x			x		x
10 Narrowings to 1 lane with raised area	(x)	x			x		x
11 Narrowings to 1 lane with humps	(x)	x			x		x
12 Staggerings with narrowing to 1 lane	(x)	x			x		x
13 Staggerings with narrowing to 1 lane and raised area	(x)	x			x		x
14 Staggerings with narrowing to 1 lane and humps	(x)	x			x		x

(x): To be used only in special cases

Figure 17. Applications of the 14 main types

Standard cross-sections should not be used. The traveled-way cross-section, curb to curb, should be based on low travel speeds. Widths of 5.2-7.0 m (17-23 ft) are suitable, with 6.0-6.5 m (20-21.5 ft) widths the most commonly used. Traffic volume does not effect traveled-way width.

Sidewalks and bicycle lanes or tracks (one-way paths) service light traffic. Crossings between bicycle and pedestrian traffic and parking cars should be minimized.

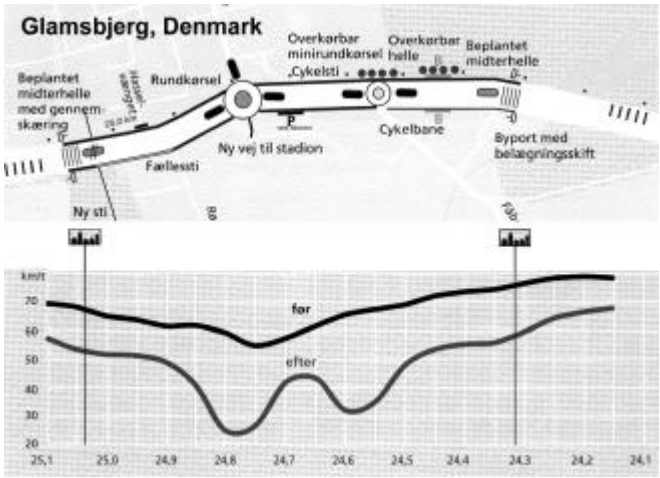
Bus stops can be built without bays, in which case stopped buses act as constraints.

EXPERIENCES AND RESULTS

Traffic Speeds

People drive slower and at a more even speed in the majority of locations. Average speeds have been reduced from 10 to 30 percent, and the speed ranges have also been narrowed. Top speeds have been appreciably reduced. The 85th percentile speed also shows sharp reductions, for example, averagingabout a 10 km/h reduction in Norwegian trial projects. The chart illustrates the

average before and after speed levels in Glamsbjerg, Denmark. Note the significant speed reduction through the use of roundabouts.



Accidents

Earlier Danish throughroad conversions show PIF accident reductions of 1/3 average. Many of the recent projects are too new to have adequate follow-up data. Similar results are expected in the newer towns. In rare cases, accidents stayed the same or increased slightly due to some poor design details, many of which have been corrected.

In Norway, there is reason to expect future accident figures to be reduced by 20-40%. In Rantasalmi, Finland, there were 5 personal injury accidents involving light traffic in the 5 years before construction; since improvements there have been none.

Significant reductions in light traffic accidents were common in all countries.

Modal Use and Traffic Flow

In many locations foot and bicycle traffic has increased. In some locations, auto and truck traffic may be reduced slightly. Through-traffic takes longer to pass through after reconstruction. In the smallest towns the delays are insignificant, only 4-5 seconds. In other towns, the delay may be up to 40 seconds. In many locations, access to intersecting roads and adjacent properties has been improved because of less speed difference between traffic.

Traffic Noise

Measurements in most locations show that traffic noise has been reduced slightly. This is attributed to reduced traffic speeds and/or volumes.

Residents and Road Users

In opinion surveys, the majority of residents and road users respond positively to the changes to the roads and to the environment.

Pedestrians and bicyclists tend to keep to the crossings created at new refuges and raised sections. In surveys, they felt satisfied with the new facilities and felt that their safety had improved considerably. Both residents and drivers have responded positively to the decreased speeds, and they liked the fact that the speeds had been lowered.

In some towns, a decrease in the number of parking spaces and the inconvenience of using them drew criticism. However, based on videotapes, there seemed to be enough parking spaces, at least on the days when the tapes were recorded, and using curbside parking spaces did not appear

difficult.

Maintenance

Maintenance costs may increase noticeably during the first summer and winter seasons after reconstruction. Winter maintenance problems include the extra care necessary to plow narrow roads, and bollards and plantings were easily damaged by plows. Curbs, raised sections, and parking bays also make plowing more difficult.

Spin-off Results

The pilot projects have contributed towards strengthening physical planning in the towns. In some locations the upgrading of the street was combined with replacement of utilities, resulting in a noticeable cost savings for municipalities.

Reports indicate that shopping has increased and there is a higher level of interest in new housing development in many locations.

CONCLUSION

The planning technique of "roadway segmentation," and the development of environmentally adapted throughroads, has produced many positive results in Scandinavian small towns. Traffic speeds and accidents are down, bicycle and foot traffic has increased, people feel safer and small city environments have improved. Residents are satisfied with the changes.

Scandinavian research in traffic speeds, traffic network planning, and the environment over the last 25 years has produced valuable information and guidance which would be of great benefit in small towns in the United States. Technology transfer activities can bring this information to interested individuals and organizations, where it can be appropriately applied in communities throughout the country.

Many public works professionals have embraced the idea of traffic calming on residential streets. Residents of towns large and small are making us aware of their desires for improved traffic safety and the environment. Information from Scandinavia is a resource that can be immediately used in meeting these needs and desires.

IMPROVEMENT OF SMALL CITY HIGHWAYS
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Session #7

Redesigning Main Streets in Small Communities
The Viagra of Transportation Investment

by
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Abstract

The national Main Street movement is building momentum. Over 1,200 small communities across America have rediscovered their Main Streets with impressive investment in time, energy and money. The tangible measures of return include: economic growth in jobs and tax revenues; effective "recycling" of infrastructure, buildings and land; a pleasing landscape environment; and more efficient transportation networks. This paper provides a brief background of the Main Street movement and describes design elements and other factors needed to make Main Street retrofit projects a success.

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Redesigning Main Streets in Small Communities
The Viagra of Transportation Investment

Traditions and Challenges

Main Streets define civic pride and create an important "place" in American towns. The birth of the classic American Main Street is rooted to the early part of this century--when our civic identity was reflected by closely knit shops, homes, offices, churches, and public spaces. Main Streets illustrated America's greatest tradition of success.

By the latter half the 20th Century, Main Street districts were in decline. Increasing competition from super regional shopping centers, power centers and sprawling suburban development, fed largely by state and federal highway projects that focused on increasing capacity for a burgeoning suburban populaton which resulted in an emphasis on mobility rather than preservation. These policies and social changes led towards a decline in Main Street investment, and in many cases a loss of traditional civic character.

The recent shift in federal and state transportation and land use policies, as embellished by the Intermodal Surface Transportation Efficiency Act of 1991, and the Transportation Equity Act of the 21st Century (TEA-21), emphasize moving people and goods (rather than vehicles) and enhancing transportation-efficient communities.

A National Main Street movement is also underway, with a host of successful case studies, lessons learned, and impressive results. In fact, the National Main Street Center estimates that over $5.8 billion has been reinvested in tangible improvements in 1,200 communities in 42 states since the 1980s. This represents a return of nearly $40 in private investment for each $1 of local public dollars spent [Johnson, Jan. 1998. Great American Main Street Awards Salute Downtown Revitalization in Five Communities, Preservation Magazine]. It is fair to say that these results please all player participants involved in Main Street planning, design and development.

Main Streets Defined

Main Street is an important place in the landscape of American towns. From a traveler's perspective, a town's "main street" is often an abrupt change in their continuous route along a state highway. It is also a traveler's dominant experience of a community's economic and architectural images. For some travelers , it may be a momentary stop with a pedestrian experience in a setting of more complexity than they would have noticed as a motorist. From a resident's perspective, a main street provides access to the town's public places and a setting for shared activities such as shopping, conducting business, and going to school. While main street is may not be a resident's dominant experience of their community, it does contribute to their sense of place and civic pride.

The classic American main street can be categorized in two basic types. The first type, found in thousands of communities with 2,000 to 25,000 population, is a linear main street which is really a

state highway passing through the town on its way to the next town. The highway becomes a commercial street, reaching an architectural climax that is usually only a few blocks long. Those few blocks create the sense of place thought of as "downtown" in most communities. What lies beyond downtown, visually and functionally, are vast corridors where mobility dominates with higher operating speeds.

The second type of main street is less common. This main street may also be part of a highway corridor and is equally linear. However, it leads to something more interesting than the rest of the highway. This main street is usually no more than a few blocks long, ending at a strong visual focus, such as a public square, a school, a civic building, or the junction of two roads. There is often a stronger sense of enclosure and architectural space compared to the first type of main street.

For both types of main street, aesthetic factors and the overall environment are critical factors in attracting and retaining businesses, shoppers, pedestrians, and motorists. Successful redevelopment efforts require careful planning to overcome the tendency of main streets in small communities to become little more than corridors and access points for vehicles in a hodge-podge of architecture and roadway signs.

What makes Main Streets successful?

The impact of transportation and changing consumer preferences have forced many Main Streets to change or suffer a slow death. Vacant department stores may get converted into smaller retail stores, offices or libraries. Specialty themes often emerge: antiques, eating and drinking, and retail boutiques--to lure consumers away from the "plain vanilla" shopping malls and power centers. Civic minded business leaders craft effective downtown promotions, events and coordinated marketing campaigns to offer choices to local residents.

As transportation and land use specialists we can influence the continuing success of Main Streets. To do so, we first must understand the fundamental components of successful main streets. Key ingredients of successful Main Streets in small to medium sized communities include:

- Dollars and Sense of Location
- Pedestrian is King (or Queen)
- Accommodate the Sunday Drive
- Streetscapes that Speak for Themselves
- Incremental Change--Attention to "Little Things"
- Proactive Champions that Leverage Returns

Dollars and Sense of Location - population density and demographics undergird the long-term success of Main Streets. A recent study titled, The Long Branch Main Street Project report, "41 Ways to Revitalize Main Street" (Toronto Metro Planning Department), examined positive and negative main street examples throughout the Toronto region. The study concluded that population density within a convenient walking distance (0.6 miles) made the most critical difference to continuing success of main streets. Because the majority of Main Street businesses

rely primarily upon local patronage, they tend to reflect disposable income levels and the overall economic health of small communities.

Pedestrian is King (or Queen) - accommodating pedestrians is as important (if not more so) than accommodating automobiles. Main Streets must look and feel like a good place to take a stroll, relax and safely move around by foot. Proper sidewalk connections along Main Streets and to adjacent population centers are both important. Consumer surveys in Lake Grove, Oregon determined that primary access to their main street is by car because walking and street crossings are perceived as too far or too dangerous.

Accommodate the Sunday Drive - go ahead and accommodate the "Sunday drive" because vehicular traffic is vital for retail businesses to survive, especially in small communities with dispersed development patterns. Since our dependence on cars will not wither away it is important to calm the street to slow down vehicular traffic. Once speeds are less than 30 mph, drivers begin to observe their surroundings more and become convenient candidates for a Main Street experience.

Traffic calming techniques have been well documented (see Washington State Department of Transportation, Pedestrian Facilities and Traffic Calming Guidebooks) in theory and practice. While most current examples are from larger cities and metropolitan areas, smaller Oregon communities such as Lake Oswego, Joseph, Klamath Falls and Hood River have used several traffic calming techniques to create a shared public use roadway and a unique driving experience. Most common techniques include:

- Redefining curbs (for tighter turns, bulb outs and ADA compliance);
- A consistent street grid with 200 to 240 foot +/- block spacing;
- Narrow street width;
- On-street parallel parking;
- Managing driveway and road approach access;
- Paving materials at crosswalks and street corners;
- Widening the sidewalk
- Raising crosswalks and providing center median refuge areas; and
- Including street trees and other landscaping;

Two-way traffic flow is usually preferred to one-way couplets when peak hour traffic is generally less than 2,000 trips per hour. However, these traffic calming techniques can work well in both situations.

Be careful to pay attention to truck movements and turning requirements. This includes designing for business services, by including appropriate on-street loading zones or service alleys. Designated truck routes may also be an effective means of limiting truck turning movements along Main Streets and reducing potential truck/vehicle/pedestrian safety conflicts.

These traffic circulation and calming techniques are important roadway design elements to be considered by transportation planners, landscape architects, and civil engineers. When used in

combination with building design and special streetscape features they create an effective Main Street environment.

Streetscapes that Speak for Themselves - People are attracted to interesting and continuous landscape patterns, attractive building frontages, shade trees, plantings, public art, and pathways. Once "off their seat and on their feet", drivers become pedestrians and patrons. As pass-by drivers witness pedestrian activity they too "get off their seat and on their feet" with reason to stop, explore, patronize or tour.

Important elements of streetscape design often include the previously mentioned traffic calming and pedestrian features plus:

- Landscape buffers for off-street parking areas
- Park benches, fountains, trash containers;
- Pedestrian activated street crossings;
- Maps of businesses or areas of interest
- Decorative details, such as hanging baskets or banners;
- Building facade enhancements, including unified signage or awnings; and
- Public art displays.

Incremental Change--Attention to "Little Things" - When redesigning a Main Street think small at first. Start with one or two blocks in the core of downtown. Focus on details and build upon unique features in the community. Start incrementally with affordable, tasteful and effective improvements that have broad based public and private acceptance. Involve local property owners, chamber officials, neighborhoods, and elected officials in the planning and design process. Small victories instill community confidence in Main Street revitalization and belief that complex problems can be solved.

Always anticipate construction staging problems regarding reduced traffic access, parking limits, and peak seasonal sales periods. Never stage construction around holiday shopping seasons such as Thanksgiving or Christmas. Make sure you involve local businesses in construction mitigation planning to offset undue burden caused during construction. There of course will be some sacrifices made, but in the end almost everyone will benefit from the improvement.

Proactive Champions that Leverage Returns--successful Main Streets have many champions. Individuals and associations must be committed to "the vision" before, during and after construction. To redesign your Main Street you must first identify who are the local champions, and confirm their role in:

- Raising public awareness of project need and importance;
- Generating support by property owners/tenants and elected officials;
- Solidifying funding partnerships for capital and maintenance costs;
- Establishing a formal design review process;
- Maintaining and promoting Main Streets once improvements are made; and
- Downtown economic development and clearing house for funding/financing.

Back to the Future

The National Main Street movement will surely gain momentum in the 21st Century as communities commemorate their unique civic culture. Future funding also looks promising. Under the congressional transportation bill TEA-21, funding is established in several programs that benefit Main Street retrofit design projects: surface transportation program, special enhancement program, congestion mitigation air quality program, and the new Transportation and Community and System Preservation pilot program.

Communities throughout the northwest are finding that Main Street improvements are cost effective means to revigorate businesses and stimulate economic activity. When along state routes, Main Street design and traffic calming projects can leverage private investment and can lead to increased state access control--which helps preserve the capacity and function of state highways.

As you partner with local and state interests on your next Main Street project, take solace in the fact that you are about to have a measurable positive affect on a community by enhancing its image and economic vitality.

Session #7

SUCCESS IN REDESIGNING MAIN STREETS FOR PEDESTRIANS

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ABSTRACT

In the fall of 1997, the City of Kirkland installed small flashing LEDs in the pavement at two crosswalks. The systems were purchased from LightGuard, Inc. of Santa Rosa, California, and installed by City crews. The LEDs are mounted in snowplow-compatible aluminum housings that are similar in appearance and installation to raised pavement markers. Devices are installed across all travel lanes for both directions of travel on each side of the crosswalk. When activated, lights in the pavement flash at drivers across the entire roadway in both directions. Pedestrians wishing to use the crosswalk activate the flashers using standard pedestrian pushbuttons and the LEDs flash in a proprietary manner via a small solid state controller, for a programmable amount of time. The paper summarizes Kirkland's successful use of the LightGuard devices through:

- Background discussion of how Kirkland came to try the device
- Explanation of the devices and their installation
- Results of a comprehensive before-and-after study
- Response of general public and elected officials
- Summary of application guidelines

Additionally, the presentation will use videotape to thoroughly explain the devices and give the audience a feel for device performance.

Flashing crosswalk devices are particularly suited to small communities because:

- They work well in relatively isolated/high speed settings
- Cost of materials and installation is around $15,000
- They are more effective than normal "constant on" overhead flashers, yet a fraction of the cost of traffic signals
- They allow local officials to respond in an effective, reasonable way to the traditionally difficult issues of school and pedestrian safety concerns.

Before they were installed in Kirkland, LightGuard devices were installed in a number of small cities in northern California. They have been approved by the California Committee on Traffic Control Devices, and Kirkland has received official FHWA authorization to experiment with the units. Additionally, before-and-after studies are being funded by FHWA.

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Success in Redesigning Main Streets for Pedestrians

Introduction

Located in the Puget Sound region, Kirkland Washington is a suburb of Seattle and has a population of approximately 50,000. The Kirkland City Council recognizes pedestrian safety and walkablitiy as key components in the livability of the City, and pedestrianism has been a theme of the City for some time. The In-Pavement Flashing Lights Crosswalk Warning System ("Flashing Crosswalk") is a series of flashing light units installed just below the pavement surface along the crosswalk lines and facing traffic. Its purpose is to warn drivers of the presence of a pedestrian about to cross or already in the crosswalk at uncontrolled intersections. In an effort to increase pedestrian safety, the first two flashing crosswalks installed outside of California were installed in fall of 1997, at mid-block locations in Kirkland

This paper describes Kirkland's experience with flashing crosswalks, including how the system works and how it is installed, effectiveness, response from the public and application criteria. In general, the flashing crosswalks are considered to be a success both in terms of their effectiveness in causing vehicles to respond to pedestrians and in terms of their public support. In fact, at the time of this writing, Kirkland is receiving bids for an additional 14 systems.

History

In 1993, in response to an unusually high incidence of pedestrian/vehicle collisions resulting in a significant number of pedestrian fatalities and injuries, the City of Santa Rosa, California introduced a new concept in proactive pedestrian warning systems for uncontrolled crosswalks, known formally as an In-Pavement Flashing Lights Crosswalk Warning System.

The idea for the system originated with a private citizen who is a pilot and believed that the strobe lights used on runways to help pilots land their planes might be useful in providing greater protection for pedestrians at crosswalks.

The California Traffic Control Devices Committee allowed the City of Santa Rosa to test the device at selected locations; and the California Office of Traffic Safety granted funds to the City to study the effectiveness of the device. In 1994-95, the system was installed at three locations in Santa Rosa and between 1996-97 at locations in the California cities of Fort Bragg, Lafayette, West Hollywood, Willits and Orinda, and two locations in the City of Kirkland, Washington. Funding to evaluate the effectiveness of the device in Kirkland was provided through the Federal Highway Administration *Pedestrian Facilities Program* which is being conducted by the University of North Carolina Traffic Safety Research Center.

The City of Kirkland first became aware of the device through a communication by the State of Washington Traffic Safety Commission (WTSC) which knew of the City's interest in pedestrian safety innovation. Based upon conversations with the manufacturer (LightGuard Systems, Inc, Santa Rosa, CA) and other user cities along with materials provided by those parties, we decided

to propose to our City Council that we experiment with the device. WTSC generously offered to provide $10,000 toward the installation costs.

System Description

The flashing crosswalk systems installed at Kirkland consist of heads imbedded in the pavement, a controller and push-button activation devices, as shown in Figure 1. Heads were installed at seven locations perpendicular to the crosswalk across both approaches and across all lanes to increase visibility and command attention. Illumination is provided by LED banks in each head which sit behind a clear lens. At the recommendation of the manufacturer, the heads are mounted at varying low angles to the roadway centerline, and aim at points 250, 300 and 350 feet down the roadway and at various positions across the traveled way (see Figure 1).

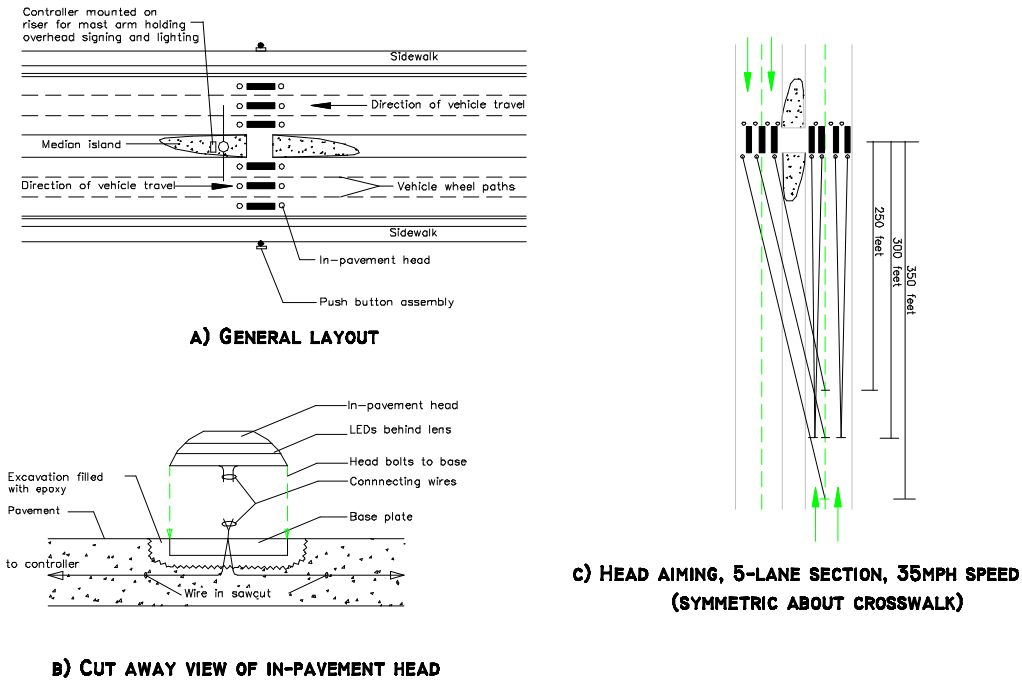
Earlier California devices used plastic heads to contain the LED units; snow plowing considerations in Kirkland required design of a snow plow resistant head. This requirement caused the manufacturer to develop a more durable aluminum head which bolts to a recessed plate. Recently, an even lower profile head has been developed. The winter of 1997-1998 was a relatively mild one in the Puget Sound and the devices were not rigorously tested. Even in the worst weather years, Kirkland does not see much snow plowing and rubber bladed plows are used. All new locations will use heads with a lower profile which will minimize the effects of snow plowing.

The device is controlled by a solid state controller unit mounted in a standard type NEMA housing. The controller is capable of flashing the LEDs for a variable amount of time, counting the number of pedestrian activations, and dimming the displays; a time clock can initiate a constant activation or allow the head to burn steadily. Because it is designed to work from a 9 volt power supply, the cabinet also contains a back-up battery which can power the crosswalk for several hours of operation.

The flash rate of the LEDs is a proprietary rate consisting of, in simple terms, two quick ons followed by a longer on followed by a long off. This flash cycle is approximately 3 seconds long and was designed to maximize the effects that attract viewer's attention while not causing negative side effects to those sensitive to flashing lights. Kirkland sets the flasher to remain active for a time interval in seconds equal to the number of feet of the crossing divided by 3. Observations show that this time is reasonable for most pedestrians. Optimally, the time would be long enough to protect the pedestrians but not long enough to show vehicles flashing heads when no pedestrians are present. Pedestrians activate the device, wait for traffic to clear the crosswalk or come to a stop, and then begin to walk across the street. Studies in Kirkland show that the 85th percentile walking speed is considerably more than 3 feet per second so that the extra time allowed for in the crossing interval used for vehicles to stop is compensated for by the walking speed.

Several methods for activation have been used by practitioners in different areas. The most straightforward of these methods uses a push button similar to those used in standard traffic signal installations and are used in Kirkland. The buttons used in Kirkland's installations include

FIGURE 1: SCHEMATIC OF TYPICAL KIRKLAND FLASHING CROSSWALK



an array of LEDs on the button mounting housing that flash when the in-pavement heads flash. Pushing the button while the crosswalk is flashing causes the timer to reset and a fresh timing interval to begin. Observations in Kirkland have not shown that pedestrian buttons cause a "false sense of security" as evidenced by caution pedestrians use after they push the activation button.

Activation schemes that are passive to the pedestrian are used following the assumption that pedestrians will exercise more caution if they do not know the crosswalk is flashing. In other cities, microwave detectors have been used with limited success; the devices were not able to detect 100% of pedestrians. Video detection as used in traffic signals have been used with more reliability. LightGuard Systems, Inc. has developed a bollard system that activates the heads when a pedestrian passes between the bollards. Whitlock & Weinberger[1] indicate that an automatic detection system is more appropriate than a push button system.

Costs

The first two systems in Kirkland were installed for $25,000 (plus $10,000 in grant funds from the Washington Traffic Safety Commission). The City purchased equipment from LightGuard, Inc. and they were installed by City crews. A recently bid road project had two flashing crosswalks

(installed) and the low bidder submitted a unit cost of $18,000 each. The latest bids received on a project to install 14 crosswalks came in at $15,000 per location.

Installation procedures

Siting and installing the in-pavement heads is the most complicated portion of the installation procedure. In Kirkland the heads were aligned with the pavement markings of the existing zebra style crosswalk the zebra stripes were laid out to be outside wheel paths (figure 1a). Manufacturer's recommendations were followed for the number of heads to be used. Once the locations and number of heads were determined, alignment relative to the centerline was set again following manufacturer's recommendations. This was accomplished by stationing a person at the head and another then at the appropriate upstream location. Working after dark, a laser leveling device was sited on the target and then rotated across the head location and the appropriate angle marked on the pavement. Simpler methods for aiming the heads can also be used satsifactorily.

At the location of each head, pavement was excavated by heating it with a torch and scooping it out using hand tools to make a hole just slightly larger than the base plate of the head (figure 1 b). A narrow bar about a yard long was bolted to the base plate, and placed in the excavation so that the bar suspended the base plate in the hole and ensured that the head was properly aligned relative to the centerline and flush with the pavement. Fast curing epoxy poured around the base adheres it to the pavement. When the base is set, the flashing head is bolted to the base and connected to the wires coming from the base.

Wire from the pushbuttons and heads is run across the pavement in sawcuts and sealed in a manner similar to that used for inductive loops at traffic signals. Conduit carries the wires under the curbs from the pavement to the push button locations. At the first two Kirkland locations, overhead illuminated signing was already present in the median, and this made a convenient location for the cabinet installations and source for AC power. Because the system runs on a 9 volt power supply, solar power is an option, but since AC power was readily available, solar power was not used.

Before and After Study

Whitlock & Weinberger Transportation, Inc. (W-Trans) of Santa Rosa, California, under a contract with FHWA (through University of North Carolina Highway Safety Research Center) conducted before and after studies on the effectiveness of flashing crosswalks[2].

Data was collected using conflict/behavioral sampling techniques since collecting adequate accident data would take five to ten years of after experience. A staged "test" pedestrian was used to ensure consistency; driver reaction to the pedestrian both looking to cross the street and stepping into the roadway was measured using four variables:

- Approach speed (from 500 to 300 feet from the crosswalk).
- Travel time and deceleration (from 500 to 100 feet from the crosswalk)
- Braking distance (distance from the crosswalk where vehicles began to brake)

- Driver reaction (what did the driver do: yield to pedestrian, react but did not yield, did not yield)

Data was collected manually using stop watches and markers pre set at 100, 300 and 500 feet in advance of the crosswalk. Measurements were made both before and after flashing crosswalk installation in both daytime and nighttime conditions.

Table 1 summarizes the results of before and after studies at each location. The data suggests that the devices are effective in both increasing the number of drivers that yield to pedestrians and the distance from the crosswalk where drivers apply their brakes.

TABLE 1 Results of Before and After Studies on two sites in Kirkland

Location	Heading	Light	Before After	Distance from crosswalk when brakes applied (ft.)	Drivers yielding to Peds (Percent)
Central Way	East	Day	Before	200	62
			After	278	92
		Night	Before	115	16
			After	238	100
	West	Day	Before	192	59
			After	244	94
		Night	Before	175	27
			After	270	98
NE 124th Street	East	Day	Before	209	46
			After	214	85
		Night	Before	204	65
			After	244	93
	West	Day	Before	271	55
			After	312	92
		Night	Before	266	48
			After	304	97

Notably, the night time yielding percentage at Central Way in the eastbound direction went from 16 to 100 percent. In fact the lowest yielding after percentage at Central Way was 92 percent. Increases in braking distances were similar to the increases in yielding drivers. Results were similar but not as dramatic at the NE 124th Street location.

The performance of the devices was similar at most of the other 10 locations covered in the W-Trans study. This led to their finding that "The concept of flashing amber lights embedded in the pavement at uncontrolled crosswalks clearly has a positive effect in enhancing a driver's awareness of crosswalks and modifying driving habits to be more favorable to pedestrians."[3]

Following installation of the two flashing crosswalks, and an article on the device which appeared in a City publication which is sent to all households, the City received many comments by phone, letter and in-person from the public. Almost all were highly favorable and supportive of additional installations. Specific statements included:

"I'm really impressed. I do a lot of walking...at least now you can get across the street...I'd like to see them all over town."

" We think they're great, especially when you can't see well, like in times of darkness. We love it for kids walking to school."

"They sure draw attention to the crosswalk. Now I feel more comfortable sending my son downtown and I feel more comfortable driving."

The only negative comment came from a bicyclist who expressed concern over the possibility of striking a lighthead while riding his bike. Lightheads were away from the wheelpath of a bicycle, and in future installations we will continue to work to avoid this potential conflict.

A more formal recognition of Kirkland's effort to improve the pedestrian environment came from WTSC which presented the City with the first annual Community Excellence award for innovation in pedestrian facilities. With the award came a $1,000 grant.

Since the installation of the two flashing crosswalks, Kirkland has received numerous inquiries from other local government jurisdictions about the device. The City of Seattle has installed the system at a busy crosswalk near a private university campus; the City of University Place, Washington plans an installation as part of a roadway improvement project and we expect other localities to follow suit. The Institute of Transportation Engineers (ITE) has constituted a technical committee to develop application guidelines.

Installation Criteria

When the City Council contemplated construction of an additional set of flashing crosswalks, it became obvious that a system was needed to select and prioritize locations. Since the City had recently completed a system of ranking other Capital Improvement Projects, a similar process was envisioned for flashing crosswalk prioritization. A committee of citizens that had worked on the earlier priority ranking was reconvened to develop ranking criteria. City Staff prepared an initial set of criteria and then ranked a set of test locations to get an idea of how the criteria work.

A major point of discussion that is a sample of the types of discussion that took place was whether to give more points to locations that already have protective devices. One theory held that if a location has improvements such as medians and overhead signing, it is a good candidate for flashing crosswalks since the level of improvement reflects its validity as a location into which more improvements should go. The other philosophy said that flashing crosswalks at locations already benefiting from improvements should be delayed with improvements coming at less developed locations first. This second approach was adopted. Similar discussions took place around other issues with the criteria ultimately being approved as shown in Table 2.

TABLE 2 Criteria for Locating Flashing Crosswalks in Kirkland, Washington

I. Threshold criteria:
Location must have a marked crosswalk and stopping sight distance must be adequate for approach speed.

II. Engineering (30 points max)
Approach speed 85th percentile (MPH)

Speed	Points
<20 or >45	0
20-29 or 41-45	4
30-35	8
36-40	12

ADT (000)

Volume	Points
<5 or >30	0
>5-<15 or >25-<30	8
>15-<25	16

Cost
(Above standard costs)

Cost	Points
Other	0
Small or no additional cost	2

III Connections (35 points max)
00 of feet to nearest crosswalk

Distance	Points
<5	0
>5-<10	4
>10-<15	6
>15	9

What type of facilities does the crosswalk cross and/or continue?
(Priority 1 and 2 Pedestrian facilities are defined in the Non-Motorized Plan.)

	Points		
Continues\Crosses	P1	P2	Other
P1	8	6	4
P2	6	4	2
Other	4	2	0

Is the crosswalk on school Walk Route?
Yes, 6 points

Is the crosswalk near schools, community facilities, etc.?

	Distance to Center	
Activity Cntr.	< 1/4 mi.	<1/2 mi
School	3 pts	2 pts
Com. Facility	2 pts	1 pt
Business Dist	2 pts	1 pt
Transit/HOV	1-2 pts	0.5-1 pt
Regional Cntr	1 pt	0.5 pt
Connect w/in Business Dist	1pt.	

IV Safety (35 points maximum)
Does the crosswalk serve a vulnerable population?

Yes 13 points

What is the ac
crosswalk?
Experience
Less than Ave
Average
More than Av

What improv
Improvements
Striped crossv
Striped+Medi
Striped+O'hea

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[1] Whitlock & Weinberger Transportation, Inc., *An Evaluation of a Crosswalk Warning System Utilizing In-pavement Flashing Lights,* April, 1998, p. 2
[2] ibid
[3] ibid

SESSION 8 - PUBLIC INVOLVEMENT: BETTER RESULTS FROM FEWER DOLLARS

Moderator: Janet Bell
Jefferson County Planning Department, Colorado

Panelists: Janet Bell, Jefferson County Planning Department, Colorado
Lee Shoemaker and Tom Schwetz, Lane Council of Governments, Oregon
Carol O'Doud, Athena's Consulting Network, Colorado

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Session #8

Public Involvement – Low-Budget Can Mean High Effectiveness

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ABSTRACT

Public involvement on a small budget can result in a more effective outreach process. When an agency has more time than money, public involvement truly can start at "the earliest possible moment."

Your community has untapped resources that can increase the time and money you have available. Once you start to identify stakeholders and existing organizations in the area, public involvement begins, with people designing, publicizing and implementing a process that **they** have developed.

Where and how you find these unrecognized resources and gain their support will be the focus of this presentation. In addition to examples of simple approaches to get your community active in transportation planning and problem solving, you will hear about the advantages of alliance building and volunteer contributions.

One example will be "The Cousins Technique."

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PUBLIC INVOLVEMENT ON A LOW BUDGET CAN MEAN HIGH EFFECTIVENESS

Public involvement must start at the earliest possible moment when your agency does not have the resources needed to do “good” public involvement. Because you have limited resources, you have to ask for help from the agencies, departments, neighborhood groups, business, civic, professional, religious, and social organizations. The more that people and groups “help” you, the more folks will talk about helping, and more people will want to help. The more the “cousins” tell other "cousins", the more human resources will become available for you. Your planning process and project implementation programs can become the “IN" thing to do in your town.

Many organizations and businesses provide their members and employees with training in group process e.g. problem identification, facilitation, conflict management, and consensus decision making. Social service providers, business leaders, neighborhood organizers, soil conservation agents, United Way chairs, Grange masters, university professors, students, ministers, chamber of commerce leaders, and other community stalwarts often have attended inter-personal skill building training provided by their national, state, and local organizations.

When you cannot find people within the community who possess these talents, you can bring into the community a public involvement/group process trainer. Next, invite a large group of citizens to receive the training. In exchange they contract with you to give "x" hours conducting public meetings, serving on task groups, etc. A simple contract with interested individuals formalizes their commitment. Each contract will increase your human resources pool. Using this approach, you can a fill a card file with the names of people willing to conduct meetings. The trick is to have trained facilitators who live in different parts of the community.

The advantage of this approach is that the local facilitator is objective, cares about the community, and will not benefit from decisions that are made. The single purpose of this meeting facilitator is to give everyone present the opportunity to speak and to get answers to their questions.

As you increase your community network, you increase the community’s awareness of your agency’s work. You will be giving your agency a face and you will be reducing the alienation from “government” that many people feel.

The Recipe Card File

A recipe card file and a package of index cards are low cost supplies that can increase your public involvement success rate. It is a technique borrowed from a soil conservation agent who entered the names, addresses and vital information about every farmer, rancher, grower, community leader, elected and appointed official, on separate cards. He was especially interested in identifying the “hidden influence leaders” within the community. You can substitute a computer

card file, provided you have a back-up system that will preserve this human resource database. Card files do not crash.

Each card serves the same purpose as the business card you bring back from meetings and social events. You can record, for future contact, the name, address, telephone, fax, and e-mail numbers of individuals. Plus, you may want to add the organizations, business, hobbies, length of residence, talents, expertise, political affiliations, attitude toward your agency, recreational interests, availability and willingness to volunteer help, etc. Your core group will grow when you ask them for the names of other people who might be interested in working on a particular project and/or plan.

When you are ready to start the next project or a plan, open your "human resource database" and retrieve the cards with the names of the people who have signed up to help you. It is easy to think of a database of environmental, social, economic, and technical information; it may take some time to become accustomed to thinking of "people" as a database. They are sources of information vital to a transportation planning process. It is easier to accept this concept by remembering that people usually feel "honored-to-be-asked".

Stakeholder is the current buzzword used in transportation planning to refer to folks who have a particular interest in a specific outcome of your work. Stakeholders can also be individuals who care about the quality of life of their whole community and are not project/plan focused. Including these "generalists" in your outreach will create a more balanced representation of community interests on work groups, committees, and task forces.

In addition to the individual citizens, staff of other agencies, departments, bureaus, and political jurisdictions are repositories of exceedingly valuable information that can affect your work. Because these "out-of-house" staff have different responsibilities and authority, they have different perspectives on your territory. They may be in contact with different people, they may enforce different regulations, and they most assuredly have useful information. These same agencies may have technical personnel and equipment that your agency cannot afford AND they may be willing to share. In exchange, find something you can share with them. Mutual benefit alliances, formal and informal, are another way to achieve cooperation and coordination among public and private entities.

Communication, Curriculums, and Current Events

School curriculums that include science, geography, government, etc. are another source of help, information, and community communication. You can tap into another under utilized resource by participating in "futures fairs", "students in government" days, Earth Days, etc. When you have plans and projects that you want to tell everyone about, you can ask these same students to help build an information kiosk. They can conduct surveys at local stores, malls, fairs, horse shows,

rodeos, etc. The secret is to **"go where people are"**. Where the local school curriculum includes a module on city planning, teachers may be willing to give students credit for working on transportation projects sponsored by your agency.

Getting the Word Out

Businesses and civic organizations may be willing to pay for "door hangers"; this usually costs less than first class mail. Cleverly designed, these communication pieces tend to have a higher readership than letters. Billboards and point-of-sale display pieces, which have a common graphic theme, reinforce awareness of your message. Flyers can be distributed at banks and grocery stores to alert citizens when transportation plans and projects are proposed in their locale. Sponsor a design competition for the graphic theme of your project. You can grab some early press and have fun doing it.

Organizations have telephone trees, mailing lists, newsletters, meetings, and bulletin boards; all of these offer communication links to the community. When you have a message to convey about a meeting or participatory process and want to let the world know about it, ask for 15 minutes on a meeting agenda, and 15 lines in a newsletter. Civic and professional organizations welcome speakers. Take your surveys to local meetings and get them completed there. You will leave with the results. Use the survey questions to start group discussions and record what is said. Join local transportation committees and share your knowledge and insight. Take base maps to meetings and local diners and get people to draw their ideas.

Neighborhood newspapers garner a higher readership within their distribution area. Real estate firms send out newsletters to clients, ask them to give you some space. Local cable access may offer free training and air time. Local theater groups can produce videos and live performances. If multiple languages are spoken in your town, you need to find interpreters to work with you. Churches, special language newspapers, schools, social service providers, etc. know who is willing to volunteer to translate.

You can communicate with special needs people: those that are physically challenged, elderly, enrolled in welfare-to-work programs, low income, and welfare recipients. Day care centers, third shift employers, social service providers, medical centers and clinics will give your message to their clients.

The secret to making public involvement work when you have a limited budget and staff is to ***create excitement*** about what your agency does. You have to convince people that you need and want the knowledge that only they possess.

ASK

Ask everyone, "who else needs to know what we're doing". Every time you ask, you add names to your file. In networking the conventional wisdom is, "you are only 6 calls away from the person you need to talk to". A corollary to this saying is, " Just remember, everyone's a cousin".

FOCUS GROUPS

You can hold focus groups when you have a limited budget. Ask market research firms, advertising councils, schools, and companies if they have personnel with focus group training. Ask one of these resources to train your staff to recruit participants, write questions, facilitate, and record focus groups. Train your secretaries, technicians, planners, and director. Everyone can have a new experience and become more involved in the "glamour" side of transportation planning and implementation. Remember, your staff has "cousins".

When you want to talk with people who are not professional citizens, consider recruiting participants outside of grocery stores. This is a technique borrowed from political candidate campaigning. Chose the location of each recruiting site to match the area where your transportation plan and project are proposed. Once you have the names of participants, mix and match the individuals to achieve the balance of interest you desire in each discussion group. NOTE: It is important to ask permission from the business and/or property owner before you recruit on their premises.

Media Coverage

Media coverage, free, will vary. You already know this. Meet with the editorial writers and reporters to talk about the plan and project that is contemplated. Personal contact produces better results. It gives you a chance to ask media folks what they know and think. Local media people may be willing to help plan, write and implement a public awareness program, if you ask. Participate in events that the media will already be covering. Attend, enter, and sponsor teams and individuals in walkathons, Special Olympics, and benefit races. Home and garden and sports shows draw crowds, so set up your traveling display and talk to people about your work. You are a salesperson pitching the value of your product and your customer service.

Cable and television program directors and personalities will become interested when you show them how what you are doing relates to their personal interest. Call in shows, satellite town meetings, neighborhood closed cable networks, and local access programming, all reach larger audiences than most agency sponsored meetings. Drive-time helicopter reporters are a great way to target a transportation audience.

Public Involvement Advisory Groups

An advisory group can assist you in designing and implementing a public involvement process. They know people, meeting places, best meeting-times, and funding sources. Ask them to edit your written and verbal communications and delete jargon. Their help can be invaluable. Your advisory group exists to be your "friend in the community". They know when the basketball rivalry game will be played and will tell you, "no meeting that night". The members can introduce you to the community opinion leaders. In addition, they will alert you when plans/projects are politically sensitive. As a group committed to public involvement, they can lobby for increases in your budget.

The invisible opinion leaders are "key cousins" that you want to influence. Political campaign treasurers' reports contain the names of many more "cousins" and offer insight into candidates' supporters.

Forums

The League of Women Voters is a desirable sponsor because their organization's mission is to be objective and to educate. Town meetings sponsored by local organizations are another avenue to engage the community in discussions of transportation problems, options, and solutions. These structured gatherings are less likely to become venting sessions. They do they offer a good opportunity to find out what the public thinks about your agency and it's work. Every meeting of this type is an opportunity to sign up volunteers to help you with your work.

Participating with other organizations minimizes the dollar cost of public involvement. Staff time spent on public involvement will increase because it will become an ongoing community relationship program. Staff work hours will change because nights and weekends are required to attend community meetings and events. Staff working relationships will change to coordinate with other agencies, and educate media and community leaders.

Creating forums for elected officials, where their constituents can participate, will underscore the value of your public involvement process and open budget doors. The bottom-line is that elected officials need to know when you arrange public meetings within their jurisdiction. Give them the opportunity to open the meeting. This is important when your agency serves multiple governmental entities. Ask elected and appointed officials to nominate people that would be assets to your process. They know the people in the community; they did get enough votes to win. Appointed and elected officials are good resources to identify foundations and other funding sources. A letter of support from these same officials is an important attachment togrant proposal submissions.

Attendance Mapping

When people sign in at a meeting, ask them to put a pin in an aerial or plat map to show where their business or residence is located. Before the meeting begins, you will know who is present and where they work and live. You will see quickly where you need to extend your outreach. This map can be useful when you present your plan/project at a public hearing. You might want to show the locations where you have met with community groups. It will help you see that you have covered the territory. A visual reference reassures public officials that you have been in touch with their constituents. This is a low cost way to show where you have been working in the community. Take it to meetings, display it in the lobby, and keep it moving so more people see it. People love maps, especially when they can locate their house or business.

Transit Plans and Projects

Transit operators are in daily contact with transportation consumers. The driver can be especially helpful in letting people know about route change meetings and corridor studies. This may require the cooperation of a union, where one exists, and may require providing pay for the extra hours. Transit drivers have been known to attend community meetings on their own time. And, they have a wealth of observations to share about traffic, bottlenecks, and infrastructure problems. Ask for free transit advertising space. Hire work-study students and interns to conduct telephone and on-board ridership surveys. The hourly pay scale will be lower than the hourly rate charged by most consultants.

Resistance

"If these techniques are so great, why isn't everyone using them?"

Control. At least the perception of having control, prevents many agency people from reaching out to community people. There is a basic fear of letting "outsiders", "others", and non-transportation planners and engineers contribute to the work. After all, "Decisions have to be made that only the properly trained staff have the knowledge to make." This attitude too often limits the quality of public involvement and the quality of the product.

Citizens do not want bad planning. They do want to be part of the decision making process. They have information and ideas that are worth heeding. You have a choice: hear what people have to say up-front and out-front OR hear them in a public hearing, after you spend "all that money". This paper is intended to give you ideas that can keep the cost of public involvement at a minimum. It is intended to convince you that public involvement is fun and exciting. It is intended to persuade you that **PEOPLE** are your best resource.

Author's Note

I have used successfully every technique and suggestion included in this paper, at least once in 28 years of public involvement fun. Please challenge, inquire, and share your experiences with me. Together we can write a reference book on how to have fun and deliver effective public involvement when you have a modest budget.

If I can help you,

ASK.

Session #8

SUSTAINING PUBLIC INVOLVEMENT IN LONG RANGE PLANNING USING A STAKEHOLDER BASED PROCESS: A CASE STUDY FROM EUGENE-SPRINGFIELD OREGON

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ABSTRACT

The Intermodal Surface Transportation Efficiency Act requires a proactive public involvement process that provides complete information, timely public notice, full public access to key decisions, and supports early and continuing involvement of the public in developing plans. This level of public involvement is a challenge to sustain over the course of a typical update of a transportation system plan. To ensure a proactive and continuing public involvement process, a stakeholder centered public involvement program was selected to guide the development of the Eugene-Springfield long-range transportation plan. The stakeholder process constituted the core of the public involvement program used in the recently completed update of the Eugene-Springfield transportation system plan and was the primary method of achieving sustained public involvement.

A main objective of the stakeholder process was to involve groups representing a comprehensive cross section of the community, who have a vital interest in the outcome of the transportation planning process. Stakeholders participated in a series of three symposiums where key decisions were made at various points in the update process. A majority of stakeholders served on one of the three task forces that met for six months early n the process to identify potential strategies for use in the plan. In addition, many stakeholders served on focus committees overseeing development of an urban rail study, high speed rail terminal location analysis, development of plan goals and objectives, and land use design.

The stakeholder process was a successful tool in getting the regional transportation plan adopted. Many valuable lessons were learned. Stakeholders can be an effective public outreach tool by partnering with them to provide two-way communication with the groups they represent, with the general public and with elected officials. Elected officials and planning commissioners were confident that all interests were represented with a comprehensive stakeholder process. Discussions with elected officials focused on the contents of the plan and rather than debating the public process.

This approach provides a practical means of providing public access to a lengthy planning process to a broad cross section of interests and developing citizen groups well informed on a complex set

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of issues. This paper will detail the stakeholder process used by LCOG, the results of the process, and lessons learned in the use of this process.

Introduction

In the "Hitchhiker's Guide to the Universe," Douglas Adams writes of the building of a hyperspatial express route through the Earth's star system, a project which "regrettably" requires the demolition of Earth. The demolition crew has little sympathy for the people of Earth as all the plans and demolition orders have been on display for fifty years in the local planning department—on Alpha Centauri. Blaming the people of Earth for not bothering to take an interest in local affairs (Alpha Centauri is only 4 light-years away), the planet is demolished and the demolition crew continues on its way.

This story humorously relates a problem typical in most long-range transportation planning efforts—little input is received on plans and programs until they are ready to be implemented. This stems in large part from the difficulty in generating interest in longer-term, relatively technical issues. It has been difficult to provide a practical means of access for a broad cross section of the community to an often-lengthy planning process typically involving a complex set of issues.

The Eugene-Springfield area is located at the southern end of the Willamette River Valley, approximately 120 miles from Portland. The current population is just over 200,000. We are presently in the adoption phase of a transportation plan update begun in the fall of 1993. The public involvement program for our plan update draws on a range of well-known techniques. At the center of our program we established a group of stakeholders representing a wide spectrum of interest groups in the community. While this is not a new technique, it has proven to be a very effective public outreach tool, involving individuals from a variety of community groups providing two-way communication with the groups they represent, with the general public and with elected officials.

In this paper we provide an overview of the public involvement effort that has been a part of the update of our long-range transportation plan (TransPlan), focusing on the stakeholder process. We outline the design of the process, our experience in its implementation, and an evaluation of its success.

Public Involvement for the TransPlan Update

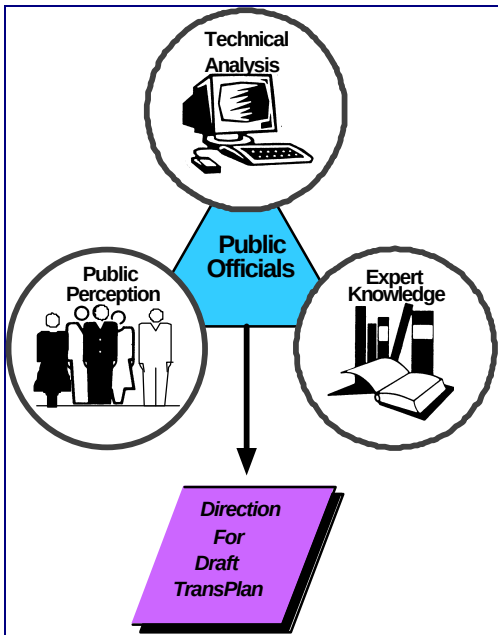
When we began to develop the work program for the update of TransPlan, we realized that we would have to put significant resources into our public involvement efforts if we were to make any of the significant changes envisioned both in federal legislation and state guidelines. We knew we would certainly have to go beyond putting the plan on display in some out of the way local planning office.

Issues related to better integrating land use and transportation, reducing reliance on the auto, meeting financial constraint, and complying with clean air standards all needed to be addressed through the development and consideration of creative alternatives – development and consideration by the community as a whole. We knew that our public involvement program would have to be proactive and provide complete information, timely public notice, full public

access to key decisions and the opportunity for early and continuing development. This was not just because it is called for in ISTEA legislation, but because of the scope and complexity of the issues requiring community input.

In the development of the plan, we acknowledged the need to provide our policy makers (MPO board members, city councilors, county board members, transit board members, and planning commissioners) with input from a wide range of sources. Typical of public policy making in general, the development of TransPlan relied on input from the following three sources:

Figure 1: Policy-Making Decision Process



1. **Public perception** of a variety of topics, including transportation issues, alternative methods for addressing those issues, and staff conclusions and recommendations. To gauge public perception we used several techniques including surveys, workshops, speakers bureaus, and newsletters;
2. **Technical analysis** generated by the travel forecasting model and a number of issue-specific studies conducted during the update process. The results of these planning efforts allowed staff to draw informed conclusions about the alternative strategies for addressing transportation issues; and
3. **Expert knowledge** obtained from staff, consultants, elected and appointed officials, stakeholders, and other contributors to the *TransPlan* update process. The primary roles of experts in this context were to interpret the meaning and relevance of technical analyses, evaluate the implications of policy alternatives, and present alternatives or make recommendations based on judgment and experience.

Figure 1, shows the relationship between these three types of input and policy makers. To best inform the policy decisions associated with TransPlan, the update process was explicitly developed to facilitate input from all three sources.

General Design of the Stakeholder Process

The stakeholder process was designed to obtain public perception as well as develop a community-based expert knowledge of the transportation plan. Objectives of the stakeholder process were to:

- Create a group of individuals well-informed on the TransPlan Update and representative of diverse groups;
- Reach consensus at various stages of planning process;
- Create an articulate group to testify to planning commissions and elected officials; and
- Create a group to convey the status of the plan to diverse interest groups and get feedback.

The stakeholders group was made-up of elected and appointed officials, chamber groups, modal interest groups, and citizen groups. To get a comprehensive cross-section, the size of the group was approximately 80 people. Various organized groups were invited to select a representative to participate (e.g., Chambers of Commerce, environmental groups, etc.). Elected bodies selected an individual to participate. At-large members were recruited from the community as a whole.

Table 1 lists the organized groups and elected/appointed officials who would be invited to participate. The table provides an indication of the primary perspective of the group and the area that they represent. It was anticipated that, while invited, many of the state and federal legislators and officials would be unable to attend. Of the total, approximately 45 - 60 were expected to commit to participation in the Task Force work and other stakeholder efforts. Figure 2 provides an illustration of the diversity of the stakeholder group.

Implementation Experience

A process was established whereby stakeholders were gathered at three key milestones in the update process. These milestone events (Symposia) were set-up to provide status reports on the update, disseminate information and establish consensus. The three milestones were:

1. Issues Identification and Priority;
2. Alternative Strategy Assessment, and
3. Evaluation and Selection of Preferred Plan Scenario.

In between these milestones, stakeholders were asked to participate in task forces and special committees. In addition, a speaker's bureau process was established to make presentations to the groups represented by stakeholders. To maintain contact with stakeholders during periods between the Symposia, check-in meetings were conducted and newsletters and technical reports were distributed. Figure 3 illustrates the various methods used to sustain stakeholder involvement over the course of the update process. Figure 4 provides a summary of the Stakeholder schedule for the TransPlan Update.

Symposium 1

The first symposium was conducted on November 4, 1993, with over 150 participants, including 68 stakeholders and 6 invited guests. The purposes of the symposium were to:

- Introduce stakeholders to the update process;
- Gain mutual understanding about transportation trends and issues in the Eugene-Springfield area;
- Reach consensus on the primary issues to be addressed during the update; and
- Obtain commitment from the participants to work together to achieve the objectives.

In addition to receiving written background material on transportation trends, issues and opportunities, symposium participants heard a keynote presentation from Michael Meyer, professor of civil engineering, Georgia Institute of Technology, on "The Need for a New Transportation Vision." A video on transportation trends and issues in the Eugene-Springfield region was produced and shown at the Symposium. A speaker panel of local

and state professional and elected officials gave additional details about the trends and issues in the region and state.

Task Forces

The primary commitment of time for stakeholders during the update process occurred with participation on Task Forces. At Symposium 1, stakeholders were informed of the opportunity to serve on one of three task forces. A total of 69 stakeholders volunteered to serve on the three task forces. The task forces met once or twice per month between November 1993 and June 1994.

The task forces were organized around the three categories of strategies that were used to achieve the transportation goals and objectives:

1. Transportation demand management (TDM) task force;
2. Transportation system improvements (TSI) task force; and
3. Land use measures (LUM) task force.

The objective of the task forces was to obtain stakeholder input on identifying and evaluating strategies and opportunities for achieving *TransPlan* update goals and objectives. While each task force had a different approach, the conceptual framework was the same:

- Which strategies work for the Eugene-Springfield Area?
- Where would be the best application of those strategies?
- How do the strategies fit together? and
- What is the best time frame in which strategies should be implemented?

Task force work included the following tasks:

1. Review and agree on task force objectives, desired outcomes, general work tasks and schedule, ground rules for group participation and decision making and the roles of staff teams, outside experts, task force members, chairpersons, facilitators, audience and core groups;
2. Identify stakeholder interests regarding transportation planning;
3. Review and discuss policy framework, issues, and interim goals and objectives;
4. Identify and discuss the range of strategies and opportunities;
5. Review and agree on criteria by which to evaluate strategies and opportunities, based on stakeholder interests and interim goals and objectives;
6. Evaluate strategies and opportunities;
7. Identify desired outcomes and desired citizen input from the Community Workshop;
8. Develop list of integrated strategies and opportunities;
9. Compare lists of integrated strategies and opportunities among task forces; and
10. Evaluate impacts of integrated strategies and opportunities on various travel modes.

A joint task force meeting conducted on June 29, 1994 concluded the task force work. At this meeting, members of all three task forces shared their recommendations for

transportation system improvements, transportation demand management strategies and land use measures.

Focus Committees

Focus committees were formed to meet the needs for in-depth analysis of transportation, land use and growth management issues and topics. Task force members (stakeholders), local staff, elected officials and appointed officials, consultants and interested parties were asked to serve on the committees. The focus committees formed included the:

- Land Use Design Team;
- Urban Rail Feasibility Committee;
- High Speed Rail Technical Advisory Committee;
- Goals and Objectives Committee; and
- Nodal Development Advisory Group.

Land Use Design Team

The Land Use Design Team met between May 1994 and June 1995. The team consisted of six stakeholders, a design professional, a University of Oregon Landscape Architecture faculty member, a professional consultant with expertise in transit-oriented development and eight jurisdictional staff members. The Design team worked with a University of Oregon Landscape Architecture design studio to develop, apply and analyze design principles for implementing the land use strategies recommended by the Land Use Measures task force. The Land Use Measures Task Force provided oversight and monitored the progress of the project.

Urban Rail Feasibility Committee

The Urban Rail Feasibility Committee met between August 1994 and June 1995. Eleven stakeholders and four jurisdictional staff members served on the committee. The committee was formed to guide consultant work on an Urban Rail System Feasibility Study. This study assessed the type of rail system that might be constructed at a conceptual level, identified when a rail system for the Eugene-Springfield area would be feasible based on cost and ridership estimates, and identified actions that could be taken during the planning period to make rail a success in the future.

High Speed Rail Technical Advisory Committee

The High Speed Rail Technical Advisory Committee met between September 1994 and September 1995. Ten stakeholders and one staff person served on the committee. The committee was formed to coordinate regional activities related to the planning and implementation of rail improvements in the Pacific Northwest High-Speed Rail Corridor. The committee also oversaw consultant work on the High-Speed Rail Southern Terminal and Maintenance Facility study.

Goals and Objectives Committee

The Goals and Objectives Committee met for a first series of meetings between January 1995 and March 1995 and for a second series between March and June 1996. The committee consisted of ten stakeholders, including the chairpersons and co-chairpersons from the three task forces, and eight jurisdiction staff. The committee reviewed and refined the *TransPlan* interim goals and objectives, taking into account the comments and suggestions from stakeholders at the first symposium.

Nodal Development Advisory Group

A nodal development advisory group was formed in the spring of 1996 and met three times. Lenders, real estate appraisers, developers along with stakeholders and local staff were recruited to serve on the advisory group. The group advised *TransPlan* update staff on the scope of work for two projects - Evaluation of redevelopment potential; and a market demand study of proposed nodal development.

Check-In Meeting 1

Check-in meetings were conducted periodically for stakeholders between the Symposia. The purpose of the meetings was to keep stakeholders involved and informed about the *TransPlan* update process. The first check-in meeting was conducted between Symposium 1 and 2 on October 18, 1994. The agenda included:

1. An overview of the *TransPlan* update status and schedule;
2. Description of exploratory plan concepts;
3. Status of projects on urban rail feasibility, demand management programs, and design principles for implementing land use strategies;
4. Review of interim goals and objectives; and
5. Status of system improvements and modeling.

Symposium 2

The second symposium was conducted on March 16, 1995. Thirty-five stakeholders participated. The objectives of the second symposium were to discuss the proposed types and range of alternative plan concepts for the update of *TransPlan* and to identify issues and concerns about the concepts to be addressed in their subsequent development and evaluation.

After a presentation by Portland Metro's John Fregonese on the use of plan concepts as part of that area's *Region 2040* project, the participants formed four small discussion groups to discuss *TransPlan's* proposed alternative plan concepts. Each group responded to seven questions concerning the plan concepts. Recorders captured the key points raised by the discussion groups. Consensus was reached on the best range of concepts and assemblage of strategies within the concepts.

Check-In Meetings 2 and 3

A second set of two check-in meetings was held prior to community workshops, which took place on May 22 and 23, 1996. The purpose of the meetings was to provide:

1. An overview of the *TransPlan* update status;

2. Objectives of the third symposium (August 28, 1996);
3. Videos on land use and transportation; and
4. A guided tour of the workshop displays.

All of the stakeholders were encouraged to stay for the community workshops and interact with the general public.

Symposium 3

The third and final symposium was conducted on August 28, 1996. Thirty-one stakeholders attended the symposium. Eight community members and public officials interested in observing the process were also in attendance. The main objective of this symposium was to obtain stakeholder input on the preferred draft plan direction.

A consultant was retained to provide electronic voting technology for the Symposium. This technology allowed the group to get instant feedback on a series of questions while providing that input in an anonymous way.

Two main rounds of voting took place. In Round 1, stakeholders indicated their level of support for each of six alternative plan concepts. Following this round of voting, each of the six tables of stakeholders chose a plan concept to refine in small group discussions. Stakeholder table leaders, who were oriented to the process before the symposium, facilitated the discussions. Through consensus, the small groups proposed changes to the plan concepts and identified related issues and concerns. A stakeholder from each table presented the refined plan concept and related issues to the large group.

In Round 2, stakeholders indicated their level of preference for each of the refined plan concepts. A large group discussion of the refined plan concepts followed, with the objective of developing a plan concept that most stakeholders supported. A series of voting sessions took place during the discussion, with the final outcome being a plan concept with a set of strategies and related issues.

Pre-Release Briefings on Draft TransPlan

The third set of check-in meetings was conducted in February 1998. Three stakeholder meetings were conducted with the purpose of previewing the draft *TransPlan*, providing an opportunity for questions and comments.

Challenges with the Stakeholder Process

In the course of implementing the stakeholder process we encountered several challenges. These challenges required us to adapt by adjusting schedules or drawing on additional techniques to sustain the stakeholder process.

Longer Timeline than Anticipated

The overall timeline for the plan update has taken much longer than the stakeholder process was originally designed for. As conceived, the process was to take 18-24 months. Based on that schedule, staff was directed not to replace stakeholders who might have

dropped out. In addition, analysis and evaluation at the staff level took longer than anticipated, creating extended periods between stakeholder meetings.

To this point, the process has taken 56 months. This has made it difficult to keep stakeholders interested. The longer timeline also made it difficult for stakeholders to track the transition from their input to final products in the planning process.

Staff responded to this in several ways. Drawing on advice from the Chairs of the stakeholder Task Forces, staff identified techniques to help sustain stakeholder interest including creation of a stakeholder newsletter, "Tracking TransPlan," and more intensive use of Speakers Bureaus to provide information at key points in the analysis and evaluation of alternatives.

Scheduling Events

During any period in the update process it was relatively easy to indicate the approximate date for a particular event (early fall, late spring, etc.). However, it took a major effort to schedule the specific date of an event so that attendance was maximized. This entailed multiple calls and written communication to all stakeholders.

In some cases, stakeholder process scheduling had an impact in the overall schedule of the update. For example, in mid-June 19, staff had completed analysis of alternative plan concepts. Due to the difficulty of scheduling events during the summer months, the process for stakeholder review of the plan concepts had to be postponed for 2 ½ months.

Stakeholder Expectations

As stakeholders continued to participate and become more informed, some felt that their role should be more than advisory. This has caused some frustration, though more active stakeholders have been influential, both in guiding the process and in the substance of the plan.

Evaluation of the Stakeholder Process

As outlined in the discussion on design of the stakeholder process, our objectives for the stakeholder process were to:

- Create a group of individuals well-informed on the TransPlan Update and representative of diverse groups;
- Reach consensus at various stages of planning process;
- Create an articulate group to testify to planning commissions and elected officials; and
- Create a group to convey the status of the plan to diverse interest groups and get feedback.

An assessment of the stakeholder process by each of these criteria follows.

Create a Diverse Group of Well Informed Individuals

In general, we were relatively successful in the development of an informed group. Particularly in the Task Force work, stakeholders were exposed to a wide range of information and a high level of detail relative to most other public involvement efforts.

As well, the opportunity to work at a fairly detailed level with consultants and staff on focused studies contributed to the stakeholders being well informed. These study efforts provided both the opportunity for input at that level and a process which allowed for time to be taken to develop an understanding of complex materials.

It should be noted that, because we lost some stakeholders over the course of the update, we also lost some of the diversity we started with. However there was a core group of individuals who participated actively throughout the process and provided diversity.

Reach Consensus at Various Stages of Planning Process

There were three key points where we sought consensus from stakeholders:

1. Identification and ranking of issues;
2. Assessment of alternative strategies; and
3. Selection of the preferred plan alternative.

At the first symposium stakeholders came to agreement on the range of issues needing to be addressed, though no strong agreement was indicated on which issues were most important. At the second symposium stakeholders reached consensus on the best range of plan concepts and the best mixture of strategies to use within each plan concept. At the third symposium, stakeholders were able to reach consensus on a preferred plan concept primarily through the use of the electronic voting technology.

Create an Articulate Group

Participation on committees dealing with consultants, staff and time invested in the process resulted in stakeholders being able to articulate the issues fairly well. Though their Task Force work focused on only 1 of 3 possible areas, many of the stakeholders were able to testify in a manner that reflected an integrated perspective.

Interestingly, their testimony was not always in support of the staff or policy-maker position. For example, one stakeholder, an active participant in the process, had embraced the goals, objectives, policies and general strategies during their formation. However, she testified against the Draft Plan because it did not result in the degree of change she was seeking (increased alternative mode use, reduced reliance on the auto). While the plan is not final, this and other testimony from stakeholders has made planning commissioners seek additional actions to improve the performance of the plan.

Create A Group to Convey the Status of the Plan

It was our expectation in the design of the stakeholder process that each stakeholder would, over the course of the update process, communicate status and issues to their relevant groups. We also expected that they would receive feedback representing their

group's position. However, we didn't communicate the expectation beyond the first letter to each stakeholder.

What happened in implementation varied somewhat from group to group. Some stakeholders accepted this role while others relied on TransPlan staff through the speakers' bureau to accomplish this task. One of the consequences of this was that the stakeholders who did not provide that communication link directly did not have as much buy-in to the overall process as those who were actively involved.

Conclusions

Both planning commissions and elected officials felt comfortable throughout the update knowing that the stakeholder process had actively engaged the public. Stakeholders, at the end of the 3rd Symposium, were asked to evaluate the Stakeholder process. Sixty-five percent indicated that the process had been useful in helping the region preserve and enhance its livability. Sixty-nine percent indicated that the process was useful in getting them involved and informed.

In another implementation of this process there are some things we would do differently and some issues we would try to address. To the extent possible, we would want to better estimate the overall timeline of the process, reconfiguring the Update work program so that there were fewer gaps in the stakeholder process. We would also want to better manage stakeholder expectations; first, so that their advisory role was clear, and that we expected them to play an active role in communicating back to their groups.

Implementation of the stakeholder process has required a significant commitment of time and funds from the agencies involved. It has, at times, contributed to the delays experienced in the overall plan update. The fact that the stakeholders have not always agreed with either a staff position or policy-maker position has required rethinking of those positions.

However, the benefits of the process have far outweighed the costs and possible frustrations. It has proven to be a very useful means of sustaining a connection between the planning process and a diverse cross-section of the community. Their participation in the details throughout the update allowed the group to become a well-informed and invaluable part of the development of the plan. In addition, their participation at this level has allowed staff to learn how to more effectively present materials, focus on a more refined set of issues and gauge more accurately the receptiveness of the community to a variety of strategies.

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Table 1: List of Stakeholder Groups

Stakeholders Group	Stake-holders Invited	Primary Perspective	Area Represented
American Association of Retired People	1	Elderly	Metrowide
American Automobile Association	1	Automobile	Metrowide
AIA, ASLA, ASCE	3	Urban Design	Metrowide
Apartment Owners Group	1	Economic Development	Metrowide
Building Construction / Advisory Committee	1	Economic Development	Eugene
Center for Appropriate Transport	1	Alternative Modes	Metrowide
Commercial Investment Division of Lane County	1	Economic Development	Metrowide
Elected Officials / Appointed Officials			
Eugene City Council	2	Community	Eugene
Federal Transit Administration	1	Transit/Consensus	Metrowide
Joint Planning Commission Committee	3	Public Involvement	Metrowide
Lane County Board of Commissioners	2	Community	Countywide
Lane County Roads Advisory Committee	1	Transportation	Countywide
Lane Transit District Board	2	Transit/Bus Riders	Metrowide
Oregon Transportation Commission	1	Statewide Transportation	Statewide
Springfield City Council	2	Community	Springfield
State Legislators/Senators	7	Community	Statewide
U.S. Congress	1	Community	National
Willamalane Parks & Rec District	1	Parks/Recreation	Springfield
Emerald Empire Railroad	1	Rail	Metrowide
Eugene Bike Committee	1	Bicyclists	Eugene
Eugene Chamber of Commerce	1	Economic Development	Eugene
Eugene City Club	1	Community	Eugene
Neighborhood reps - River Road/Santa Clara/Glenwood	3	Unincorporated Areas	Eugene
Eugene - Springfield Convention & Visitors Bureau	1	Economic Development	Metrowide
FRESH, 1000 Friends, Audubon	3	Environment	Metrowide
High School Student	1	Students	Metrowide
Lane Couty Labor Council	1	Labor	Metrowide
Lane Community College	1	LCC/Students	Metrowide
Lane County Direction Services	1	Economic Disadvantaged	Metrowide
Lane County Home Builders	1	Economic Development	Metrowide
League of Women Voters of Lane County	1	Community	Metrowide
Metro Partnership	1	Economic Development	Metrowide
Oregon Association of Railway Passengers	1	Railway Passengers	Statewide
Oregon Trucking Association	1	Trucking	Metrowide
School Districts (3)	3	Education	Metrowide
Southern Pacific Railroad	1	Rail	Metrowide
Special Transportation Advisory Committee	1	Elderly/Disabled	Metrowide
Springfield Bike Committee	1	Bicyclists	Springfield
Springfield Chamber of Commerce	1	Economic Development	Springfield
Springfield Tomorrow	1	Community	Springfield
University of Oregon	3	Admin/Faculty/Students	Metrowide
Road Users for Business	4	Goods Movement	Metrowide
Youth Development Commission	1	Youth/Childcare	Metrowide

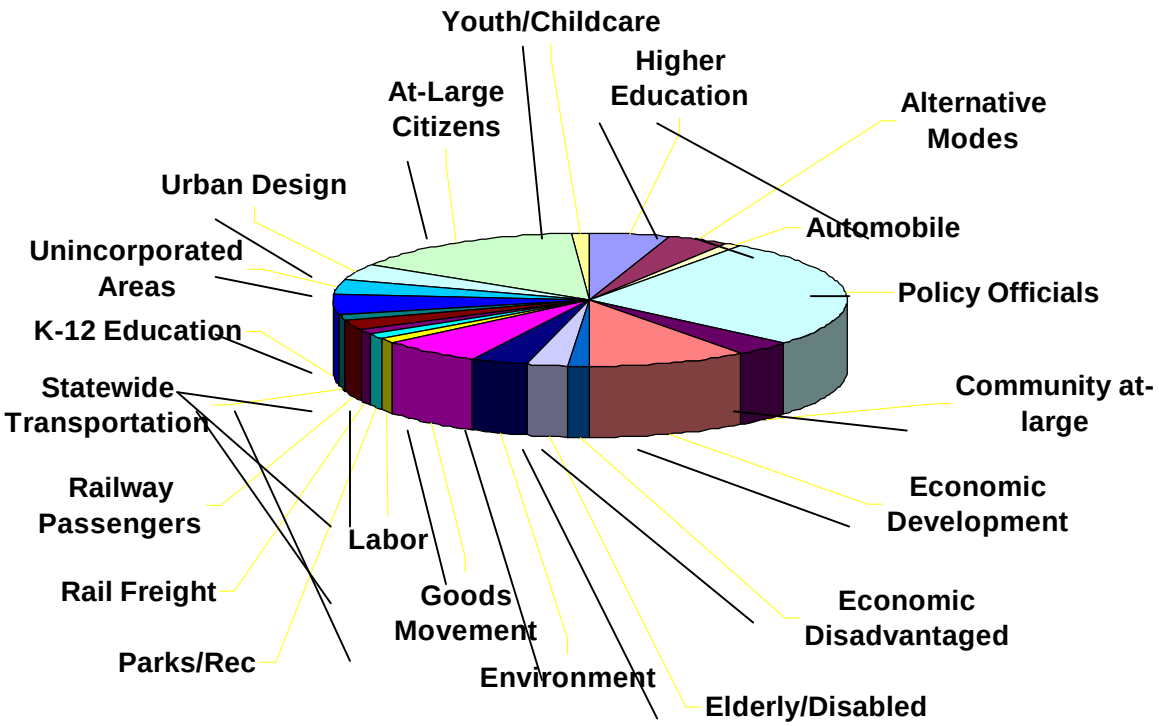


Figure 2 Diversity of Stakeholder Group

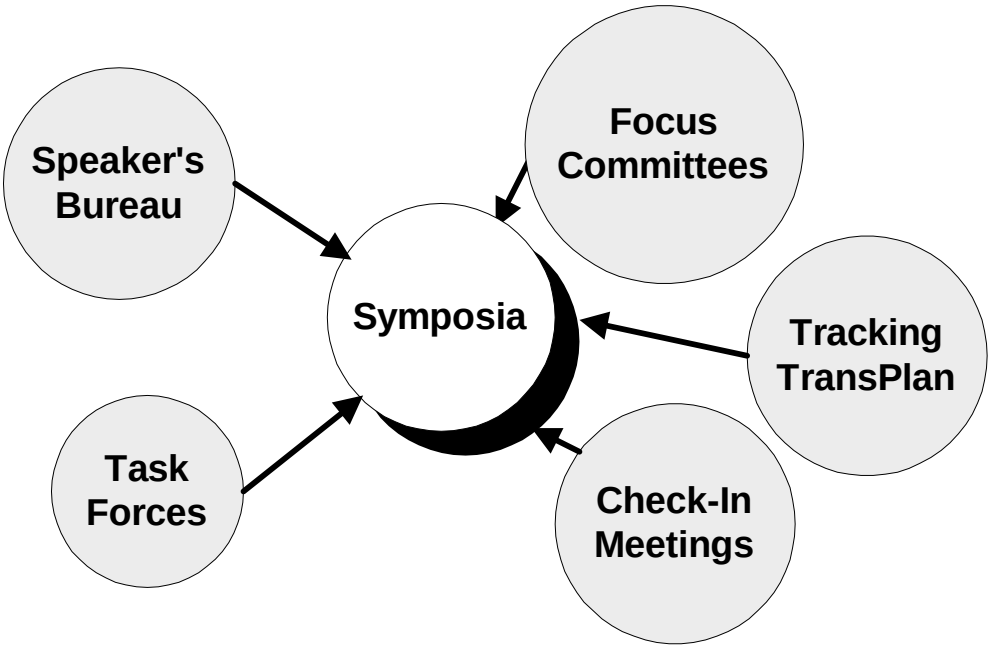
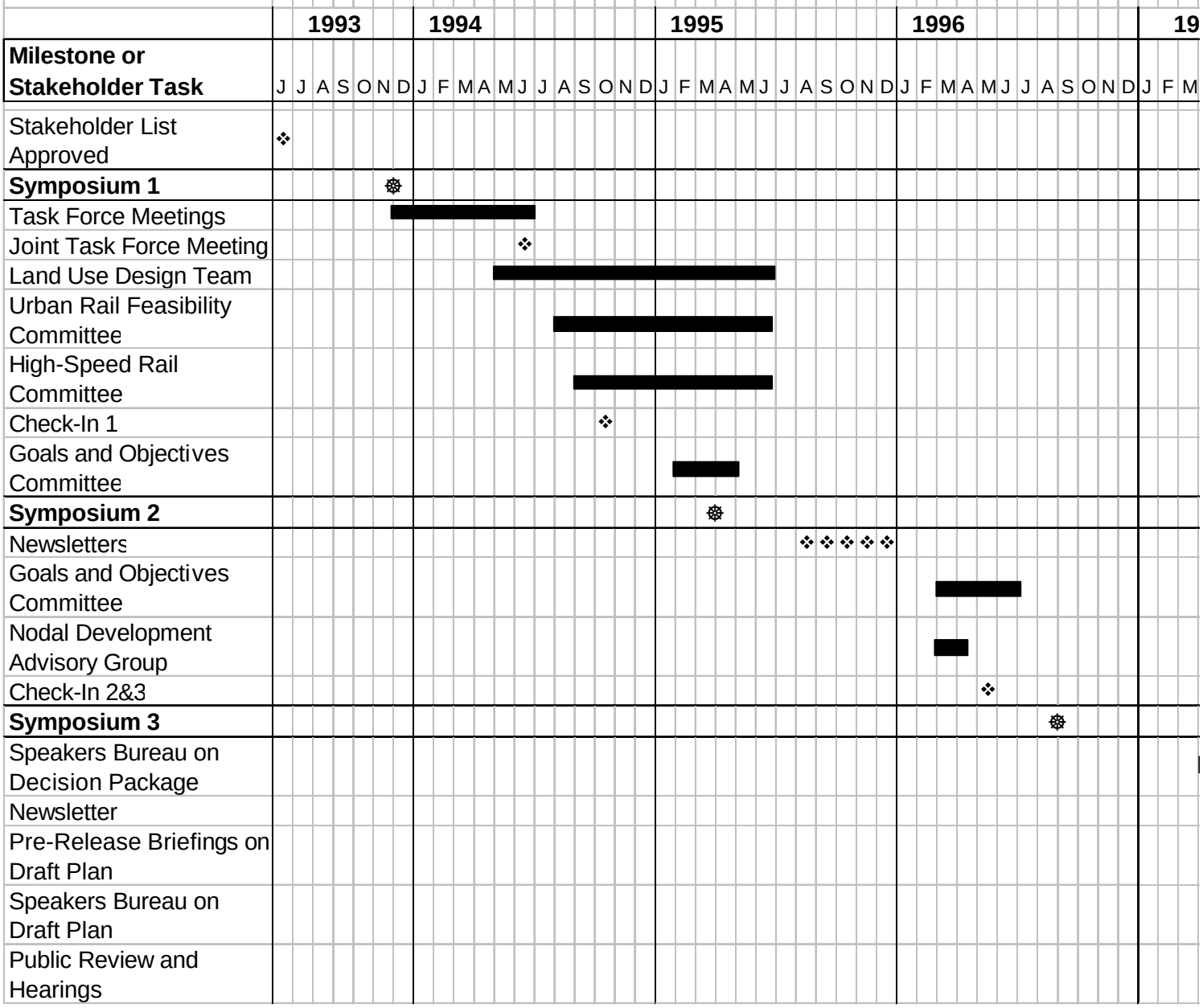


Figure 3: Techniques for Sustaining Stakeholder Involvement

Figure 4: Stakeholder Schedule for TransPlan Update



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Session #8

A PUBLIC INVOLVEMENT ROAD MAP

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ABSTRACT

In order to have effective public involvement, governments need a road map for the decision-making process. Yet, citizens from small and medium sized cities frequently do not have the resources to use sophisticated technology for public involvement programs. With limited budgets, small cities and towns frequently are not able to allocate substantial resources to public involvement. Having the funds for constructing transportation infrastructure is the priority of the local government as well as its citizens. At the same time, if the public is not involved in the decision-making, the government may run into major community resistance after investing time and money into pursuing its preferred alternative.

So, what is required to prepare a public involvement road map that can guide involving a diverse public on a limited budget? Carol O'Dowd, CMC as a former small town manager and a participatory process consultant has used a variety of techniques to meet this challenge. She will review how to:

- identify and recruit participants for the public involvement journey
- promote local leadership and ownership of the process
- design decision-making processes that work
- keep diverse groups focused on accomplishing results
- solicit input and participation without creating unrealistic expectations

A major challenge to mapping a strategy for reaching a diverse public is reaching an audience that frequently is not high-tech. It is not unusual to be working with a public that is not connected to electronic media. For example, as of January 1998 only 33% of small businesses had internet addresses. Although this number is growing dramatically, many associations representing low income citizens are fortunate to have large coffee pots for their meetings, much less a modem. In some cases, citizens most impacted are in neighborhoods where the newspaper is not read with great frequency.

The presentation to be made at the Small and Medium Sized Cities Communities Conference will review a variety of low cost techniques. The presentation will be interactive to give participants the opportunity to share their local public involvement

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challenges and to identify techniques that work best in their communities. A paper outlining how to build a road map for a diverse public will supplement the presentation.

A PUBLIC INVOLVEMENT ROAD MAP

WHY A ROAD MAP?

A road map is a critical tool for guiding citizens and government officials through a public decision-making process. These processes have some degree of federal, state or local mandates that can range from the type of study conducted to local public hearing requirements. When government or decision-making agencies invite citizens to participate, they are frequently expecting people who may not know the rules exist, to behave as willing drivers on the government's decision-making road. Without an understanding of the rules of the road, citizens get frustrated by not knowing where they or their government(s) are going with a particular process or activity. Telling citizens, who do not know the rules exist, that they did not follow rules and it is too late for their input to have any impact, can easily generate anger. The result is frustrated citizens and an increased resentment of government.

A road map that creates a vision of the process reduces frustration. A road map that provides a clear understanding of the process provides participants with the vision of how to get where they have agreed to go. The road map does not have to outline the outcome; it needs to outline the process. When the process is done well, participants will defend the results even when they disagree with the outcome. Following a specific agreed upon road map can avoid frustrations on a decision-making journey. A public involvement road map should outline:

- existing conditions
- who should be involved
- destinations and stops to be made

WHAT ARE THE EXISTING CONDITIONS?

Know the Social, Economic, Legal and Political Landscape

The landscape for decision-making includes social, economic, legal and political conditions. Social terrain can best be described with demographics. Census data as well as origin and destination studies are useful for understanding the social terrain. Who lives in the community and where do they travel? Where do people gather and why?

Another factor is the economic conditions. In addition to looking at current and projected employment centers, questions can be asked that may lead to ridership issues. For example, is a potential work force not tapped because they do not drive and are too far from employers who want to hire them? After doing some investigation for one client, we discovered several non-profit agencies focused on employing the handicapped. After talking with major hotels in the area, we discovered that major employers would support mass transit improvements to connect them to entry level employees.

Scanning the political horizon for signs of support or future obstacles can provide useful information. Have recent votes occurred that depict public sentiment towards funding transportation projects? Will the politicians in office during the planning phase be the ones in office to support funding the decisions made during the planning phase?

Clearly understanding the legal constraints can help determine how to structure promotional efforts for projects. For example, some local government charters have limits on the use of public lands for transportation projects. Keeping citizens informed of legal requirements can help avoid creating unrealistic expectations. For example, something as simple as explaining to citizens that they must have their comments in prior to the close of a public hearing in order to be heard avoids some from feeling ignored. Another important legal factor to keep in mind when dealing with controversial projects is the likelihood of citizens undertaking an initiative or referendum.

Define Current Trends

When evaluating transportation proposals, it is important for all involved to understand any major trends. Obvious trends include the use of transit, automobiles and other forms of transportation. Other trends to be attentive to include major shifts in population. When inner cities face an increase in teens and teen parents, demands for access to employment and day care centers increase. Meeting such diverse transportation needs will be a challenge that cannot be ignored when evaluating transportation alternatives for such communities.

Depending upon the community, some trends can become determining factors in how a transportation alternative is viewed. For example, crime and safety are frequently priority community issues. If an alternative can be used to improve safety or reduce crime in the community, it may become a more valuable option compared to a cheaper option that does not improve these conditions.

Sources for Mapping Existing Conditions

Demographics and geography of a transportation study area are useful indicators of community character and condition. Census data are an excellent resource for developing a picture of the demographic and economic characteristics of the community at large. Other sources include the GIS mapping divisions of the governments and developers in the area.

WHO SHOULD BE INVOLVED

When developing a road map for public involvement, it is important to know who will be traveling the road. Obviously the "public" is not a single entity like the Jolly Green Giant. Because the public is composed of three parts, To involve the "public" requires outreach at three levels simultaneously -- society, organization and individual. Effective public involvement programs connect with communities, organizations, and citizens.

Community Level of Involvement

To determine if transportation proposals address community issues, it is important to define the larger community within which the transportation system operates. A study area map showing geographic landmarks as well as the road system gives citizens an easy reference tool for determining whether they, themselves, their friends, their businesses or their neighborhoods are in the area. Including major portions of a larger community rather than just transportation corridors in the analysis allows the evaluation process to build community awareness of transportation needs.

While many portions of a transportation system function as connectors, others function as barriers. It is important to observe what areas are connected in a community and how the transportation system supports and hinders those connections. Identifying connections and barriers in a community early is useful for avoiding unnecessary conflict.

Identify Barriers as well as Connections

Portions of a transportation system can function as barriers or connections among parts of a community. For example, highways are seen as connectors when crossing rivers, gulches, railroad tracks and other land forms that function as barriers between communities. On the other hand, citizens frequently define interstate highways, four lane highways and even two lane arterials as barriers more difficult to cross than a river. In some cases, portions of a road or rail system are walled off and function as major physical barriers between certain portions of a community or between neighborhoods. Constructing a map of the major barriers is an exercise that gives people a different way to look at their community.

It is important to observe what areas are connected in a community and how the transportation system supports those connections. By identifying those connections early, confrontation can be avoided later with community members. A connected trail system became as important for connecting neighborhoods as an improved transportation system. Constructing a map of major barriers and connections is an exercise that gives people a different way to look at their community.

Sources for Community Representatives

When deciding who can speak for or represent the community at-large, we have found elected officials to be important community representatives. However, it is critical to remember that government is not the community. Therefore, it is critical to include representatives of organizations that work on community-wide issues. Boards of directors as well as program staff are likely to be citizens respected as community leaders among the public.

Organization Level of Involvement

In any community citizens participate in a variety of organizations. They join organizations that represent a specific interest or provide them employment. Examples are businesses, governments, churches, environmental associations, health clubs, alumni associations, and parent-teacher organizations to name a few.

Governments Are an Active Part of Community

Governments are key players in community decision-making. Local governments are organizations actively involved in transportation issues. Obvious governments to include in a public process include cities, towns, state legislatures, regional councils and regional transportation districts. If more than one local government or regional government is in a planning or project area, multiple needs must be accommodated. Also, special districts or quasi-government organizations created through intergovernmental agreements may be resources for financial support of transportation projects or be entities that make major demands of transportation systems. Such governments need to be involved in the public process.

Organizations and Institutions

A variety of organizations have major concerns with transportation services and will become active to influence the outcome of transportation projects. Major businesses located in employment centers can become a major force in defining what transportation alternatives the business community will accept. Chambers of Commerce frequently organize their business members to address transportation issues.

Educational institutions are another organizational group that have transportation concerns and can impact transportation alternatives. Transportation alternatives that directly impact access to schools may require involvement of the schools and/or the affected school districts. Also, large educational institutions such as colleges and universities rely on public transportation systems for access. These organizations can have strong community identify. Therefore, how transportation alternatives impact these community facilities can become factors in a community evaluation of alternatives.

Homeowner and neighborhood associations are becoming more active as political organizations. Some are well organized and deliver hundreds of citizens to meetings to block the implementation of decisions made by governments. These organizations when joined by special interest groups frequently force debate over the "consent of the governed." Therefore, it is wise to make a list of neighborhood associations even if they are not active. At Athena's Consulting Network, we have dealt with associations that were maintained on paper only to bloom into life to stop a development proposal. Yet, when leaders of these types of associations are invited to participate early in a process to identify effective transportation solutions, they can be most helpful in getting community feedback.

Sources for Organizational Representatives

Developing a list of organizations active with or concerned about transportation issues can provide an indication of how transportation decisions are influenced in the community. An easy reference tool for locating organizations is the local phone book. Other sources include Chambers of Commerce and governments. These entities maintain listings of active service organizations and homeowner associations in the community.

Individual Level of Involvement

With so many political agendas being driven by organizations, politics has shifted the focus of government to special interest groups. Many government officials operate as if only organizations with large memberships, special interest groups or big businesses are the public. The collective impact of individuals or a group of small businesses tends to be ignored when they are not organized.

Therefore, understanding individuals' needs is critical to involving the public in a transportation decision-making process. Sometimes describing characteristics of individuals in the transportation study area is useful for identifying individual needs. For example, an increasing number of single teen parents and a substantial number of low paying service workers in a community may cause transportation to jobs and daycare to be a priority transportation issue. If the number of seniors is increasing, access to employment centers may not be as critical as access to pharmacies, recreation facilities and health centers. Individuals in the community will expect the evaluation of transportation projects to include factors that address their needs.

Sources for Individual Representation

To get names of key individuals, we have found a variety of sources useful. A valuable resource is attendance lists collected at public meetings on local transportation issues. More and more local governments tend to record and maintain attendance at public meetings. Such lists provide names of individuals that have expressed concern about previous transportation issues. Contacting these citizens can lead to key participants.

Interviews of key citizens are another way to collect names of individuals in the community. By asking during the interviews who else should be interviewed, we collect names of individuals regarded as caretakers in the community. Caretakers are people that others look to for advise or are sought out as community advisors. These individuals are not always positional leaders. They may be a local shop owner who is viewed as the source for neighborhood news or a senior citizen that neighborhood children tend to adopt as an after-school grandparent. Such individuals tend to be the volunteers for local projects or programs. They are connected to others in the community regardless of organizational affiliation and can influence organizations. We have found them to be useful barometers of whether our evaluation process will have validity with the community at large.

WHAT ARE THE DESTINATIONS AND STOPS

Involving citizens in a public decision-making process requires establishing a common vision of the process. In some cases citizens without prior experience in government processes do not know where they are going much less understand where government officials are going. Therefore, it is critical to pinpoint the key decisions along the way as a guide for citizens and government officials through the decision-making process.

Pinpointing decisions ahead of time, gives everyone involved a sense of direction by clearly defining the decisions to be made and the time frame for making the decisions. For

citizens to be productively involved in a decision-making process, they need to understand the decision that is to be made. Frequently misunderstandings are created when government staff assume that citizens know the impacts of specific decisions. Unfortunately the outcome is frustration on the part of government employees and resentment of government on the part of citizens.

In addition to making a map that pinpoints the key decisions, it is important to frame the impacts the decisions can make. Some clarifications that help citizens understand their role and avoid creating unrealistic expectations include explaining frequently if the decision:

- is a final decision or a recommendation used by another government entity
- has any legally binding authority or legal status
- impacts a neighborhood, community, region or is part of a larger plan
- is short term or long term in duration
- will be considered part of another political agenda

To keep citizens interested in reaching the destinations and stops along the way, the process must stay focused on results. An effective way to focus the process on results, it is best to begin with the end. Take the time up front to explain clearly what the end result will be. Is it a comprehensive plan, a report, a recommendation, a collaborative agreement or something else? Make sure the public process includes educating the public on what will and will not be achieved to avoid unrealistic expectations. Help the public understand what the contents of the final product will be, how the final product will be used and who will use it.

Having a clearly defined end product, an updated Comprehensive Plan, as a focus helps explain why there are certain stops along the way to the final destination. We found having written documentation shared up-front with citizens a useful tool for reminding citizens what topics will and will not be addressed by a particular process. An effective tool for sharing the vision of the results is to chart how the final document will be produced and who makes the final decisions.

By educating citizens, staff and consultants can work with citizens as partners in the decision-making process. By involving diverse groups and citizens with diverse interests throughout the process, community-wide communication is established. By keeping the process open and flexible, conflicts generate creativity and alternatives for addressing a wide variety of community needs. The end result is community-based decisions built upon consensus. With publicly supported decisions, expensive lawsuits or special elections are avoided, saving the government and its taxpayers money and time in the long run. Direct citizen involvement in making tough transportation decisions, helps build an educated citizenry ready to tackle the next tough public issue.

Clearly defining the issues is critical in order to attract the participants and stakeholders needed to develop implementable solutions. With highly controversial issues, participants

are likely to come to the table with firm positions. By taking time to clarify and define the issues, citizens become less emotionally attached to specific positions and focus more on developing solutions. There are a variety of techniques for defining the issues.

SESSION 9 - HIGHWAYS AND CORRIDOR STUDIES

Moderator: Montie Wade
Texas Transportation Institute

Panelists: Saad A. Shbaklo, URS Consultants, Florida, and Lorin B. Krueger, Florida Department of Transportation
Patrick DeCorla-Souza, Federal Highway Administration
Robert M.O'Loughlin, Federal Highway Administration
Terrance Beuthling, Rust Environment and Infrastructure, Texas
George Reed, URS Consultants, Florida, and Harshad Desai, Florida Department of Transportation
Linda Dossé, North Carolina Department of Transportation

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Session #9

A PILOT APPLICATION STUDY OF CORRIDOR PERFORMANCE INDICATORS

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ABSTRACT

The need for effective multimodal performance indicators (or measures) is becoming increasingly important for adequate planning in all sizes of transportation environments, including small and medium-size communities. These measures are essential for several reasons. First, an initial determination of performance by measuring existing conditions indicates the degree of needed improvements. Second, after improvements are implemented, measurement of their performance is often required. Third, such measures are beneficial for measuring roadway improvements examined within the context of the Transportation Equity Act for the 21st Century (TEA21). Finally, multimodal measures can be used to monitor the performance of the transportation system over time by examining changes in performance from an established base year.

The purpose of this paper is to report on the testing of selected multimodal corridor performance measures for a small and medium-size area, including an evaluation of the amount and cost of required data. These measures are either based on corridor volume to indicate quantity of travel, or on time to indicate quality. Measures of corridor quantity include person throughput, vehicle miles of travel, and average vehicle occupancy. Measures of quality include average travel time, average travel speed, density, and percent time heavily congested.

The measures are developed and tested within a 5-mile segment along I-95 in the City of Hollywood (population of 127,000 in 1997), located in Broward County in southeast Florida. While this city is surrounded by a much larger developed area, the test area serves the purpose of illustrating the applicability of the selected performance measures as well as data collection and cost elements for a small and medium-size area. The corridor also contains a commuter train service (Tri-Rail) that is operated by the Tri-County Commuter Rail Authority. Several types of

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highway and transit data were collected along the corridor.

One key concern regarding the application of these measures in small and medium-size areas is the cost and method of data collection. This is because some measures may require new data that may be difficult or expensive to obtain, resulting in an extra financial burden on the smaller urban area where the competition for scarce tax or other revenue resources is high. This concern is addressed and several inferences regarding data collection and system utilization are made from this study. The results presented in this paper can be extended to apply to several classes of roadways/transportation corridors, and should benefit those responsible for the implementation of transportation corridor improvements in small and medium-size areas.

A PILOT APPLICATION STUDY OF CORRIDOR PERFORMANCE INDICATORS

INTRODUCTION

The need for effective multimodal transportation performance indicators (or measures) is becoming increasingly important for adequate planning in all sizes of transportation environments, including small and medium-size communities. These measures are essential for several reasons. First, an initial determination of performance by measuring existing conditions indicates the degree of needed improvements. Second, after improvements are implemented, measurement of their performance is often required. Third, such measures are beneficial for measuring roadway improvements examined within the context of the Transportation Equity Act for the 21st Century (TEA21). Finally, multimodal measures can be used to monitor the performance of the transportation system over time by examining changes in performance from an established base year.

The development and implementation of a single measure to describe multimodal performance is not recommended. This is because one measure cannot adequately depict the performance of all modes, may not be sufficiently sensitive to indicate a change in performance, and is not likely to achieve all the goals and objectives defined for measuring performance. As such, several measures should be used that would satisfy the needs of management while meeting other specific technical needs.

A wide variety of existing performance measures have been reported in the literature. The most common measures are based on traffic volume (vehicle flow) and person movement. Examples of volume-based measures include vehicle miles or vehicle hours of travel [1]. Travel time, speed, and delay measures include total travel time, running time, and speed; in addition to delay rate and delay ratio [1,2]. Person movement measures include person volume and person miles or person hours of travel [3,4,5]. Finally, examples of transit measures include frequency of service, riders per vehicle mile, and load factor [3,4].

The purpose of this paper is to report on the testing of selected multimodal corridor performance measures for a small and medium-size area, including an evaluation of the amount and cost of data necessary to apply these measures. The City of Hollywood (population of 127,000 in 1997), located in Broward County in southeast Florida was selected for the analysis. The results from the study can be extended to apply to several classes of roadways/transportation corridors in small and medium-size areas, and should benefit those responsible for the implementation of transportation corridor improvements. This analysis is part of an on-going pilot application study conducted by the Florida Department of Transportation (FDOT) to examine the applicability of performance measures along a 46-mile corridor in southeast Florida that included three counties (Miami-Dade, Broward, and part of Palm Beach). FDOT is in the process of developing appropriate multimodal measures of performance, and is planning to prepare a *Mobility Performance Measures Handbook* for statewide use in late 1999.

The paper is organized into six sections following this introduction. The *first section* reviews the alternative corridor performance measures used in the study. These measures are selected based on an extensive review of measures examined or used by other agencies in numerous states [4], and on an analytical procedure for the recommendation of multimodal measures [5]. The *second section* describes the characteristics of the study area which includes both highway and transit. The *third section* presents the alternative data collection methods used in this study for both modes. This includes data about the corridor collected in the field or obtained from historic databases. The *fourth section* presents key results of the study, reported in terms of several spatial and temporal parameters that characterize each measure. The *fifth section* provides some valuable insights concerning the results and their applicability to small and medium-size areas in terms of data collection needs and methods. The *final section* provides a summary of the study.

CORRIDOR PERFORMANCE INDICATORS

There are numerous performance measures that are either used or proposed for the evaluation of transportation systems in small and medium-size areas. Some of these measures are simple and widely understood while others are more complicated and less known. These measures are likely to evolve over the next few years, reflecting the experience and knowledge gathered from different studies, and the changing needs of management. The wide variety of existing measures has necessitated the need for the development of an analytic process to ensure that performance measures are not selected arbitrarily; instead, they are based on a pre-determined and systematic methodology. This methodology includes a screening process in which a representative group of measures is selected from the list of existing measures based on an established set of minimum criteria. It also includes a prioritizing process in which a number of primary and secondary attributes that characterize each measure are defined and rated. Finally, the process includes the development and application of a scoring function that assigns numeric values to the representative measures, and the selection of measures with the highest scores. A detailed description of this analytic methodology and the scoring function are presented elsewhere [5,6].

The resulting performance measures from this process are being tested in this paper for their applicability in small and medium-size areas. They are either based on corridor volume to indicate quantity of highway and transit travel, or on time to indicate quality of travel. They can be used together to identify and assess the overall performance of corridors, identify problems, evaluate and compare alternative improvement strategies, and monitor these corridors over time. Each of these groups include measures classified as either primary or secondary. Primary measures are most important for measuring performance; secondary measures augment and verify primary measures.

- **Measures of Corridor Quantity (volume)**

  - *Person throughput (or person volume)* is the primary measure of effectiveness. It represents the total number of people moved within or through a corridor during a time period. The measure is expressed in total persons for highway analysis, and in total passengers for transit.

  - *Vehicle miles of travel* is the product of the total number of vehicles in the corridor at a particular time and the total number of miles that these vehicles travel. It is expressed in vehicle miles for highways, and in bus (or train) miles for transit.

  - *Average vehicle occupancy* is the average number of occupants per vehicle. It is expressed in persons per vehicle for highways, and in passengers per bus (or train) for transit. This measure is essential for the development of a person throughput measure.

- **Measures of Corridor Quality (time)**

  - *Average travel time* is the primary measure of efficiency. The measure represents the average time required to traverse the corridor, and is expressed in minutes of travel for highway and transit.

  - *Average travel speed* is expressed in miles per hour for highway and transit. It represents the average speed of all vehicles in the corridor. Data for this measure can be obtained in conjunction with traffic counts collected in the field, or can be derived from roadway distance and travel time data.

  - *Density* is expressed in vehicles per lane mile for highways, and in passengers per seat for transit. This measure provides little information about the movement of vehicles in highly congested corridors.

  - *Percent time heavily congested* is the percentage of time in which highway and transit demand exceed capacity as indicated by the Level of Service (LOS) standards established for the particular type of facility.

These selected measures may be sensitive to extraordinary conditions. As such, these measures should normally be used under typical conditions, because they may provide misleading results or conclusions in situations where extraordinary conditions exist.

Extraordinary conditions include several transportation and non-transportation events. For example, a change in posted speed limits can influence the performance of a highway. The elimination of parking along an arterial, or the widening of an existing roadway both obviously influence roadway performance. Transit systems are vulnerable to changes in fares, route structure, and other operational decisions.
Non-transportation events include a change in the price of fuel and the general health of the economy, both of which can influence individual travel patterns. In addition, local land use

decisions including taxing regulations can influence land development patterns, thereby, affecting the performance of the transportation system. These and other similar events are not considered or examined in this paper.

CHARACTERISTICS OF THE STUDY AREA

The City of Hollywood (population of 127,000 in 1997) is located in Broward County in southeast Florida between Fort Lauderdale and Miami. Interstate 95 (I-95) is the primary north-south limited access facility that crosses the center of the city, providing a connection between several small and medium-size urban areas in the region. It consists of eight general-purpose lanes and two HOV lanes that extend throughout the corridor in both directions. Other major complementary roadways that serve the same origin/destination patterns in the vicinity of I-95 include Florida's Turnpike, US 1, and US 441.

The 5-mile segment along I-95 in Hollywood is selected for applying and testing the multimodal corridor performance measures. This corridor is heavily traveled by commuters who use I-95 for their daily trips to/from work, and by both in-state and out-of-state tourists who travel within the region. As such, the corridor is frequently congested; particularly, during the peak hours. For example, an estimated average daily traffic of 295,000 vehicles was observed on I-95 near Hollywood in 1997. In addition, due to travel convenience resulting from the large number of access points along the facility, the corridor is a primary truck route (more than 17,000 daily truck trips were observed in 1997) for increasing freight movements.

The corridor also contains a commuter train service (Tri-Rail) that was established in 1989. The train system is operated by the Tri-County Commuter Rail Authority, an agency of the state of Florida. Tri-Rail runs parallel to I-95, and provides service to the public on weekdays as well as weekends. It has an extensive network of feeder service, including free Tri-Rail shuttle bus service from most stations and free connections to county bus service to downtown Miami.

The system operates between the hours of 4:00 A.M. and 11:00 P.M. on weekdays, between 5:30 A.M. and midnight on Saturdays, and between 8:00 A.M. and 8:30 P.M. on Sundays. On a typical weekday, six northbound trains are operational during the morning period, while eight similar Tri-Rail trains are operational during the afternoon. The corresponding number of southbound weekday trains is seven for both periods. On the weekend, three northbound trains are operational during the morning period, while either four or five trains are operational during the afternoon period. The corresponding number of southbound weekend trains is between three and four for both periods. The capacity of each train is 600 passengers.

The Tri-Rail system is comprised of 6 zones, and weekday ticket prices are determined by the number of zones through which a passenger travels. The one-way fare for trips within the same zone is $2.00, while the corresponding fare for trips made through all six zones is $5.50. Several types of discounts are available including one-way discounts, round-trip discounts, monthly discounts, and weekend/holiday discounts.

DATA COLLECTION

Several types of highway and transit data were collected along the corridor. Field data collection took place during the fall school year so that the collected data would represent average daily traffic patterns. Further, in order to reduce the potential for obtaining biased indicators of roadway performance, no highway data was collected during holidays, periods of inclement weather, or major sporting events.

Highway data included traffic volume counts, speed, travel time, and vehicle occupancy. Standard roadway service volume at congestion was also calculated. Hourly traffic counts and spot speed data was obtained from the Transportation Statistics Office (TSO) of FDOT at one Traffic Count Telemetry System (TTMS) site along the corridor. The data was obtained in both directions for three consecutive weekdays in September 1997 along the HOV lanes and several general-purpose lanes. Travel time information was obtained from a previous study for FDOT [7] in which 48 travel time runs were conducted along the corridor using the floating car method. This information was collected during the morning and evening peak hours (7:00 to 9:00 A.M. and 4:00 to 6:00 P.M.). Vehicle occupancy data was collected for one day during peak hours in both directions along the HOV lane and along one general-purpose lane using the *carousel method* of observation. This method is sometimes used for collecting vehicle occupancy data on multilane routes with high traffic volumes. It involves an observer and a driver, both traveling in a car that is operated to move slightly slower than the general speed of traffic (vehicle occupancy is therefore determined for vehicles that pass the observer). The carousel method allows a better view of the front and rear seat passengers, especially in vans and automobiles with tinted windows. Standard roadway service volume at congestion (i.e., service flow rate at LOS D as defined for this type of facility) was calculated using procedures from the 1994 Highway Capacity Manual (HCM), and used to establish congestion standards for the corridor.

Transit data was obtained from the Tri-County Commuter Rail Authority that operates the Tri-Rail commuter train service in the southeast region. This data included monthly ridership by station, travel direction, time of day, day of week, and train for a period of one year (1996). It also included information about scheduled travel time for trains between stations during the same time period.

MAJOR RESULTS

This section presents the results of the analysis of highway and transit measures for the pilot corridor. The indicators include person throughput, average travel time, vehicle miles of travel, average vehicle occupancy, average travel speed, density, and percent time heavily congested. They are reported in relation to a set of unique spatial and temporal parameters that are consistent with guidelines for reporting multimodal performance, and are tailored to the amount of detailed data that is available for each mode.

Highway spatial parameters include lane classification (HOV and general purpose lanes) and direction (northbound and southbound), while temporal parameters include time of day (morning peak and evening peak). For the purpose of this study, the morning peak represents the hours between 7:00 A.M. and 9:00 A.M., and the evening peak represents the hours between 4:00 P.M. and 6:00 P.M. Transit spatial parameters include direction (northbound and southbound), while temporal parameters include time of day (A.M. and P.M. periods), and day of week (weekdays and weekends).

The results of the highway performance indicators are presented in **Table 1**. The person throughput measure is based on average vehicle occupancy and traffic counts, and reported as the number of persons carried through the corridor during a time period. As such, the corridor carries approximately 27,600 persons northbound during the peak hours every day (20 percent are in the HOV lane). Similarly, approximately 22,800 persons travel southbound along the corridor during the same period every day (18 percent are in the HOV lane). The vehicle miles of travel (VMT) measure is based on traffic counts and traveled distances, and reported as an average daily estimate. On average, total daily VMT during peak hours is approximately 0.13 million northbound and 0.11 million southbound. Average vehicle occupancy is based on a sample of traffic vehicles, and reported as the average number of occupants in a vehicle during a time period. The results indicate that average vehicle occupancy in the HOV lane is 1.42 northbound and 1.39 southbound. These numbers are relatively low, suggesting the need for increased lane enforcement. The corresponding vehicle occupancy for the general purpose lanes is 1.11 in both directions. Average travel time for the corridor is between 4 and 5 minutes. Total time savings in the HOV northbound direction during the evening peak hours are 21 seconds (or 7 percent), while the corresponding savings in the HOV southbound direction during the morning peak hours are 18 seconds (or 6 percent). As such, annual time savings to commuters traveling on I-95 in the vicinity of the city of Hollywood are approximately three hours per person assuming regular use. Average travel speed in the HOV lane is higher than the corresponding travel speed in the general purpose lanes, suggesting better highway travel conditions. Also, the difference between spot and computed speed is relatively small (less than 10 percent), indicating the potential for using one speed measure as a surrogate for the other. Average roadway density in the HOV lanes is approximately 12 vehicles per lane mile compared to 18 vehicles per lane mile in the general purpose lanes. Finally, the results indicate that the corridor is heavily congested (i.e., LOS D for this type of facility) between 15 and 16 percent of the day northbound and between 16 and 17 percent southbound.

Table 1

Highway Performance Indicators
Average Daily Results

Type	Description		Northbound				Southbound			
			AM Peak		PM Peak		AM Peak		PM Peak	
			HOV	Other	HOV	Other	HOV	Other	HOV	Other
Measures of Quantity	**Person Throughput** (in thousands)		2.60	9.40	3.00	12.60	1.20	6.60	2.90	12.10
	Vehicle Miles of Travel (in thousands)		9.80	49.00	12.30	59.60	5.00	34.60	11.40	57.40
	Avg. Vehicle Occupancy (persons per vehicle)		1.47	1.06	1.37	1.17	1.35	1.05	1.42	1.17
Measures of Quality	**Avg. Travel Time** (minutes)		4.50	5.00	4.80	5.15	4.50	4.80	4.95	4.92
	Avg. Travel Speed	**Spot speed** (miles per hour)	75.80	64.80	74.00	64.40	77.10	65.70	74.10	63.70
		Computed speed (miles per hour)	74.10	65.80	69.20	64.50	74.10	68.80	67.90	67.50
		Difference (percent)	2.3%	1.5%	6.9%	0.2%	4.0%	4.7%	9.1%	6.0%
	Density (vehicles per lane mile)		11.70	17.10	15.00	20.90	13.90	20.30	5.90	11.90
	Time Heavily Congested (percent)		15%	16%	15%	16%	16%	17%	16%	17%

The results of the Tri-Rail transit performance indicators are presented in **Table 2**. The person throughput measure for the corridor indicates that approximately 2,000 daily northbound passengers use Tri-Rail on weekdays compared to 600 passengers on weekends. This represents an average vehicle occupancy of 280 passengers on weekdays and 170 on weekends. Similarly, 1,900 daily southbound passengers use Tri-Rail on weekdays compared to 550 passengers on weekends. This represents an average vehicle occupancy of 270 passengers on weekdays and 160 on weekends. The numbers are similar for both directions, indicating that transit users who use Tri-Rail for their morning commute to work also use Tri-Rail for their evening trip home. Daily VMT is approximately 70 train miles on weekdays and 35 train miles on weekends.

Table 2
Tri-Rail Transit Performance indicators
Average Daily Results

Type	Description	Northbound				Southbound			
		Weekdays		Weekends		Weekdays		Weekends	
		AM	PM	AM	PM	AM	PM	AM	PM
Measures of Quantity	**Person Throughput** (number of passengers)	756	1,222	194	409	1,091	792	290	262
	Vehicle Miles of Travel (train miles)	30	40	15	20	35	35	15	20
	Avg. Vehicle Occupancy (passengers per train)	126	153	65	102	156	113	97	66
Measures of Quality	**Average Travel Time** (minutes)	8	8	8	8	8	8	8	8
	Average Travel Speed (miles per hour)	38	38	38	38	38	38	38	38
	Density (passengers/seat; percent)	21%	26%	11%	17%	26%	19%	16%	11%
	Time Heavily Congested (percent)	0%	0%	0%	0%	0%	0%	0%	0%

Average travel time for the Tri-Rail trip along the corridor is 8 minutes, compared to an average travel time between 4 and 5 minutes for an automobile trip. The resulting average speed is approximately 40 miles per hour for the train, compared to an average speed between 65 and 75 miles per hour for an automobile. The density analysis indicates that between 19 and 26 percent of the train capacity is being utilized during weekdays, while percent utilization is only between 11 and 17 percent on weekends. As expected, the Tri-Rail tracks are never congested since all trains are scheduled with constant headway, indicating that there is no time during the day in which this transit system is heavily congested.

GENERAL IMPLICATIONS OF STUDY

The multimodal measures discussed earlier are considered suitable for evaluating the performance of corridors in small and medium-size areas. The selected quantity and quality measures are expected to provide sufficient information about the status of the transportation element being considered in these areas. In addition, these measures are flexible in terms of achieving the goals and objectives of potential users. For example, if the goal of city and local officials is to improve mobility in a small urban area by moving more people between different origins and destinations

quickly, efficiently, and safely, corridor measures such as person throughput or average vehicle occupancy can be used for that purpose. Similarly, if the purpose is to quantify congestion along a major transportation corridor in a medium-size urban area to determine the location and nature of transportation problems, corridor measures such as average travel time, average travel speed, or density can be used. Finally, these measures are useful for evaluating corridor performance during different hours of the day, such as peak hours, off-peak hours, or an entire day.

However, a key concern regarding the application of performance measures in small and medium-size areas is the cost and method of data collection. This is because some measures may require new data that may be difficult or expensive to obtain, resulting in an extra financial burden on the smaller urban area where the competition for scarce tax or other revenue resources is high. As such, several important strategic inferences regarding data collection and system utilization can be made from this study.

- Transportation performance can be adequately determined using traditional data collection techniques. These include roadside observations, special traffic volume counts, or permanent count stations (TTMS sites) if available. In addition, transit databases should be utilized if available. Small and medium-size areas do not need to invest in new and expensive technology at this time to collect the required data. For example, the use of video cameras or infrared technology to collect vehicle occupancy information may prove to be costly for a small community. Such technologies should be monitored for potential applications in the future when their prices become more affordable. Alternatively, less expensive methods of data collection can be fully utilized. For example, the use of additional TTMS sites is expected to save data collection costs in the future. Also, working in conjunction with other agencies such as a state office in acquiring network data may help cut costs.

- HOV lanes save time. As such, small and medium-size areas in cooperation with county and state officials are encouraged to promote such services. These are particularly useful for "bedroom communities" near larger urban areas (satellite communities). Under these circumstances, an HOV lane in a medium-size community should encourage carpooling; thereby, reducing the overall cost of congestion to that community by eliminating the incremental costs of single-occupant vehicles on the road. The results presented in this paper verify that HOV lane utilization is higher than the utilization of an average general purpose lane.

- The cost of collecting travel time data in the field can be minimized by using spot speed as a surrogate to calculate the travel time measure (the results from this study indicate that the difference between spot speed and speed computed from travel time is small -- less than 10 percent). In this case, spot speed information can be obtained in conjunction with traffic counts at no extra cost, and used with roadway distances to calculate travel time. Borrowed police radar guns may also be an inexpensive way to collect spot speed data. Such methods are appropriate only under normal or slightly congested traffic conditions, since spot speed is negligible in stopped or severely congested conditions. As such, travel time data will still need to be collected in the field for situations of stopped traffic or severe congestion.

- The cost of collecting accurate and sufficient vehicle occupancy information should be an important element for determining the level of success of these multimodal measures in small and medium-size areas. This is because prior experience has shown that vehicle occupancy data is expensive to collect due to the intensive labor and setup effort involved, in addition to several other necessary supplementary costs. Particular savings in vehicle occupancy data collection can result from repeated observations at the same location.
- Vehicle occupancy should initially be collected for at least one full day, and then be followed by short counts of one to two hours during the morning and evening peak periods. This method is satisfactory because vehicle occupancy is site specific and dependent on localized conditions, and once a site has been calibrated by an all-day control count, short counts can be subsequently used. The two primary methods suggested for the collection of vehicle occupancy data in small and medium-size areas are the roadside/windshield observation and the carousel method (where roadside observation is not possible, the carousel method of observation is recommended). Many factors influence the results of the roadside/windshield observation method, including human fatigue, weather conditions, amount of daylight, traffic density and speed, vehicle mix, and site location. The primary advantages include simplicity, and the ability to obtain large and representative sample sizes. On the other hand, the primary disadvantages include high cost due to extensive use of labor (i.e., sampling methods are usually used), and the difficulty of necessary observation at high volume, high speed multilane sites. The carousel method of observation is particularly useful in locations with three or more lanes, with high speed traffic, and in locations where it is difficult to station a roadside observer. It has proven to be reliable, efficient, and cost effective for collecting vehicle occupancy. The primary advantage of this method includes the ability to accurately observe from a short distance the number of people in the front and back seats of each targeted vehicle. However, the primary disadvantage includes the potential for observers in different survey vehicles to collect duplicate data when the spacing between these vehicles is not well designed.

- Small and medium-size areas may need to select alternative strategic options that provide commuters with incentives to promote transit ridership. These incentives include promotional and/or permanent cash discounts; coupon books; improving service reliability, safety, and cleanliness; and the provision of sufficient park-and-ride facilities.

SUMMARY AND CONCLUSIONS

The purpose of this paper is to report on the testing of selected multimodal corridor performance measures for a small and medium-size area, including an evaluation of the amount and cost of required data. These measures are either based on corridor volume to indicate quantity of travel, or on time to indicate quality. Measures of corridor quantity include person throughput, vehicle miles of travel, and average vehicle occupancy. Measures of quality include average travel time, average travel speed, density, and percent time heavily congested. The measures have been selected based on an analytic procedure and a scoring function that have been described elsewhere [5,6].

The measures are applied to the 5-mile segment of I-95 in the City of Hollywood, located in southeast Florida. I-95 consists of eight general-purpose lanes and two HOV lanes that extend throughout the corridor in both directions. The corridor also contains a commuter train service (Tri-Rail) that is operated by the Tri-County Commuter Rail Authority. Tri-Rail runs parallel to I-95, and provides service to the public on weekdays as well as weekends.

Several types of highway and transit data were collected along the corridor. Highway data included traffic counts, travel speed, travel time, vehicle occupancy, and standard roadway service volume at congestion. Transit data included monthly ridership by station, travel direction, time of day, day of week, and run for a period of one full year (1996). It also included information about scheduled travel time for trains between stations during the same time period.

The multimodal measures are reported in relation to a set of unique spatial and temporal parameters that are consistent with guidelines for reporting multimodal performance, and are tailored to the amount of detailed data that is available for each mode. They were found to be suitable for evaluating the performance of corridors in small and medium-size areas. This is because the variety of proposed quantity and quality measures are expected to provide sufficient information about the status of the transportation element being considered in these areas. In addition, these measures are flexible in terms of achieving the goals and objectives of potential users, and for application during different times of the day.

One key concern regarding the application of these measures in small and medium-size areas is the cost and method of data collection. This is because some measures may require new data that may be difficult or expensive to obtain, resulting in an extra financial burden on the smaller urban area. Several inferences regarding data collection and system utilization are made from this study: 1) multimodal transportation performance can be adequately determined using traditional data collection methods; 2) HOV lanes save time, suggesting the need for providing such lanes in smaller areas; 3) the cost of collecting travel time data in the field can be minimized by using spot speed as a surrogate to calculate the travel time measure; 4) the cost of collecting accurate and sufficient vehicle occupancy data should be an important element for determining the level of success of these measures; 5) vehicle occupancy should initially be collected for at least one full day, and then be followed by short counts of one to two hours during the morning and evening peak hours (where roadside observation is not possible, the carousel method of observation is recommended); and 6) small and medium-size areas may need to select alternative strategic options that provide commuters with incentives to promote transit ridership.

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Session #9

ACCOUNTING FOR INDUCED TRAVEL IN EVALUATION OF URBAN HIGHWAY EXPANSION

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Abstract

This paper demonstrates application of the principles of economic analysis to evaluate highway capacity expansion in an urban setting, using a sketch-planning model called "Spreadsheet Model for Induced Travel Estimation" (SMITE). The application takes into account new travel that may be induced by highway expansion over and above that which is simply diverted from other regional highways. We demonstrate how the effects of induced travel can be incorporated into the evaluation process at a sketch planning level of analysis, especially in cases where four-step urban travel models are either unavailable or are unable to forecast the full induced demand effects, such as in small and medium-sized urban areas. The methodology and the SMITE spreadsheet can be used to provide useful information to assist policy makers in evaluating proposals for specific additions to highway capacity for corridor studies. The spreadsheet will soon be made available at: *www.ota.fhwa.dot.gov/steam.*

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1.0 INTRODUCTION

Recently, the Federal Highway Administration (FHWA) (1) showed that the role of highway capacity expansion in increasing highway travel has been small relative to other factors. However, the paper concluded that "..the inducement of travel due to highway capacity expansion is an issue that needs to be and can be addressed..." FHWA has underway a travel model improvement program, which is attempting to develop improved modeling techniques for use in addressing issues such as the magnitude of induced travel. While these improved procedures are being developed, the debate about induced travel and its probable magnitude continues. This paper attempts to demonstrate how less sophisticated but currently available techniques may be used in the interim to estimate the magnitude of induced travel, at a sketch planning level of analysis.

Environmental groups, and occasionally the transportation literature, perpetuate certain misconceptions about induced traffic. For example, Hansen (2) states: "A 1.0 percent increase in lane miles generates a 0.9 percent increase in vehicle miles traveled (VMT) within 5 years. With so much induced traffic, adding road capacity does little to reduce congestion." Statements such as Hansen's are based on several misunderstandings about the sources of "induced" travel and the effects of capacity expansion on congestion levels. Through this paper we hope to clarify the misunderstandings that persist on the subject of travel "induced" by highway capacity expansion, and the value of highway expansion in relieving congestion in metropolitan areas. We discuss how induced travel can be estimated at the corridor level using the sketch-planning model called "Spreadsheet Model for Induced Travel Estimation" (SMITE), and demonstrate our methodology using an example travel corridor involving a proposal to expand freeway capacity.

2.0 DEFINING INDUCED TRAVEL

Much of the misunderstanding about induced travel stems from differing interpretations about its meaning in the context of highway capacity expansion. These interpretations are related to:

- whether the travel being referred to is "person" travel or "vehicle" travel -- for example, shifts from non-highway modes to the highway mode would not be acknowledged to be "induced" by those thinking in terms of person travel, since no *new* person trips are involved;

- whether the vehicle or person travel being referred to as "induced" consists only of absolutely new trips or whether it also includes additional miles of travel on existing trips, i.e., whether the *unit of measure* is "trips" or "miles";

- whether an increase in peak travel resulting from shifts in time of travel from off-peak to peak periods, without an increase in total daily travel, can be considered to be induced travel, i.e., the *time frame of reference*;

- whether travel on a specific facility, or in a specific corridor or sub-area, is being considered or whether it is the regionwide travel market that is of interest, i.e., the

geographic frame of reference -- for example, much of the travel that may rightfully be considered to be "induced" with respect to a specific improved facility may simply be travel that has been diverted from parallel facilities in the travel corridor, or from other origins and destinations in the region, and is therefore not considered to be "induced" by those taking a regionwide perspective.

The debate about induced travel in metropolitan areas has arisen primarily because of the presumed negative environmental impacts of increased vehicle use. These impacts generally do not vary significantly by time of day. Thus, it is clear that what is of concern to environmental groups is additional *daily vehicle miles* of travel that might be generated at the *regionwide* level, and occasionally at the *corridor or facility* level. In other words, of relevance in the induced travel debate are changes in: (1) *vehicle*, not person travel; (2) vehicle *miles*, not vehicle trips; (3) *daily* vehicle miles, not peak period or peak hour vehicle miles; and (4) *regionwide* daily vehicle miles, or daily vehicle miles in a *specific corridor* or on a *specific facility*. In this paper, therefore, we define "induced" travel as an increase in daily vehicle miles of travel, with reference to a specific geographic context.

3.0 THE NEED TO ESTIMATE INDUCED TRAVEL

Induced travel can come from the following sources:

1. An increase in person trip production (P) related development

2. An increase in person trip attraction (A) related development

3. An increase in number of daily motorized person trip P's and A's *per development unit*

4. An increase in average motorized person trip distance

5. An increase in share of person travel by private motorized vehicles

6. A shift in vehicle travel to improved facilities from unimproved facilities within a corridor, or to an improved corridor due to diversion of traffic from other corridors.

When the frame of reference is the regionwide travel market, induced travel comes only from the first five sources. The sixth source comes into play at the facility and corridor levels, and may be more appropriately defined as diverted travel. Most transportation models do not capture induced travel from the first three sources. Most urban modelers do not increase input forecasts of total development regionwide to account for additional business and residential development induced to locate in the region by improvement in transportation levels of service, and often improved corridors are modeled with the same development inputs for the Build and No-Build cases. Environmental groups, on the other hand, believe that improved highways can significantly increase regional development (sources 1 and 2), a belief often shared by Chambers of Commerce. Also, it is believed that development induced by highway expansion is generally inaccessible by non-highway modes, resulting in dependence on automobiles, and consequently more vehicle trips

per development unit, i.e. source 3 (3).

Most modelers use doubly-constrained trip distribution models, i.e., trips attracted to locations within the improved corridor are constrained by the number of trip attractions provided by the modeler. Therefore, additional trips attracted to a corridor due to accessibility improvements are not obtained from most four-step models, i.e., a portion of diverted travel (category 6) is not estimated by many four-step models, unless development and trip attractions are increased exogenously to reflect accessibility improvements.

The inability of four-step models to forecast the above sources of induced travel within a corridor may result in lower forecasts of traffic and air pollutant emissions, and higher estimates of speed for the Build case than would actually occur. Thus, four-step models could overestimate highway user travel time savings and underestimate environmental costs. Therefore, it is important for planners to account for induced travel sources not addressed by four-step models.

At the facility or corridor levels, induced travel comes from all six sources shown in Table 1. A study by Goodwin (4) compared model forecasts with observed traffic flows on nine improved urban roads in the U.K. He found that, for an average road improvement for which traffic growth is forecast by travel models, unpredicted traffic in the first year, over and above the forecast, was +5.7%. It is unclear whether the model estimates incorporated trip lengthening effects (source 4) and mode choice effects (source 5). On alternative routes (i.e., "relieved routes"), the average unpredicted traffic was +0.7% above the forecast. Based on long-term studies in six corridors, Goodwin suggests that unpredicted traffic in the long term is double the unpredicted traffic in the short term. He equates an additional 10% traffic to a demand elasticity, with respect to travel time, of -0.5. This suggests a short-term demand elasticity of about -0.28 at the corridor level in urban areas, based on the 5.7% unpredicted traffic, and a long term elasticity of about -0.57 (i.e., double the short-term elasticity).

4.0 ESTIMATING INDUCED TRAVEL IN A CORRIDOR

Only when capacity changes result in a reduction in the total user-perceived price of a trip (including both out-of-pocket and travel time costs) can any new travel be induced. Depending on the context, a capacity addition can either result in no change in price at all (e.g., if congested travel conditions do not exist to begin with); or it can reduce total price by varying amounts, depending on the level of congestion pre-existing. Thus the *context* of the capacity addition is of prime importance in estimating induced travel demand.

When capacity is added on a congested facility or to a congested network, new travel is attracted to it, depending on the elasticity of travel demand with respect to the travel time component of the full price of the trip. As discussed in Section 3, the recent literature suggests that *long term* demand elasticity averages -0.57 at the corridor level. However, researchers in the past have produced elasticity estimates as low as -0.2 and as high as -1.0 (5). The wide range results from several factors:

- *The relative importance of travel time in the full context of the trip*: For example, if the

trip involves a high parking price at the destination end, it is likely that elasticity with respect to travel time will be relatively low.

- *The time frame*: In the short term, elasticity tends to be low, since route changes (part of source 6 in Table 1) and time of travel are the primary impacts (6). In the mid-term, mode shifts (source 5) and destination shifts (source 4 and part of source 6) become more important. In the long term, origin ends of trips may also shift or new trip origins may be generated due to absolutely new development (source 1), and further destination shifts may occur and new trip destinations may be generated (source 2) as homes and businesses locate in the improved corridor in response to accessibility improvements .

- *Diversion from other parts of the region*: The rate of increase in trips attracted to a corridor and the rate of increase in corridor development may differ based on other location characteristics of the improved corridor, e.g., availability of vacant land.

- *Length of trips served*: For example, Goodwin's study (4) shows that, while urban roads (which carry mainly intra-urban trips) have unpredicted traffic in the short term amounting to +5.7% on average, rural roads (which carry mainly long-distance and inter-urban traffic) have average unpredicted traffic amounting to +13.3%.

If we wish to develop an estimate of induced travel demand using demand elasticities, we must first estimate the reduction in the time "price". This reduction, converted into a percentage reduction, can then be used with elasticity estimates to provide estimates of induced travel demand. However, one complication is that as travel increases due to induced demand, the initial price reduction is slowly eroded. It is therefore necessary to go through a process of equilibration of demand and price. The change in travel time that occurs with increases in demand is easily modeled using speed-volume relationships (7). By iteratively estimating induced travel demand and the resulting time price change, an equilibrium point can be found at which demand and price are in balance.

A sketch planning application of the above methodology is demonstrated in this section for a hypothetical example corridor, using the Spreadsheet Model for Induced Travel Estimation (SMITE) developed by the authors. The analysis represents an 8 mile long corridor with a freeway facility which is proposed to be widened from 4 to 6 lanes, i.e., a 50% increase in capacity. There are several parallel arterial facilities. The analysis is demonstrated for scenarios representing three levels of initial congestion: low, medium and high.

The low congestion scenario assumes an average daily traffic (ADT) of 80,000 on the freeway. Hourly capacity (HC) is assumed to be 2,000 vehicles per lane, or 8,000 vehicles for all four lanes in both directions, yielding a ratio of average daily traffic volume to hourly capacity (ADT/HC) of 10.0. Over the 8 mile length of the facility, the freeway handles 640,000 VMT under this scenario. The moderate congestion scenario assumes a freeway ADT of 96,000, yielding an ADT/HC ratio of 12.0 and a facility VMT of 768,000. The high congestion scenario assumes a freeway ADT of 112,000, yielding an ADT/HC ratio of 14.0 and a facility VMT of 896,000.

Under pre-existing conditions, corridor traffic is assumed to be distributed 40% on the freeway and 60% on the arterials. Traffic diverted from arterials to the expanded freeway is first estimated, by redistributing traffic such that relative levels of congestion on the freeway and the arterials stay the same. This technique is based on principles in NCHRP Report No. 255 (8). Note that, alternatively, these estimates of the redistribution of traffic can be obtained by running traffic assignments with and without the freeway improvement, using a fixed vehicle trip table from the No-Build model run.

SMITE uses speed relationships developed by Margiotta et al. (9) to estimate the effects of congestion on speeds. The ADT/HC ratio is a key variable used to predict congestion-related delays. The speed estimates are sensitive to peak-spreading as well as queuing under congested conditions, and queues carried over from a congested hour to the next hour are accounted for. The speed relationships also consider variations of traffic volumes from day to day, which have a big impact on speeds when demand volumes are close to capacity.

SMITE allows the user to provide travel demand elasticity estimates to obtain estimates of induced travel (other than that diverted from arterials). For the example corridor, we used a moderate demand elasticity of -0.5 and an extreme value of -1.0. The -0.5 elasticity means that a reduction of travel time per mile of 10% will result in a demand increase of 5%, while the -1.0 elasticity means that the same 10% reduction will result in a 10% increase in demand. The -0.5 elasticity is close to the -0.57 elasticity estimate for urban areas derived from Goodwin's work (see Section 3), while the extreme -1.0 elasticity is reflective of a scenario where abundant vacant developable land exists within a corridor.

Note that SMITE applies these elasticities to estimates of traffic and travel time obtained *after* traffic diversion from arterials to freeway (part of source 6) is estimated. We believe this base is comparable to the modeled traffic used by Goodwin (4) in estimating unpredicted traffic growth. Induced VMT estimates are calculated for the freeway as well as for parallel arterials using these elasticities. Induced traffic associated with increases in highway speeds is calculated as follows:

$$F = \frac{1}{1 - \frac{1}{E_s * E_d}}$$

$$E_s = M * S_{av}$$

where:

- F is the fraction of an initial decrease in travel time that is off-set by induced traffic; e.g., F = 0 implies that none of the initial decrease is off-set. For very high values of both E_d and E_s, F approaches 1.0.

- E_d is the elasticity of demand for highway travel with respect to travel time; i.e., the percent change in demand due to a one percent increase in highway travel time (E_d is negative because an increase in highway travel time will reduce demand).

- E_s is the elasticity of supply price (travel time) for highway travel with respect to demand; i.e., the percent change in the highway travel time per vehicle mile due to a one percent increase in VMT.

- M is added hours of congestion delay to other vehicles per added vehicle mile.

- S_{av} is average speed.

For highway capacity improvements:

$$F = \frac{H_i}{H_o}$$

where:

- H_o is the "initial" time savings for current users due to the improvement

- H_i is the subsequent increase in travel time for current users due to induced traffic

Recognizing that by definition $H_i = V_i * M$ (with all variables defined above), the following equation results from substituting for F, H_i, and E_s:

$$V_i = \frac{H_o}{M - \frac{1}{E_d * S_{av}}}$$

This is the equation used in SMITE to calculate induced travel for improvements to highway capacity, with S_{av} estimated as vehicle miles of travel divided by vehicle hours of travel after traffic diverted from arterials is accounted for. Table 1 summarizes the results. As indicated in the table, induced VMT estimates for the freeway vary by a factor of more than 2 between the low congestion and high congestion scenarios. Under severe initial congestion levels and an assumption of high demand elasticity, the 50% increase in capacity is almost "consumed" by the 47.5% VMT increase due to diverted and induced travel. When the entire corridor (including arterials) is considered, however, induced traffic ranges from 4.8% of base corridor traffic for low elasticity and low congestion to 11.5% for moderate to high congestion with high demand elasticity.

The increase in daily VMT on the freeway at high initial congestion levels would generally be accompanied by a shift in traffic from off-peak to peak periods, creating the perception that congestion has not been reduced significantly. This is the source of the misperception that "..adding road capacity does little to reduce congestion"(2). However, as the freeway and arterial average daily speeds shown in Table 2 suggest, congestion is reduced significantly, on both the freeway as well as the arterials, under all scenarios.

TABLE 1. EFFECTS OF FREEWAY EXPANSION IN THE EXAMPLE CORRIDOR

	Level of Congestion		
	LOW	**MODERATE**	**HIGH**
For demand elasticity of -0.5			
Freeway:			
Initial VMT	640,000	768,000	896,000
Diverted VMT	160,000	192,000	224,000
Induced VMT	43,810	102,410	135,865
Total VMT after improvement	843,810	1,062,410	1,255,865
Percent change in VMT	31.85%	38.33%	40.16%
Arterials:			
Initial VMT	960,000	1,152,000	1,344,000
Diverted VMT	(160,000)	(192,000)	(224,000)
Induced VMT	37,799	45,365	51,359
Total VMT after improvement	837,799	1,005,365	1,171,359
Percent change in VMT	-12.73%	-12.73%	-12.85%
Corridorwide:			
Initial VMT	1,600,000	1,920,000	2,240,000
Diverted VMT	0	0	0
Induced VMT	81,609	147,774	187,224
Total VMT after improvement	1,681,609	2,067,774	2,427,224
Percent change in VMT	4.85%	7.15%	7.71%
For demand elasticity of -1.0			
Freeway:			
Initial VMT	640,000	768,000	896,000
Diverted VMT	160,000	192,000	224,000
Induced VMT	81,692	167,891	201,802
Total VMT after improvement	881,692	1,127,891	1,321,802
Percent change in VMT	37.76%	46.86%	47.52%
Arterials:			
Initial VMT	960,000	1,152,000	1,344,000
Diverted VMT	(160,000)	(192,000)	(224,000)
Induced VMT	69,555	82,097	88,639
Total VMT after improvement	869,555	1,042,097	1,208,639
Percent change in VMT	-9.42%	-9.54%	-10.07%
Corridorwide:			
Initial VMT	1,600,000	1,920,000	2,240,000
Diverted VMT	0	0	0
Induced VMT	151,246	249,988	290,441
Total VMT after improvement	1,751,246	2,169,988	2,530,441
Percent change in VMT	8.64%	11.52%	11.48%

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TABLE 2. ESTIMATED AVERAGE DAILY TRAVEL SPEEDS

	Level of Congestion		
	LOW	MODERATE	HIGH
For demand elasticity of -0.5			
Freeway:			
Initial speed before improvement (mph)	48.12	35.86	25.88
Final speed after improvement (mph)	53.79	41.64	29.92
Arterials:			
Initial speed before improvement (mph)	18.59	18.03	16.92
Final speed after improvement (mph)	19.15	18.71	17.93
For demand elasticity of -1.0			
Freeway:			
Initial speed before improvement (mph)	48.12	35.86	25.88
Final speed after improvement (mph)	52.22	37.38	26.80
Arterials:			
Initial speed before improvement (mph)	18.59	18.03	16.92
Final speed after improvement (mph)	19.01	18.56	17.72

5.0 EVALUATING HIGHWAY EXPANSION IN A CORRIDOR

For policy makers faced with the controversial issue of induced travel, the critical issue is not the magnitude of induced travel. Rather, the issue is whether the user benefits, including benefits to induced travelers and pre-existing travelers, and other benefits will exceed the external costs of induced travel (e.g., increases in air, water and noise pollution) and the public, social and environmental costs to be incurred in providing the added capacity. SMITE produces estimates of user benefits of the capacity addition, both for induced travelers as well as for pre-existing travelers, using conventional benefit-cost analysis procedures (10). User benefits calculated for the various scenarios for the example corridor are shown in Table 3.

SMITE also computes "external" costs of induced travel using user-provided estimates of external costs per VMT. For our example corridor, we used lower bound and upper bound estimates of average external costs per VMT of 3.7 cents and 86 cents respectively, based on research by Delucchi (11). Results for the example corridor are shown in Table 3. To account for the fact that some induced travel at the corridor level is actually due to diversion of traveler destination or diversion of development, SMITE allows a portion of the corridor-wide induced traffic attributable to these diversions to be first subtracted out to obtain true "regional-level" induced travel. The results in Table 3 suggest that, while the magnitude of induced travel as well as social costs associated with it increase with increasing levels of initial congestion, user mobility benefits also increase, due to larger reductions in congestion delays.

TABLE 3. USER BENEFITS, EXTERNAL COSTS AND NET BENEFITS

	Level of Congestion		
	LOW	**MODERATE**	**HIGH**
For demand elasticity of -0.5			
Daily user mobility benefits	$34,816	$66,307	$113,299
Other user benefits	$8,704	$16,577	$28,325
Total daily user benefits	$43,520	$82,883	$141,624
Daily external costs:			
Lower bound cost	$1,177	$2,034	$3,047
Upper bound cost	$27,357	$47,275	$70,821
Net benefits daily:			
(a) with lower bound external costs	$42,343	$80,849	$138,577
(b) with upper bound external costs	$16,163	$35,609	$70,803
NPV of net benefits per lane mile (million $):			
(a) with lower bound external costs	$8.41	$16.06	$27.53
(b) with upper bound external costs	$3.21	$7.07	$14.06
For demand elasticity of -1.0			
Daily user mobility benefits	$26,802	$31,857	$55,338
Other user benefits	$6,700	$7,964	$13,835
Total daily user benefits	$33,502	$39,821	$69,173
Daily external costs:			
Lower bound cost	$880	$938	$1,457
Upper bound cost	$20,456	$21,791	$33,871
Net benefits daily:			
(a) with lower bound external costs	$32,622	$38,883	$67,716
(b) with upper bound external costs	$13,046	$18,030	$35,302
NPV of net benefits per lane mile (million $):			
(a) with lower bound external costs	$6.48	$7.72	$13.45
(b) with upper bound external costs	$2.59	$3.58	$7.01

SMITE next computes net daily societal benefits (or disbenefits), and the Net Present Value (NPV) of a stream of benefits over the life of the investment. The capacity addition is economically justified if public agency, social and environmental costs to implement the capacity addition do not exceed NPV of societal benefits. To obtain the NPV, daily external costs were first subtracted from daily user benefits to get net daily societal benefits. These daily net benefits were then annualized using an annualization factor of 300, and a stream of uniform net annual benefits over a period of 20 years was converted to a NPV of benefits, using a 7% discount rate. This value was then converted to a NPV of benefits per lane mile, by dividing corridor net benefits by the 16 lane miles of added freeway capacity proposed for the example corridor. Table 3 shows the results. The NPV of benefits per lane mile is the maximum present value (PV) of public expenditure, including both capital and operating and maintenance costs, that is economically warranted per lane mile, so that economic benefits to society might exceed costs to society,

assuming no uncompensated environmental or social impacts from the expansion itself.

The results suggest that, when demand elasticity is -0.5, depending on pre-existing congestion levels and monetary values ascribed to external costs per VMT, public costs ranging from $3.2 to $27.5 million per lane mile could be justified in the corridor. For the high demand elasticity extreme of -1.0, $2.6 million to $13.5 million per lane mile could be justified. For comparison, the U.S. DOT
uses a typical cost of $2.283 per lane mile in 1989 dollars (i.e., $3.0 million per lane mile in 1997 dollars) for freeway lane additions in national policy analysis (12).

6.0 CONCLUSIONS

For policy makers faced with the controversial issue of induced travel, the critical issue is not whether highway capacity additions result in induced travel, but whether net societal benefits, after accounting for the external costs of induced travel, will exceed the public costs and social costs to be incurred in implementing the capacity addition. The application example in this paper shows how answers to this question can be obtained under typical scenarios at the corridor level of analysis, using the spreadsheet software SMITE. The application example also demonstrates how the effects of induced travel can be incorporated into the evaluation process at a sketch planning level of analysis, especially when urban travel models are either unavailable or are unable to forecast the full induced demand effects.

The results of the example analysis provide a basis for some broad conclusions about the user benefits and external costs of vehicle use resulting from highway capacity additions. The results suggest that, while the magnitude of induced travel as well as social costs associated with it increase with increasing levels of initial congestion, user mobility benefits also increase, due to larger reductions in congestion delays. Consequently, even when the magnitude of induced travel is high, capacity expansion could be warranted, depending on the public and social costs to be incurred in implementing the capacity expansion.

Acknowledgements: The views we have expressed in the paper are ours alone, and do not necessarily represent the views or policies of the FHWA or the US DOT. This paper has been abridged from a longer paper presented by the authors at the 77th Annual Meeting of the Transportation Research Board in January 1998 (Paper no.980132).

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13.

Session #9

Addressing Concerns About the Major Investment Study Requirements

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ABSTRACT

One of the new requirements of the Intermodal Surface Transportation Efficiency Act of 1991 is the requirement that State Departments of Transportation, Metropolitan Planning Organizations, and transit operators conduct a major investment study (MIS) in metropolitan areas where (1) a major investment is proposed, and (2) federal funds are potentially involved. On October 28, 1993, the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) issued the Statewide and Metropolitan Planning Rule which sets out the criteria for where and when an MIS is required, what agencies should be involved, factors to be considered, relationship to the environmental process, and funding options for developing studies.

Although the FHWA and FTA crafted the Metropolitan Planning Rule with the intent of providing the MIS requirements in a way that emphasized flexibility and local decision-making, the federal agencies were soon faced with concerns from local and state transportation agencies about the MIS requirements.

On January 5, 1996, the FHWA and FTA authorized the FHWA and FTA Region Nine Offices (Region Nine encompasses the States of Arizona, California, Hawaii and Nevada, and the Pacific Islands) to conduct a pilot program to look at the concerns about the MIS requirements, and to make recommendations on addressing these concerns, including alternative simplified procedures for meeting the MIS requirements.

In January, 1998, the FHWA and FTA Region Nine Offices submitted to their respective Headquarters Offices, the FHWA/FTA Region Nine Major Investment Study Pilot Program Evaluation Report. The two-year MIS Pilot Program included an evaluation of seventeen areas of concern with the MIS requirements, a review of three MIS efforts that successfully used innovative approaches, and the evaluation report presents findings and recommendations to address concerns about the MIS requirements.

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Addressing Concerns About the Major Investment Study Requirements

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) is considered by many transportation professionals as a new way of doing business in the surface transportation world.

ISTEA introduced new approaches to solving transportation problems, and stressed the need for flexibility and consideration of multi-modal and intermodal solutions.

One of the new approaches contained in the planning requirements of ISTEA is the requirement for major investment studies (MIS). The MIS is derived from Section 3012 of the ISTEA, which states "(n)ot later than 6 months after the date of enactment of this section, the Secretary shall initiate a rulemaking proceeding to conform review requirements for transit projects under the National Environmental Policy Act (NEPA) of 1969 to comparable requirements under such Act applicable to highway projects. Nothing in this section shall be construed to affect the applicability of such Act to transit or highway projects."

Although both the Federal Transit Administration (FTA) and the Federal Highway Administration (FHWA) operate under the same regulation pertaining to NEPA (23 CFR Part 771), in practice each administration carried out the environmental process in a different way. Before the ISTEA, project sponsors would often decide whether they would pursue funding from the FTA or the FHWA, and then conduct the environmental process to suit the requirements of that particular agency.

With the ISTEA stressing the flexibility of funds to meet multi-modal and intermodal needs, the FTA and the FHWA realized that it was important to influence the planning activities prior to the NEPA process in order to accomplish the requirement of Section 3012 of the ISTEA.

The MIS requirements are therefore contained in the FTA and FHWA Statewide and Metropolitan Planning Rule (23 CFR Part 450; 49 CFR Part 613). Section 450.318 of the Planning Rule sets out the criteria for where and when an MIS is required, what agencies should be involved, factors to be considered, relationship to the environmental process, and funding options for developing studies.

The development of the MIS in the planning process is meant not only to enhance the planning process, but it also allows the early consideration of the principles of NEPA to streamline the environmental/project development process.

BACKGROUND ON THE FTA/FHWA REGION NINE MIS PILOT PROGRAM

In response to concerns about the MIS requirements, on January 5, 1996, FTA and FHWA authorized the FTA and FHWA Region Nine Offices to conduct a pilot program with the State Departments of Transportation (DOTs), Metropolitan Planning Organizations (MPOs), and transit operators to test and evaluate alternative simplified procedures to meet the principles of the MIS requirements.

The four objectives of the MIS Pilot Program are as follows:

(1) to test a variety of alternative ways to address MIS principles in the metropolitan transportation planning process;

(2) to evaluate these alternatives in comparison with the approach outlined in 23 CFR 450.318;

(3) to share the results of this evaluation with the States, MPOs, transit operators, and other participants in the metropolitan planning process; and

(4) to use the results of this evaluation, as appropriate, as the basis for future MIS guidance, technical assistance, and possible regulatory revisions.

The outcome expected of the MIS Pilot Program is to demonstrate approaches which reduce the burden (real or otherwise) which has been attributed to the MIS requirements while satisfying the statutory requirements and principles.

MIS PILOT PROGRAM STEERING COMMITTEE

FTA and FHWA Region Nine determined that the best approach for conducting the MIS Pilot Program was to establish a true "bottoms up" approach, where local, state and other federal agencies would direct the MIS Pilot Program with FTA and FHWA facilitation. To accomplish this, FTA and FHWA recruited a 21-member MIS Pilot Program Steering Committee made up of the U.S. Environmental Protection Agency, the U.S. Corps of Engineers, State DOTs, MPOs, transit operators, congestion management agencies, and regional transportation agencies in Region Nine.

The MIS Pilot Program Steering Committee determined their role in the MIS Pilot Program to be (1) to assist the FTA and FHWA in the evaluation of the MIS Pilot Program; and (2) to establish criteria for any MIS test cases that would be evaluated as part of the MIS Pilot Program. During the two-year effort, the MIS Pilot Program Steering Committee contributed much more however, especially in providing insights on the concerns about the MIS requirements, and needed improvements as expressed in the findings and recommendations.

CONCERNS RELATED TO THE MIS REQUIREMENTS

ISTEA requires a collaborative, multi-modal metropolitan transportation planning process leading to transportation plans containing projects specific as to design concept and scope (components of the project). NEPA involves the consideration of alternative courses of action in solving transportation problems. Although the MIS is established in the metropolitan transportation planning process, it provides the linkage between the metropolitan transportation planning process and the environmental process carried out under NEPA.

This linkage is needed because in the past, the results of the metropolitan transportation process were not always used for the environmental/project development process. Although this linkage is

needed, it brings with it new institutional relationships, new partners, new technical methods, and new decision-making processes. These types of changes, especially related to a new federal requirement, have led to concerns about the MIS requirements.

The approach taken by the MIS Pilot Program Steering Committee was to list the major observed concerns about the MIS requirements, and to summarize the pros and cons of these observed concerns. The following are the seventeen concerns addressed by the MIS Pilot Program:

1. MIS is an added requirement

Pros	**Cons**
MIS formalizes good planning practice and assists project delivery	MIS is a new federal mandate

2. Preparation cost

Pros	**Cons**
MIS potentially saves cost by preventing delays later	MIS uses limited project funds

3. Role of the FHWA and FTA

Pros	**Cons**
FHWA/FTA do not approve the MIS (local flexibility)	FHWA/FTA do not approve the MIS (potential for federal second-guessing)

4. What is a major investment?

Pros	**Cons**
The flexibility to define what a major investment is as part of the collaborative process	No regulatory support for conducting or not conducting the MIS

5. "Pipeline" projects

Pros	**Cons**
A reexamination of projects ensured the MIS objectives were considered	Applying MIS to decisions already made on projects created delays

6. Collaboration/Interagency Coordination

Pros	**Cons**
The MIS requirements have brought together new or conflicting interests to address various interests	The collaborative process leads to delay and conflicts

7. Training/technical assistance

Pros	**Cons**
The NTI Course on MIS was used to introduce the MIS requirements needed	More training related to the technical approaches that should be used in the MIS is

8. Political decision-making

Pros	**Cons**
MIS provides the information to assist elected officials make or reconsider decisions	MIS is perceived to be not needed when elected officials already have made decisions

9. Modal bias

Pros	**Cons**
The MIS has increased the consideration of multi-modal solutions	Agencies are coming into the MIS collaborative process with modal biases

10. Relationship to other local/state feasibility/planning activities

Pros	**Cons**
MIS expands the scope of previous planning efforts	Prior corridor and project planning was already being done

11. Relationship with NEPA

Pros	**Cons**
MIS is an effective tool to address NEPA principles	NEPA does not recognize decisions made in the MIS

12. Participation by state/federal resource agencies

Pros	**Cons**
MIS offers resource and permitting agencies the opportunity to address environmental concerns early	Lack of participation by the resource and permitting agencies leave MIS decisions open to second guessing

13. Level of detail in an MIS

Pros	**Cons**
The level of detail should be determined by the MIS collaborative process	Without a prescribed level of detail, decisions will be questioned

14. Reasonable alternatives

Pros	**Cons**
The MIS allows for the opportunity to consider an appropriate level of information to determine what is reasonable	Agencies are mandated to look at alternatives that are not reasonable

15. Option 1 versus an Option 2 MIS

Pros	**Cons**
Option 1 and 2 provide the flexibility to address MIS requirements	Option 1 may not suit the NEPA requirements; Option 2 may result in supplemental NEPA documents

16. Role of modeling

Pros	**Cons**
Modeling allows for an analytical process that that provides critical information for decision-makers	Modeling can be expensive, and the results can be questionable

17. Who makes the decision once the MIS is complete?

Pros	**Cons**
The results of the MIS may be incorporated into the Regional Transportation Plan by the MPO	The lack of clear approval authority can lead to questioning of decisions

The MIS Pilot Program Evaluation Report also includes observations made by the MIS Pilot Program Steering Committee about each of the concerns.

THREE TEST CASES

On May 14, 1996, the FHWA and FTA Region Nine Offices sent a letter to State DOTs, MPOs, transit operators, local transportation agencies, and federal resource and permitting agencies requesting expressions of interest in submitting an MIS to be evaluated as part of the MIS Pilot Program. The FHWA and FTA received expressions of interest to evaluate the following studies: (1) The Transportation Strategy for Metropolitan Bakersfield; (2) The North San Francisco Bay Corridor Study; and (3) The Las Vegas Resort Corridor Major Investment Study.

The purpose of evaluating the three test cases was to look at how transportation agencies had approached the development of an MIS in an innovative or unique way that demonstrates addressing some of the concerns related to the MIS requirements. For instance, the Las Vegas Resort Corridor MIS demonstrated that a number of modal options could be evaluated sufficiently in the transportation planning process to allow the consideration of one preferred alternative and a no-build alternative in the NEPA process. This demonstrates the ability of the MIS to address NEPA principles early, and allow for a more streamlined environmental and project development process later.

FINDINGS AND RECOMMENDATIONS

After a two-year effort of discussion of the major concerns with the MIS requirements and review of the three test cases, the MIS Pilot Program Steering Committee had reached some findings about the MIS requirements. The following are the findings:

1. An alternative approach for meeting the MIS requirements and addressing the concerns related to the MIS requirements is not needed. The current MIS requirements, with some revisions, provides adequate flexibility and discretion to address the concerns raised about the MIS requirements.

2. The three test cases reviewed as part of the MIS Pilot Program are examples of how concerns about the MIS requirements can be addressed. The Steering Committee believes other MIS efforts would also serve as examples of how concerns about the MIS requirements have been addressed.

3. How the MIS addresses NEPA principles, to avoid later "second guessing" of decisions made, is viewed as the most significant issue. The lack of participation for most MIS collaborative efforts by the state/federal resource and permitting agencies, as well as FHWA and FTA at times, compound the problem of addressing NEPA and other environmental requirements.

   In addition, not updating the federal environmental regulation (23 CFR Part 771) to reflect the MIS requirements, or other ISTEA requirements, has also left open the connection and legal basis for connecting MIS decisions with NEPA decisions.

4. Public participation and transportation modeling are typically the higher cost components of the MIS. Although concerns have been raised about the costs related to public participation and transportation modeling, there has been acknowledgement that the success of implementing major investments can hinge on the public acceptance and analytical credibility. A positive finding is that the MIS requirements are perceived to be flexible enough to allow each metropolitan area to tailor its own public participation and analytical process.

5. The federal resource and permitting agencies still maintain a project perspective in their reviews, and have not fully accepted the MIS as a planning document that attempts to address environmental issues early. FHWA and FTA have not developed a formal agreement with the federal resource and permitting agencies to establish a role for them in the MIS process.

The FHWA and FTA wanted the MIS Pilot Program Steering Committee to make recommendations on improving the MIS requirements. The following recommendations were developed with the understanding that they did not necessarily reflect a consensus of the Steering Committee, nor the agency position of the members of the Steering Committee. The recommendations are categorized as legislative, regulatory, and guidance or training.

LEGISLATIVE RECOMMENDATIONS

1. Add language to Title 23 and the Federal Transit Act, which were amended by ISTEA, that explicitly recognizes the MIS by requiring the long range transportation plan identify major corridor investments only after conducting a major investment study, undertaken in a cooperative manner, that considers a reasonable range of alternatives against investment criteria. Placeholders would continue to be allowed in the long range transportation plan until the MIS is completed.

2. Eliminate the reference to "alternatives analysis" in Section 3 of the Federal Transit Act, and substitute the words "major investment study".

REGULATORY RECOMMENDATIONS

1. Amend 23 CFR Part 771, Environmental Impact and Related Procedures, to add the definition of a major metropolitan transportation investment by cross referencing the new planning requirement which requires the MPO in a collaborative process to establish guidelines, including a definition of an MIS, for its area and coordination of the guidelines with adjacent metropolitan areas.

2. Amend 23 CFR 771 to allow the use of an Option 1 or Option 2 MIS (as an approach for addressing NEPA principles) and provide the criteria and process for the options necessary to support legal sufficiency.

3. Amend 23 CFR 771 to require that the FHWA and FTA request comments from the federal resource and permitting agencies at the point when an MIS will narrow down the range of alternatives and that the FHWA and FTA will advise these agencies that failure to comment at this time may foreclose consideration of alternatives at a later date.

4. Amend 23 CFR 771 to require that when there is a significant time delay between completion of an Option 1 MIS and preparation of a NEPA document, the lead agency will initiate the collaborative process as part of the scoping process under NEPA to ensure the results of the MIS are still valid.

5. Amend 23 CFR Part 450 and 49 CFR Part 613, Statewide Planning / Metropolitan Planning to require the MPO in collaboration with the State DOT, transit operators, and other appropriate agencies to establish guidelines, that at a minimum define criteria on what constitutes a major metropolitan transportation investment, identifies the participants in the collaborative process, addresses a scope adequate to meet metropolitan planning/NEPA requirements, and defines when an MIS is complete.

GUIDANCE OR TRAINING RECOMMENDATIONS

FHWA and FTA with the involvement of representatives from State DOTs, MPOs, transit operators, and other appropriate agencies should provide the following guidance/training/technical assistance:

1. Examples on the World-Wide Web of MIS case studies conducted throughout the nation.

2. Efforts that link the NEPA/Section 404 memorandum of agreement or some other similar agreement (possibly broader than NEPA/Section 404) with the collaborative effort required for each MIS.

3. In a technical advisory format, the information or level of detail appropriate in an MIS to establish a level of confidence that environmental requirements are being met. This would recognize that the MIS is less detailed than a NEPA document, but allows the MIS to contain decisions that meet the intent of NEPA.

4. Provide an MIS Help Desk, i.e., a national contact for MIS practitioners to contact with technical questions.

5. Guidance and training on techniques and criteria for analyzing and evaluating multi-modal alternatives.

6. Establish a National MIS Advisory Committee, made up of various agencies and interests throughout the country. The Committee could serve as a review group for any MIS guidance, and serve as a "sounding board" for MIS practitioners.

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REFERENCE

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Federal Transit Administration and the Federal Highway Administration Region Nine, 1998.

Session #9

DETERMINATION OF VEHICLE OCCUPANCY FOR SMALL AND MEDIUM SIZED AREAS

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ABSTRACT

Recent revisions to transportation system performance monitoring techniques have resulted in the need for data related to vehicle occupancy, or the number of persons carried in all types of highway vehicles. Rather than a continued focus on the number of vehicles moved through a corridor, measurement of the number of persons moved and speed of movement is now required in the mobility management process and congestion management systems. In addition, many strategies to improve transportation system performance have the goal of increasing vehicle occupancy. The result is the need for increasing amounts of vehicle occupancy information.

During 1996 and 1997, the Florida Department of Transportation undertook a statewide study of methodologies to efficiently collect and analyze vehicle occupancy. Over 2,000 hours of data collection at 21 different types of roads. Data analysis studied variation by type of facility, travel lane, direction, hour throughout the day, day of the week, and month of the year. Alternative methods of collecting data, observation locations, dealing with commercial vehicles, overhead observation points, and similar characteristics were included. Automated methods and use of alternative databases were surveyed.

This paper presents a brief summary of study findings, oriented to the small to medium sized area. Overall study findings useful in evaluating how to establish an overall vehicle occupancy program, alternative methods of data collection, as well as techniques to determine vehicle occupancy for single roadways are included. The paper includes best practice recommendations for vehicle occupancy data collection, analysis, and use for small and medium sized areas.

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DETERMINATION OF VEHICLE OCCUPANCY FOR SMALL AND MEDIUM SIZED AREAS

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), and its continuation, the Transportation Equity Act for the 21st Century (TEA-21), revisions to the joint FHWA/FTA urban transportation planning regulations, and individual state and local area efforts to monitor transportation systems performance have resulted in new data requirements. Transportation planning agencies are now monitoring travel trends and developing multimodal transportation improvement plans at both the regional and local level. Rather than a continued focus on the number of vehicles moved through a corridor, measurement of persons moved and speed of movement is now required for the mobility management and congestion management processes. In addition, many strategies to improve transportation systems performance have the goal of increasing vehicle occupancies, or the number of persons individually or collectively carried in all types of highway vehicles.

During 1996 and 1997, the Florida Department of Transportation undertook a statewide study of methodologies to collect and analyze vehicle occupancy. Alternative methods of collecting data, observation locations, field procedures, how to deal with commercial vehicles, use of roadside or overhead observation points, and similar characteristics were included.

This paper presents a brief summary of the findings of the overall study and information useful in conducting a vehicle occupancy data collection and analysis effort. The paper is oriented to the small and medium sized area, includes a discussion of alternative data collection methodologies, and concludes with “best practice” recommendations.

STUDY FINDINGS

The subject study included the collection of more than 2,000 hours of vehicle occupancy data from a series of 21 individual sites throughout Florida, ranging from two-lane rural routes to four and 6-lane urban arterial routes. Basic data collection was accomplished by the roadside / windshield (personal observation) method during daylight hours by lane and direction, for five consecutive weekdays. Four sites were observed once each month for a year, to determine the temporal changes in vehicle occupancy over a year's time.

Hourly Variation

Vehicle occupancy rates generally start low in the early morning, increase after the morning peak period, remain level during the middle of the day, drop around 5:00 P.M., and reach a high point around 6:00 P.M. This may be explained by the higher percentage of commuter traffic in the morning, business and lunch traffic during the midday, commuters returning home around 5:00 P.M., and recreational and shopping trips in the evening.

Lane Variation

Vehicle occupancy rates vary among lanes (i.e., inside, middle, and outside) and generally do not equal the population mean for the entire roadway site. Several factors such as traffic characteristics, difficulty of seeing the inside lanes, or the surveyors' skill may have contributed to this result. This finding suggests that estimating vehicle occupancy rate using the data collected from any single lane would not be accurate. Also, there is no uniformity concerning which lanes have higher vehicle occupancies.

Directional Variation

Directional variation was also found to vary by site, as expected. The vehicle occupancy rates obtained from different directions do not always represent the average value for the site. A negative correlation between traffic volume and the occupancy rate was also found at sites that mainly serve commuting traffic. This means that vehicle occupancy drops as traffic increases, which can be explained by the larger percentage of commuters in the higher vehicle streams.

Daily Variation

It was found that distributions of occupancy rates vary by day throughout the week. The daily average vehicle occupancy rates observed on some days were closer to the five-day average value than were other days of the week. Vehicle occupancy rates on Fridays were nominally higher. The occupancy rates on Tuesdays and Wednesdays were generally lower than other days during the same week. The best day for collecting data may be Thursday. Mondays and Fridays should be avoided for vehicle occupancy data collection.

Monthly Variation

For the Florida data, occupancy rates observed in March and July were higher than other months of the year, which might be accounted for by travel involving the spring break and summer vacation at schools. The occupancy rates observed in September, November and December were lower than other months of the year at all four sites. However, conclusions from this phase should consider the tourist and part-time residential characteristics of travel within Florida.

USE OF CONTROL DATA

Vehicle occupancy is a derivative, or results-oriented variable. Conditions affecting vehicle occupancy at a particular location includes the number and characteristics of commuters, patterns of ridesharing, external factors affecting the amount and character of vehicle usage (fuel shortages), land uses influencing the trip, and similar matters. The conditions that result in a particular vehicle occupancy cannot be determined solely by observance of passing vehicles at a

data collection site. Much like early estimates of trip origin, a pure vehicle occupancy study, or one adequately explaining the background influences would require detailed interviews with the vehicle occupants.

In addition, the reasons for a particular trip and resulting vehicle occupancy can change over time (for example, vehicle occupancy on rainy days would be expected to be higher than on clear days). Similarly, vehicle occupancy on routes serving areas of concentrated employment, or school destinations where multiple-person commuting is the norm would be higher than the vehicle occupancy from a high-type "executive" subdivision, or to areas of concentrated high-economic employment.

Initially, it was thought that, similar to traffic volume counting, a "control station approach" would reduce the cost of obtaining vehicle occupancy. In this method, data would be collected at one or more sites for a full day, to allow factors to be determined that would subsequently be used to adjust short counts obtained at other sites to an all-day average, or another hour of the day. It was also hoped that sites from similar roadway types or geographic subareas could be grouped together, so a particular control station count could represent multiple sites, and that annual average vehicle occupancy (yearly) could be determined using factors derived from the annual site measurements. Findings and conclusions resulting from this phase of the study represent a major caution for those using the control station approach. The analyst must ensure that travel conditions resulting in the particular vehicle occupancy at a control station represent the conditions at the other station(s) to be adjusted using the control data. This is not an impossible task, but caution and common sense are required in applying particular control station vehicle occupancy data to multiple locations, or to roadways with different characteristics.

Use of control station data to adjust subsequent short counts at that station is very appropriate. For example, it is not likely that the character of traffic at a particular site will change drastically within short periods. Control station adjustment factors to be used in future data determinations at that site will result in economy of effort over a several-year data collection effort, or until some external factor results in a major change in the character of traffic.

TAILORING DATA COLLECTION FOR PARTICULAR PURPOSES

Initial decisions for vehicle occupancy studies involve the desired survey period, the anticipated usage of the data, the characteristics of the study area, and the type of vehicle to be included, as discussed in the following sections.

Peak Period

Morning and evening periods of peak traffic flow are normally required for traffic engineering or alternative mode investigations. If peak-period vehicle occupancy is needed, then obtaining the data during the specific period is best. As discussed, appropriate vehicle occupancy control data can be used to adjust other counts for peak-period vehicle occupancy. Vehicle occupancy control data also reveals when the peak period for vehicle occupancy occurs, although this will normally be during late afternoon.

Average Daily Vehicle Occupancy (AVO)

The first step in determining average daily vehicle occupancy is to define the period to be averaged. For example, the "average day" for vehicle occupancy may be defined as a full 24-hour day, daylight hours only, average weekday, or an average for a full week (including weekend days), or other combinations thereof. A short vehicle occupancy count can be adjusted to represent an "average" daily condition, but the adjustment must be based on representative control data for the total average time in question.

Average Annual Vehicle Occupancy (AAVO)

Average annual vehicle occupancy (AAVO) represents the yearly average for a site, taking into account the seasonal change in vehicle occupancy. Accurate determination of AAVO is more complex, requiring data on how vehicle occupancy changes over a year's time. It is not likely that the analyst will have control data for annual conditions for a particular location so a substitute must be found. In critical locations the analyst may wish to take short counts over a year's time (same day of the week, same week of the month, avoiding unusual weather or traffic flow conditions, etc.) to determine the annual change for the area in question.

Daylight or Full 24-hours

This seemingly elementary question should be determined early. Of course, as the collection of vehicle occupancy data requires determination of the number of occupants, the observer must be able to see into the vehicle. Special lighting that might be provided for data collection purposes could be dangerous to vehicle operators and is not normally used for vehicle occupancy studies. If full 24-hour data is required, then counts should be made at locations where existing roadway lighting allows proper observation. Such locations include lighted roadways, ramp terminals, intersections, etc.

An interesting question is why nighttime vehicle occupancy would be needed. If the vehicle occupancy data is to be used for congestion management, measuring mode shifts or similar purposes, daylight-hour or peak-period data should suffice. Exceptions might be locations where

early nightfall or late morning darkness makes full data collection for peak periods difficult. In these cases, adjusting a later (partial) count can represent the full “day travel” period.

Areawide, Corridor, or Single Roadway

If the data is to serve a corridor study, sufficient sites should be chosen along the corridor to cover all areas having different travel characteristics. Data collection methodologies for a single roadway corridor are similar. For area coverage, sufficient sites should be selected to cover all routes anticipated to exhibit different travel characteristics, different lane arterial, local streets, etc.). Although every major route may not have to be counted, in smaller areas this can easily be accomplished.

Passenger Vehicles or Total Vehicles

Before starting data collection, the analyst should specify what types of vehicles are to be included. A ranking of vehicles for determination of vehicle occupancy includes the following: automobile, light (passenger) truck, van, motorcycle, transit bus, school bus, charter bus, large (commercial) truck, and bicycle. Pedestrian counts may also be included for determination of total person travel. All these modes have differing degrees of importance, depending upon the study or use of the data. For normal vehicle occupancy purposes, data should be collected for the first four types: automobile, light truck, van, and motorcycle. In addition, transit buses are often included. While the remaining categories are important, they are not normally included in studies of vehicle occupancy.

“Before and After” Studies

Vehicle occupancy is frequently required to determine the performance of certain types of improvements. These “before and after” studies involve measuring the vehicle occupancy before the improvements are made, followed by the "after" element following the improvements and when conditions have stabilized. Obviously, “before” data should be collected before the condition being examined is established, or before any construction begins. Both the before and the after study should be conducted at comparable times representing normal conditions, or when conditions are sufficiently stable to show the physical change in the mode being studied, as opposed to some change occurring from external conditions. It is also worthwhile to collect data from a control route, external but parallel to the study route, to show how overall conditions may have changed during the survey period.

STUDY METHODOLOGY

Vehicle occupancy is normally determined by manually counting the number of vehicles and the number of vehicle occupants passing an observation point over time. Because vehicle occupancy is a more stable variable than vehicular volume, there are alternative data collection methodologies. A valid determination of vehicle occupancy can be based on short observation intervals, although the data collection period should desirably be within the period of interest (e.g., peak hours, etc.). Counts of one to two hours will produce data with sufficient accuracy and precision for most purposes. Counting both directions and all lanes is important.

Tuesdays through Thursdays are normally adequate for data collection. Mondays and Fridays should be avoided. Data should not be collected during periods of inclement weather, due to the possibilities of a biased sample. For a rule of thumb, if short counts are to be made, counts during the midmorning to mid-afternoon period are adequate for most purposes.

Although the traditional (roadside / windshield) observation method is simple, economical, and adequate, there are several alternative methods as discussed in the next sections.

Roadside / Windshield Survey

The roadside / windshield survey is the simplest and most reliable method of vehicle occupancy data collection. This method requires stationing an observer(s) near the roadside edge, who then counts and records the number of vehicles and the number of their occupants passing the observation point during the survey.

No special, expensive, or high-technology equipment is required, and a high sampling percentage can normally be obtained. Use of electronic intersection count boards increases accuracy, results in better recording and faster data transfer. Nevertheless, if these devices are not available, a clipboard, preprinted forms, a pencil, and a watch are all the observers require.

One observer per lane should normally be used (except very low volume roads). A trained observer can accurately record data from about 800 vehicles per hour. If anticipated lane volumes are higher, a sample should be taken. Use of two observers per the same lane is not recommended due to the difficulty of communications between them about which vehicles each should count. Data recorders should be instructed not to guess. If they cannot see the number of occupants, they should not try to estimate them. Unlike traffic counting, the accuracy of a vehicle occupancy count is not affected by missing a few vehicles.

Occupancy data for regular transit vehicles may be available from the transit agency, but can also be obtained by several methods. One is to prearrange to have the vehicles stop when flagged by an observer, who then boards the vehicle and makes a quick count of passengers. Charter buses

represent a more difficult problem. Sometimes the charter agency will cooperate, but the problem arises because it is not usually known when a charter bus will pass by, and the name of the company operating the vehicle may not be readily apparent. Counting these vehicles, with a subsequent assumption of the number of occupants, may be sufficient. Large trucks may have two occupants, but stopping them for an occupant count is usually impossible. However, missing these vehicles will not significantly bias the sample.

Field Data Collection Methodology

In the selection of vehicle occupancy data sites, make sure that each lane is clearly visible and that the vehicles in the different lanes can be distinguished from each other. Field check each site before data collection begins to ensure that the site is suitable from an observation and safety perspective and that it is suitable for the placement of traffic counters. On arterial streets, mid-block locations should be chosen for data collection to avoid the interruption of traffic due to traffic signals and turning movements at intersections or interchanges. In addition, selection of a mid-block location should result in a greater clear zone for observation and yield better data. The longer that an observer can view a vehicle, the better the data will be. Vehicles with passengers in the back seat often require more attention to determine the occupancy. A good view from the side of the vehicle often allows confirmation of the number of people in the back seat.

For high volume locations in urban areas, it is recommended that a police officer be present at the site to ensure that the survey does not cause a traffic problem. Even with advance notice being given to all interested agencies, experience has shown that data collection activities at a site without an officer present will attract other officers who require an explanation of what is happening. This disrupts the count and causes a loss of data.

Use of Crash Data

Vehicle occupancy determinations have been successfully extracted from vehicular crash (accident) records, and a trial of the method was conducted as part of the overall study. In this method, the number of occupants per vehicle is determined from crash data using a computer analysis. While additional investigation is warranted, this method holds promise for an economical method of determination of vehicle occupancy rates. Better results would be expected for large area determinations, route studies, or similar applications where a larger data sample can be obtained. Data derived from this method, however, does not appear to provide sufficient accuracy for corridor studies or for specific before and after studies. Shortcomings also include the age of the crash data (availability of crash data typically lags the year of collection by two years) and potential differences between persons who have vehicular crashes as opposed to the entire population.

Video Recording

This method requires the use of video cameras, strategically placed to record vehicle occupancy data with subsequent manual or possibly the use of machine vision technology to reduce the data. The method requires complex equipment, and has many shortcomings of the roadside/windshield survey method such as inadequacy of the method during darkness. Overall, the method does not seem appropriate for widespread usage, unless the equipment is used to collect other data, and the vehicle occupancy can be determined as an "extra".

Carousel Method

The data collection effort verified a particular problem on high-volume, multi-lane facilities. The roadside observer probably cannot stand close enough to the roadside edge (due to police or other safety regulations) to be able to see into the vehicles. In addition, survey efforts showed that observing from overhead locations is not often adequate, because the observers cannot see into the back seat area of vehicles.

An alternative method has been developed by which observers in automobiles that move with, but slower than the traffic flow observe vehicles and their occupants. The vehicle is driven along a facility between intersections or interchanges with the observers recording vehicle occupancy data for vehicles in the traffic stream. At the end of the site, the driver returns to the starting point and starts a second run. Hence the term "carousel" method.

Adjustment of Data

As noted previously, the type of vehicle occupancy data to be collected and analyzed depends on the needs of the study. Vehicle occupancy data collected with short counts (one to two hours) results in sufficient accuracy for most transportation planning requirements. With appropriate control counts, a short count can be adjusted for another period, or another site. Because vehicle occupancy is a results-oriented variable, external factors should be carefully considered in choosing control stations. Once control counts are prepared, short counts result in significant economy, particularly in widespread applications.

RECOMMENDATIONS

The precision of required vehicle occupancy data should be correlated to the anticipated usage of the data. More precision is required for "before and after" studies, less is required for corridor studies (except that different characteristics of the corridor should be distinguished), and even less precision is required for area-wide systems performance determinations. Therefore, the following overall methodologies are recommended:

Before and After Studies

For before and after studies, the condition to be measured and the necessary accuracy should be determined with a specific study design prepared for the particular effort. Data collection should be by the roadside/windshield method, or by an alternative method as discussed previously. Control data should not be used to adjust short counts. The entire evaluation period should be counted, with sufficient counts obtained to ensure statistical stability and accuracy.

Corridor Studies

For corridor studies, sufficient locations along the corridor should be chosen to fully represent all traffic characteristics of the corridor roadway(s). Control data may be used if conditions warrant use of adjusted short count data.

Areawide Studies

Areawide studies may use control-adjusted data or surrogates obtained through other methodologies. For an areawide traffic volume monitoring program, it would be logical to initially obtain vehicle occupancy information at each of the volume count stations. For an adequate program, a sample of major arterials and collector streets should be chosen. Developing area control stations for these roadways may be possible, but again, caution should be used to ensure that the control stations represent the sites to be adjusted. Lacking this approach, a one-day control count should be obtained for each site.

Obtaining monthly counts at an annual site(s) for at least one full year may also be desirable, to allow determination of long-term trends. Once control data has been obtained for these sites, short counts can be used to obtain the subsequent data.

An area may wish to investigate whether vehicle crash data is sufficient to determine area or sector vehicle occupancy. This can be accomplished by obtaining the crash data, calculating vehicle occupancy, and comparing it with data obtained through normal count methods. As noted, one shortcoming of this method is the age of the traffic crash data when it can be made available for other uses.

CLOSURE

For transportation monitoring and evaluation purposes, vehicle occupancy has become an essential variable. This will allow the analyst to determine measures of person throughput, as opposed to simply describing vehicular flow. Person throughput is a meaningful performance measure, as, with volume flow and measures of travel time, it allows a much more meaningful description of the function of a transportation corridor.

The Florida Department of Transportation should be recognized for its efforts to improve the collection and processing of vehicle occupancy information, and for its development of transportation performance measures. However, the opinions expressed in this paper are those of the authors and do not imply endorsement by that agency or others.

Session #9

MAJOR INVESTMENT STUDY FOR A SMALL URBANIZED AREA CORRIDOR: CABARRUS/SOUTH ROWAN, NORTH CAROLINA

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ABSTRACT

The Cabarrus/South Rowan Urban Area, which has approximately 155,000 population, decided to combine their effort on a major investment study with their effort on a long-range transportation plan update. A major investment study and a long-range transportation plan both require an urban area to fulfill similar requirements, but on different scales to meet the requirements of ISTEA, the CAAA, and NEPA. The long-range transportation planning study must consider alternative modal solutions and financial resources for the area as a whole, while a major investment study focuses on these issues for a corridor or subarea.

This paper describes the purpose and need for a major investment study in the Cabarrus/South Rowan Urban Area in North Carolina; how the long-range transportation planning study was adapted to meet the major investment study requirements; six alternate strategies considered for the major investment study; environmental considerations; what conclusion was determined, and why it was chosen; and the coordination effort which took place.

Table of Contents

Major Investment Study for a Small Urbanized Area Corridor: Cabarrus-South Rowan, North Carolina

Introduction and Background

In 1993 the Cabarrus-South Rowan Urban Area MPO began work on updating their long-range transportation plan. As part of the development of the long range transportation plan, it is necessary to fulfill the requirements of the Intermodal Surface Transportation Efficiency Act (ISTEA), the Clean Air Act Amendments (CAAA), and the National Environmental Policy Act (NEPA).

In the 1991 ISTEA legislation,(23CFR 450 Subpart C), MPOs were required to also conduct Major Investment Studies(MIS). An (MIS) is a planning tool that fuses the principles of ISTEA and NEPA. Under the metropolitan planning regulations the MIS focuses on corridor or subarea transportation demand and other problems that may lead to a high type transit or highway investment with a substantial capital investment or impact on the metropolitan transportation system.

The purpose of an MIS is to develop information about the likely impacts and consequences of alternate transportation investment strategies at the corridor or subarea level. The study should include all reasonable alternatives for addressing the identified transportation purpose and need. Only those alternatives that have a reasonable likelihood of being an effective solution or component should be carried forward in the study.

An MIS is a cooperative effort. This one was between the Cabarrus-South Rowan Metropolitan Planning Organization (MPO), the North Carolina Department of Transportation's Divisions of Highways and Public Transportation, the Federal Highway Administration, local transit operators and the public.

Purpose and Need

At the onset of the long-range planning study it became apparent that Interstate 85 fit the qualifications for an MIS. Interstate 85 is of primary importance to the area because it runs through North Carolina connecting seven of its urbanized areas including the Cabarrus-South Rowan Urban Area. Traffic on this facility makes both intrastate trips and local trips inside the urban areas. Present truck percentages, historic traffic growth rates, future traffic projections, and scheduled and recommended construction projects in the planning area all point to high levels of congestion for I-85 in the future. See Figure 1.

The traffic volumes along I-85 just north of the planning area increased 5.5% per year to 53,000 vehicles per day (VPD) from 1990 to 1995. The data from the 1996 long-range transportation planning study model showed that I-85 will experience congestion by the design year 2020 and carry approximately 97,200 VPD near that point. It is anticipated that approximately 70-80% of that traffic will be through traffic or traffic with neither end of the trip stopping inside the urban area. According to the 1994 NCDOT Highway Traffic Statistics Report, I-85 in Salisbury, just

north of the study area, presently carries 20% trucks.

The identified need for this project was derived from the above information. The present volume of traffic on this stretch of I-85 was approaching the highway's effective capacity. It will be nearly double that volume by the design year. The high through trip rate gives rise to transit concerns. Finally, I-85 has one of the highest truck rates in the country. Each of the alternates considered in this document will be examined according to how well it will resolve these problems.

Long -range Transportation Plan

The MIS for I-85 was conducted as part of the Transportation Plan update rather than as a separate document. The Thoroughfare Plan is shown in Figure 2. Both must meet the requirements of ISTEA, the CAA, and NEPA. Alternative mode solutions and financial resources must be considered in both. Also, doing both studies together would save on costs, manpower, and other resources. The long-range plan update included some environmental screening, accident history and safety investigation, air quality analysis, freight movement analysis, and extensive public involvement.

These investigations were also used for the MIS. The public involvement included a Goals and Objectives Survey, many public meetings, and presentations to local policy boards. The G&O survey was designed to focus on several areas. The five-page survey included questions on transit, congestion areas, financing, and where their money should be spent. Also included was a list of 41 social and environmental questions to find out the respondents' opinions on light rail, parking, air pollution, greenways, signal timing, greenways, and industrial access. A more detailed description can be found in Appendix E of the 1997 Cabarrus-South Rowan Thoroughfare Plan Report.

Alternate Strategies Considered in the MIS

Each of the following six strategies were examined, either in the planning study or in the MIS document, to see if they met the purpose and need of the project.

1. Do Nothing--This approach would prevent destruction of the surrounding environment due to construction of any new facilities and the outlay of funds for vans or buses. The traffic volumes on I-85 near the planning area, though, have been growing at a rate of 5.5% per year. If no improvements, other than what was already scheduled in the 1995 State Transportation Improvement Program, are made traffic volumes on I-85 could reach as high as 107,400 VPD by the year 2020.

2. Transportation Demand Management--In the past there have been few attempts in the region at Transportation Demand Management oriented toward reducing the number of trips or number of vehicles on the roadways by encouraging other types of transportation service. There is no existing general public transportation system in the Cabarrus-South Rowan urban area, therefore, major transit alternatives within the area were not considered as a reasonable strategy to the present transportation problems of I-85. A travel market analysis for the whole

I-85 corridor indicated that initiating alternate modes of transportation would not be a viable option due to the high level of through travel, but that the Cabarrus-South Rowan MPO should consider carpool/vanpool commuter programs in the transit study scheduled to begin in FY 1997. Although there are several paratransit programs centered in the City of Charlotte and Mecklenburg County, southwest of the Cabarrus-South Rowan area, as of late 1996 only a few vanpools were making regular trips as far away as the Cabarrus-South Rowan urban area. Cabarrus County does have a local van service for the elderly and handicapped and others without access to transportation, but that does not reduce the number of vehicles on I-85. The major employers in the planning area like Philip-Morris and Fieldcrest Cannon Mills already have their employees on shift time. *(In 1998 a transit study for the Cabarrus-South Rowan Area was begun in conjunction with one in Mecklenburg County).*

3. High Occupancy Vehicle Lanes--An investigation into the viability of HOV lanes for I-85 through the planning area shows that an insufficient number of vehicles will be removed from the traffic stream to warrant separate travel lanes. For example:

    - If the above-mentioned 97,200 future vehicles per day and a 10 percent peak hour percentage factor were used to determine the viability of HOV lanes there would be a possible 9,720 vehicles on the highway during each peak hour. The majority of the HOV users would be on the highway during the peak hour. In Appendix D of the 1996 Cabarrus- South Rowan Transportation Plan Report the average AM Peak Hour VOR for the area is 1.17 and the average PM Peak VOR is 1.66 persons per vehicle. This would make 11372 persons during the AM Peak and 16135 persons during the PM Peak hour. Adding these gives 27507 persons making trips during the peak hours of the day. An October 1987 HOV lane study by the Metropolitan Transit Authority of Harris County, Texas stated that two successful HOV programs, the Shirley Highway Expressway in Washington D.C. and the El Monte Busway in Los Angeles, move at least 30 percent of the total person-trip movement on the freeway from the mainline freeway lanes to the HOV lane. Therefore, there would be a possible 3412 and 4841 persons, respectively, transferred to the HOV lanes during the peak hours in this analysis. To determine the number of vehicles removed, each peak hour should be divided by the respective VOR. These two numbers can be added together to give the total number of vehicles, 5833, moved from the total ADT into the HOV lanes. If that number were subtracted from the ADT there would still be 91,367 vehicles in the original four freeway travel lanes.

4. New Facilities - The Cabarrus-South Rowan Area is developing rapidly. Both residential and commercial development are consuming available land. There is floodplain both east and west of the present I-85 location and the surrounding urban area. The Westside Bypass, Transportation Improvement Projects R-2246 and U-2009, and its extension northward already appear on the adopted Transportation Plan.

5. Supplementary facilities--There are several smaller projects currently in the North Carolina

Transportation Improvement Program and on the 1996 mutually adopted Cabarrus-South Rowan Transportation Plan. Project I-2511 widens I-85 to an eight-lane cross section from Exit 68 to Exit 81 through Rowan County north of the Cabarrus-South Rowan Area with construction to begin in FY1997. The project I-301 widened I-85 to eight lanes through Charlotte as far north as the NC 49 Connector with construction completed in FY1996. Project R-2315 is a new facility just north of the Mecklenburg County line called Kings Grant/Speedway Boulevard with a new interchange on I-85 to be completed in FY1997. Projects R-2246 and U-2009, the Westside Bypass, have an interchange on I-85 with construction to begin in FY2002. Also on the Transportation Plan, an interchange is proposed between I-85 and Old Beattys Ford Road. There are potentially nine interchanges in the eighteen mile (30 kilometer) stretch of I-85 through the area. I-85 through the Cabarrus-South Rowan Area is currently only a four-lane freeway cross section. Even with these existing and proposed projects, though, the congestion problems on I-85 will not be completely solved.

6. Widening--The data from the 1996 long-range transportation planning study model showed that I-85 will experience congestion by the design year 2020 and carry approximately 97,200 VPD. This is much higher than the 60,000 VPD capacity recommended for the design of a four-lane freeway facility from the 1994 Highway Capacity Manual. It is also higher than the suggested 80,000 VPD for a six-lane freeway facility.

Environmental Considerations

To minimize any environmental effects of this project on the surrounding land it is suggested that any work on I-85 take place within the existing 300 feet (91.5 m) of right-of-way. The general environmental consequences of these alternate strategies were considered during the transportation planning study, but more precise environmental effects of the project will be evaluated during the completion of the planning document once the project is programmed in the local and State Transportation Improvement Programs.

Conclusions

After considering all the above alternatives it was determined that widening the facility to eight lanes would be the best course of action because:

1. If nothing is done, the anticipated traffic will overburden the existing facility and increase congestion and reduce safety on the facility.

2. The majority of the present travel on this facility is through traffic. A high percentage is also truck traffic. Neither of these travel types are conducive to travel management within the planning area. There is no existing bus system, no previous need for one and according to the comments from the goals and objectives survey there is little interest for one at this time.

3. From the cursory analysis for high occupancy lanes there would not be enough vehicles or riders transferred out of the main traffic stream to warrant the addition of the designated extra

lanes.

4. As part of the alternatives analysis of the long-range study it was determined that no new highway-type facilities can be accommodated along the existing I-85 corridor through the urbanized area. There would be extensive environmental and socio-economic damage to the area if a major new facility with a wide right-of-way is introduced.

5. The existing Interstate projects on either end of the subject section will cause a bottle-neck effect through the area decreasing travel safety and increasing congestion. The new interchanges will increase the number of weaving sections through the area also reducing safety along the four-lane section. The other projects will not significantly decrease the volume of traffic on the interstate through the area.

6. The approximate 97,200 VPD is higher than both the four- lane and six-lane recommended capacities in the Highway Capacity Manual.

This document will serve as the Major Investment Study (MIS) for I-85 through the Cabarrus-South Rowan Area and identifies the reasonable alternatives and strategies studied for the I-85 corridor and reports on the alternative selected for the corridor. The selected alternative will be carried forward into the project development stage where a NEPA document will be prepared.

Coordination

This document may be incorporated into the planning document for this project by the Planning and Environmental Branch of NCDOT. This MIS has been a cooperative effort between the Cabarrus-South Rowan Metropolitan Planning Organization (MPO), the North Carolina Department of Transportation's Divisions of Highways and Public Transportation and the Federal Highway Administration. The correspondence from the Cabarrus-South Rowan MPO and the NCDOT Public Transportation Division (Figure 3) are included.

What follows is an excerpt from the minutes of the January 15, 1997 meeting of the Cabarrus-South Rowan Metropolitan Planning Organization Transportation Advisory Committee at which the Major Investment Study for I-85 was approved:

> *Dosse briefly defined the MIS and that one is conducted on all high-cost projects that are identified in the Thoroughfare Plan. She explained that the only project in the Cabarrus-South Rowan Urban Area is the improvement and widening of I-85. Her presentation was summarized in a handout that provided the definition, purpose and need, how it relates to the long-range transportation plan, and environmental considerations. Additionally, her materials included a discussion about alternative strategies for improvement that were considered as well as the final recommendations. In short, it was determined that widening the current facility from four to eight lanes, through the urban area, was the best course of action. This document will be included in the area transportation plan update technical report due this summer. Dosse explained that she is asking the TAC for*

formal approval of the MIS and its findings. Geathers asked for clarification about what exactly, does the MIS satisfy? For example, compliance with CAAA, the Thoroughfare Plan, etc. Dosse responded that this study was a recent requirement and part of the Thoroughfare Plan. Discussion continued about the justification for the recommended widening of I-85 from four to eight lanes rather than to six. The primary reasons are that this would be consistent with the improvements to I-85 in Mecklenburg and Rowan Counties. Additionally, traffic volume forecasts justify the eight-lane expansion. Geathers asked for a motion to approve the MIS and its findings. Sloop moved with a second by Brown. The motion passed unanimously. Brown and Geathers asked for more information. Geathers was curious whether the I-85 project would proceed regardless of local support. Brown asked when we were going to get the funds to begin. Dosse said that this was up to the action of the BOT. Sloop discussed some of the plans for improvements to I-85 in Rowan County. Dosse further explained that the MIS will be reviewed by the Planning and Environmental Department but this first effort, hopefully, will save time in the required Environmental Review process all projects must pass through prior to design and construction. Rankin asked for clarification of the funding obligation for the Interstate project. Dosse agreed to confirm this information when she returned to Raleigh.

GEOGRAPHIC LOCATION
FOR THE
CABARRUS /SOUTH ROWAN
URBAN AREA
OF
NORTH CAROLINA

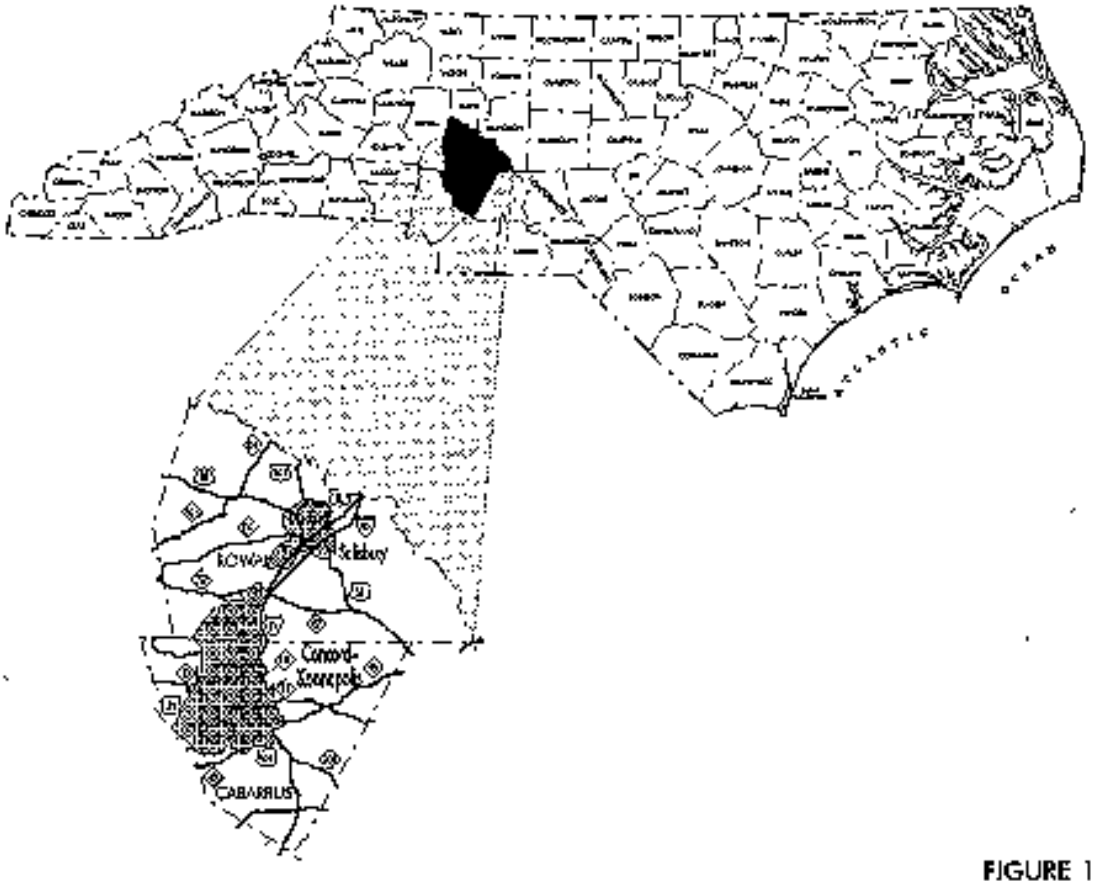

FIGURE 1

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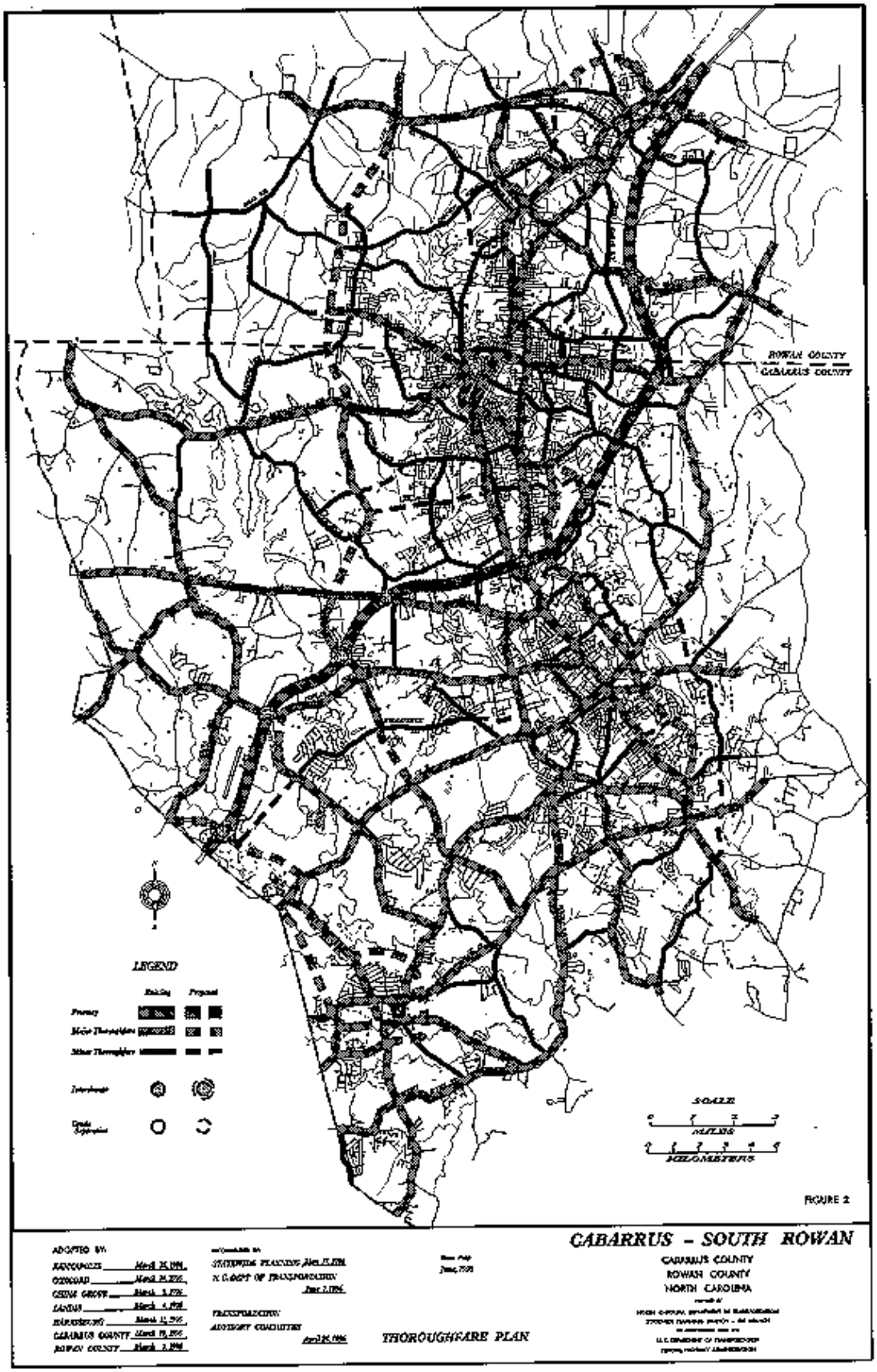

tplan.m(75.swp4) bob@swp4. Wed Jul 1 16:20:57 EDT 1998

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

JAMES B. HUNT JR.
GOVERNOR

PUBLIC TRANSPORTATION DIVISION
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GARLAND B. GARRETT JR.
SECRETARY

October 14, 1996

MEMORANDUM

To: Ron Poole, Ph.D., P.E., Manager, Statewide Planning Branch

From: Sanford Cross, Director, Public Transportation Division

Subject: Major Investment Study for I-85 Widening Project in the Kannapolis-Concord Urban Area

The Public Transportation Division has reviewed the above referenced study and has the following comments:

1) We recognize that this study is being conducted in the early stages of planning for facility improvements (in conjunction with the Thoroughfare Plan Update), therefore it is difficult to make final decisions on modal opportunities in the corridor. We will monitor the progress of the proposed project, and once it is scheduled in the North Carolina Transportation Improvement Program for a final environmental planning document, re-evaluate the need for alternative improvements.

2) We concur that the Kannapolis-Concord area needs to look at Transportation Demand Management measures on a regional basis, as well as in an effort to relieve congestion on the I-85 corridor. We also concur that, given the projected traffic volumes, TDM programs alone will not remove the need for improvements to the corridor.

3) We would like to address the High Occupancy Vehicle issue again once the final environmental documentation is programmed. The methodology presented in this major investment study is somewhat simplistic in its effort to determine the future effectiveness of HOV on the I-85 corridor. The Division recognizes that we need to work with the Statewide Planning Branch in determining an appropriate methodology in evaluating the effectiveness of HOV facilities. The Urban Section will undertake this activity so that we can have an agreement on a better methodology for future studies.

Given these findings, the Public Transportation Division believes that the subject study has sufficiently investigated alternative transportation modes for the future I-85 widening

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project as proposed in the Kannapolis-Concord Urban Area Thoroughare Plan. We w.l retain the opportunity to re-evaluate the High Occupancy Vehicle (HOV) alternative o ice the final environmental planning document is prepared for the project. There is the potential for changes in travel behavior, traffic projections, and project restrictions tha may require such an effort at that time.

Thank you for the opportunity to work with your staff and to comment on this study. We look forward to working on all of the major investment studies listed in your program of work in the future.

If you have any questions, please contact Carol Carter, Urban Section Manager, at 73: - 4713, extension 226.

CC: Linda Dosse, SWP
Sarah LaBelle, Kanlacon

SESSION 10 -GETTING THE MOST OUT OF YOUR GEOGRAPHIC INFORMATION SYSTEM (GIS)

Moderator: Paul Hershkowitz
Michigan Department of Transportation

Panelists: Thomas Schwetz and Cress Bates, Lane Council of Governments, Oregon
Suzette Thieman, Cheyenne Metropolitan Planning Organization, Wyoming
Paula Reeves, Washington Department of Transportation
Howard Slavin, Caliper Corporation, Massachusetts
Zaher Khatib, Yanmei Ou, and Karl Chang, University of Idaho

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Session #10

Cooperation and Patience: The Key To A High Quality, Sustainable GIS

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ABSTRACT

GIS provides a powerful tool to transportation planners and engineers for a variety of analytical tasks. However, even with the advent of PC-based GIS systems and strong state and federal support, transportation planners and engineers in small and medium-sized communities face many constraints in finding the resources to pay for a GIS and in the development of a data base that can be used for practical applications.

The Lane Council of Governments (LCOG) has been a leader in the design, implementation and management of Geographic Information Systems (GIS) for almost three decades. The root of this successful implementation of GIS lies in the formation of multi-jurisdictional (cities, county, utilities, MPO), multi-application (transportation, natural resources, public works, assessment and taxation, land use planning) approach (termed the Common Mapping Project) and development of a Cooperative Project Agreement which has provided for sustained development of a parcel-level data base.

This approach has allowed LCOG's transportation planners to have access to a very rich database. For example, the GIS provides land use and demographic inputs to the system model and overlay analyses incorporating the transportation system (both supply and demand characteristics), natural resources (soils, topography hydrology, etc.) and other public works features (sanitary, storm sewers, utility lines, etc.). In addition, this approach has allowed LCOG to focus its transportation planning resources on the transportation system as other agencies have provided the resources for development and maintenance of other parts of the database. The 30-year history provides evidence of success of the approach.

Without this cooperative, long-term approach, it is doubtful that GIS would be available to transportation planners in the Eugene-Springfield area. Certainly, we would not have the rich database that has resulted from this integrated approach. This paper/presentation will describe the approach taken by agencies in the Eugene-Springfield area in the development of its GIS, the benefits of this approach to transportation planning in a medium-sized area, and the key lessons learned over the years.

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Cooperation and Patience:
The Key To A High Quality, Sustainable GIS

The heart of Lane County is situated at the southern end of the Willamette Valley along the Interstate-5 corridor in western Oregon. At over 4,600 square miles, Lane County stretches from the crest of the Cascade Mountains in the east to the Pacific Ocean in the west. The Eugene-Springfield area, with a population of just over 200,000 people, is one of four Metropolitan Planning Organizations (MPO) in the state. The transportation planning effort in the region is coordinated by LCOG and includes participation by the Federal Highway Administration, the Oregon Department of Transportation, Lane County, the City of Springfield, the City of Eugene and the Lane Transit District. Elected officials provide input to local transportation planning efforts through the Metropolitan Planning Commission (MPC). In addition, LCOG receives a variety of state and federal grants to assist in such efforts as transportation corridor planning, land use model refinement and origin-destination surveys. The Lane Transit District serves an area about one-third the size of Lane County that also includes the Eugene-Springfield area. With over 100 routes, LTD provides transit service to over 22,000 riders a day. Known as a "bicycle-friendly" place, Eugene and Springfield have over 200 miles of on and off-street bicycle paths.

A BRIEF HISTORY OF GIS IN LANE COUNTY

The regional GIS started in 1968 as a project to create a consistent, digital grid for all of Lane County. In that year, a set of planemetric maps was used as a base for digitizing each section corner within Lane County. In 1970, the digital section data was used as registration points to digitize over 750 Assessment & Taxation maps for the Eugene-Springfield area. Known as the *Map Model System*, this effort established a parcel level mapping system by 1974 and was built primarily as a tool for land use planning. This initial effort established four important data groups:

1. Land parcels - consisting of tax lots and their internal land use polygons
2. Road-related information
3. A standardized set of site addresses for each addressable structure in Lane County
4. A set of overlay, or boundary files such as zoning, plan diagram, city limits and Urban Growth Boundary.

The parcel data base that was developed in the mid-1970's used a file structure that can keep track not only of individual tax lot boundaries, but can also depict individual land uses within each tax lot. This file structure has enabled planners to perform a wider variety of analyses that would not be available otherwise.

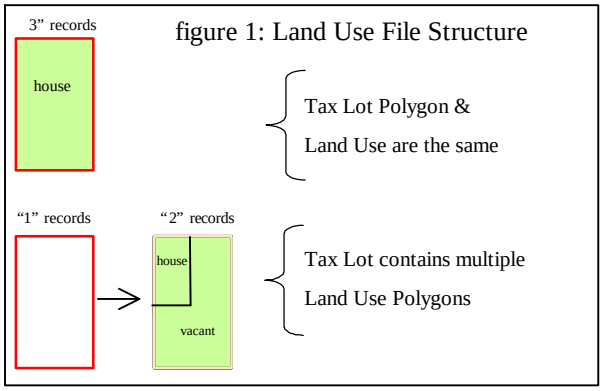


figure 1: Land Use File Structure

Projects using the land use data include:

- Vacant Land inventory
- Residential Land study
- Urban simulation modeling
- Impacted Forest Lands
- Redevelopment scenarios
- Transportation node-link modeling
- More . . .

The Map Model system remained in use up until 1982. The data was stored and managed on a large IBM mainframe computer and LCOG was the only agency that had access to the data and the only agency serving data, reports and map products to the participating government agencies. This period represented the "Central Processor - Single User" concept in place at the time.

In 1982 the partners began planning for implementation of the *Common Mapping Project* which used vendor-supplied software in a more shared environment. The mission of the Common Mapping Project was to develop a shared, integrated, commonly accepted digital base map of Lane County. In 1984 the partners purchased Synercom Technology Informap software and the City of Eugene, LCOG, Lane County, and the Eugene Water & Electric Board (EWEB) each purchased their own GIS workstations connected to a VAX mini-computer. The City of Springfield continued as a partner in the project but delayed their purchase of workstations until the region upgraded to the current ArcInfo system.

By now the regional GIS had evolved into a "Central Processor - Multiple User" environment, with the partners gaining their own access to the GIS, creating their own data layers and producing products using their own staff. In addition, the City of Eugene, City of Springfield and EWEB added municipal utility data layers to the GIS; such as storm sewer, sanitary sewer, and electrical system data. The GIS also evolved from being primarily a land use planning tool, to also serving the needs of the local utilities.

In 1992 the partners began looking at yet another upgrade to the GIS and in 1993 ESRI Arc/Info software was chosen by four of the five partners. EWEB has now chosen to use Small World for their GIS and still continues to use AutoCAD for much of their cartography applications. On the surface, this may appear to be a split among the GIS ranks, but the partners also established a set of values during that transition. One of the core values is maintaining good data and worrying less about the GIS and mapping products that make use of it. The GIS partners also use MapInfo and Maptitude and the engineering departments at Eugene, Springfield and Lane County continue to rely heavily on AutoCAD. This has proven to be a sound philosophy. It gives each agency the flexibility to chose the right GIS tool for their business and has not proven to be a roadblock to sharing and/or maintaining the data. Currently the Common Mapping Project is in a "Distributed Processing - Multi-User" environment. As the technology continues to mature the expectation is that a single data format can evolve that will allow any of the GIS systems in the region to access,

update and manipulate the hundreds of GIS layers in use today.

Transportation planners in the region have been one of the big winners over the years in terms of having access to a variety of GIS data. And, as Figure 1 illustrates, transportation planning efforts have been able to leverage the GIS data created by other projects and initially for other purposes.

Figure 1 – Transportation leveraging GIS data creation efforts

Data Layer	Purpose	Created
Tax Lots	Land Use Planning	1975
Land Uses	Land Use Planning	1975
Zoning	Land Use Planning	1976
Comprehensive Plan	Land Use Planning	1980
Employment Data	Land Use Planning	1978
Site Addresses	Common Data	1977
Road Network	Common Data	1980
Transit Routes/Stops	Lane Transit District	1991

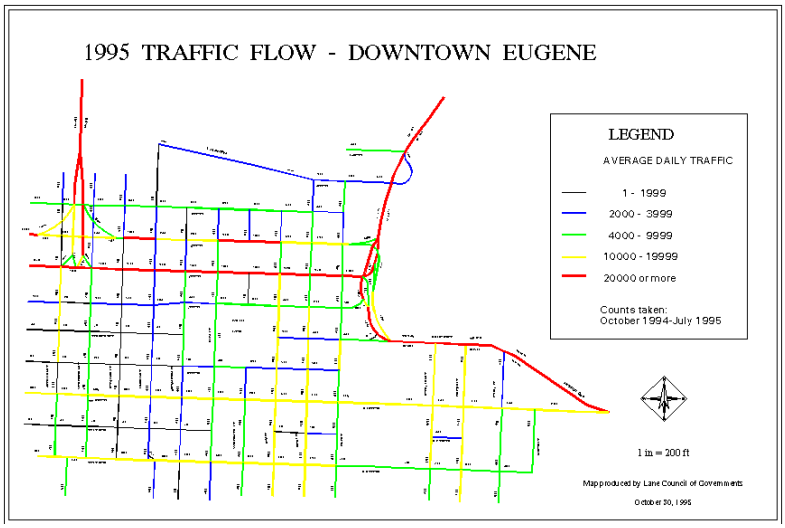
GIS and TRANSPORTATION PLANNING

LCOG is currently using a variety of Environmental Systems Research Institute Technology (ESRI) products for our GIS work. These products include Arc/Info for managing and maintaining the data and ArcView for providing easier access, mapping and some basic analysis. Transportation planners at LCOG use emme/2 software for the transportation modeling work. Output from the emme/2 model can be handed off to an ArcView extension product known as M2View marketed by the Travel Model System Group. This software works within ArcView and builds shapefiles from the emme/2 node-link model output. Additional work remains to be done to better integrate the modeling process with the GIS.

Products and Mapping

Early efforts at using GIS data for transportation purposes included producing computer-generated maps. The earliest example of this includes the production of the traffic flow map for the Eugene-Springfield area as shown in figure 2. This map was initially drawn by hand and updated once a year from information provided by Eugene, Springfield and Lane County traffic engineers. The computer version of this effort has evolved to the point where today, a GIS coverage exists that contains the volume information for each arterial and collector street in the metro area. The arcs representing each collector/arterial have an attribute field, which contains the volume data as reported by the local transportation engineers. This tabular data is updated once a year and the resulting changes to each street segment are automatically reflected in the newer version of the traffic flow map. This process has saved countless hours of manual labor and is now, in fact, the only way to produce this map since LCOG no longer employs any traditional cartographers.

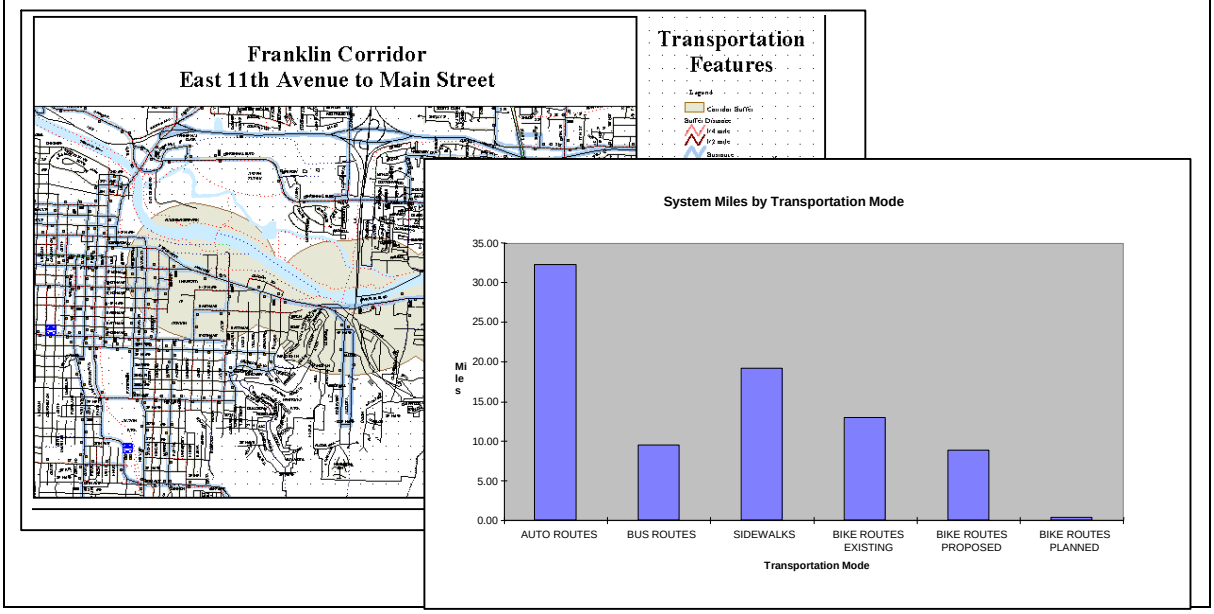
The computer mapping process for a transportation project was recently taken to a much higher level when LCOG, working under a grant from the Oregon Department of Transportation (ODOT), produced an atlas of the state road corridors within the Eugene-Springfield area. The mapping was done entirely in ArcView and involved creating 10 different themes for each of the 23 corridors identified in the metro area. Information provided by the GIS allowed LCOG GIS staff to create a quarter-mile buffer along each corridor that was expanded to a half mile at each major intersection. The corridor buffer was displayed as a reference so that the companion GIS data could be examined in relation to the corridor area. The ten themes are:



- Road and base data
- Transportation features
- Land Use
- Vacant land by comprehensive plan
- Employment data
- Population Density
- Natural features - water, flood, wetlands, topography
- Storm Sewer system
- Wastewater (Sanitary) system
- Non-Private ownerships

In addition, a companion chart was generated by analyzing the tabular data associated with each theme and exporting the results to an Excel spreadsheet where the business chart was produced. An example of this is shown on the following page in figure 2.

Figure 2 – Urban Corridor project

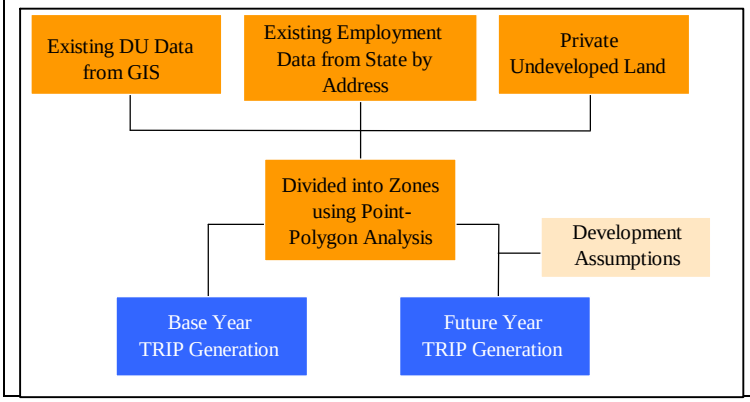


Other examples of mapping transportation data using the GIS include creating a set of bus stop inventory maps for LTD and generating a bicycle path condition/volume map for the metro area.

GIS and Transportation Modeling

The transportation modeling effort takes place within a piece of software known as emme/2; however the GIS was used extensively to populate much of the information used for the model. The initial node/link data was extracted from the GIS and converted to an AutoCAD .dxf file for import to the emme/2 software. Creating the trip generation and trip attraction characteristics for each transportation analysis zone involved a fair bit of geoprocessing within the GIS environment. The diagram in figure 3 depicts the basic process for doing this.

Figure 3 – Trip Generation Model



In the 1980's LCOG staff created a GIS coverage of transportation analysis zones (TAZ's) for the metro area.

Trip generation characteristics were applied to each TAZ by using the parcel-based GIS land use layer. The regional GIS has information for each tax lot which includes a breakdown of the number and type of land uses for each parcel. Each residential land

use was assigned to a TAZ through a process known as geocoding. This resulted in providing the emme/2 model with the number and type of each residential unit for each TAZ in the metro area.

Trip attraction characteristics were created by geocoding the employment data with their respective TAZ. Since 1976 LCOG has taken the state employment file for Lane County and assigned a coordinate to each employer location. Even if a business has multiple locations within Lane County (such as a major grocery store having multiple stores) the state only reports a total for each employer. This has meant that LCOG GIS staff have had to disaggregate the employment data to depict proper site locations.

Once the trip generation and trip attraction characteristics for each TAZ are known, then base data can be loaded to the emme/2 model. The model is calibrated by actual data from various traffic engineering departments to verify that the model accurately depicts traffic volumes along the same streets.

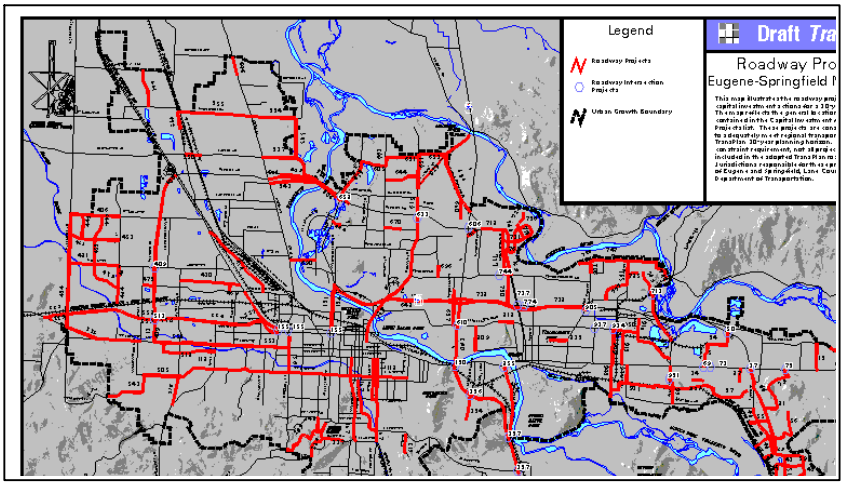
To calculate the future year trip generation the emme/2 model is loaded with future year projections for residential dwellings. This is derived by selecting the vacant land from the GIS land use layer and geocoding each vacant parcel with the projected plan designation. Plan designations are a planner's view of how the metro area will develop at some future point in time and, in the case of residential plan designations, at what density. This "look into the future" is loaded into the emme/2 model to predict what the transportation network loads will look like out to the year 2015.

Transportation Plan Project

The Eugene-Springfield Metropolitan Area Transportation Plan (TransPlan) serves as guide for regional transportation planning within the metro area. The plan predicts where, and when, a variety of regionally agreed-on transportation projects are needed over a 20-year period. As part of the formulation of the TranPlan document, a series of six maps and a variety of analytical work was provided by the GIS group to this project.

One of the key components of TransPlan is a detailed description of the transit, road, intersection and bicycle system improvements that need to occur within the metro area. Transportation planners created a MS Access database containing project identifiers and a detailed description of what each project would accomplish. Missing from this database were the actual project lengths necessary to calculate road project costs. LCOG GIS staff worked with transportation planners to standardize the project numbers within the Access database and applied the same identifiers to the set of street segments (arcs) in the GIS representing individual projects. The GIS then calculated project length and produced a report, which was then used to update the project length field in the Access table. The next step was to create a set of six maps, which not only integrated the Access data, but also used a variety of GIS layers as reference information, including a shaded relief map of the metro area. Figure 4 on the following page is an example of the format, type of map and data used to produce the TransPlan maps.

Figure 4 – TransPlan Roadway Projects Map



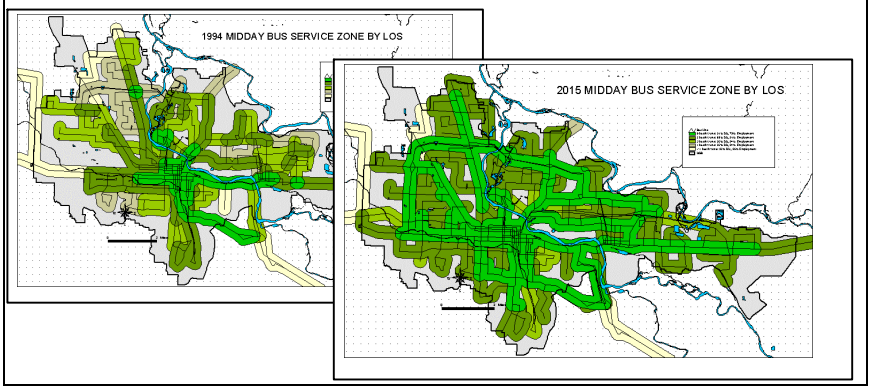
The availability of this information in GIS has allowed transportation planners to produce maps of specific neighborhoods for use in public involvement efforts.

Metro Area Transit Applications

A GIS coverage for bus routes and bus stops was initially created as a means of creating a bus stop inventory map for the Lane Transit District. LTD is also exploring ways to integrate their passenger count data with the bus route and stop data so that passenger volumes can be displayed on a map. In the meantime, LCOG staff have worked through a series of steps to map the level of service that is provided along the LTD bus route system.

To map levels of transit service, LCOG transportation staff created a model in the emme/2 environment that could depict the 1994 transit system and what it would look like in the year 2015. A set of transit lines for the year 1994 and another set of transit lines for the year 2015 were created from the model output. This data was translated into Arc/Info coverages and quarter mile buffers were generated for each transit route for the two scenarios. Each buffer was used to select the residential dwelling units and employment sites to calculate how well the transit route served households and businesses within a quarter mile. Map output from this information is shown in figure 5.

Figure 5 – 1994 and 2015 Midday Level of Service (LOS) maps



Proposed LTD Service Boundary Expansion

The Lane Transit District began providing bus service to the Cities of Creswell and Cottage Grove which are located south of the Eugene-Springfield area and also south of LTD's service boundary. City officials in Creswell and Cottage Grove, and LTD staff, needed to know the impact of imposing a six- percent payroll tax on all employers that fell within a 2.5 mile buffer within the proposed service area expansion. The GIS was used to generate such a buffer, which was then used to

select all employers from the 1994 employment file. The employment file contained total payroll for each employer which was summarized for the 2.5 mile buffer, for the city limits, the city UGB's and the north and south half of the buffer area. These numbers were then used to generate the total payroll tax by the various areas within the 2.5 mile buffer.

There are numerous other examples of how the regional GIS is used as a tool for transportation planning within the region. An interesting observation is that transportation planning was not an initial purpose for building and maintaining the GIS in Lane County.

PARTNERSHIPS - A KEY TO GIS SUCCESS

Much has changed over the 30-year history of providing GIS services within the region. What started out as an "experiment" with GIS has now evolved as a standard way of doing business. Over this period just about everything involving GIS has changed. Technological changes have been incredible. People working on the project have come and gone, funding sources have been altered and data capture methods have evolved.

But two constant factors stick out as key elements responsible for the success of GIS in the region:

- The focus has remained on the data. Data created 30 years ago is still in use today. This is not a bad investment when you can amortize the cost of collecting data, which is a huge cost, over a 30-50 year period.
- Early on, the partners constructed organizational frameworks to keep the lines of communication open, provide a forum for solving GIS problems and allowing partners to get information on shared efforts.

GIS Nirvana

GIS projects rarely work in a perfect environment. GIS projects must compete against other disciplines for limited resources, which are allocated in a political arena. A vision for the perfect GIS environment would include the following concepts:

- There is unlimited funding available for GIS projects
- Everyone cooperates to the highest degree possible
- Perfect data has been created and is available to all users
- Any product can be created - immediately
- GIS projects have the most capable staff
- GIS projects have the most current technology - and it works
- Policy makers believe GIS is indispensable.

Our region has not yet reached a state of GIS Nirvana. But a series of "successes" during each of the GIS project phases mentioned earlier has led to a continued growth of GIS in the region.

First Generation Successes: 1968 - 1982

The initial start-up phase of any GIS project can be risky. This was especially true in the late 1960's when our region embarked on this "GIS Experiment." What turned out to be key elements to keeping the GIS afloat then are true today for any GIS project just getting underway. For our region these successes included:

1. Early Project Champions

   These are the people who see GIS has an important way of doing business and are in a position to dedicate both staff and fiscal resources to making the GIS a reality. Without these folks, GIS can not gain a foothold.

2. Access to "unlimited" computing power

   The regional partners had the foresight to provide equal access to the mainframe computing resources for the various regional projects; GIS included. Without this commitment GIS would have been left begging at the door.

3. Data was removed from the political arena

   Once the initial databases and GIS coverages were built and verified, planners in the region were able to focus on the policy decisions surrounding the data; rather than spend long hours arguing over whether the data was accurate or not. GIS proved to be a great tool for focusing discussion away from the data accuracy and more toward substantive policy issues.

4. Initial products could be produced

   Even before all of the first phase work was completed the GIS was turning out products. These included simple maps, tabular reports and mailing labels. Producing a product gave the policy makers confidence that GIS could really have a return on their investment.

5. Long-term funding was secured

   Our region established a Cooperative Project Agreement (CPA) in 1975, which has been renewed each year since. The CPA provides a detailed budget and work plan for the shared GIS tasks that will occur during the fiscal year. Quarterly progress reports are provided to the partners and each agency has opportunity to provide input to the work plan and make "course corrections" numerous times during the fiscal year.

Continued Successes: 1982 - 1998

As mentioned, in 1982 a major shift in technology and the distribution of the user base created numerous changes in the way the partners approached GIS. These "growing pains" were

overcome by several additional key factors that kept the GIS moving forward.

1. The financial and user base was broadened.

   The utility partners were brought into the GIS project along with the public safety agencies. The utility folks brought additional, and more stable, funding sources; and public safety folks began building applications that depended on GIS. This, in effect, started a move to institutionalize the use of GIS in the region.

2. Partners recognized that data is a corporate asset.

   Just as public works agencies realize that a bulldozer or road grader is an asset, so too did the GIS partners realize at this time that they had a huge investment in GIS technology, data and staff that should be protected through long-range GIS planning efforts.

3. Partners committed individual resources to the overall GIS project.

   The success of any agency's GIS project is directly proportional to the number of GIS staff they have on hand. During this period a substantial growth in GIS personnel occurred within virtually each agency. Those departments that failed to "hire-up" were left lagging behind in their use of the GIS technology.

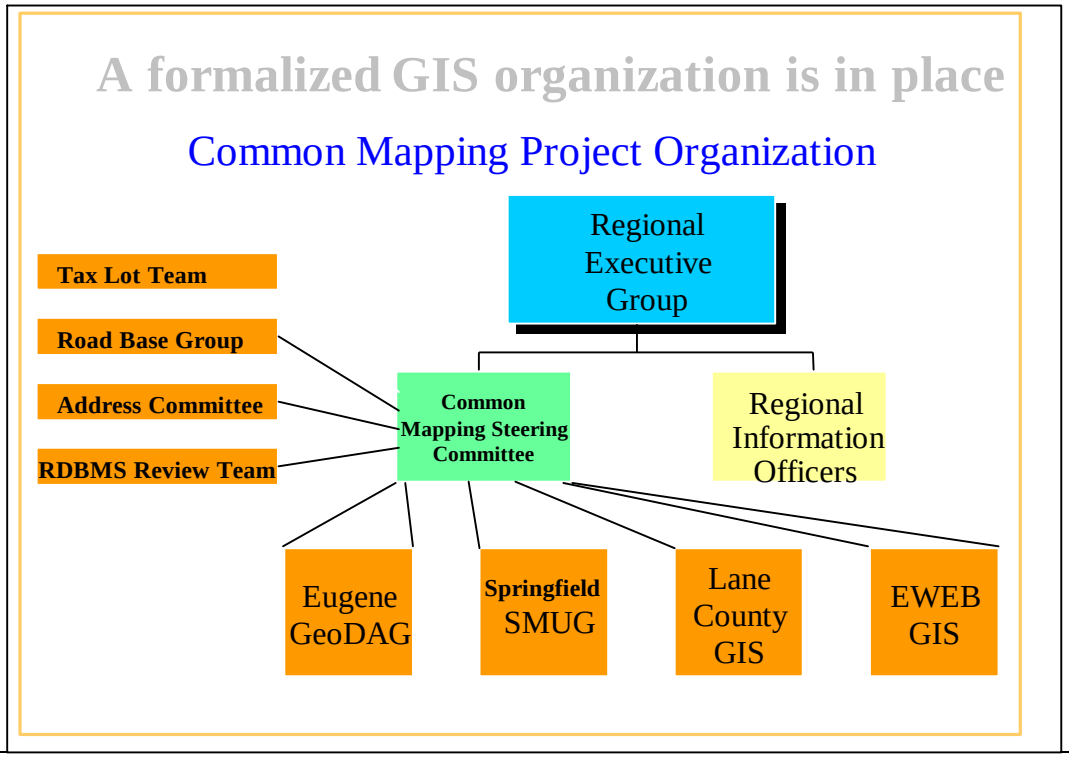
4. More extensive products became available

   The GIS began to offer more functionality and became a tool to provide a higher level of analysis to a wider variety of projects.

5. A formalized GIS organizational structure was adopted.

   Figure 7 depicts the current organizational structure within the region. This diagram is shown here only to illustrate that GIS is part of a regional forum that extends to the chief executive officers of each partner agency. The City Manager from each city, the County Administrator, the EWEB and LCOG directors serve on the Regional Executive Group (REG) whose purpose is to provide policy-level direction on how the shared computing resources within the region will be maintained. Not the least of those resources is the GIS. Another key point about the organizational structure is that each agency has an internal committee that meets to discuss their own GIS issues. This information is brought back to the regional Common Mapping Steering Committee (CMSC) which serves as the oversight committee for GIS in the region and makes recommendations to the REG. And finally, the CMSC directs the formation of special tasks groups and subcommittees to work on special GIS issues. The regional ethic is that once these committees have completed their mission, they are disbanded in order to avoid falling into a rut of having a meeting with no real purpose.

Figure 7 – Regional GIS Organizational Chart



CONCLUSION

Today, the challenge is to hold on to the sense of purpose that caused our region to form a GIS partnership in the first place. With the advent of cheap computing power, the growth of inexpensive desktop GIS software and the ever-evolving distributed nature of the GIS data; partners are left wondering why they must continue as a partner in a large project. The regional GIS project has certainly had its share of detractors and renegades over the last 30 years. We have not seen the end to some agencies questioning why they should participate in a shared venture when they can provide GIS services to their organization quicker by going it alone.

As a partnership we are still promoting that "glue" which serves as reason for holding us together. That glue today includes:

- The need to develop, maintain and share common data
- We must plan together in order to reduce redundant data collection and maintenance practices. This requires a team effort.
- Shared application development can reduce individual agency costs.
- Marketing GIS products has great financial potential and can be done more efficiently as a group rather then as individuals. And the result will be better service to the partners, to other levels of government and to the public.

Additional work is being done to make GIS-T more useful within our region. This includes:

- Creating better integration with GIS and the modeling processes. An example of this would be performing the network editing in Arc/Info and passing the results automatically back to the emme/2 modeling software.
- Expanding the transportation model to cover a greater area beyond the Eugene-Springfield MPO to include the surrounding small cities.
- Create and maintain an integrated, multi-modal GIS-T which would include:
  - road geometry – lane, turns, direction of travel
  - pavement type and condition
  - traffic counts
  - bus stops and bus routes
  - sidewalks
  - bicycle routes for on and off-street paths
  - planned improvements on all systems

  This data currently exists in a variety of electronic forms and by pulling it together in a GIS-T environment it can be used to :
  - identify and track transportation-related issues
  - develop multi-modal solutions
  - track the implementation of proposed solutions

GIS-T is a powerful tool and its application has evolved in Lane County to become an integrated part of the region's transportation planning efforts. Today, essential inputs to the network model are organized and processed by GIS. Moreover, GIS-T serves, through mapping and data organization, as a tool to create outputs useful for informing the public about transportation issues. The GIS-T provides a graphic framework that creates relevancy in the public decision-making process for the regional transportation system.

Session #10

ACCIDENT DATA USE AND GEOGRAPHIC INFORMATION SYSTEM (GIS)

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ABSTRACT

Project Description: The Cheyenne Area Transportation Planning Process (ChATPP) has developed a PowerPoint presentation demonstrating how to use an existing accident database with GIS software. The slides are followed by a hands-on demonstration of the GIS system using the actual data.

ChATPP has been intensely involved and a leader in GIS development in the City of Cheyenne and Laramie County. Recently we have taken the steps to try and interest users, that are not GIS technical people, in the use of ArcView in a desktop application. One of the projects that has been developed, is making accident data obtained from Wyoming Department of Transportation (WYDOT) available to ArcView users. How this project was developed is explained briefly below. What is important to stress is that the information is available to users and demonstrating to them how the software works.

Background: The Cheyenne urban area has a population of approximately 72,000 people. We have a slow but steady growth of about 1% and is the northern most city along the rapidly growing Front Range in Colorado. The Metropolitan Planning Organization (MPO) is responsible for transportation planning in the urban area. To assure the safety of the traveling public as the population grows, we are looking at access management standards for our main arterials.

Need: Our first step was to establish if there was a need for access management standards. The number and cause of collisions are the main determinate of the safety of the roadway. So, we needed to be able to examine, in depth, the collisions that occurred along our arterial roadways to determine if they could be prevented by having access control measures in place.

GIS: The Wyoming Department of Transportation is responsible for collecting all of the accident information in Wyoming. Using an extract of the state's database, we obtained database files for accidents from 1984 to 1996. The files were then put into ArcView GIS to create maps of specific locations or to use the databases for queries. The end result could then be displayed graphically as well as in tabular form. The GIS also allows inquires on the map that is linked to the database.

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INTRODUCTION

Need for Traffic Crash Analysis

The need for crash data in Cheyenne, Wyoming started with the Metropolitan Planning Organization (MPO) looking at access management controls on functionally classified streets. Cheyenne is a steadily growing community of approximately 72,000 people living in the urban area. It is felt that as the community grows, the need for access controls will become more necessary. Out of this project, the ability to analyze crash data became apparent as a means to determining the need and type of access controls. Safety is a driving factor in access management and the crash reports are the best indicator of the lack of safe roads. This paper presents the development and findings of crash data from police reports and how they are being used in a Geographic Information System (GIS).

Development of the Data

The City of Cheyenne had been producing an accident report annually. This report contained limited information. The type and cause of the crashes were not included. Plus the location of the accidents was summarized and not detailing specifically where the crashes had occurred. The City report did contain every crash, including private property, that occurred in the City limits. The geographic scope of this report was limited to just the City, not the complete urban area, nor was the detail adequate for the type of analysis desired.

The next step in the search was the Wyoming Department of Transportation (WYDOT), Safety Branch. This office receives all accident reports statewide. The State of Wyoming is fortunate in that all police agencies including highway patrol, sheriff departments, and municipal police use the same traffic accident report form. A copy of this form is shown in Figure 1, *State of Wyoming, Investigator's Traffic Accident Report*. These respective enforcement agencies send all reports to WYDOT where they are scanned and input into a database. All of the information, over 150 different pieces of information, are input into the database.

Limitations of Data

The decision was made to use the WYDOT data as the basis for accident analysis. This data covers the desired geographic area and includes all police agencies. There are limitations however, on the data from WYDOT that need to be kept in mind while performing crash analysis. If an accident could be located within 50 feet on a map from the report, it is given an x,y coordinate with a digitizer. If an accident could not be located on a map, a coordinate was not assigned but the data still resides in the database. (The coordinate system that WYDOT uses is the same as the City and County in State Plane Coordinates). The lack of coordinates occurs in about 10% of the data for each year.

Second, if the crash damage is less than $500 it is not included in the database. This eliminates the small crashes from being reported and therefore would not be in the database. Thirdly, private property accidents are not included unless related to an access or intersection onto a public roadway.

Obtaining the Data

The first step to obtaining the data was to look at the database structure and determine what fields were needed and which where not. The MPO did not want any data that would be of a confidential nature, such as names, addresses, and social security numbers. Also, information that was not relevant to the study where eliminated.

The data was extracted and compressed in a ASCII comma delimited text format. The software used to extract and run the data is PKUnzip, a spreadsheet, and ArcView. A spreadsheet software was also used for data manipulation after the Dbase file was established.

The format of the database is actually four separate databases for each year. The main database is called *base*. This contains all of the general information about the accident such as date, time, conditions, and if available, the coordinates. The other databases called *vehicle*, *driver*, and *person* detailed each of these areas of the crash. These four databases contain a common "Key" field that keeps the data elements tied together.

Type of Data

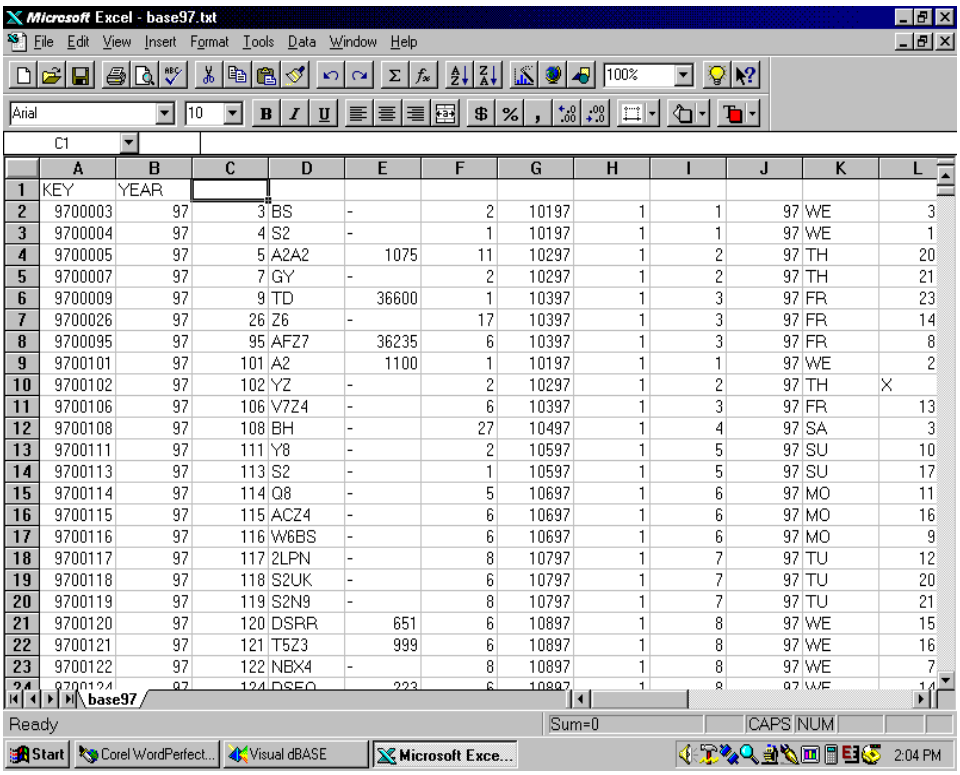
The initial data that was obtained spanned the years 1984 to 1996. Annual updates are obtained to keep the data current. The type of information that the MPO obtained included such items as:

- the number of vehicles involved
- the number of injuries
- number of fatalities
- number of alcohol involved accidents
- violations issued
- type of and severity of injuries
- type of accident
- activity prior to the accident
- human contributing factors
- safety restraints

This level of detail allowed the more in depth analysis that was necessary for the project.

Data Conversion

The ASCII text file was unzipped, renamed to a ".txt" file, and opened in a spreadsheet, (Figure 2). Column titles were added to the spreadsheet as well as parsing the street code into two separate fields (Figure 3). The *vehicle*, *driver*, and *person* databases went through the same process including parsing the "Key" field to correspond to the *base* database. Each spreadsheet is saved in a .dbf format.



	A	B	C	D	E	F	G	H	I	J	K	L
1	KEY	YEAR										
2	9700003	97	3	BS	-	2	10197	1	1	97	WE	3
3	9700004	97	4	S2	-	1	10197	1	1	97	WE	1
4	9700005	97	5	A2A2	1075	11	10297	1	2	97	TH	20
5	9700007	97	7	GY	-	2	10297	1	2	97	TH	21
6	9700009	97	9	TD	36600	1	10397	1	3	97	FR	23
7	9700026	97	26	Z6	-	17	10397	1	3	97	FR	14
8	9700095	97	95	AFZ7	36235	6	10397	1	3	97	FR	8
9	9700101	97	101	A2	1100	1	10197	1	1	97	WE	2
10	9700102	97	102	YZ	-	2	10297	1	2	97	TH	X
11	9700106	97	106	V7Z4	-	6	10397	1	3	97	FR	13
12	9700108	97	108	BH	-	27	10497	1	4	97	SA	3
13	9700111	97	111	Y8	-	2	10597	1	5	97	SU	10
14	9700113	97	113	S2	-	1	10597	1	5	97	SU	17
15	9700114	97	114	Q8	-	5	10697	1	6	97	MO	11
16	9700115	97	115	ACZ4	-	6	10697	1	6	97	MO	16
17	9700116	97	116	W6BS	-	6	10697	1	6	97	MO	9
18	9700117	97	117	2LPN	-	8	10797	1	7	97	TU	12
19	9700118	97	118	S2UK	-	6	10797	1	7	97	TU	20
20	9700119	97	119	S2N9	-	8	10797	1	7	97	TU	21
21	9700120	97	120	DSRR	651	6	10897	1	8	97	WE	15
22	9700121	97	121	T5Z3	999	6	10897	1	8	97	WE	16
23	9700122	97	122	NBX4	-	8	10897	1	8	97	WE	7

Figure 2

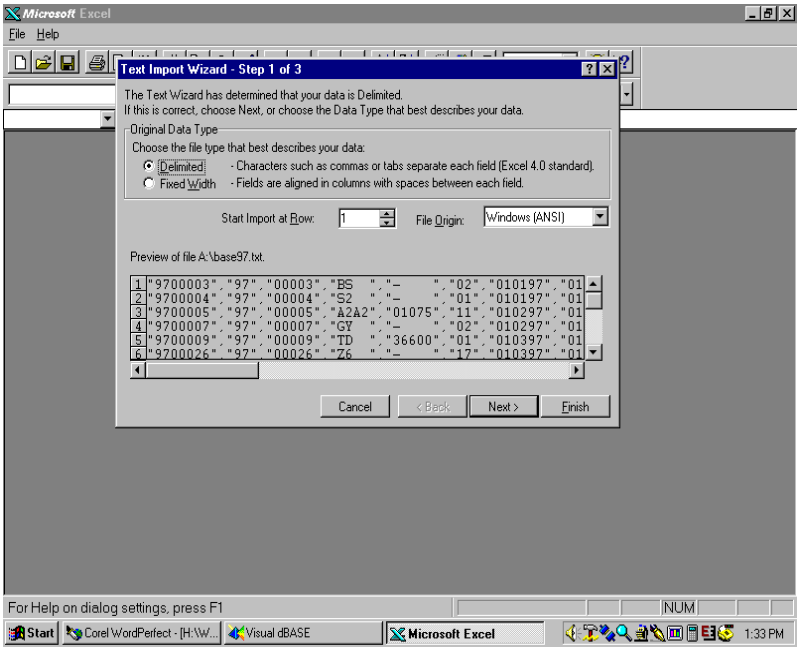


Figure 3

Using GIS

ArcView GIS and Dbase are directly compatible. The coordinates in the *base* database allows the locations to be read directly into ArcView. Using the street centerline as a backdrop an "Event Theme" is added (figure 5) using the Dbase database. Once added, the database is converted into

a shapefile, ".shp", that can be edited and manipulated in ArcView.

The GIS platform allows for a visual map connection to the database. Figure 4 shows the accident locations across Cheyenne and the database connected to the map. This allows queries to be made either from the map or from the database. This system allows various maps and charts to be made that go into the annual report production.

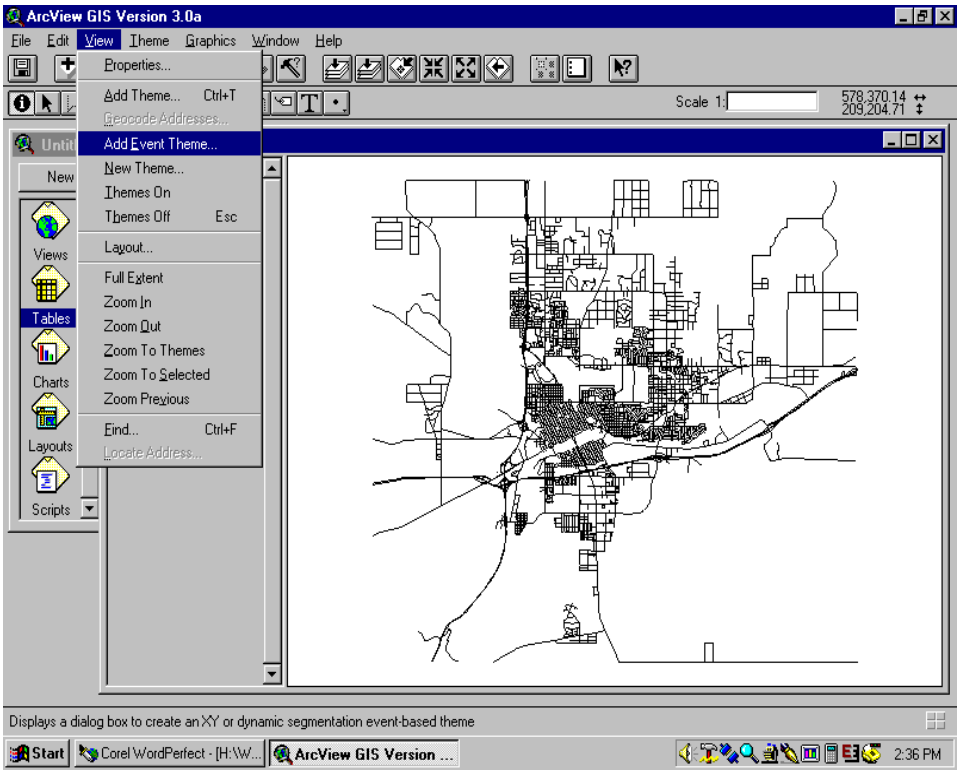


Figure 4

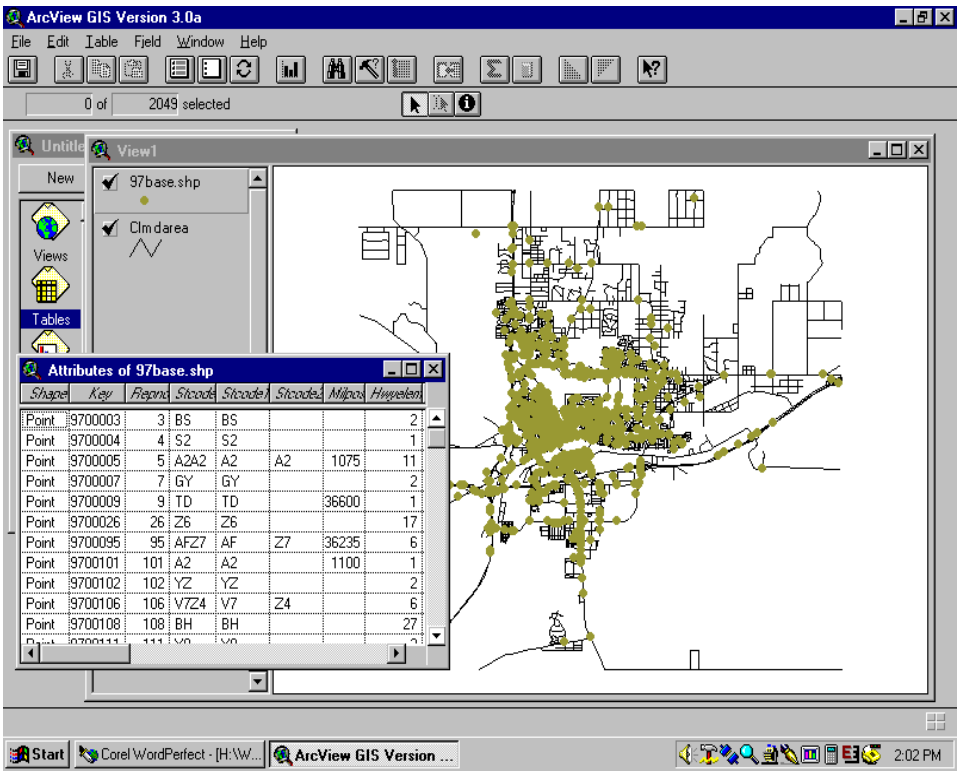


Figure 5

Linking Tables in ArcView

The *base* database is now useable in the GIS to use for queries, buffering, and other types of analysis. The three other databases *driver, vehicle, and person* are then linked in ArcView to the *base*. This allows all four databases to respond to analytical queries.

GIS Cooperative Agreement

The GIS system in Cheyenne is based on a cooperative agreement between the City of Cheyenne and Laramie County. This agreement, first established in 1992, has allowed for the free exchange of data and GIS products between these agencies. The duplication of effort has been virtually eliminated and each area can freely use anothers coverage or database. The accident data is on a network server that can be used by anyone with access to the server system.

Conclusion

In general, this has been an enviable project. There have been no complications in the use of the data and the conversion to the GIS system. The conversion of the data was fairly seamless, and the accident points matched well, generally within 40 feet, of the road centerline.

The future plans for the data include relating the two digit street code to the actual arc segments and tying this to the traffic count information. This will allow us to calculate accident rates rather than using raw crash numbers for analysis.

Overall the data received has been an invaluable aid in the planning process. The data worked out well for the access management project and continues to be a valuable tool for applications other than originally intended. This was an important lesson to us in working with other agencies and departments.

Session #10

Integrating Transportation Modeling and "Desktop GIS": A Practical and Affordable Analysis Tool for Small and Medium Sized Communities

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ABSTRACT

This paper and presentation discuss some of the benefits of integrating travel demand models and "desktop GIS" (ArcInfo for PCs and ArcView for PCs) including: enhanced graphic display capabilities, increased analysis capabilities, and more efficient use of staff time. The paper and presentation describe an affordable way for small and medium sized communities to fully utilize this technology without purchasing expensive equipment.

The paper and presentation also identify specific improvements to transportation planning made possible by the integration of travel demand models and GIS such as:

- graphic displays that engage the public,
- better comparison of alternatives in NEPA/SEPA processes and documents (e.g., Environmental Impact Statements, Environmental Assessments), and
- enhanced travel demand management (TDM) and/or alternative mode modeling.

Two examples of actual uses for this integration technique are discussed. One example is the transportation system analysis conducted for Thurston Regional Planning Council's (TRPC) Long Range Transportation Plan. The other example is the graphic enhancement of information presented to citizens, stakeholders, and policy makers during the TRPC planning process.

The paper and presentation briefly discuss other potential uses for the integration of a travel demand model and desktop GIS. Examples of potential uses may include calculation of a multi-modal roadway level of service and enhanced detail for road capacity calculations.

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Integrating Transportation Modeling and "Desktop GIS": A Practical and Affordable Analysis Tool for Small and Medium Sized Communities

Introduction

Integrating a travel demand model and desktop GIS (ArcInfo and ArcView for PCs) can enhance graphic display capabilities, increase analysis capabilities, and make more efficient use of staff time.

Engaging the public in the planning process is dependent on clear and direct graphic displays. The GIS integration technique discussed in this paper allows the transportation planner or public information specialist to provide the public and elected officials clear, easy-to-understand information. See the following two pages for examples of a travel demand model map and a map created using the GIS integration technique discussed in this paper. See Maps

This integration technique also improves the process of comparing alternatives for Environmental Impact Statements (EISs) in compliance with NEPA/SEPA. The transportation planner can evaluate each alternative in an EIS more accurately and efficiently using GIS information such as: hydrology, critical areas, and wildlife habitat.

Transportation planners or analysts can use this integration technique to create a travel demand management (TDM) or alternative mode model. GIS integration provides a greater level of detail and the additional information needed to produce effective TDM models.

Smaller jurisdictions may realize a savings of staff time after implementing GIS integration. Staff no longer have to manually extract information from travel demand models. Desktop GIS enables the transportation planner to conduct one step queries, automate processes for extracting data, and view or map several layers of geographic information at one time. Some staff training may be required. However, the longer term savings in staff time is likely to cover these costs.

The GIS integration technique discussed in this paper does not have to be performed using an expensive workstation. The tasks outlined in this paper can be performed using a GIS that runs in a DOS or Windows environment rather than in a Unix environment. This is important because the cost of a PC with a DOS or Windows operating system is approximately $2,000-$3,000, versus the cost of a workstation with a Unix operating system which is approximately $20,000-$30,000.

Resources

Resources needed to integrate GIS and a travel demand model include a copy of PC or NT ArcInfo and ArcView. PC ArcInfo is much less expensive at approximately $3,000. The Windows NT version of ArcInfo is more expensive at $13,000 - $18,000. The primary difference between the two is that the Windows NT version has many of the capabilities that Unix based ArcInfo does. PC ArcInfo is limited in its ability to handle larger databases. However, the PC version is capable of doing all the functions discussed in this paper, and may be adequate for smaller communities.

This paper refers to GIS running in a DOS or Windows environment rather than in a Unix environment. This is an important difference due to the cost of a PC with a DOS or Windows operating system ($2,000-$3,000) versus the cost of a workstation with a Unix operating system ($20,000-$30,000).

Smaller jurisdictions may also realize a savings of staff time after implementing GIS integration. Staff no longer have to manually extract information from travel demand models. Desktop GIS enables the transportation planner to conduct one step queries, automate process for extracting data, and view or map several layers of geographic information at one time.

Methods

Transportation modeling, especially alternative transportation modeling, is increasingly dependent on quality GIS based information to provide a level of detail not currently available in most travel demand models.

This is only one method of integrating a travel demand model and GIS that can help smaller jurisdictions enhance their graphic display capabilities, increase analysis capabilities, and perform calculations more efficiently. There are many ways the user could alter or enhance this method and many additional ways to integrate GIS and travel demand modeling to create more detailed models. The method discussed in this paper can also be automated, or made to perform with a few key strokes.

The first step is to export desired information from the travel demand model to a standard format (e.g., .txt or .dbf file). Then, using a data base manager, reformat the model output to be compatible with the desktop GIS. The desktop GIS is capable of using the model output to create a visual representation of the transportation network with intersection locations that correspond to their actual spatial location. This integration process enables the transportation planner to analyze the transportation network with the benefit of knowing more about the area wildlife habitat, land uses, lakes, streams, rivers, critical areas, and any other available GIS information.

The following is a discussion of the method of GIS integration TRPC used in their most recent update of their 2020 Long Range Regional Plan:

First, export a link report or a text file containing desired link attributes (e.g., capacity, posted speed, operating speed, volumes) from the travel demand model.

Table 1. Link Attributes

ANODE	BNODE	CLASS	AREA	TYPE	LANES	CAP	LENGTH	SPEED
2	546	7	50	207	2	4000	782	60
3	2552	7	50	307	3	6000	40	65
5	2572	29	50	1029	1	1200	76	45
7	2531	7	50	207	2	4000	524	60
9	542	1	30	111	1	1000	19	15
10	601	1	30	111	1	1000	42	15
10	611	1	30	111	1	1000	29	15
11	631	1	30	111	1	1000	21	15
12	612	1	30	111	1	1000	17	15
13	641	1	30	111	1	1000	29	15
15	593	1	30	111	1	1000	12	15

Then export a node report or a text file containing desired node attributes (e.g., node number, node X and Y-coordinates, node capacity) from the travel demand model.

Table 2. Node Attributes

NODE	XCOORD	YCOORD
1	-2254	12791
2	3207	19137
3	15269	14010
4	19154	17080
5	20766	7825
6	7434	-1112
7	5719	-2999
8	-1289	4356
9	13861	14766
10	13624	14064
11	12974	13828
12	13718	13786
13	12659	13629
14	12440	13310
15	12252	14053

To simplify the process of importing the files into a database manager, change both files to comma delimited or space delimited format using a text editor and remove any headings or page breaks.

Using a database manager such as Microsoft Access, Dbase, or Foxpro, combine the data in Table 1. and Table 2. to create a new table including items: A-Node number, A-Node's X and Y coordinates, B-Node number, B-Node's X and Y coordinates.

Table 3. Combined Table 1. and Table 2.

ANODE	AXCOORD	AYCOORD	BNODE	BXCOORD	BYCOORD
2	3207	19137	546	3803	14449
3	15269	14010	2552	15111	13824
5	20766	7825	2572	20314	7759
7	5719	-2999	2531	6251	119
9	13861	14766	542	13863	14652
10	13624	14064	601	13877	14064
10	13624	14064	611	13613	13888
11	12974	13828	631	13068	13744
12	13718	13786	612	13725	13888
13	12659	13629	641	12831	13639
15	12252	14053	593	12261	14127
16	12440	14012	594	12463	14115

In order to establish a common item between tables, add an item to Table 3. called AB Node and concatenate, or merge, the A-Node number and the B-Node number into one numeric item.

Table 4. Table 3 with AB Node Item Added

ANODE	AXCOORD	AYCOORD	BNODE	BXCOORD	BYCOORD	ABNODE
2	3207	19137	546	3803	14449	2546
3	15269	14010	2552	15111	13824	32552
5	20766	7825	2572	20314	7759	52572
7	5719	-2999	2531	6251	119	72531
9	13861	14766	542	13863	14652	9542
10	13624	14064	601	13877	14064	10601
10	13624	14064	611	13613	13888	10611
11	12974	13828	631	13068	13744	11631
12	13718	13786	612	13725	13888	12612
13	12659	13629	641	12831	13639	13641
15	12252	14053	593	12261	14127	15593

Reformat the new table again for use by ArcInfo GIS software. Simply, combine the link report and the node report. ArcInfo's Generate module requires the following file format to generate a line coverage:

Table 5. File Format Required to Create an ArcInfo Line Coverage

```
ID#
X-coordinate, Y-coordinate
X-coordinate, Y-coordinate
End
```

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Repeat this format in a consecutive list for each link of the network (Microsoft Access report tool is especially useful for formatting this file).

Table 6. List of Node Coordinates and ID#'s as Shown in Table 5

```
1763
1308865.875, 636949.938
1327158.875, 638229.625
END
2546
1352796.375, 689343.813
1357590.875, 650638.688
END
32545
1449827.875, 647014.25
1449039.625, 646246.375
END…
```

The concatenated A-Node and B-Node number may be used as the ID# for the ArcInfo Generate module. Using the concatenated A-Node and B-Node number as the ID# in this file helps establish a link for joining other desired data in the next few steps.

Next, open the ArcInfo program and generate a line coverage or a point coverage by using the properly formatted file as input (Note: the input file format for generating a point coverage is slightly different. It requires only one set of X,Y coordinates).

At this stage, either build the generated ArcInfo coverage as a point or a line coverage. You may link other desired attributes to this coverage using the ID# (concatenated A-B Node number).

It is likely that the GIS coverage created in this process will not be in the same coordinate system as other GIS data created through different processes. The transportation planner may want to use either the Arc command 'Transform' or 'Project' to change the coordinate system to correspond with other GIS data.

Discussion

The most quickly realized enhancements GIS integration can provide are to graphic display and mapping capabilities. Most travel demand models have limited graphic display. Some travel demand models may not be able to layer information. For example, it may not be possible to graphically display hydrology, land use, or wildlife habitat, in addition to roads, using a travel demand model. Travel demand models often have limited line types and widths. Some travel demand models do not have the ability to customize legends or keys.

Graphic display of travel demand model output is a critical part of any transportation planning process that includes public involvement. The GIS integration technique discussed in this paper gives the transportation planner the tools to develop maps and graphic displays explaining traffic patterns and problems clearly and directly. This information is very important for public hearings, public involvement meetings, and presentations. Clear, easily understood, visual presentations help to engage the public in the planning process.

With more of a time commitment, transportation planners can use GIS integration to increase analysis capabilities and perform calculations more efficiently. During development of the 2020 Long Range Transportation Plan for Thurston County, transportation planners used GIS integration to estimate total acres of impervious surface and lane miles added to the road system for each alternative. They also estimated the number of trips generated by each traffic analysis zone (TAZ) and growth in trips by TAZ.

GIS integration increases analysis capabilities by improving road capacity estimation. Travel demand models often include general capacity estimates. For example, a travel demand model may include assumptions that major arterials carry 1000 vehicles per hour/per lane, minor arterials carry 800 vehicles per hour/per lane, and collectors carry 600 vehicles per hour/per lane.

This practice may be adequate for some long range plans. However, by collecting GIS data on shoulder widths, locations of bicycle facilities, growth management area boundaries, locations of sidewalks, pavement quality, surrounding land uses, location of medians, transit service, freight movement, or other information, the vehicle carrying capacity can be much more accurate. Transportation planners could also use GIS integration to develop multi-modal capacities. Accurate capacities improve travel demand estimates and help smaller jurisdictions make more informed decisions about where to invest in the transportation system.

The GIS integration technique discussed in this paper can help jurisdictions meet SEPA or NEPA requirements for Environmental Impact Statements by enabling a more accurate and efficient comparison of alternatives.

For the most recent update of the 2020 Long Range Transportation Plan, TRPC looked at a total of five future transportation alternatives. They based each of these long range transportation alternatives on different assumptions about the number of new roads, TDM efforts, transit, and bike improvements. Transportation planners exported and converted the travel demand model results for each alternative to GIS coverages through the integration process described in the Methods section of this paper. Maps of each transportation alternative along with land use, hydrology, critical areas, and other information helped planners, elected officials, and the public compare the impacts of each alternative and make effective transportation choices.

TRPC also showed the graphic displays at public hearings and other presentations. The "Desktop GIS" connection helped TRPC to convey the travel demand model information, as it relates to other environmental information, and improve the level and quality of public input.

TRPC's transportation planners used GIS integration in the development of a travel demand management (TDM) model. Using GIS, transportation planners developed a TDM index, and applied trip reductions based on this index. The TDM index included the following factors:

- potential trip reduction for each TDM option,
- population and employment density,
- proximity to and frequency of transit,
- a transit origin and destination survey, and
- consideration of the transit orientation index (TOI) developed by Cambridge Systematics for the Thurston County Area Mode Choice Model.

To develop the TDM model, TRPC's transportation planners converted the traffic analysis zones (TAZs) and transit routes from the travel demand model to a GIS coverage using the method discussed in this paper. They used all the factors listed above to create the TDM index. The TDM index number assigned to each TAZ determined the percent trip reduction applied to each TAZ. Without the GIS connection this process would have been more labor intensive, more prone to error, and more subject to interpretation.

Conclusions

Integrating a travel demand model and desktop GIS (ArcInfo and ArcView for PC's) can improve transportation planning by enhancing graphic display capabilities, improving the comparison of alternatives in NEPA/SEPA processes and documents (e.g., Environmental Impact Statements, Environmental Assessments), and enabling travel demand management (TDM) and/or alternative mode modeling. GIS integration provides stakeholders more information in a clear and direct display, helping them to make more informed decisions about transportation investments.

There are many ways the GIS integration technique discussed in this paper could be altered or enhanced. There are also many ways to integrate GIS and travel demand modeling to create more detailed and accurate models. This paper only touches on a few of the ways transportation planners use GIS integration to improve travel demand modeling.

The GIS integration technique discussed in this paper does not have to be performed using an expensive workstation. To perform the tasks outlined in this paper a "desktop GIS", or GIS that runs in a DOS or Windows environment rather than in a Unix environment, can be used.

The total cost of purchasing software and hardware needed to integrate GIS and a travel demand model can quickly be recouped in savings of staff time, more effective planning, and enhanced public involvement processes.

GIS is playing an increasingly important role in transportation modeling, as transportation planners seek ways to answer questions, from the public and elected officials, regarding impacts of alternative modes of transportation. As travel demand management (TDM) methods, including commute trip reduction (CTR), gain increasing support and raise additional questions, the ability to model their impacts is advantageous.

Figure 1. Travel Demand Model of Grand Mound Area

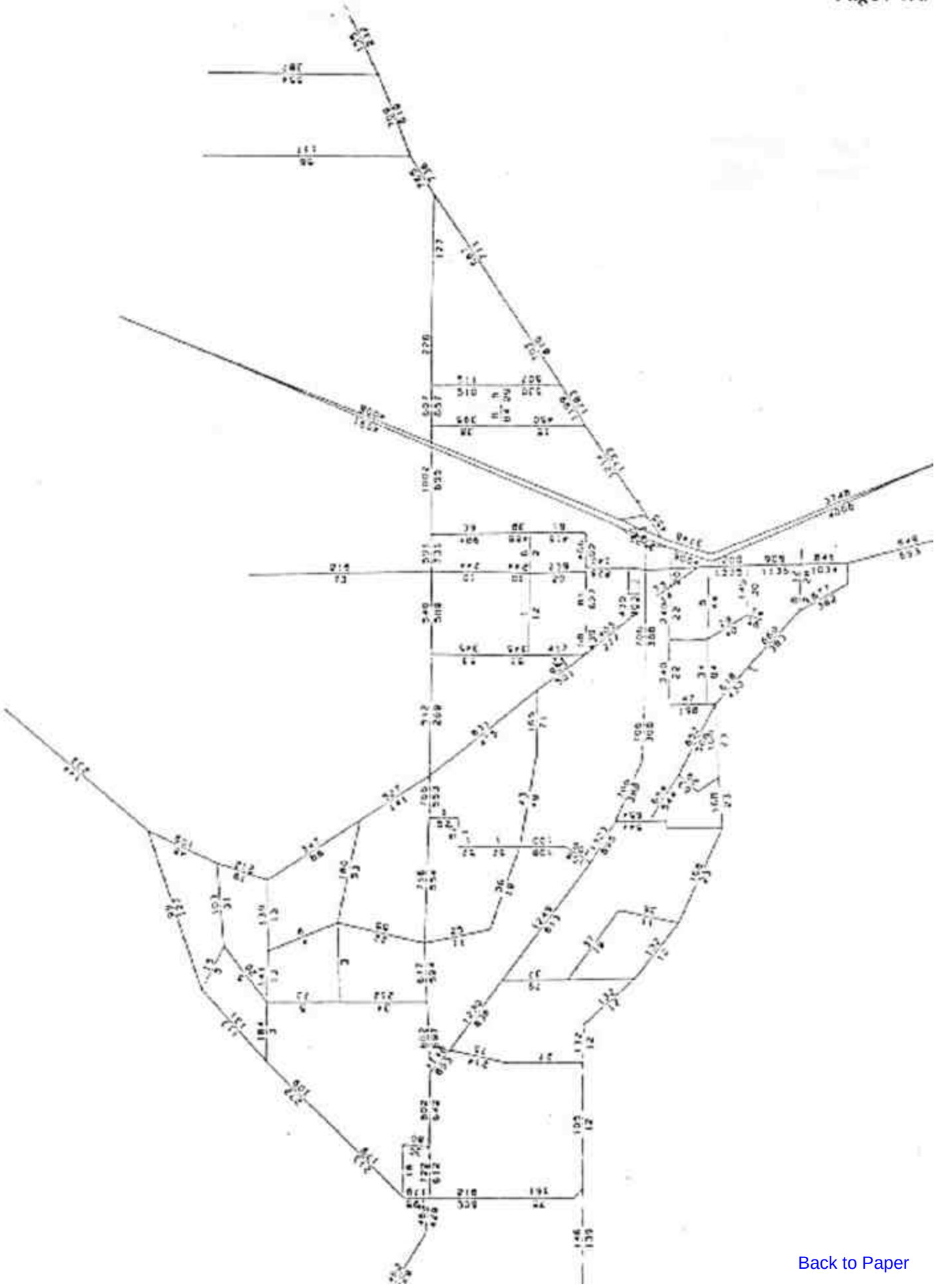

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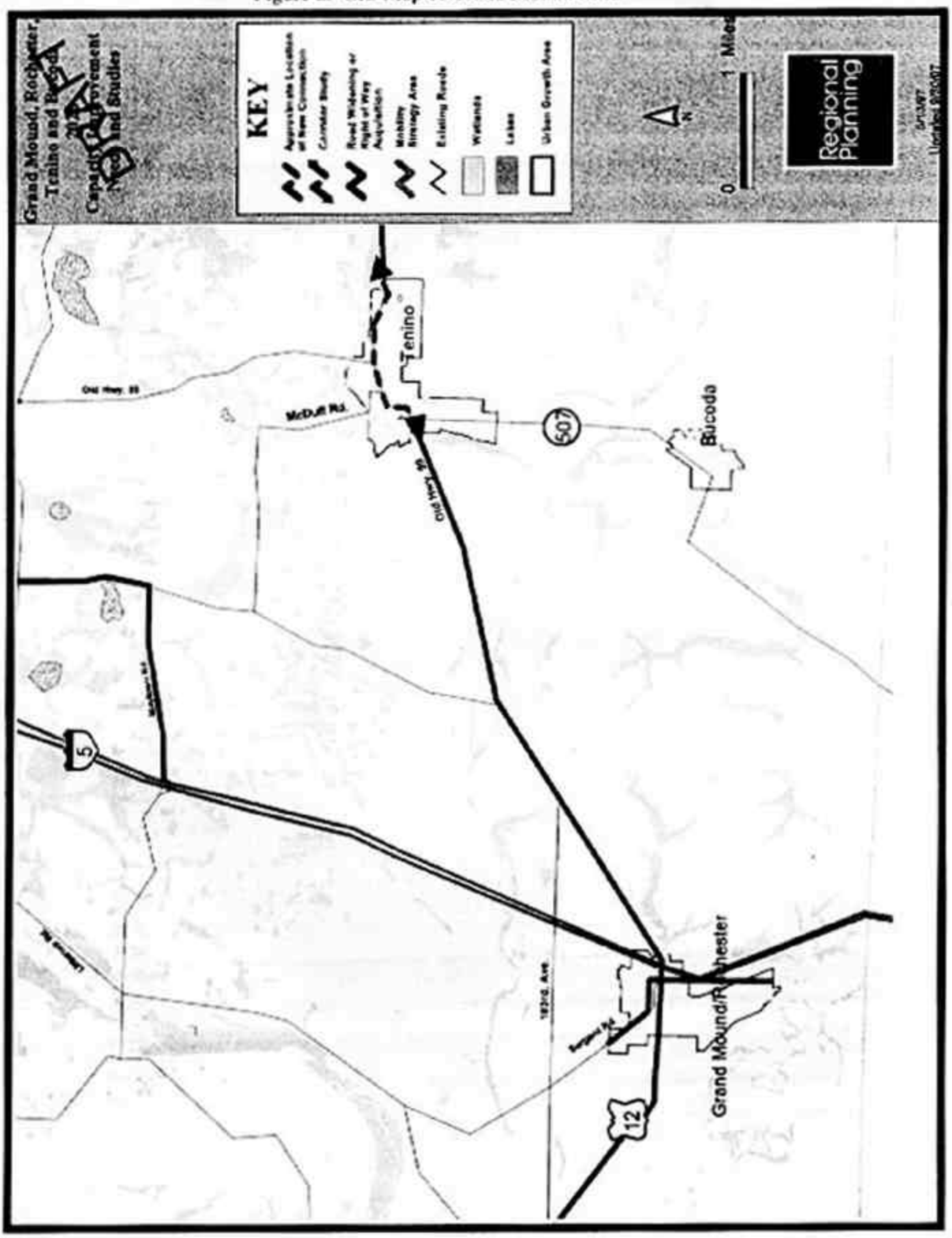
Figure 2. GIS Map of Grand Mound Area



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Session #10

ENHANCED FRAMEWORK FOR MODELING URBAN TRUCK TRIPS

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ABSTRACT

Recently there has been renewed interest in modeling urban truck movements. This is potentially important for improving traffic forecasts as well as for a host of other applications including ITS. Despite attempts to fit truck trips models into a passenger modeling framework, there are unique aspects of urban freight movements, such as trip chaining, that must be considered for credible models. Most urban truck trips occur on tours comprised of many vehicle trips that are chained together for efficient routing.

This paper discusses models for intraurban trips and provides an enhanced framework for modeling urban truck trips that is workable for most MPOs. This framework can be implemented in the form of either aggregate or disaggregate models at the zone or establishment levels, respectively.

Various approaches for overcoming data obstacles are considered including use of truck traffic counts to estimate trip tables. Use of geographic information systems (GIS) and new data sources is examined, and practical guidance is provided for model implementation.

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ENHANCED FRAMEWORK FOR MODELING URBAN TRUCK TRIPS

Recently there has been renewed interest in modeling urban truck movements. This is potentially important for improving traffic forecasts as well as for a host of other applications including ITS. Despite attempts to fit truck trips models into a passenger modeling framework, there are unique aspects of urban freight movements, such as trip chaining, that must be considered for credible models. Most urban truck trips occur on tours comprised of many vehicle trips that are chained together for efficient routing.

This paper discusses models for intraurban trips and provides an enhanced framework for modeling urban truck trips that is workable for most MPOs. This framework can be implemented in the form of either aggregate or disaggregate models at the zone or establishment levels, respectively.

Various approaches for overcoming data obstacles are considered including use of truck traffic counts to estimate trip tables. Use of geographic information systems (GIS) and new data sources is examined, and practical guidance is provided for model implementation.

An Overview of Urban Goods Movement

Truck traffic accounts for a substantial fraction of the traffic stream in many regions and is often the source of localized traffic congestion and potential parking and safety problems. Ignoring truck traffic in transportation demand forecasting makes it impossible to plan for network improvements and causes inaccuracies in passenger transportation forecasting and planning. Modeling air quality and designing transportation projects to improve air quality requires effective treatment of trucks in demand forecasting.

Currently, urban truck trips tend to be ignored or treated superficially in regional transportation planning models. This reduces the effectiveness and accuracy of travel demand forecasting and may result in misguided transportation policy and project decisions.

Various approaches have been developed for incorporating truck trips in regional forecasting efforts. In the Seventies, there were a number of models constructed that loosely followed the four-step model paradigm to some degree or another. However, researchers (of whom the author was one) established that there were important differences in truck traffic determinants that should be taken into account in modeling.

One of the important differences is the fact that truck trips in urban areas are chained together in tours comprised of multiple delivery, pickup, and mixed pickup and delivery trips. The degree of trip chaining is so high compared to that encountered in urban passenger travel that it warrants special consideration in modeling.

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A second major difference was that trucks differ greatly in size and trip operating characteristics. In contrast to cars whose size differences are relatively unimportant for travel forecasting, the composition of truck traffic is of interest.

A third difference is that the number of trucks and the number of truck trips vary considerably by location and by industry. Trucking and warehousing activities, not surprisingly, have the highest rates of truck trip generation.

It is commonsensical that the number of truck trips in a region is related to the number of trucks in a region, but bizarrely, most modeling efforts ignore this relationship. Moreover, none of the important differences noted above are appropriately reflected in recent work on freight models.

Virtually all MPOs need to address truck traffic in their modeling process; however, very few have done so. Moreover, where trucks are included they are usually treated like car traffic leading to problematic results. The need for appropriate methodologies for urban truck demand forecasting is nearly universal.

Recent Modeling Research

Recent work in the area of modeling urban freight has been extremely limited. However, a quick response method manual sponsored by FHWA has recently been released (TMIP 1996). Unfortunately, the approach follows the passenger forecasting paradigm too closely, and the recommended method has neither a sound conceptual basis nor an adequate means of addressing trip chaining, vehicle supply, or the role of truck operators. However, it has stimulated interest and attention on the part of MPOs which will hopefully lead to the development of better tools.

The report entitled, Characteristics of Urban Freight Systems, contains a fascinating array of statistics on aspects of urban freight transportation in North America. However, this report does not address the underlying mechanisms that have to be modeled in order to forecast future truck trips.

Ken Ogden in his 1992 book on Urban Goods Movement (p. 292) noted “that the state-of-the-art in urban freight modeling is quite undeveloped, having a poor theoretical base, a primitive analytical framework, and very little good data to permit the development and calibration of models. The second is that there has been very little model development since the 1970s, and in fact the whole area of urban goods analysis for planning and policy purposes has hardly seen any advance for over a decade.”

Slavin (1979) may be the only known attempt to develop a theory of urban freight from the behavioral perspective of firms. This research included extensive empirical analysis of a truck survey performed in Boston to explore and validate key relationships between industry employment and truck trip levels. Both aggregate and disaggregate modeling approaches were implemented experimentally. Work is currently underway to update the method and its implementation in software.

Urban areas coping with goods movement issues have usually been thwarted by data. However, there are an increasing number of metropolitan areas that are collecting data on truck traffic.

An interesting approach to data is the use of origin-destination table estimation methods to derive vehicle trip tables by type. This has been done successfully by Mark Turnquist and Arnim Meyburg of Cornell and George List of RPI for New York under the University Transportation Research Centers Program.

Modeling Objectives and Background

The most important goal is to develop modeling approaches that are conceptually reasonable, can be implemented empirically, and are useful for forecasting. Multiple designs are necessary as it does not appear that “one size will fit all” areas.

From a conceptual point of view, truck trips arise from the decisions of freight transport providers who, based upon the demand for goods, determine how they will pick up and deliver freight consignments. Transport providers include not only the for-hire carriers including package carriers such as Federal Express and UPS, but also the businesses that operate their own vehicles.

Over time, firms change location and size, as well as evolving in terms of product mix and pricing. They also adjust their distribution methods, inventories, and their vehicle fleets. Many decisions influence trade in transportable commodities and eventually result in truck trips.

The generation and distribution of truck trips is intimately related to the economic system of a metropolitan area and the number and size of business establishments contained therein. Truck travel is derived from the demand for goods that are exchanged between entities. These exchanges are either business-to-business or business-to-consumer linkages.

While it might appear conceptually appealing to attempt to model commodity flows directly within urban areas and then convert these flows to truck trips, this has proven to be largely an unworkable approach. One reason is that at the disaggregate level, business establishments are unwilling to provide information on the specific nature of their customers and business volumes associated with each. Another reason is that even small entities deal in a multiplicity of input and output commodities. Typically, trucks transport many commodities together and there may be no information that the transportation provider has about what is in their vehicles.. Direct modeling of truck trip generation, distribution, vehicle size, and network utilization has been shown to be

empirically feasible with both aggregate and disaggregate data. This is the approach that is recommended for application.

Another important aspect of the problem is the need for classifying industries by type. Empirically, it has been demonstrated that different industries have very different patterns of urban truck trip generation and distribution. Table 1 indicates the average trip rate and trip length for a one-digit SIC classification of industries from an old study of the Boston Metropolitan Area. As can be seen in the Table, special consideration of the transportation industry is warranted due to its particularly high trip rates. Also, the rather short trip lengths measured for urban truck trips are a direct reflection of the fact that most intra-metropolitan truck trips occur in the context of multi-trip tours.

Each of the various aspects of trip generation, distribution, vehicle mode, and route are substantially complicated by the nature of freight transportation and the presence of trip chaining. Figure 1 illustrates a simple delivery problem and the various possible trip structures that could be chosen for delivering goods from a single depot to just four customers. It also shows the characteristics of the various possibilities.

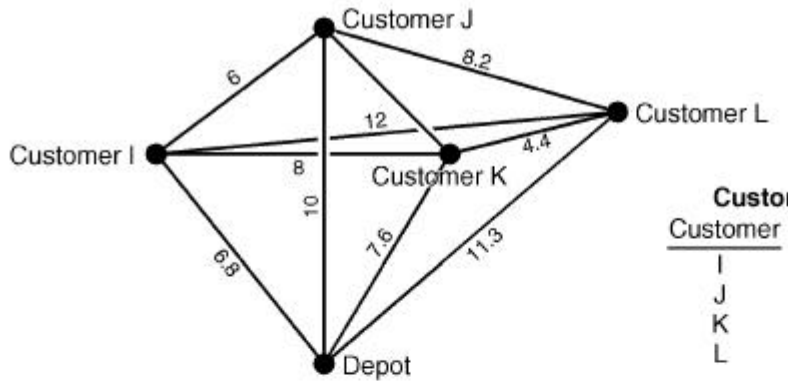
The choice of the best delivery pattern is clearly a function of the distance or time to be traveled. However, many other factors may be relevant. For example, capacity constraints and time windows on deliveries will substantially alter feasible solutions. Another important aspect of the problem is that as demand increases, the previous delivery solutions will no longer be feasible resulting in the need for a completely different solution.

TABLE 1: Industry Truck Trip Generation and Trip Lengths

	Trips/Employee	Average Trip Length (Min.)
Agriculture	3.3	N/A
Mining	6.5	N/A
Construction	1.2	14.35
Manufacturing	0.3	8.24
Transportation/Warehousing	2.1	9.72
Trade	1.3	7.86
Services	0.2	6.75
Government	0.4	7.68

FIGURE 1: Delivery Pattern Characteristics

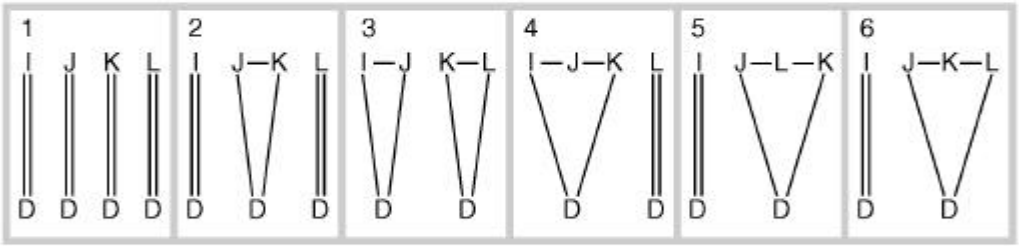
Delivery Problem



Customer Demands

Customer	Shipment Size
I	30
J	25
K	20
L	50

Some Alternative Trip/Tour Patterns



Trip Pattern Characteristics

Trip Pattern Alternative	# Tours	# Trips	# Trips/# Tours	Total Distance
1	4	8	2.0	71.4
2	3	7	2.3	58.9
3	2	6	3.0	46.1
4	2	6	3.0	48.1
5	2	6	3.0	43.8
6	2	6	3.0	44.4

From a modeling perspective, another difficulty is that the number of alternatives faced in choosing a delivery pattern is combinatorially explosive. For example, for a problem with 10 delivery destinations, there are 3×10^9 alternatives.

Transport pattern choice behavior is not just of theoretical interest. The empirical significance of trip chaining and disaggregation by industry is shown in the Table 2.

Clearly trip chaining is ubiquitous in urban areas. Therefore, a major objective in improving the modeling of urban truck trips is to incorporate tractable methods for dealing with the impact of trip chaining on trip generation, trip distribution, vehicle mode, and route assignment.

TABLE 2: Measures of Trip Chaining

	Trips/Vehicle	Tours/Vehicle	Trips/Tour
Agriculture	3.64	1.41	2.58
Mining	8.95	2.86	3.11
Construction	5.30	1.47	3.60
Manufacturing	17.35	1.84	9.41
Transportation/Warehousing	13.41	1.42	9.43
Trade	18.55	1.85	10.04
Services	43.16	4.28	10.08
Government	11.55	2.16	5.35

An Enhanced Approach

In the remainder of this paper, we outline an enhanced framework for modeling urban truck trips. In this approach, we will attempt to capture the salient characteristics of urban truck travel and treat trip chaining, industry characteristics, and vehicle size as explicit factors. In doing so we outline a quick response system that should be more accurate than the proposed quick response method. The method can also be implemented with local data for greater accuracy.

As currently envisioned there will be five separate major model components. A tour and trip generation model will be used to model productions and attractions of trips. Please note that properly handling trip chaining requires reformulation of trip generation models to include tours. There is also a need to treat import and export truck movements in a fashion that is integrated with intra-urban trips.

A destination choice model will be used to explain and predict the spatial distribution of trips. This involves consideration of how to model the arrangement of trips within tours.

A third component will be a model of vehicle supply by type. Prior research has shown that this is a critical element in trip generation and trip distribution. Given the vehicle supply, it may be most appropriate to generate trips by vehicle type directly as part of the first model component.

The final component envisioned in the model is that of a multimodal network assignment with possible extensions for trip chaining. While it is possible that the network assignment could be performed in passenger travel demand forecasting packages, a complete solution for urban freight will make it possible to run a network assignment for trucks and cars simultaneously.

Because of data impediments, we suggest a method for using traffic counts as part of the forecasting and validation process. There are new methods for estimating trip tables from traffic counts that can be used to derive truck trip tables. Special generators of truck traffic must also be identified and incorporated into the model.

Structuring the Model—Business Activity Segments

It is not surprising that truck trip generation and distribution differ significantly by industry. A practical compromise in modeling is to adopt a one digit SIC disaggregation of business activity. A further refinement is to treat truck and warehousing activities separately. To accomplish this, it is necessary to obtain employment data for business establishments or by zone for each industry group. Government and residential activities will also need to be represented in the model due to the large number of truck trips attracted.

A Multi-Equation Model of Trip and Tour Generation

A multi-equation model for trip and tour generation is described in great detail in Slavin (1979). In this model, there is one equation to explain the trips generated by industry e in zone i as a function of activity levels for industry e in zone i. Note however that these trips need not originate in zone i, rather many, if not most of these trips will connect zones i and j. In the proposed model, other causal determinants of tripmaking that may enter this equation include vehicle supply, accessibility, and the average maximum degree of trip chaining associated with industry e.

A second equation is utilized to calculate the number of tours generated by industry e in zone i which is determined by the trip frequency and the average maximum degree of trip chaining.

The trips generated by industry e and attracted to zone j depend upon activity levels in all segments in zone j with each activity having its own coefficient or weight. Trip attraction may also be influenced by accessibility or location and the mix of vehicle types utilized. From the total number of trips generated by an industry in all zones, the share attracted to any particular zone is modeled in a third equation.

Trip balancing is not necessary as trip productions and attractions will be identical for each industry insofar as only intrametropolitan trips are considered.

There are a variety of special econometric considerations to be taken into account in estimating the model which are discussed in the reference. Elasticities have also been derived for this model system which can facilitate empirical application. Note that the system described above was for an aggregate zonal system. However, an establishment level model could also be developed.

Vehicle Supply

Note that vehicle supply enters directly in the system described above. For forecasting purposes, vehicle supply can be modeled as a function of employment and other variables or projected from time series data. In the model system above, the more vehicles present, the greater the level of total tripmaking by trucks.

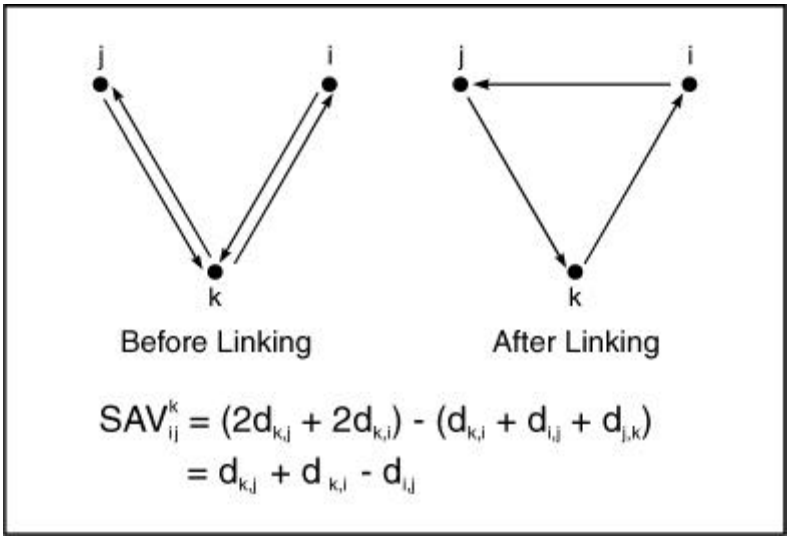
Trip Distribution

Trips are chained together on tours for efficiency in distribution. As shown in Figure 2, combining deliveries on the same tour results in savings from the cost of making deliveries separately. Indeed, the probability that deliveries are chained together is, in part, a function of the savings.

Modeling truck trip distribution is much more challenging than modeling trip distribution for work trips in that the assumption of independence of each trip is clearly unwarranted. Moreover, only destinations served by the same firm are actually considered for trip connections. As a result, many zones will not be included in the possible destinations for a firm's or an industry's trips.

These characteristics render the gravity model unsuitable for intraregional truck trip distribution models. In contrast, logit destination choice models can be utilized and the ability to restrict destination choice sets as a function of the origin zone or other factors can be exploited. Slavin(1979) estimated various experimental models of this type.

FIGURE 2: The Savings Function



Multi-class Traffic Assignment

Since the peaking characteristics of truck trips differ significantly from those of passenger cars, separate hourly truck factors or trip tables should be utilized. Hourly traffic counts by vehicle size should form the basis for the estimation method.

Hourly assignments are imperative as the effect of truck traffic on cars and vice versa cannot be captured properly with 24-hour or peak period assignments.

Multi-modal, multi-class assignments are recommended utilizing user equilibrium or stochastic user equilibrium methods. In these assignments, each vehicle class is restricted to the specific network links that are permitted to carry that type of traffic. Also, there are distinct cost functions for each vehicle class. For example, travel time savings are more valuable for trucks than for cars based upon the high labor rates typically paid to truck drivers. For traffic with obviously

predetermined routes, truck traffic can be preloaded. These types of assignments are available in TransCAD and some other planning software.

Considerations for Small and Medium Size Communities

In small and medium size areas, there will be more through traffic and internal-external/external-internal trips. Consequently, these trips will require more attention in counts and in the models.

Special generators also stand out more in small and medium size communities and should be reflected directly in the model. When resources are very limited, the recommended surveys could be gathered for a relatively small number of establishments including the important special generators.

Developing a good working relationship with trucking and distribution firms and their terminal managers can be an effective means of understanding the traffic associated with these activities.

Obtaining the Data

The best method of obtaining data for urban truck modeling is through a survey of firms. The most important information to obtain would be the SIC code for the firm, the number of employees, the number of trucks operated by type, the locations from which they are operated, and trip logs for each truck or a healthy sample of trucks for one or more sample days.

While surveys may be preferable, they will usually not be feasible. Therefore, alternative methods of data collection must be utilized. There are three main approaches that are workable. The first of these is observation or counting of trucks at specific locations such as manufacturing plants, retail stores, etc.

Estimates of employment can be obtained or purchased from a variety of sources. Employment estimates are included in some of the low-cost business directory CDs that are available. Vehicle registration data is available in many states and will give valuable information on the types of trucks registered and the registration location. Of course, many trucks are based at locations that are different from the registered address so corrections will need to be made.

Truck counts should be obtained at key locations on the network. Then, O-D table estimation techniques are a recommended means of deriving truck trip tables from traffic counts. There are many different methods available for this and future research will be needed to establish the most appropriate methods for estimating truck trip tables.

Trucks attracted may be gathered through observation if establishments cannot report this information or do not wish to cooperate with a survey effort. Truck activity is, for the most part, highly visible and can be quantified if sufficient resources are available for observation.

The network should be coded so as to reflect any truck restrictions that may apply. This would include both height and weight restrictions as well as formal exclusions. Also estimates of running speeds should be derived for each type of vehicle.

Every modeling effort should make use of some amount of local data, and planners should understand that similar firms in different metropolitan areas need not have similar trip generation characteristics. Therefore, quick response default values should be avoided if possible. If one must use defaults, the parameters should be determined based upon surveys in similar locations.

Use of GIS

The use of GIS has been shown to be valuable in supporting passenger travel demand models and should be just as useful if not more so for urban truck modeling.

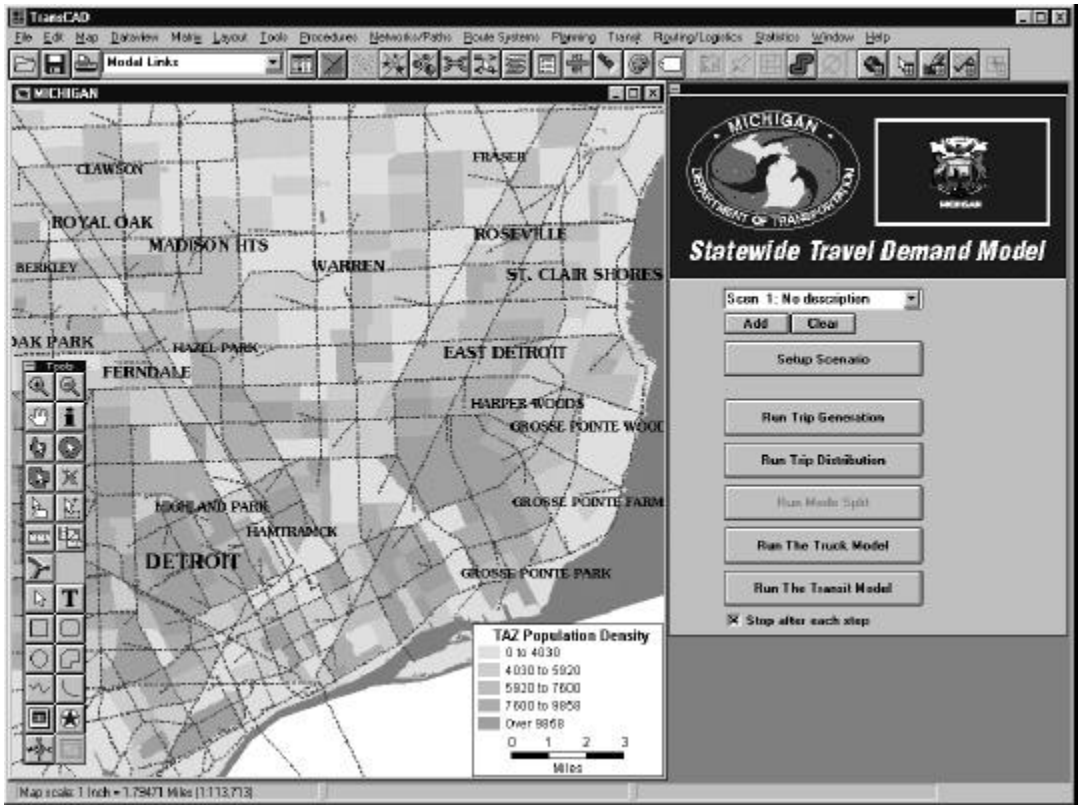
The most obvious uses for GIS are for data preparation and visualization of model output. GIS can be used to geocode business establishments and assemble economic data by TAZ. When there is survey data, the GIS can be used to plot the locations of respondents and show the spatial distribution of truck traffic. Another important use of GIS is to develop the truck network and store data on truck restrictions and counts.

The most subtle and in many respects most important application is the use of spatial disaggregation in the models. This takes the form of different equations for spatial subsets. The subsets need not be contiguous however, but should be determined based upon homogeneity of behavior and the resulting tripmaking characteristics.

With an advanced GIST, model management and application can be facilitated. This can be important in a system in which there are more than 30 equations to be applied. A scripting language is used to ensure that models are evaluated in the correct sequence for each scenario.

Another important use of GIS in an integrated GIST modeling system is to create a user interface for the models. An illustration of a simplified user interface for a model system that includes trucks in shown in Figure 3.

FIGURE 3



Directions for Future Research

There are quite obviously many important topics for research on modeling urban truck traffic. There is a need for both theoretical improvements in modeling trip chaining and many practical issues to resolve in implementing accurate forecasting tools.

Given the state of the practice, priority in research should be given to operationalizing practical solutions. In this regard, some direct experience with the proposed system will be obtained from implementing the model in TransCAD for the Las Vegas region as part of a modeling project for Clark County, Nevada.

Intrazonal tripmaking is so characteristic of goods movement in urban areas that it too warrants further consideration. Most planning models ignore or treat intrazonal trips simplistically; for trucks this may be not be acceptable.

Interregional freight analysis is an active area with new data becoming available from the Census of Transportation. Several statewide modeling projects have implemented freight models, including the Michigan DOT, and these efforts have some methods and data to share with urban freight initiatives.

Finally, there is a body of work on routing and scheduling algorithms and software that has insights to lend to urban freight modelers. It is important to consider how to utilize these methods in model design and implementation.

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Session #10

GIS and Transportation Planning

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ABSTRACT

Two main objectives of transportation planning are to simulate the current traffic volume and to forecast the future traffic volume on a transportation network. Traffic demand modeling typically consists of the following tasks (1) defining traffic analysis zones (TAZs) based on land-use characteristics, (2) building the transportation network, (3) collecting traffic data for calibration, and (4) performing the four-step traffic demand modeling process of trip generation, trip distribution, mode choice, and trip assignment. The first two tasks used to be time-consuming because paper maps and aerial photographs were the primary tools for constructing TAZs and the transportation network. In recent years, transportation planners have used geographic information systems (GIS) to perform the tasks. A GIS is a tool capturing, storing, and analyzing spatial or geo-referenced data. It also has the additional capability in data integration, such as integration of socioeconomic and traffic data for traffic demand modeling.

This paper describes our experience of using a GIS to prepare TAZs and the transportation network for an Idaho statewide traffic demand model. ARC/INFO is the GIS software package for our pilot study, Latah County. We have used ARC/INFO to construct TAZs from TIGER files at different spatial scales and to build the transportation network from different data sources. Using AML programs, we have run experiments to automatically assign TAZ centroids and centriod connectors, and to measure the effect of centroids and centroid connectors on traffic demand forecast. Overall, GIS has proved to be an efficient and effective tool for our study. It should be noted, however, GIS cannot by itself improve the quality of input data, a critical factor in transportation planning.

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GIS and Transportation Planning

Introduction

In recent years, efforts have been made to integrate the geographic information system (GIS) technology with transportation planning modeling. GIS has assisted in building the transportation network and traffic analysis zones (TAZs) (1, 2). GIS has made it easier to perform sub-area analysis and to modify the TAZ structure (3, 4). A number of transportation agencies have used GIS for network coding, socioeconomic data manipulation, and display of data from travel forecasting models (5, 6, 7, 8, 9, 10). The advantages and the ways of integrating GIS with traffic demand modeling have been studied by Anderson et al. (11), Anderson (3), Bailey and Lewis (1), Basile et al. (5), Lewis (12), Martin and McGuckin (13), Prastacos (14), and Sutton (15).

The literature suggests that GIS applications in transportation planning are primarily in the following three areas:

To prepare input data for traffic demand modeling

Input data for traffic demand modeling include a transportation network, TAZs, TAZ centroids, and centroid connectors. GIS can help build a transportation network from different data sources, such as road networks maintained by state or local transportation agencies and the TIGER files. TAZs usually follow available census data boundaries, such as census tracts, block groups, or blocks, so that data collected in the decennial census can be used with minimal manipulation. However, these census data boundaries are sometimes not well suited for analyzing proposed development sites. Tracts or blocks must then be split by community plan boundaries, zip code boundaries, and/or planned roadways. GIS can help create a TAZ map interactively or automatically by overlaying the necessary boundary files and performing query and analysis of socioeconomic and land use data. To connect the transportation network with TAZs, it needs centroids and centroid connectors. Again, GIS packages offer commands and macro programming capabilities that can automatically define centroids and centroid connectors.

To establish an integrated database

A GIS can be used to maintain and manage all map layers and their attribute data related to transportation planning as long as the map layers are geo-referenced. The database may include the transportation network and related traffic data, zonal boundary files such as census tracts and blocks and associated socioeconomic data, and other layers on land use, hydrography, soil, and elevation. Increasingly, image data, such as digital orthophotos and satellite images, are used in transportation planning. A GIS allows integration of data from different sources and different scales. It can also aggregate forecasted traffic data and produce cross-reference files between different levels of geography.

To Display Modeling Output

GIS is an excellent tool for displaying transportation data and model results. The graphic presentation is important for effectively communicating the results of a transportation model to

the public and elected officials. GIS's query capabilities make it possible to quickly respond to questions that arise during meetings, and to focus attention on affected areas.

Case Study

We are developing a statewide traffic demand model in Idaho. To help us design the model and to anticipate potential problems at the state level, we have conducted a pilot study using Latah County as the study area. We use ARC/INFO as the GIS software package and TRANPLAN as the traffic demand modeling package. In the following, we describe our work so far in linking GIS with transportation planning.

Traffic Analysis Zones (TAZs)

TAZs link travel with population, land use, and socioeconomic data. They represent geographic units that have similar land use activity characteristics. Traditionally, transportation planners have used land use maps and aerial photographs to define TAZs. The manual process is, however, time consuming. With the use of a GIS, preliminary TAZ boundaries can follow census statistical boundaries, such as block groups, census tracts, or counties.

In our study of Latah County, we used the GIS to first establish an integrated spatial database with boundary files of census tracts and block groups, and a land use map. The database enabled us to experiment with TAZs at either the census tract level or the block group level. It also allowed us to integrate spatial data, such as aggregating block group data to be used at the census tract level. We overlaid census block group files with the land use map and found that some census blocks were not homogeneous in land use. Those census blocks were split into two zones using the map overlay and editing capabilities of the GIS.

Transportation Network

A transportation network is a digital format of road centerlines. It consists of nodes and links. Nodes are intersections and critical turns and links are road segments between nodes. The digital file of a transportation network must also contain node coordinates and link characteristics such as speed limits, capacity, and functional classification. For our study, road centerlines were available from several data sources, such as the TIGER/Line files, the USGS Digital Line Graph (DLG) files, and data files from the Idaho Transportation Department (ITD). Link characteristics such as speed limit, capacity, and functional classification were available from ITD.

We decided to use MicroStation DGN road centerline files and the MACS\ROSE database, containing all link attribute information from ITD. Dynamic segmentation was performed in ARC/INFO to attach the link attributes with the coordinate file. Because ITD maintained rural road and city street files separately, we had to put all files together to create a single file in ARC/INFO. An Arc Micro Language (AML) program was written to prepare node coordinate and link attribute files in the format required by TRANPLAN.

Assignment of Centroids

A centroid represents the "center of activity" of a TAZ and is used as the specific location of the origin and destination for all trips to and from the TAZ. A centroid may be a city, a town, or a shopping center, depending on the spatial scale used in transportation planning. In practice, however, it is often difficult to define a centroid if the TAZ is large and contains more than one center of activity. Optionally, a centroid may be defined as a center of gravity or the geometric center of a TAZ.

This section describes our experiment of automatically assigning centroids using the center of gravity concept, i.e., how to assign centroids to TAZs at the census tract level by using the household data at the block group level. We used the City of Moscow as our study area. The equations for the center of gravity are as follows:

$$\bar{Y} = \frac{\sum_{i=1}^{n} yP}{\sum_{i=1}^{n} P}$$

$$\bar{X} = \frac{\sum_{i=1}^{n} xP}{\sum_{i=1}^{n} P}$$

In which:

$\bar{X}$ and $\bar{Y}$ are the x,y coordinates of the centroid,
x and y are the x,y coordinates of a point,
n is the number of points,
P is the value at the point.

Although it was possible to use the equations directly by assigning a point, such as the geometric center, to each of the block groups in Moscow, we decided to conduct the experiment in raster format for the following reasons. First, raster data analysis was more efficient than vector data analysis. Second, raster data analysis allowed cell by cell, neighborhood, and zonal functions, which were particularly suited for hierarchically structured spatial data such as census data. Third, raster data simulated a continuous surface and, as such, avoided the problems of area partition and weighting, common in vector data analysis with different spatial scales.

We chose a cell size of 100 x 100 meters. The initial steps in our algorithm involved the preparation of input grids. The household density grid was converted from the Moscow block group coverage using its household density attribute as the cell value. The X grid contained the X

value of each cell in the household density grid, and the Y grid contained the Y value. The fourth input grid, called the TAZ grid, was converted from the Moscow census tract coverage. The next phase in our algorithm performed analyses with the input grids. We multiplied the household density grid by the X grid and Y grid, respectively, to derive the XH and YH product grids. We then used the TAZ grid as the zone grid to sum the product grids and the household density grid for each zone, i.e., for each census tract. The X coordinate of the centroid was then calculated by dividing its zonal sum of the XH product grid by its zonal sum of the household density grid. The Y coordinate of the centroid was calculated in the same manner. The final steps in our algorithm prepared the centroid grid by setting all cells in the grid to no data except the centroid cell and converted the centroid grid to a point coverage. Figure 1 shows the centroids derived from our algorithm.

Assignment of Centroid Connectors

A connector attaches a centroid to the transportation network. It is usually treated as a dummy link, connecting the centroid to the closest point on the network in a straight line. The ARC/INFO command "NEAR" is used to identify the closest point on the closest link of the surrounding network to the centroid. Then the "GENERATE" command can create the centroid connector from both X, Y coordinates of the centroid and the closest identified point on the network. In our pilot study, we wrote an AML macro to automate the process of building centroid connectors.

Measuring the Effect of Centroids and Connectors on Traffic Demand Forecast

The primary purpose of our second experiment was to measure the effect of centroid location and number of centroid connectors on traffic demand forecast. As mentioned earlier, a centroid may represent a real object such as a city or a town, a center of gravity, or a geometric center. A centroid may be linked to a transportation network through a single connector or multiple connectors. Multiple connectors are preferred if a TAZ is served by more than one road in its vicinity.

We chose Latah County in Idaho for our experiment. We used 33 block groups as the TAZs. About half of the TAZs were located within the city limit of Moscow and the rest in the rural area of the county, see Figure 2. We prepared four data sets to represent four different scenarios with respect to centroid location and number of connectors. The first data set, or geocen1, consisted of centroids at the geometric centers of the TAZs and one connector per centroid. The second data set, or geocen2, was the same as the first except that a centroid could have two connectors, as long as two roads were present in the vicinity of the centroid and the closest point of the road to the centroid was within 8 km (5 mi). The third data set, or towncen1, used towns as centroids in rural TAZs as long as the town had a population of greater than 100. Nine such towns in rural areas of Latah County were chosen as centroids; they were combined with other geometric center centroids. The fourth data set, or towncen2, was the same as the third except that it allowed two connectors per centroid. The NEAR command was used directly in the case of one connector per centroid. We had to write an AML macro to generate two connectors per centroid. Essentially, the macro builds the first connector, drops the link to the first connector from the network, and finds the second connector among the remaining links. We also wrote AML macros for data

exchange between ARC/INFO and TRANPLAN, a software package for traffic demand modeling.

We ran TRANPLAN with one data set at a time to generate traffic demand forecasting for each scenario. The TRANPLAN output showed the estimated traffic volume for each link on the transportation network. The Latah County network had over 300 links. To measure the rate of change in estimated traffic volumes between different scenarios, we used the following root mean squared formula:

$$C = \left[\sqrt{\sum_{i=1}^{n} \left(\frac{T_{1i} - T_{2i}}{T_{1i}} \right)^2} \Big/ n \right] * 100$$

Where T_{1i} is the estimated traffic volume of a link under scenario 1; T_{2i} is the estimated traffic volume of the same link under scenario 2; and n is the number of sampled links. The *C* value measures the rate of change in traffic demand estimates when the model is changed from scenario 1 to scenario 2.

We selected 28 links from the Latah network for the preliminary data analysis. Fifteen of these links were located in the rural area; they were all near centroids and road intersections. The other 13 links were located within the city limit of Moscow; they were randomly selected.

Table 1 summarizes the *C* values from data analysis. The change from geocen1 to geocen2 resulted in a 4.2 percent change in the estimated traffic volumes of the 28 sample links. The rate of change increased to 8.1 percent from geocen1 to towncen1, and 8.7 percent from geocen1 to towncen2. The results suggest: (1) centroid location was a more important factor than number of connectors in traffic demand forecasting, and (2) the change in both factors such as in the case of towncen2 resulted in the largest change in the estimated traffic volumes of the sample links.

The second part of Table 1 shows that the use of nine town locations as centroids resulted in a 15.1 percent change in the estimated traffic volumes of the 15 rural links. The rate decreased to 9.2 percent in the case of two connectors per centroid. The third part of Table 1 shows that the effect of the change from one to two connectors was relatively small, and even smaller when town locations were used as centroids.

Table 1. Rates of change (%) in estimated traffic volumes of sample links between scenarios

Part	Sample (Links)	geocen1/ geocen2	geocen1/ towncen1	geocen1/ towncen2	geocen2/ towncen2	towncen1/ towncen2
I	28	4.2	8.1	8.7		
II	15 rural		15.1		9.2	
III	28	4.2				3.6

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Conclusion

We have described in this paper our experience in using a GIS to prepare a transportation network and TAZs as input to traffic demand modeling. We have also experimented with the automatic assignment of TAZ centroids and centroid connectors, and measured the effect of centroid location and number of centroid connectors on traffic demand estimates. GIS has proved to be an efficient and effective tool for our pilot study. However, we have realized at the same time that GIS cannot by itself improve the quality of input data, a critical factor in transportation planning. Our pilot study should help us in building a statewide traffic demand model.

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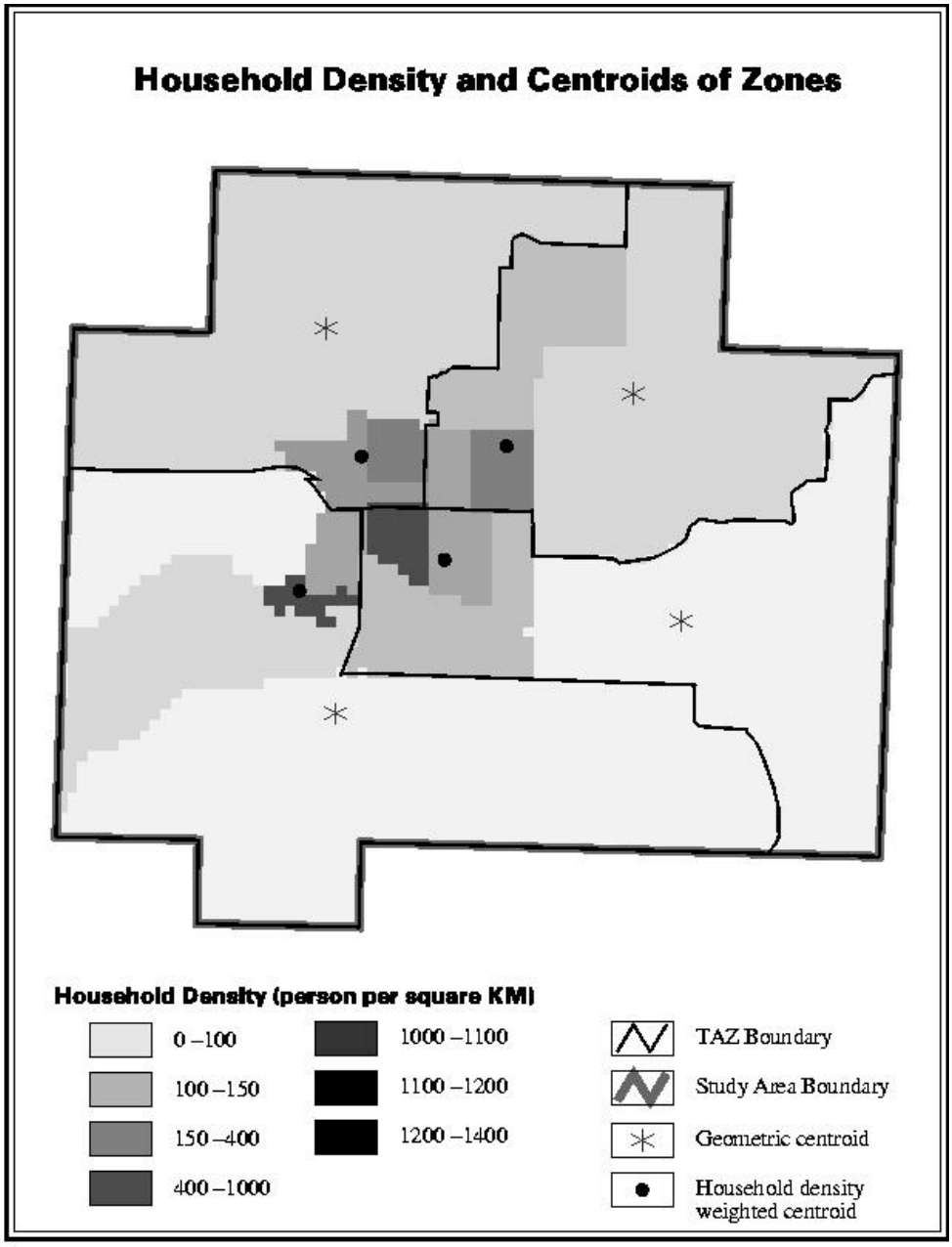

Figure 1 Household Density weighted centroids vs geometric centroids

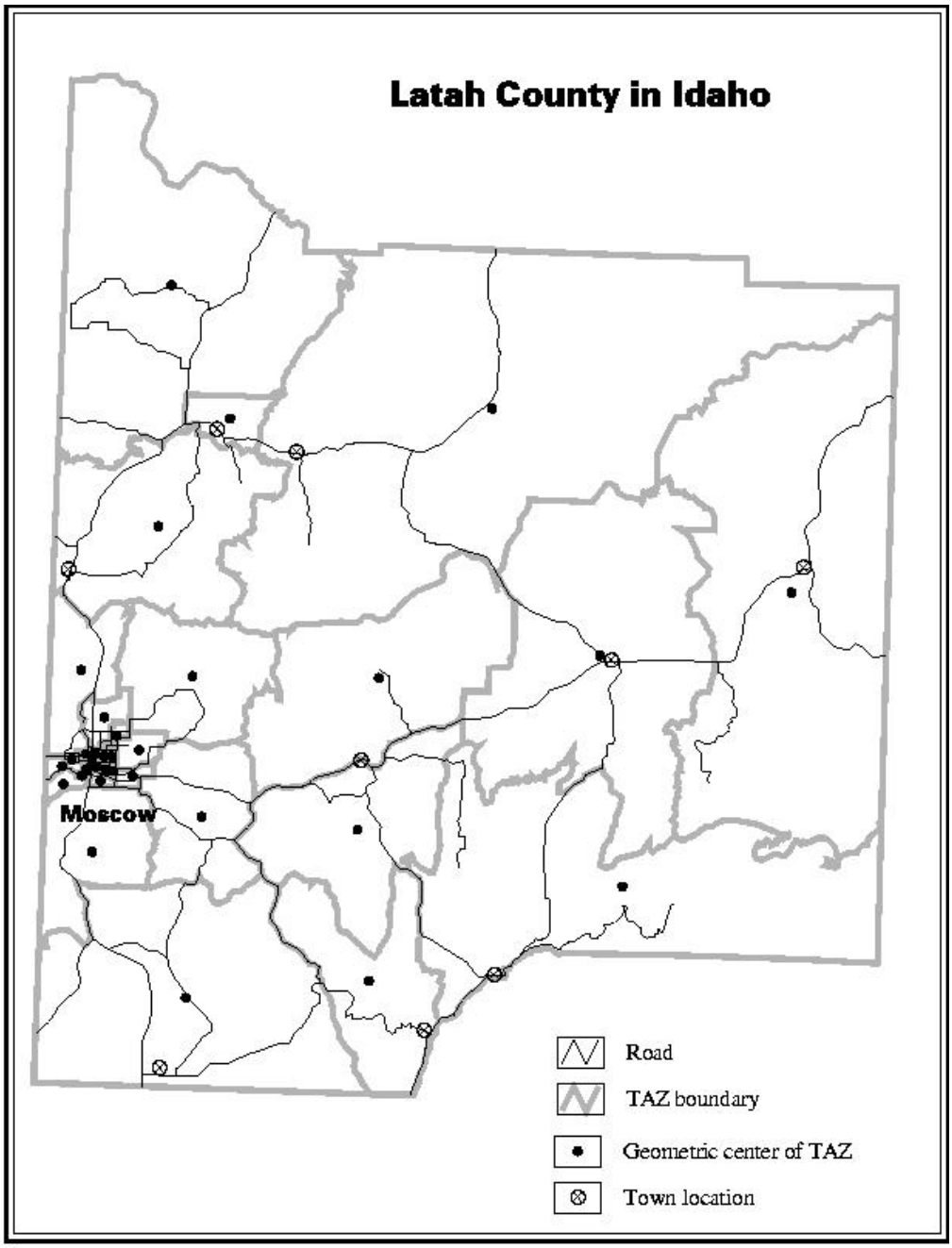

Figure 2 TAZs and centroids in Latah County traffic demand model

SESSION 12 - “TOOLTIME” FOR PLANNERS

Moderator: Kathy Briscoe
Minnesota Department of Transportation

Panelists: Kristie Billiar and Bob Works, Minnesota Department of Transportation
Marsha Anderson, STREET SMARTS, Georgia and Dr. David Hartgen, UNCC
Brian Roper, St. Cloud Area Planning Organization, Minnesota, and Chris Hiniker, Short Elliot Hendrickson
Joseph Kott, Marin County Community Development Agency, California, and Steve Beningo, FHWA
Gordon Rogers, Whatcom County Council of Governments, Washington

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Session #12

Citizen Transportation Planning:
A Working Model

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Abstract

All communities, regardless of their location or size, face the need to re-think and plan their transportation futures. Historically, many communities have left planning to outside sources; whether it was the district level of a state's transportation department or consultants. Each source has typically designed plans with little early input from the citizens of the community. This method, while accepted by tradition, has little opportunity for the informed community experience that allows for quality transportation decisions. One process, the Transportation Action Model, challenges the status quo of transportation planning.

The Transportation Action Model (TAM), initiated and designed by a national consortium led by the U.S. Department of Agriculture, was created with two guiding principles. First, sound transportation systems and the decisions behind them are critical to the social and economic well being of communities. Second, informed community participation creates better transportation decisions. By marrying technical information with a citizen-driven decision process, the TAM helps communities produce their own blueprint for local action. In twenty-one weeks, with a minimum of twenty-five participants from a broad range of transportation stakeholders and citizens, a community can become an active voice in their transportation future.

Two rural communities in Minnesota, Two Harbors and Nisswa, challenged themselves and their planning histories by using the Transportation Action Model. Both communities, each with unique transportation histories and development sought this model as a way to deal with existing congestion impacts and future development pressures. Through public dialogue each community could frame local transportation issues and develop potential solutions to create a Transportation Action Plan that will assist the formal transportation plans and decisions of the future.

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The Transportation Action Model

Transportation shapes and defines how we relate to and experience our communities and all communities, regardless of their location or size. Most communities face the need to re-think and plan their transportation and, subsequently, their community's future. Favoring one mode over another or failing to plan for an integrated accessible transportation network can drastically alter a community's livability or its ability to sustain its economic future. The impacts of not planning or not having an informed public process can be seen everywhere, but the effects are most immediate and obvious in smaller communities.
Prior to ISTEA, many communities left planning to experts and whether it was the district level of a state's transportation department or consultants, each designed plans with little input from the citizens of the community. Citizens rarely had a chance to voice ideas or concerns until a final public hearing in which their input had a minimal effect on the outcome of a transportation decision. This method, while accepted by tradition, has little opportunity for the informed community participation that allows for quality transportation decisions, which reflect the needs and interests of a community. One process, the Transportation Action Model, challenges the status quo of transportation planning.

In 1991, the U.S. Department of Agriculture initiated a national consortium to design the Transportation Action Model (TAM). Recognizing the impact of transportation decisions on rural localities and the potential of ISTEA, TAM was created with two guiding principles. First, sound transportation systems and the decisions behind them are critical to the social and economic well being of communities. Second, informed community participation creates better transportation decisions.

By uniting technical information with a citizen-driven decision process, the Transportation Action Model helps communities produce their own blueprint for local action. In twenty-one weeks, with a minimum of twenty-five participants from a broad range of transportation stakeholders and citizens, a community can become an active voice in their transportation future. The twenty-one week process is divided into twelve steps called the Action Planning Process. Each step is designed to engage citizens and stakeholders in learning about their transportation systems.

For discussion purposes the steps of the action planning process can be grouped into four main parts: community selection and commitment, orientation and background, solutions and strategies, and plan development.

Community selection and commitment comprise the first three steps of the Transportation Action Model. These organizational steps include finding a sponsoring committee, identifying and inviting the transportation stakeholders to the TAM process and securing a facilitator.

Steps four through six are focused on orienting a community to the TAM process and their own transportation system. During these four weeks two of the community meetings are held. The first meeting is an orientation meeting at which the TAM process and expectations are reviewed and citizens are introduced to the transportation funding process and the history of their community's development. At the close of this meeting the technical committee and the public

involvement committees are formed. The purpose of these committees, respectively, is to gather technical information and keep the public informed of TAM proceedings and upcoming meetings. During the second meeting (A Look at Today's Transportation System), the community reviews their existing transportation system and demographic trends and plans. From the information that is acquired at the first two meetings a community's transportation system begins to exist within a context. With this base citizens generate a list of potential transportation issues that they would like to address. Through a nominal selection, three issues are then determined and issue committees are formed to work on each topic.

For steps seven through ten, citizens in their issue groups, begin to define potential solutions and strategies for their transportation issues. Preliminary ideas are brought to the third community meeting for suggestions and revisions. During the third meeting citizens also have the opportunity to vision what their future transportation system will look like. At the fourth and final meeting the issue groups will present their refined strategies to the community and the technical committee. During this time the technical committee will act as a review panel and make additional suggestions to the issue committees to improve their recommendations.

Plan development begins at the close of the fourth meeting with the formation of an Action Plan Committee. This group will be responsible for putting closure on the TAM process by writing the Action Plan and presenting it to the appropriate government entities. There should also be someone on this group who will track the progress of the Action Plan once it has been completed.

During 1997 and 1998 the Minnesota Department of Transportation (Mn/DOT) worked with the communities of Two Harbors and Nisswa to implement the TAM process. Both communities, each with unique transportation histories and development, sought this model as a way to deal with existing congestion, safety and future development pressures. Through public dialogue, each community framed local transportation issues and developed potential solutions to create a Transportation Action Plan that will assist the formal transportation plans and decisions of the future.

The first community is Two Harbors, Minnesota. Located on Lake Superior's North Shore, Two Harbors was founded on an economy based in shipping, forestry and mining. As the reserves diminish mining, shipping and forestry take a less central role and the Two Harbors economy now includes more light industry and services. Many of the residents now work in nearby Duluth or cater to the tourist traffic that frequents the North Shore. While Two Harbors has been slow to develop as a tourist destination, they are impacted by the growing recreational traffic headed to points further north.

The community selection and commitment phase was begun in August of 1997 by the Two Harbors' city planner and administrator. When Two Harbors approached Mn/DOT, initial concerns were centered on topics that had been discussed for years and had many grassroots groups behind them. The issues encompassed a potential extension of Scenic Highway 61 into the downtown area and projects relating to the overlay of Trunk Highway 61(7th Street). Concerns specific to Trunk Highway 61 included improving traffic flow and creating a more cohesive look for the east/west corridor. Highway 61 has begun to follow a pattern of strip development, as it

becomes the center of Two Harbors' commercial development. The influx of tourist traffic on summer weekends has caused extreme congestion on T.H. 61, which also serves as their "main" street[1]. During peak traffic times it is difficult for North/South vehicular traffic and virtually impossible for bicycles and pedestrians to move from one side of town to the other.

To prepare for the TAM Mn/DOT hired a facilitator from the Arrowhead Regional Development Commission. The individual selected is a transportation planner who has a knowledge base of Two Harbors from previous work with the community. From the concerns noted by the city planner a key set of transportation stakeholders was determined to be the landowners and business owners along Seventh St. and those committed to downtown revitalization. A broad public notice in the paper was made about the TAM, but no special mailings or contact was made to reach stakeholders mentioned.

The orientation meeting was held in January, five months after Mn/DOT was first contacted by the city. While the commitment to do the TAM was secured in the amount of time recommended by the model, the starting time was delayed by the approaching holiday season and other activities in the town. At the first meeting attendance was lower than anticipated and the agenda was deviated from slightly. Rather than grounding the meeting in information about the town's history and development which would have demanded more citizen involvement, most of the evening was spent on the transportation system as it currently exists and the issue of transportation funding and how it related to the county and state.

In the second meeting more ownership was taken by the citizens though a series of presentations. One of the most compelling presentations was a citizen's adaptation of the slide show exercise in which areas of transportation concern are photographed. By creating a five minute video that was narrated with a series of open-ended questions, the participants saw their transportation environment and concerns in an understandable framework that provided an effective point of discussion. While, the video provided a useful tool that assisted the citizens in identifying their transportation issues, issue selection was stifled by a predetermined set of suggested issues. Attendance was up for this meeting due in large part to a more aggressive approach taken by the public involvement committee to obtain broader participation. This was accomplished by creating a flyer that was distributed in church bulletins. The flyer listed a series of potential transportation issues that could be discussed, many of which already had focused constituencies behind them.

Issue selection in Two Harbors was driven by two distinct forces. First, as mentioned earlier, many of the issues that face the town have been in the public forum for as many as ten years and have been discussed at length without resolution. Second, in an effort to give the TAM process focus and distinction from other planning processes, it was decided to create flyers that had a list of potential issues that might be discussed. Citizens were not discouraged from bringing in new

[1]Two Harbors commercial main street was originally 2nd Street which is closer to the harbor. As the town became more automobile oriented development shifted to Highway 61 and has followed the "strip" development mentioned. Today several buildings on 2nd Street and in downtown are vacant and it is possible to go through Two Harbors and not even see much of the town or Lake Superior.

issues that they felt might be of importance, but there is a sense an opportunity for broader participation was missed by recommending topics. The issues that were selected suggest that the participant pool may have been limited since three of the four selected were on the flyer. The issues selected were: the extension of Scenic 61, Trunk Highway 61, the Trails System and Through Streets and the Segog Neighborhood on the Northeast side of Two Harbors.

The third segment of the process, solutions and strategies, created the most unique part of the Two Harbors' experience. Meetings three and four were the most productive of the meetings, due in large part to how the issue groups were handled. The model works under the assumption that the issue groups are autonomous and will meet twice with little formal guidance. Two Harbors had the issue groups meet on four separate occasions with facilitators for each issue. Using this method, the strategies that the citizens brought to the large group meetings were far more detailed and complete than they would have been otherwise. There was a tradeoff for following this method. While the strategies brought forth were detailed they were not refined with any sort of visioning that would typically happen in meeting three, leaving some issues looking out only five years rather than the long range of fifteen to twenty years.

The fourth meeting, in which the citizens' finalized strategies are presented to a technical panel of transportation officials and citizens, ran closer to the model. Of the four issues three reached resolution at this meeting. The fourth issue, the extension of Scenic Highway 61, proved to be too large, from both a technical and political standpoint, to deal with that evening. A fifth meeting was held three weeks later following the format of the fourth. This method allowed the issue committee to voice concerns about a lack of technical information on potential routes for Scenic 61 and political developments from TEA-21 that made the extension of Scenic 61 a demonstration project with $800,000 in funding. Resolution on the Scenic 61 issue rested in the determination that more information was needed before a final decision could be made. A recommendation was made to conduct an engineering study that would rough out potential extension routes.

The writing of the final plan was handled by the facilitator from the Arrowhead Regional Development Commission with information drawn from the minutes of the issue groups. A draft version of the plan was presented to the participants for comment before the final plan was written. The plan was presented to the City Planning Commission in May. In June the City Council made a resolution to adopt the Action Plan into the city's comprehensive plan bringing the TAM process to an official close..

The second community of Nisswa, with a population of approximately 1,400 is located in central Minnesota and traces its roots to the logging industry. As the timber industry moved to more profitable locations, Nisswa, like Two Harbors, moved to a service economy based on tourism. In recent years Nisswa has seen a slight growth in their population and an explosion in tourism that is fueled by the lakes that surround Nisswa and the construction of the multi-use recreational, Paul Bunyan Trail that was built parallel to Main Street on an abandoned railroad grade. Summer use of the trail is currently estimated at 200,000 people and that number is expected to double in the next two to three years.

Initiation of the TAM was handled by Nisswa's Mayor and the City Council. In December of 1997 the Mayor called a special council meeting with the TAM as the only agenda item. Citizens in attendance had been contacted by a special mailing. It was decided that evening, by a citizen vote, to start the TAM in January of 1998. To prepare for the TAM, Mn/DOT hired a facilitator from the local area University of Minnesota's Extension Service, and two of Nisswa's citizens began developing a presentation of Nisswa's transportation history.

Like Two Harbors, Nisswa's decision to become involved in the TAM was the result of long-standing transportation concerns that were being exacerbated by growth. In Nisswa, safety was the cornerstone of their issues when they began. Trunk Highway 371 is intersected by Nisswa's County Road 18 (Main Street) at an obtuse angle and traffic movement from one to the other is hindered by an obstructed view. This intersection has been the sight of numerous fatalities and that number is anticipated to climb as traffic increases. Additionally the connection of 18 to 371 has created an ambiguous entryway into the town making clear traffic patterns almost nonexistent for all modes during the height of the tourist season. Another concern was planning for the potential turnback of County Road 18 to the city of Nisswa when County Road 18 is rerouted The town also wanted to increase the amenities provided for the bicyclists that use the trail.

The Orientation Meeting was held in January, one month after their decision to do the TAM. The meeting closely followed the prescribed agenda, setting the tone that would continue in the other meetings. The historical development presentation provided a common ground that everyone, citizens and transportation officials alike could refer to. The presentation of transportation financial workings, while necessary, proved to be overly technical.

The second meeting focused on the demographic trends and the selection of transportation issues. The demographic presentation revealed that population in Nisswa would grow by ten to eighteen percent by the year 2001, and traffic on County Road 18(Main Street) would expand by seventy percent by 2013. With this context the issues were determined to be Re-Routing of County Road 18 to eliminate congestion on Main Street, Improving Safety at the Intersection of Main Street and Highway 371, Improving Parking and Pedestrian Traffic Flow. From the issues that were generated and selected, it was clear that the citizens of Nisswa had more ownership in the information and issues than the citizens in Two Harbors. This was evident in the strategies and solutions that the citizens developed.

At the third meeting, citizens presented their draft strategies and worked on the visioning exercises. Few recommendations were made to the plans presented; but, by the end of this meeting, there was a clearer sense of how issues and their solutions related to the future vision of Nisswa. This connection was evident when issue committees met again on their own and the time lines developed began to have both long-term and short-term components.

During the fourth meeting the final strategies and solutions were presented to the community and technical panel. Of the three issues only two were brought to resolution that evening: parking and pedestrian issues and the rerouting of County Road 18. The third issue, the intersection of Highway 371 and County Road 18, would need to be addressed at a later meeting to clarify technical and financial issues.

The fifth and final meeting of the TAM occurred two weeks later. The Technical Panel was reconvened, and the solution that had been presented was reviewed. The main concern was finding a solution that would address the immediate safety needs of the intersection without negatively impacting Nisswa's long range goal of rerouting County Road 18 and closing the existing intersection. The engineering that will improve the intersection is fairly straightforward and could be programmed into the construction schedule in the next two seasons. The issue is with funding. The county, which is strapped for funding will likely delay a rerouting of 18 if they feel that the fix of the intersection is adequate, particularly if they must participate in covering the cost of the project. The goal is to recognize the short term issue with a solution that meets safety concerns and is fiscally responsible. The final determination was to realign the east/west segment of County Road 18 with Highway 371 at a right angle. Further studies will be conducted to determine if a traffic light is needed.

Nisswa's action plan was authored by city staff with consistent input from one to two members from each issue committee. The draft was presented to the community in July and the final was completed in August. The Action Plan has already been adopted by the city, and presentation to the county by the Mayor of Nisswa has been made.

Nisswa and Two Harbors represent only the second and third times that Mn/DOT has conducted the TAM and many valuable lessons were learned from their experiences and their outcomes. Throughout both TAM processes several strengths, weaknesses and potential improvements were highlighted. Some of these observations follow.

The first lesson is that the TAM is highly flexible. Both towns made changes in how the model would be carried out. Neither town utilized the optional visioning exercises that the model prescribes, and Two Harbors handled the issue committees with a higher level of structure than the model deems necessary. All of these changes reflected the needs and temperaments of the town and largely strengthened the experience. There will always be pros and cons in deviations that are made; but if the basic components of open public input and creating a positive learning environment are maintained, the TAM will meet its intended goals.

One aspect of the TAM that does not work well with change is the time line. The TAM was created to be a quick-paced learning environment with a definite conclusion. In each town we experienced alterations of the time line that diminished the quality of the process. In Nisswa there was concern that the public involvement meetings be completed before the beginning of the tourist season. The twenty-one week time line was condensed by two weeks, but there is simply too much information to absorb for it to be handled effectively in less time. In Two Harbors we learned the importance of momentum to the success of the TAM once the process has been committed to. The five month span from discussion to implementation was somewhat causal in the slow start in January. This time gap was not aided by the fact that a positive article for the upcoming TAM process was run in October, a full three months before the process began.

One additional note on time. Both towns needed a fifth meeting. This is one time alteration that we fully expect to make and are now including in our presentations to towns interested in doing

the TAM. In our limited experience we are finding that there is always an issue that is so ingrained in a community that the decisions that will be made will have an impact well beyond the asphalt elements and deserves the time of an additional meeting if necessary and desired.

The second, and most important lesson, that we have learned from our experiences in Nisswa and Two Harbors is the importance of the Technical and Public Involvement Committees. The role of each committee is defined, but it is possible for each committee to languish without proper support and direction. In each TAM the role that these two groups play becomes clearer.

In the area of technical support, transportation officials, along with citizens, make up the Technical Committee and are responsible for gathering and conveying technical information as recommended by the model and as demanded by the process in a given town. In this capacity Mn/DOT has been only moderately effective. Citizens in both communities expressed concern that basic information and who is responsible for it is often unclear. In terms of delivering special services, especially design services, Mn/DOT has been an invaluable resource. Utilizing these tools citizens have been able to see their ideas in a preliminary form that generates and opens discussion.

In the area of public involvement citizens create the entire committee, and we found that this is a task that has the potential to be forgotten, especially as TAM moves further along. The role of the public involvement group needs to be kept in the forefront to keep the community aware of what is occurring at the TAM meeting. Maintaining a high level of awareness on the progress of the TAM allows citizens the opportunity to comment as the process proceeds. In each TAM this group has taken a more proactive role as result of the expectations being made clear at the beginning of the TAM process and assistance is provided.

In future TAMs there are potential solutions that may be used to aid the citizens in utilizing and serving on these two committees. First, develop a contact list that clearly indicates who the members of the technical and public involvement committees are and their area of expertise. Second, prepare a simplification of how transportation funding works and how it relates to the community. In both cases citizens did not feel this information was accessible, and a potentially valuable tool was left unused. Third, develop a press kit that will walk the members of the public involvement committee through what they need to do and when.

The third lesson is the importance of a neutral facilitator. When Mn/DOT introduced the TAM, we began with the ground rule that the process would not be facilitated by a Mn/DOT employee or someone who is a transportation stakeholder in the community. By not having a government entity facilitating the TAM many suspicions that the government is here to “help” are immediately diffused and citizens feel free to participate. In both towns the importance of the objectivity provided by a facilitator was confirmed. Neither facilitator had a specific stake in the town, and that allowed for open discussion on issues that, at various points in the towns’ history, had been rather contentious.

The fourth lesson of the TAM is the strength that it has to bring city, county and state levels of government into a cooperative planning process. All of these entities have worked with one

another in the past on a project by project basis but not always in a long-range planning capacity. This resource is an invaluable opportunity for citizens. The TAM provides the opportunity for a community to see its transportation system from variety of perspectives; modal, historically and politically.

The fifth and final lesson is cost. The TAM was designed in such a way that a community could conduct a TAM on a relatively small budget with the facilitator comprising the largest cost. Currently, Mn/DOT covers the cost of facilitation with no local contribution and it is Mn/DOT's goal to keep that cost at approximately six thousand dollars. To date we have been successful in keeping to budget however, as we look to private parties for facilitation we are expecting that cost to increase slightly. The other cost of the TAM has not been formally tracked, but is no less important, the cost of time for the local staff to participate. From the time that the process is initiated to the plan's formal adoption a town can expect to spend up to two thousand dollars in staff time and should take the availability of their staff into account when deciding to participate in the TAM.

As a process the TAM is showing promising signs of success. In both towns the participants indicated that it was one of the most positive public involvement experiences they had participated in. Citizens felt that they had an opportunity to be heard and make decisions about their town's transportation future. Also, many came away feeling that they had learned a good deal about their towns and transportation in general.

In both cases the ultimate measure of the Transportation Action Model's success, the implementation of recommendations, is not yet apparent. Many of the recommendations that were made were on State and County projects which will not be programmed for another two to three years. There is encouraging evidence that the Action Plans will be used. In Nisswa before the first draft of the plan was even completed they had acted on one of their recommendations--the expansion of parking: and, at the time of this writing, a total of twenty-five new spaces had been striped.

As TAM moves forward it will have several growth issues that Mn/DOT will need to address. One immediate issue that faces the future of the TAM is finding enough facilitators and fiscal resources to conduct the TAM. Four more TAMs are scheduled in the next year, and there is interest for double that number. The TAM, while a relatively short process, is time consuming while going on and the quasi-government agencies that we have used in the past may not be able to accommodate the demand. For the next series of TAMs, Mn/DOT is looking to private industry for facilitators.

In conclusion, Mn/DOT is satisfied with the initial success of the TAM and optimistic about its future. Mn/DOT's Districts and Central Office alike have found it to be a useful method to interact with their communities in an innovative non-confrontational manner. As the TAM process is refined, we will be looking at expanding it to a sustainable planning base. The participants in the TAM have already indicated that there logical links between this process and the discussion of sustainability. Another potential for the TAM would be a closer alignment with existing formal transportation planning methods such as the State Transportation Improvement

Plan.

Session # 12

Innovative Data Collections to Analyze North Carolina's Airport Activities

By

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ABSTRACT

The North Carolina Department of Transportation, Airport Division, contracted with the University of North Carolina, Charlotte (UNCC) and Street Smarts to collect origin-destination (O-D) data at all 14 North Carolina airports. UNCC was responsible for the project management and data analysis. Street Smarts was charged with the task of collecting the data.

When it comes to data collection of any kind, public officials care most about one thing, "How can we get the most useable data for the money we have budgeted?" It is a reasonable question that needs an innovative answer. There are really three elements in that question that demand attention: quality of data, quantity of data, and cost of getting that information. The North Carolina Airport O-D study was an exercise in achieving an optimal balance of all three.

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PROJECT SCOPE

A crucial step in satisfying a public agency is defining a clear scope up front that is beneficial to all parties. For data collection, the scope is as large as the budget allows. The negotiating process is familiar to anyone in the public or private sector:

- The client has a number of records needed to address statistical validity requirements
- The data collection company gives a price for that quantity under a certain set of assumptions
- The client revises its number to reduce the cost and still maintain confidence in the ultimate results
- The data collector revises its price under the same set of assumptions
- The client can't reduce its cost and either 1) walks away from the project thinking there is no way to get the analysis done, or 2) hires someone who will work for the money and risk getting sub-par data, or 3) helps develop a new methodology for collecting the data
- The data collector either 1) walks away thinking there is no profit in the job, or 2) becomes more efficient, creative and innovative in its methodology
- Assuming both work together to reach a solution, the project proceeds using the new methodology.

This type of negotiation could apply to just about any public/private job. In the case of the North Carolina Airport Study, the data collectors (Street Smarts) already had the experience of working with new technology to obtain more information at a substantially reduced cost.

The Airport Division wanted to determine in what manner and for what reason people were traveling by air throughout North Carolina. An airport O-D study is the most common way of determining this information. However, it was felt that a meaningful study would require interviews at all 14 commercial airports in the state over 4 seasons of a year which ended up being 87 days of surveying. The airport planners who would eventually use the information set a target minimum of 6,500 records.

To put this figure into perspective, some agencies have paid up to $150 per record for this type of information. *Source: SBIR Final Report, produced by Street Smarts for FHWA, July 1997.*

The common method for collecting Airport O-D information is to:

1. Position interviewers at the airport departure and arrival gates
2. Interview passengers in the waiting area or baggage claim area
3. Record the responses on pre-made form
4. Code the responses into a database at the home office
5. Spot check the data entry
6. Clean up responses and delete "bad" records

It became clear early on that some things would have to be different from the "common" methodology.

PLANNING FOR THE STUDY

Survey "Form"

NCDOT Airport Division and UNCC were charged with developing the questionnaire which would be used in the passenger interviews. The length of the survey form is a factor in the number of records that can be obtained. Every question adds a little more time to the survey and reduces the number of passengers who can be interviewed.

The questions generally followed national guidelines used by USDOT and the FAA for origin-destination studies. However, there were also questions pertaining specifically to North Carolina and its visitors. A response to a question might branch to another set of questions before continuing. And, every survey would have to have the name of the airport, the airline surveyed, and a date/time stamp.

Figure 1 shows the survey, as it would appear on paper. However, a paper form was not the preferred method of collecting the data.

Figure 1. NC Airport Survey Questionnaire

1. How did you arrive into the airport today?
- ❑ Transfer from other flight city
- ❑ Flew here (arriving flight)
- ❑ Drove self
- ❑ Given a ride
- ❑ Public transit
- ❑ Taxi/Limo
- ❑ Shuttle service
- ❑ Rental car
- ❑ Other
- ❑ Don't know

2a. Which airport did you start you trip from? *Arriving passengers only!*

_____

2b. If you came by private car, was the vehicle…
- ❑ Not parked, but driven away
- ❑ Parked at meter
- ❑ Parked in an airport parking lot
- ❑ Parked in a commercial lot

3. What type of place was your starting location?
- ❑ Your workplace
- ❑ Other workplace/business
- ❑ Your home
- ❑ Other home
- ❑ Hotel/motel
- ❑ Other

4. What is your starting location?

City/County _____
Zip _____
Intersection _____
_____
Address Num: _____
Street: _____

5. What is the purpose of this trip?
- ❑ Business
- ❑ Commute to/from work
- ❑ Visit friend/relative
- ❑ Personal activities
- ❑ Recreation/vacation
- ❑ Other

6. Which airport will you end your trip?

_____

7. What type of place is your ending location?
- ❑ Your workplace
- ❑ Other workplace
- ❑ Your home
- ❑ Other home

8. How many people are in your group?

_____

9. How often do you make this round trip between these two place?

<1/year	1-2/week
1/year	3-4/week
2/year	5+/week
3-5/year	Other
6-12/year	Don't know
1-3/month	

10. How will you get to your final location from the airport?
- ❑ Driving self
- ❑ Getting a ride
- ❑ Public transit
- ❑ Taxi/limo
- ❑ Shuttle service
- ❑ Rental car
- ❑ Don't know
- ❑ Other

11. What improvements would you like to see:

_____

12. If you are a visitor, what are your daily average expenditures at this location?

- ❑ $1-50
- ❑ $51-150
- ❑ $151-200
- ❑ $200+

13. Gender
- ❑ Male
- ❑ Female

14. Age Category

<18	18-20	21-30
31-40	41-50	51-60
>60		

15. How many people live in your household?

_____

16. What is the total before tax income of your household (in $1,000's)?

<$20	$20-39	$40-59
$60-79	$80-99	$100-119
$120-139	$140+	

Survey Instrument/Tool

Based on research done by Street Smarts for the USDOT, Federal Highway Administration, a handheld, pen-based computer was the preferred survey instrument.

A pen computer is light enough to be carried around all day. Most small pen-based computers are under 2 pounds. The one employed in the North Carolina O-D study was 20 ounces. The computer is powered by three AA batteries. The small battery power means lightweight and a streamlined CPU.

Some handheld computers are not pen-based. They are small notebook computers in a clam shell design, with a small keyboard. That design makes it uncomfortable to see and hold in one hand all day. Most pen-based computers have just a screen, a few hot key buttons and use a pen for all entry.

The computer is programmed with the same questions as the paper form with additional intelligence. The major difference in the recording of responses is the computer guides the surveyor through the interview. The order of the questions is laid out for the surveyor.

The automatic time stamping of records was found to be a great advantage. The automatic time stamping allowed the user to concentrate fully on the interviewee.

The program has intelligence built into it so it "knows" what to do after a particular response. In the North Carolina Airport Study, if a respondent arrived at the airport via personal automobile, the next questions pertained to where the vehicle was parked. Obviously, if the person came by taxi, his/her vehicle was not parked at the airport. This type of branching is easily accomplished using the computer but can be difficult to train using a paper form. (For an example of a confusing, paper-form branching scheme, refer to any IRS tax form.)

A computer can also check the data that are entered before the interviewee walks away. The most common error in paper-form surveys is incomplete records. There is nothing that requires a surveyor to complete an entire form or specific "minimum" required fields. The Airport O-D survey requires four fields to be entered before a record can be considered "complete" and then saved.

Logic checking data entry is impractical and virtually impossible using a paper method. The Airport O-D Survey checks for logic errors such as no like starting and ending locations. Had it been necessary to the client, cities and zip codes could have been checked against one another. Other pen-based, data collection programs have more logic checking needs than the Airport O-D survey.

The most cost-saving feature of computer, field-data entry is the storage of responses in an electronic database at the time the data is collected. This greatly reduces post-processing and speeds up analysis. In the Airport O-D survey, all records were written to

a .dbf file and sent to the client. The analyst had to lookup zip codes for some long entry fields; but, other than that, he/she was able to start the analysis.

In addition to the time saving, automatic entry eliminates coding errors from duplication of data. The data is already in electronic form and does not require another processing step that often introduces error. This improves accuracy in analytical or automated processing.

The computers were usually found to be easy to use. A computer like one shown in Figure 2 was used to collect the data in the North Carolina Airport Study.

Figure 2. Survey Instruments

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Survey Schedules

One of the most difficult challenges faced in the North Carolina Airport study was conformity to the schedule dictated by UNCC. Through a random generator process and a required number of surveys at each airport, the number of days and specific days of the week were fixed. That is, interviews would be collected in Asheville on a Thursday and Sunday during the Fall, a Monday and Tuesday in the Winter, and only a Friday in the Spring. The challenge was to make the most efficient use of the surveyor by moving from one airport on one side of the state to a different airport the next day.

The problem: how to manage 23-25 trained surveyors, in 14 cities with variable days, over an 7 or 8 day period, with 20 pen-based computers? The easy solution would have to be fly everywhere. However, the budget didn't allow for such an easy solution. In fact, the budget didn't allow for full-time employees to perform the surveying; college students had to be used. One added complication was the availability of the students: e.g., Joe could work on Tuesdays, Thursdays and all weekends except the 2nd weekend in February.

Each surveyor had to be trained. Each one had to have hotel accommodations. Some surveyors needed plane flights; some needed car rentals; some had other special needs. Supervisors had to be trained and assigned to a group of surveyors for quality, good public relations, and problem solving.

Specific destination cities were determined by UNCC and were based on a random generator corresponding to a flight frequency. That is, a Tuesday in Charlotte might include four flights to New York City, three to Atlanta, one to Spartanburg, SC, one to Anchorage, AK, etc. This threw yet another kink in an already messy chain.

It either takes a sophisticated computer program to perform the necessary scheduling with all the previously discussed constraints, or, a lot of costly man-hours. The reality of origin-destination surveys is that there are fixed costs which are not accounted for in a purely per record cost. Half the number of records is not half the cost.

CONDUCTING THE SURVEY

Once actually in the field and surveying, the interviews were quite easy. The pen-based computer tool made collecting the data simple. The computer flowed through the questions, prompting interviewers for the next question, recording responses with little or no typing and generating interest from other [potential] interviewees.

Approaching Interviewees

Approaching a passenger is not always an easy task. All people naturally gravitate to those they are most comfortable being around. But that type of attraction can create a bias in the results. Therefore, it was necessary to instruct all surveyors to make an effort to approach all types of people. For example, if Joe is single and likes to talk to women, Joe would

have to force himself to talk to men. Similarly, Ahmed is Islamic and is culturally uncomfortable speaking to women; he, too, must avoid bias and talk to some women. The supervisor monitored potential sources of bias and took steps to correct them.

Introduction

Passengers were approached in departure/arrival gates and at baggage claim areas and asked something like: "Hi! I'm doing a study for the North Carolina Department of Transportation. How did you get to this airport today?" [the first survey question] The credibility is established from the start – North Carolina Department of Transportation. And, this is not a survey; it's a study! Also note, the passenger is not asked if he/she wants to participate; the study just begins.

It is important to note, all surveyors had special permission from airport management to conduct the interviews. All surveyors wore badges with their name in large letters and NCDOT, UNCC and Street Smarts in plain view. At the Charlotte-Douglas Airport, the surveyor had to don badges issued by the airport with his/her picture on the badge.

Interview

The questions are shown in the paper version of the form in Figure 1. Some questions were harder to ask than others. For example, no one liked asking Household Income because many passengers did not like answering the question. And while it is humorous to talk about, answering the Gender question by observation was not always straightforward.

NCDOT and UNCC defined a minimum acceptable set of questions which would constitute a "complete" record. Those were 1) How did you get to this airport today? 2) Where did you come from [City and Zip]? 3) What is your purpose for traveling? 4) What is your final airport city? These questions could be asked very quickly if a passenger was about to board a flight or arrived on a flight and was headed out the door. Observed responses such as gender, age, group size, and possibly others could be coded once the passenger left the interview area.

Entry

Data entry on pen-based computers is most efficient if all acceptable responses are present on the computer form. One tap of a pen marks an entry and one can continue. However, there are "long entry" fields which require creative programming of the survey instrument in order to make entry fast and accurate.

In the Airport O-D Survey, all origins and destinations are cities. Respondents who arrive at an airport via ground transportation had to supply additional location information. A zip code, intersection, or place name was sufficient. These responses required some time to code.

To lessen the coding time on long entry fields, intelligent pick lists were created. For the ground transportation origin city, all cities and counties in North Carolina were sorted and indexed. The user simply had to start "typing" the first letters of the name and four cities starting with those letters appeared in a pick list. The same algorithms are used in most on-line help screens on personal computers; but instead of subject, cities are the pick items.

The requirements of the study only required zip code entry. In fact, if the zip code was known, no other information was necessary for analysis. However, in order to logic check the records, city and zip were required of the surveyors. If a city was known but not the zip (as in the case of a traveling salesman), the surveyor would "type" the name of a place (hotel, convention center, resort, etc.) and general location. Intersections or other place names were acceptable. Due to the vast number of streets in the state, it was decided not to provide a pick list of streets.

As stated previously, there were a minimum number of fields that constituted a complete record. The program would not let a record be saved without these fields. All of the fields could have been required and then programmed as such.

LESSONS LEARNED FROM THE SURVEY METHODOLOGY

An origin-destination study of the magnitude of the North Carolina Airport study has its challenges; a lot was learned.

Random Cities Hurt The Way Data Can Be Collected

The scope of the project was set with the assumption that surveys could be conducted at cities based on their geographic proximity to one another. The randomness of cities constrained the way data could be collected. The scheduling was more difficult, more costly, and much less efficient.

Students

Another lesson that is not too unfamiliar to the data collection community is that students are economical and smart but their schedules are difficult to work around. Over 50 students were trained to conduct the study and fewer than ten worked more than four days during the four seasons of the project. Classes, projects, homework, exams, and personal activities had to be accommodated.

Supply and Demand

At the small airports, the number of records depends more on supply of passengers than on the speed of interviews. The expectations of the NC DOT and UNCC were based on the ability to continually collect records like at the larger airports. The number of records statistically needed at the small airports required more survey days in order to interview more passengers.

Smile When You Say That

A positive, friendly attitude really helped. Surveyors found that passengers were much more receptive to those types of people. While this is not a major revelation, it is an important reminder.

Session # 12

PLANS, TRAINS, AND AUTOMOBILES: BIG RIVER CROSSING ISSUES IN A SMALL COMMUNITY

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ABSTRACT

As transportation system elements of this country continue to evolve, issues that may have seemed foregone to a prior generation have crystallized into topics requiring substantive review. Witness, for example, the resurgence of both freight railroad and non-motorized traffic concerns. This trend is particularly noticeable in smaller metropolitan areas. The challenge for today's transportation professionals is to systematically identify and incorporate these broad issues into a meaningful project-specific context. This paper addresses cross-cutting topics associated with the replacement of a regional Mississippi River crossing along the Great River Road. The breadth and depth of issues define the ease with which transportation problems can be solved. In the St. Cloud, Minnesota, metropolitan area, the Sauk Rapids bridge replacement has generated a myriad of these issues. When applied to a river crossing replacement of metropolitan significance, broad-based representation from the community (defined as residents, business owners, elected officials, and transportation professionals) is essential. Engaging and educating this cohort has ultimately fostered consent in the selection of the preferred replacement alternative.

Since the structural condition of the existing bridge warrants replacement, consideration of alternatives has commenced. The presence of a railroad mainline on one of the existing bridge approaches broadened the scope of potential replacements to encompass grade-separation. The practicality of applying computer tools such as MicroBENCOST, TRAF-NETSIM, and TranPlan to monetize the user benefits associated with eliminating the current at-grade crossing is evaluated. This paper also discusses the paradigm shift among area planners regarding alternative transportation modes. The existing structure is two lanes wide, with little accommodation for non-motorized transportation. On the replacement, however, these other modes will be encouraged through the provision of enhanced bicycle and pedestrian capacity. The paper summarizes the qualitative and quantitative attributes of the alternatives and reports on the outcome of the engineering feasibility study and environmental assessment.

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PLANS, TRAINS, AND AUTOMOBILES: BIG RIVER CROSSING ISSUES IN A SMALL COMMUNITY

INTRODUCTION

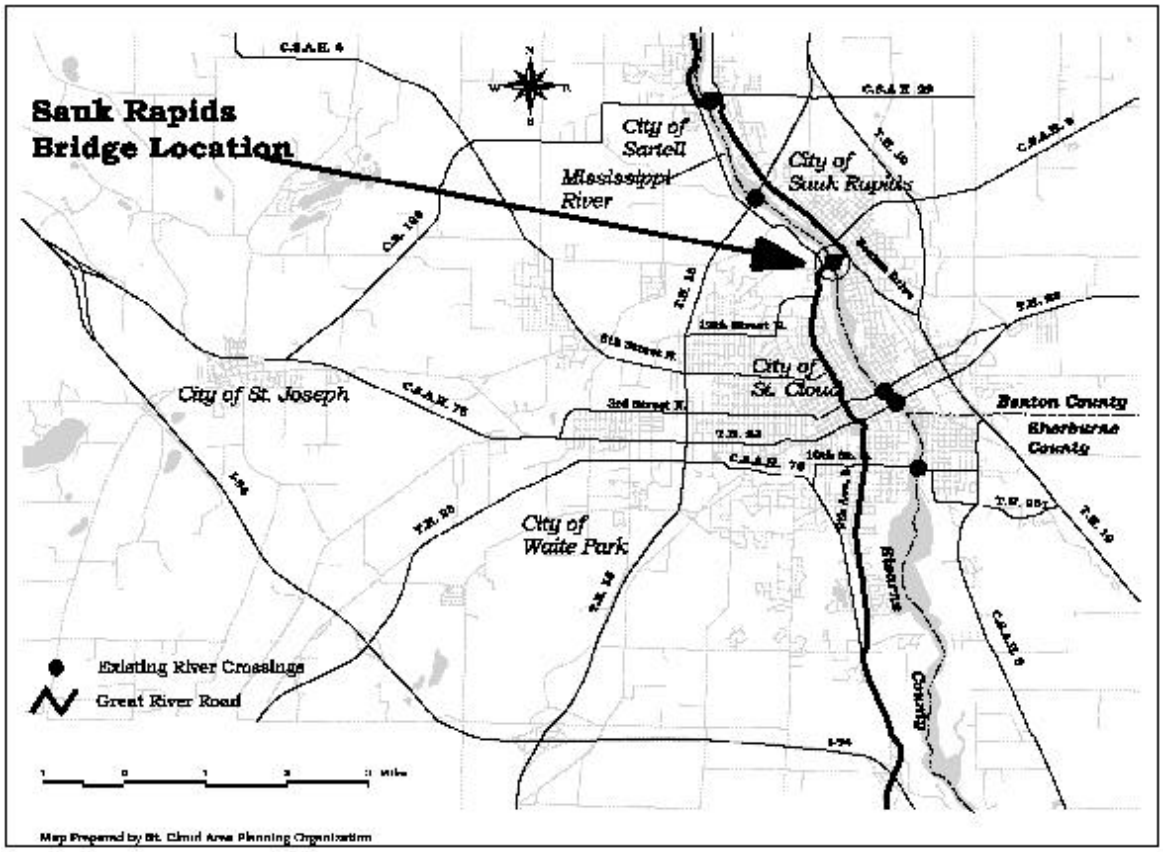
As transportation system elements of this country continue to evolve, issues that may have seemed foregone to a prior generation have crystallized into topics requiring substantive review. Witness, for example, the resurgence of both freight railroad and non-motorized traffic concerns. This trend is particularly noticeable in smaller metropolitan areas. The challenge for today's transportation professionals is to systematically identify and incorporate these broad issues into a meaningful project-specific context. This paper addresses cross-cutting topics associated with the replacement of a regional Mississippi River crossing along the Great River Road.

The breadth and depth of issues define the ease with which transportation problems can be solved. The St. Cloud, Minnesota, metropolitan area is located 70 miles northwest of Minneapolis-St. Paul. In this small community, the Sauk Rapids bridge replacement has generated a myriad of these issues. When applied to a river crossing replacement of metropolitan significance, broad-based representation from the community (defined as residents, business owners, elected officials, and transportation professionals) is essential. Engaging and educating this cohort has ultimately fostered consent in the selection of the preferred replacement alternative.

PROJECT BACKGROUND

First constructed in 1878, the Sauk Rapids bridge crashed into the Mississippi River when an ice jam uprooted its foundations. Rebuilt in 1879-80, it withstood storms and ice until 1896 when a tornado loosened a span, causing considerable damage. The third bridge was built in 1900, but was labeled inadequate prior to the Second World War. In 1947, a new two-lane bridge and approach roadway was constructed (Figure 1). This marked the first significant change to the approaches since the first bridge was built.

The replacement of other St. Cloud metro area Mississippi River bridges over the last 25 years has been accompanied by significant changes in horizontal and/or vertical alignment. In the early 1970s, the western approach for a replacement in downtown St. Cloud shifted a block north. A decade later, the replacement bridge location and its connecting roadways in the City of Sartell were altered to facilitate grade separation. At the same time, a replacement bridge on the south side of St. Cloud cut off several intersecting roadways. Given the historic context of bridge replacement in the St. Cloud metro area, similar changes for the Sauk Rapids location would not be unprecedented.



BIG RIVER CROSSING ISSUES

The study undertaken to identify a preferred alternative for replacing the existing Sauk Rapids bridge was framed by a broad set of design, operational, social, economic, and environmental issues. When considered in total, these issues represented a rather unique and challenging setting. The process for identifying the major project issues that played a large part in defining the course of the study is detailed below.

Issues Identification

The metropolitan planning organization for the St. Cloud Metropolitan Area initiated the identification of issues in 1995. At that time, the Sauk Rapids bridge was about to be turned back to Benton and Stearns Counties from the Minnesota Department of Transportation. The following spring, the MPO convened a task force with representatives from those agencies and the Cities of St. Cloud and Sauk Rapids. At the beginning of each meeting, the engineers muttered the mantra "It's okay to dream, but you have to build it when you wake up". These meetings resulted in a preliminary list of issues of concern. During the project development process, this list was refined to reflect additional information, agency responses, and citizen input.

Plans

Land Use

Development plans from the past have defined the setting within which the project is being undertaken. Existing land uses within the study area are a key force for driving the need for a new bridge. In addition, these uses define many of the issues which a solution needs to consider and satisfy.

Land use around the Sauk Rapids bridge is markedly different between the east and west sides of the Mississippi River. On the east side, the commercial/retail development of downtown Sauk Rapids is the dominant feature. The area contains millions of dollars of investment from the Sauk Rapids Housing and Redevelopment Authority and from the private sector. As a result, any potential right-of-way acquisition will come at a significantly higher cost. In addition to right-of-way costs, the proposed roadway changes need to avoid significant adverse impacts on access to and from the existing business community. City parkland provides a further constraint at the east approach to the bridge. Park property surrounds the existing approach roadway to the north and south.

On the west side of the river, development is primarily residential, with exception of the strip mall. The residential property owners along the west bank of the river near the bridge have historically been active regarding transportation issues in the area. Involving both the business owners on the east side of the river and the residents on the west side of the river has been an essential component in developing a preferred alternative for the river crossing.

Alternative Modes

Providing provisions for alternative transportation modes is another key planning aspect of the project. The existing bridge provides only a four-foot raised sidewalk for alternative travel modes including pedestrians and bicyclists. The limited pedestrian and bicyclist facilities on the bridge restricts effective and safe linkages between the trail systems which have been established on both sides of the Mississippi River. Transit service has also been impacted by the current bridge. Ten years ago, fixed route service was removed from the crossing because of unmanageable congestion at the bridge and the adjacent railroad grade crossing.

A paradigm shift has occurred among area planners regarding alternative transportation modes since the passage of ISTEA. Integrating both pedestrian/bicyclist and transit modal considerations into the preferred river crossing alternative has been important in attaining community consensus as well as federal funding support. Consequently, incorporation of these enhancements into the design concepts for the bridge has been accomplished with little fanfare.

Great River Road

The Sauk Rapids Mississippi River crossing is part of the federally designated route for the Great River Road. In the future, this route also has the potential for becoming designated as a federal All-American Route or a national Scenic Byway. The Great River Road has been established to provide a scenic, historic, and recreational roadway along the Mississippi River. Consequently, improvements

undertaken as a part of this project will need to be carefully designed to complement the Great River Road experience.

Trains

Railroad Traffic

The mainline corridor of the Burlington Northern Santa Fe (BNSF) railroad, which is the highest speed and highest volume rail corridor in Minnesota, serves as a national conduit for intermodal, freight, coal, and agricultural products. Growth in intermodal shipments and coal demand over the past twenty years have contributed to increasing levels of railroad traffic on the BNSF mainline, which runs parallel to the Mississippi River through the project area immediately adjacent to downtown Sauk Rapids. Since our nation's Bicentennial in 1976, maximum train traffic has risen from 25 to 60 trains per day. Forecasts in the mid 1970s had predicted that 45 trains per day would use the BNSF mainline by 1990, with that number stabilizing and potentially declining by the year 2000. During the project development process, the public was skeptical of the existing and forecasted train values.

Additional growth in railroad traffic is limited by the lack of two continuous mainline tracks between Minneapolis and Fargo, North Dakota. BNSF has indicated that this bottleneck will be eliminated in the near future. As a result of building their way out of railroad congestion, a marked increase to 80 trains per day is certainly possible. The 21st century will usher in other strategies for increasing throughput, such as advanced railroad signaling systems.

Railroad Grade Separation

The presence of the BNSF mainline has been affecting bridge and roadway design in the St. Cloud metro area for over 40 years. When a new state highway alignment was constructed through the metro area in the 1950s, a roadway underpass was included three blocks east of the Mississippi River to eliminate conflicts with railroad traffic. During the mid-1970s, a series of studies focused on the impacts of the railroad and offered potential grade-separation strategies for coping with roadway service disruption at heavily traveled crossings. Over the past two decades, two grade-separated alternatives were chosen for bridging both the river and BNSF mainline. In both of these projects, a longer, more costly bridge was used.

Mn/DOT estimates the "exposure" at Minnesota's 5,100 railroad crossings by multiplying the average daily traffic times the number of daily trains. The exposure at the BNSF railroad and roadway interface adjacent to the Sauk Rapids bridge (1,200,000), which is the highest in the state, has increased by nearly 500 percent in the past 20 years. Currently, 40 percent of the vehicles crossing the BNSF mainline at-grade in the St. Cloud metro area use the Sauk Rapids bridge crossing. When taken with forecasted vehicular traffic, the Sauk Rapids bridge crossing could have an exposure of 3,200,000 by the Year 2020, an increase of 166 percent. This will have a

tremendous impact on both safety and congestion. Thus, the presence of the Sauk Rapids bridge railroad crossing required broadening the scope of potential replacements to encompass grade-separation.

Automobiles

Structural Condition

Recent inspections of the bridge conducted by the Minnesota Department of Transportation (Mn/DOT) have concluded that the structural condition warrants replacement within the next eight years. An important factor in this determination is the presence of fracture critical structural members. With a sufficiency rating low enough to trigger structurally deficient status, this Mississippi River crossing has also been identified as the area bridge in greatest need of repair or replacement. Thus, the need to expediently pursue a preferred replacement alternative was clear.

Roadway Traffic

Growth in the St. Cloud metro area over the past twenty years has contributed to increasing levels of traffic on area roadways. These effects are witnessed most at bottlenecks formed by rivers and/or railroads. In the mid 1970s, approximately 10,000 vehicles per day crossed the Sauk Rapids bridge. Less than 20 years later, volumes had more than doubled to 23,000 vehicles per day. Despite the opening of the Minnesota Highway 15 bridge two miles upstream of the Sauk Rapids bridge in 1995, minimal traffic diversion has resulted in volumes of 20,000 vehicles per day on the latter. With a doubling to 40,000 vehicles per day forecasted for the Year 2020, a Sauk Rapids bridge replacement would need four through lanes.

PROJECT DEVELOPMENT PROCESS

An ambitious project development schedule was established to facilitate the implementation of this critical transportation project. This first step in the process includes the engineering feasibility study and environmental assessment. These efforts are scheduled for completion in the winter of 1998. Construction is scheduled to begin in the spring of 2001, with bridge opening anticipated for the fall of 2002.

Engineering Feasibility Study

An engineering feasibility study was begun in May 1997. The focus of the study was on the challenges of crossing the river and the railroad while addressing the four objectives outline above. Conducted in two steps, the definition of alternatives fueled creativity while deferring detailed consideration of impacts.

Universe of Alternatives

The first step considered the universe of options for crossing the Mississippi River and/or the railroad tracks at a very conceptual level. The initial screen focused on the physical feasibility of placing the

alternatives in the built environment. Alternatives were screened out because they were unable to achieve minimum design standards. It was necessary to conduct and document this conceptual level screening analysis to avoid consideration of inappropriate alternatives at a later date.

Refined Set of Alternatives

The second screen involved a more detailed evaluation of screened alternatives based on identified evaluation criteria. The detailed evaluation was based on an assessment of the benefits, costs, and impacts of each alternative. Of the multitude of grade-separated alternatives generated in the first step, seven of them were deemed worthy of further consideration. Three of these alternatives, which would bridge over a minor arterial running parallel to the BNSF mainline, had few redeeming qualities and were cast into the ashbin of history. From the remaining four alternatives, two distinctly different grade-separated options were chosen to join the at-grade and no-build options in the environmental assessment. Although the grade-separated alternatives included temporary railroad track construction adjacent to the mainline, this feature was not fully defined until the environmental assessment phase.

Environmental Assessment

After agreement from the involved jurisdictions on the field of alternatives, the environmental assessment was initiated. Further review of social, environmental, and economic impacts, coupled with more refined engineering analysis, yielded a wealth of information on impacts. Of particular concern were the right-of-way acquisitions necessary in Sauk Rapids to accommodate the temporary railroad track. Given the perspectives of the different stakeholders, consensus could not be reached on a preferred alternative. A spirit of acrimony was beginning to take hold as policy boards ratified mutually exclusive recommendations on the alternatives. Ultimately, the consensus committee (described in the next section) renewed consideration of alternatives previously screened out of the process.

SMALL COMMUNITY INVOLVEMENT

A comprehensive community involvement program was developed at the onset of the feasibility study to ensure that the perspectives of all stakeholders were represented in the process. At the core of the program was the Oversight Committee, which included staff from Mn/DOT, Benton and Stearns Counties, the cities of Sauk Rapids and St. Cloud, the St. Cloud Area Planning Organization (MPO), the Sauk Rapids business community, and residences on both sides of the river. This group was effective and efficient in providing both technical guidance and community perspective.

One function not fulfilled by the Oversight Committee was direct communication among elected officials. Ultimately, a Consensus Committee composed of both staff and elected officials from those same agencies replaced the Oversight Committee. This group returned to the beginning of

the project development process and proceeded forward, occasionally reviving previously discarded alternatives. This mixture ultimately reached consensus (hence the name) on a preferred alternative.

There were several other key components of the community involvement program. Four public information meetings were held at critical stages of the process. A cordial relationship was pursued with the newspaper and radio outlets to ensure that the project information was being received and understood. In addition, numerous presentations were made to local civic and citizen groups. Other innovative approaches toward public outreach including meeting announcements on changeable message signs located along the Mississippi River bridge approach roads. Together, these outreach efforts resulted in broad-based community representation and input on what has been recognized as a uniquely difficult regional transportation problem.

TOOLTIME IMPLEMENTATION

TranPlan

The MPO's travel demand model was applied to develop forecasts for the universe of alternatives during the engineering feasibility study. Since the variations among the alternatives were small when considered at a macroscopic level, the resultant traffic forecasts were similar. Incorporating travel time penalties for the at-grade crossing was not considered, since this practice was inconsistent with other locations within the model.

TRAF-NETSIM

This microscopic traffic model was used in an attempt to simulate the impact of the railroad at the at-grade crossing and adjacent signal. Unfortunately, the program is not sophisticated enough to simulate pre-emption at crossings. In addition, it became difficult to simulate long trains. Thus, this tool had limited usefulness in estimating user impacts.

Micro-BENCOST

During the alternatives evaluation process, some concern was raised relative to the financial justification for considering the more expensive grade-separation alternatives. To monetize the user benefits associated with eliminating the at-grade crossing, the economic analysis software package Micro-BENCOST was used. Of greatest importance when considering railroad grade crossing issues were railroad operation values such as train distribution, length, and speed. With the assistance of the BNSF, this data was collected and summarized in a meaningful fashion.

Downtown Business Survey

This tool was used by the local Chamber of Commerce because some members were concerned that business impacts were not being adequately addressed during the environmental process. With questions ranging from open-ended opinions to estimates of the potential for lost revenues and employees, the survey garnered a 50 percent response rate. The subsequent reaction from the elected officials questioned the credibility and objectivity of the results. Thus, this tool had limited

effectiveness.

LESSONS LEARNED

As seen in this paper, addressing big river crossing issues in a small community requires more than just mindless rhetoric and black box evaluation. Indeed, modernization of this regional Mississippi River crossing in Sauk Rapids, Minnesota, has been undertaken with a consideration of diverse and complex issues. Presenting these issues in an effective manner requires engagement of a broad cross-section of concerned stakeholders to ensure that the cross-cutting issues do not place the transportation professional in the crossfire. Most assuredly, the preferred alternative in the case of the Sauk Rapids bridge replacement will result by achieving some level of mutually attained consent. From this experience, four key lessons have been learned:

1) *Engage Public in Issues Dialogue* – Using information meetings, civic and citizens groups, and the media, this activity will foster understanding and good will.

2) *Assemble Consensus Committee First* – With a cross-section of elected officials and technical staff from affected jurisdictions, this group can communicate ideas and positions directly and effectively in a non-threatening manner.

3) *Define Railroad Profile Impacts* – Given the required distances and offsets for constructing temporary railroad tracks, the alignment of any potential changes should be developed and reviewed prior to advancing alternatives into an environmental analysis.
4) *Apply Software Tools Appropriately* – Identification of potential applications should be accompanied by a review of each tool's capabilities to ensure a positive correlation between the desire for meaningful output and the ability to produce it.

ACKNOWLEDGMENTS

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Session #12:

INTELLIGENT TRANSPORTATION SYSTEMS EARLY DEPLOYMENT PLANNING FOR A SMALL REGION

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ABSTRACT

Strategic planning for intelligent transportation systems (ITS) in smaller metropolitan areas presents a number of difficulties. Transportation problems such as high levels of traffic congestion and complex operational challenges in both traffic and transit management often create interest in high tech solutions in large metropolitan areas. Such solutions are typically not viable in the nation's less populated regions, as solutions devised in Atlanta, Houston, Seattle and Phoenix usually do not apply to problems in places like Portland, Maine. Moreover, awareness of and experience with the use of electronics and communications systems among transportation system operators is often more limited in a small metropolitan region like Portland, Maine than in a major metropolitan center. This paper and presentation describes the successful ITS early deployment strategic planning process developed for the Portland region. This process began with assembly of relevant stakeholders, attention to raising stakeholders' awareness of ITS capabilities, costs, and benefits; development of a framework based on regional goals for evaluating ITS applications; preparation and ranking by stakeholders of a program of ITS projects; and completion of a report of findings and recommendations to regional, state, and federal decision-makers.

While not populous, the Portland, Maine region is a promising setting for ITS deployment. Portland is a multimodal environment for both passenger and freight movement. Passengers are served by one local and one international ferry operator, four local and two intercity bus companies, and a busy regional airport. Planning is also underway for the restoration of passenger rail service from Boston to Portland. Freight operations included containerized and bulk shipping services at the port. Rail and truck operations take place both portside and inland. The region is served by the Maine Turnpike, which has recently deployed electronic tolling, the state's first major ITS deployment. In addition, the region has a manageable number of agencies and decision-makers.

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INTELLIGENT TRANSPORTATION SYSTEMS EARLY DEPLOYMENT PLANNING FOR A SMALL REGION [DRAFT]

Introduction

A few years ago, advanced transportation technologies known as Intelligent Transportation Systems (ITS) were thought to be solely the concern of large metropolitan areas. This is no longer the case. There are many ITS technologies that can be used by small and medium sized communities to improve traffic flow, transit operations, and travel information dissemination. This paper looks at how one medium sized area, the Portland, Maine Metropolitan Area, utilized an Early Deployment Planning (EDP) Program to determine which ITS technologies would be appropriate for their region.

1. Early Deployment Planning Program

a) Early Program History

The Early Deployment Planning Program came about as a result of the passage of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). Section 6055(b) of ISTEA authorized the Federal Highway Administration (FHWA) to "make grants to State and local governments for feasibility and planning studies for development and implementation of intelligent vehicle-highway systems." This grant program became known as the Early Deployment Planning (EDP) program, and became an important part of the US Department of Transportation's Intelligent Transportation Systems initiative.

The EDP Program originally focused on the 75 most populous metropolitan areas, and well as 30 major intercity corridors. By March 1996, 66 EDP studies had been completed or were underway.

b) Portland Decides to Apply for Program

On March 11, 1996, the FHWA published a call for metropolitan areas to apply for Early Deployment Planning grants. The Federal Register notice stated the EDP Program is designed to assist metropolitan areas to develop an ITS strategic deployment plan that would:

1) *Identify and document applicable ITS user services,*
2) *Establish system performance criteria,*
3) *Assess the functions and requirements of the system,*
4) *Identify and evaluate potential technologies on the basis of performance, compatibility, flexibility, and cost,*
5) *Assess potential funding and implementation options, including use of private sector resources, and*
6) *Identify time frames for implementation.*

Applicants for the EDP program were required to submit an application demonstrating that the

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officials in the metropolitan area had an understanding of local needs, a commitment to good transportation management, a cooperative relationship between agencies, and a general understanding of the type of ITS user services which will address local needs. At the urging of the Maine Division of the Federal Highway Administration, the Greater Portland Council of Governments decided to apply for an EDP grant.

On May 9, 1996, the Greater Portland Council of Governments (GPCOG) submitted a formal expression of interest in receiving an EDP grant to FHWA. The proposal emphasized the progressive multimodal transportation planning that the Portland area has engaged in over the years and the cooperation among transportation agencies in the area. The proposal was endorsed by the Maine Division and Region 1 of FHWA, and sent to FHWA Headquarters in Washington.

c) Project Selection and Orientation Session

On September 24, 1996, the FHWA Associate Administrator for Safety and System Applications, Dennis Judycki, approved the Greater Portland EDP project for Early Deployment funding. Portland was among thirteen metropolitan areas that received EDP grants at that time. As it turned out, the September 1996 EDP grants were the last set of EDP grants, and no further EDP grants are expected to be awarded in the future. The Portland, Maine region, with an urbanized area population of about 120,000 and countywide population of about twice that number, became the smallest region in the nation to have received funding for ITS early deployment planning.

On October 30, 1996, Joe Kott from the Greater Portland Council of Governments and Steve Beningo from the FHWA Maine Division attended an Early Deployment Planning Seminar in Washington, DC. The purpose of seminar was to provide the September 1996 recipients of EDP grants with an overview of the EDP process. The importance of mainstreaming ITS considerations into the transportation planning process was stressed. Participants learned that ITS works best when transportation problems are first identified and then ITS solutions are crafted to the dynamics of the existing problems.

2. Early Process

a) *Formation of the EDP Committee*

GPCOG staff began the ITS early deployment planning process by inviting a broad spectrum of stakeholders to join a Greater Portland ITS Early Deployment Plan Advisory Committee that would provide policy guidance to the effort. In this role, the Advisory Committee would ensure that the Early Deployment Plan met regional needs. In turn, the Committee would add its

credibility to the planning process by formally adopting a recommended Early Deployment Plan, including a generalized program of ITS projects, for the Portland region. The City of Portland's Transportation Director, whose purview included the state's busiest airport and a containerized port terminal operation, served as ITSEDP Advisory Committee Chair. In addition, the Advisory Committee included Portland's Mayor (who was also a member of the local transit district board), both Portland's Parking Manager and its Fire Chief, the Greater Portland Transit District General

Manager, the Casco Bay Island Transit District (a local ferry service) General Manager, the Portland MPO Director, the Town Planner for the nearby retail shopping mecca of Freeport, GPCOG's own Rideshare Program Coordinator, engineering and planning staff from the Maine Turnpike Authority, a staff engineer who was then coordinating Maine DOT's ITS efforts, a transportation energy specialist with the Maine Department of Environmental Protection, officials from both the Federal Highway Administration and the Federal Transit Administration, and a local physicist and engineer who was also a citizen member of the Portland MPO Technical Committee. The Advisory Committee and staff worked together from January 1997 through adoption of a final report of findings and recommendations in January 1998.

b) Defining the EDP Process

The EDP planning approach approved by the Advisory Committee was strategic and regional, rather than project-level, in nature. Such an approach took into consideration region-wide transportation goals and the suitability of various ITS technologies to meet those goals. The planning time horizon chosen was ten years, a compromise between taking the "long view" – often defined in transportation planning as twenty years – and the reality that technological change has become so rapid that in twenty years whole new and largely unforeseen technologies are likely to be available. The Committee and staff defined the Greater Portland ITSEDP work program as an investigation of ITS capabilities, benefits and costs; development of a recommended program for ITS development in the region; and promulgation of a report of findings and recommendations to decision-makers at all level of government, as well as to interested citizens. This final report would contain Advisory Committee ITS priorities for the region in rank order, a logical deployment timeframe for the deployments, and identification of appropriate entities to carry out each deployment.

c) Establishing Goals for a Regional ITS Program

Early in the EDP process, the Advisory Committee adopted a set of goals for ITS development. These goals would guide the planning process and provide a basis for assessing the potential for ITS deployments in the Portland region. The Committee decided on a limited set of desired and important outcomes of a regional ITS effort. The seven broad goals established for Portland's ITSEDP were as follows:

- *More accessible and complete travel information*
- *A more efficient, cost-effective transportation system*
- *Safer travel*
- *Cleaner air*
- *More energy-efficiency*
- *Economic development*
- *Improved interagency coordination/cooperation*

The Committee also formally endorsed the six national ITS objectives that had been established by the USDOT:

- *Reduced travel time*
- *Increased service reliability*
- *Cost reductions*
- *Safety and security improvement*
- *Ridership and revenue increases*
- *Reduced emissions*

During the evaluation process, the Advisory Committee decided to use these national objectives weighted by the Committee to suit the Portland region's needs, to score prospective ITS deployments. In doing so, the Committee recognized the similarity between the national objectives and the set of regional goals it had established. Most importantly, the Advisory Committee wished to develop an ITS program for the Portland region that would be competitive for any national funding that might be available for operational tests or model deployments. In the Committee's view, aligning the Portland ITS evaluation process with national objectives, appropriately weighted to reflect regional priorities, would help accomplish that end.

d) Committee and Staff Education

An important task for both the Advisory Committee and staff throughout the year-long Portland EDP process, particularly in the first several months of work, was to learn more about ITS capabilities, benefits, and costs. As described in the first section of this paper, the Portland ITSEDP project manager and an FHWA transportation planner who later participated as a member of the EDP Advisory Committee attended an Early Deployment Planning Seminar at the Federal Highway Administration's offices in Washington before formal initiation of Portland's ITS strategic planning effort. Staff field investigations included participation in an ITS Executive Scan and Tour of Atlanta ITS deployments and a week-long Institute of Transportation Engineers Southwest U.S. ITS Study Tour. Two of the transit managers on the Advisory Committee participated in Federal Transit Administration ITS study tours in Montana and California, respectively. Both staff and Advisory Committee members also joined in a field investigation of Maine Turnpike Authority electronic toll and changeable message sign installations.

Guest presenters also contributed to Committee and staff education. Federal Highway Administration staff presented an "ITS Awareness Seminar" for all participants in the Portland EDP process. This session was also attended by a number of other officials and citizens not directly involved in the ITS planning effort. One Advisory Committee meeting featured a guest presentation by an executive from SmartRoute Systems on the use of ITS in Boston and other metropolitan areas to disseminate traveler information. In addition, a number of national ITS experts and vendors participated in a day-long Maine ITS Symposium and Vendor Exhibition jointly sponsored by the Advisory Committee and the Greater Portland Council of Governments. This event is described in more detail below.

Portland ITSEDP staff also did considerable research in ITS capabilities and deployment results. Results of this work were presented to the Committee verbally and in a series of briefing papers. ITS America and both the Federal Highway and Federal Transit Administration were important resources for this research.

e) Maine ITS Symposium and Vendor Exhibition

The Maine ITS Symposium, held in March 1997 at the campus of the University of Southern Maine in Portland, assembled ITS subject matter experts to discuss and display advances in transportation electronics and communications technology. Featured presenters included National Transit Institute Fellow David Hill and Marion Waters, a well-known Georgia Department of Transportation official who played a key role in ITS deployments for the 1996 Olympic Games. Vendor's exhibits comprised ITS applications such as smart cards, electronic toll payment systems, changeable message signs, automated traffic signal programs, and both transit trip itinerary planning and paratransit scheduling programs. Concurrent with the program of individual speakers and panel discussions, David Hill conducted morning and afternoon ITS workshops for transit managers. The Symposium and Vendor Exhibition attracted attendees from throughout Maine and from nearby states.

An ITS Public Focus Group was also held as a companion activity to the Symposium and Vendor Exhibition. The focus group, which included members of the lay public without a professional transportation background, was given a tour of vendor displays and a brief introduction to ITS applications. With this information as background, members of the group discussed the utility of various ITS technologies from the perspective of automobile and transit users. Results of this session were summarized and presented to the Advisory Committee. Since most Advisory Committee members were transportation professionals, this citizen perspective was a useful supplement to the insights provided by Committee members themselves during the EDP process.

f) Development of Briefing Papers

The results of staff research, the ITS Symposium and Vendor Exhibition, ITS study tours, and guest presentations to the EDP Advisory Committee were organized and condensed in a series of briefing papers. Portions of these papers were also included in the Portland ITS final report of

findings and recommendations. Briefing paper subjects included traveler information systems, advanced public transit systems, and advanced traffic management systems. Each paper described pertinent technologies and applications experience in the field throughout North America. While these documents were written to be readable and accessible, technical appendices and bibliographies for supplementary reading were included at the end of each briefing paper. The papers were not only distributed to the Portland ITSEDP Advisory Committee, but also to members of the Portland MPO Technical Committee as reference documents.

3. Ranking Process

(a) Developing ITS "Projects"

Based on the research and education initiatives described previously and using a typology recommended by USDOT, Portland ITSEDP staff prepared five preliminary ITS market packages, which were termed "projects". Each project was comprised of a series of ITS applications, as shown below. The Advisory Committee decided to retain italicized items, including four of the five proposed projects, for further evaluation. Note that transportation safety was eliminated by the Advisory Committee as a separate project. Instead, the Committee endorsed an emphasis on safety in the planning and design of all ITS deployments.

- ***Project 1: Traveler Information***

  electronic bulletin boards/text television
  smart kiosks/worldwide web
  highway advisory radio
  parking advisory radio
  weather advisory radio (roadside)
  changeable message signs, highway information
  changeable message signs, parking information
  radio and television
  toll-free and pay number
  traffic automated telephone system

- ***Project 2: Public Transit***

  computer-aided dispatch (subsequently grouped with AVI/GIS below)
  electronic fare payment
  automated vehicle identification/geographic positioning/geographic information systems
  smart kiosks/worldwide web
  on-board vehicle annunciators and electronic bulletin boards
  radio/tv
  automated passenger counters
  on-board vehicle diagnostics
  trip itinerary planning
  stop and terminal information systems
  on-board vehicle guidance
  security systems

Project 3: Traffic Management

signal automation and coordination
signal preemption
parking management
emergency management
incident management
lane control/variable speed signs
ramp metering

- ***Project 4: Electronic Payment***

smart cards
electronic tags

- ***Project 5: Safety***

pedestrian/bicycle crossing systems
traffic violation deterrent and enforcement
smart intersections
call box/mayday systems
weather warnings
wildlife warnings

(b) Preliminary Project Scoring

Portland EDP staff developed an evaluation framework that was used, after review and modification by the Advisory Committee, for preliminary project scoring purposes. The evaluation or scoring process combined weighting national ITS objectives to reflect regional needs with a broad, qualitative assessment of the impact of an ITS project or application. The
The Advisory Committee weighted each of the six national USDOT ITS objectives as follows:

Established National Objective	**Assigned Regional Weight**
▪ *Reduced travel time*	*.15*
▪ *Increased service reliability*	*.10*

Established National Objective	**Assigned Regional Weight**
▪ *Cost reductions*	*.20*
▪ *Safety and security improvement*	*.20*
▪ *Ridership and revenue increases*	*.20*
▪ *Reduced emissions*	*.15*

It is interesting to note that, while the Portland region is classified as Nonattainment for Ozone

and has congested intersections and links on its roadway system, economic and transportation safety objectives were weighted more heavily by the Advisory Committee than air quality or traffic congestion. Moreover, the Portland region has long emphasized economic development and the shortfall of funding available for transportation systems. More polluted and congested regions would in all probability reflect different priorities.

The scoring scale used in qualitative assessment of ITS impact on each of the above objectives was as follows: no impact (0), marginal impact (1), moderate impact (2), and substantial impact (3). The Advisory Committee charged EDP staff with the task of scoring each ITS project and constituent applications based on a subjective assessment of impacts on the regionally-weighted national objectives. The subjective assessment of staff was to be based, in turn, on research and education in ITS as well as professional judgement and local knowledge. Based in scoring done by EDP staff, Composite "Potential Performance Values", average ratings on the 0 to three scale, were developed for each of the remaining four ITS projects. "Composite Weighted Scores", ranging from 0 to 100%, were also calculated for each remaining application within the projects. These scores reflected the percentage contribution of each application to the overall score of the project. Illustrative results for all projects and applications and for one of the Projects (Traveler Information) and its constituent applications are as follows:

For all Projects –

Project	**Potential Performance Rating (average rating)**
Traffic Management	1.80
Electronic Payment	1.55
Public Transit	1.20
Traveler Information	1.125

For all Individual Applications –

Application	**Potential Performance Rating (average rating)**
AVI/GPS/GIS	2.30
Traffic Signal Preemption	2.00

Application	**Potential Performance Rating (average rating)**
Signal Automation/Coordination	1.60
Changeable Message Signs (roadway)	1.60
Smart Cards	1.55
Highway Advisory Radio	1.55
Smart Kiosks/World-wide Web (Transit)	1.30
On-board Annunciators	1.20
EBB/Text TV	1.20
Smart Kiosks/World-wide Web (Travel Info)	1.15

Weather Advisory Radio (roadside)	1.10
Changeable message signs (parking)	1.05
EBB/Text TV (Travel Info)	0.95
Parking Advisory Radio	0.95
Passenger Counters	0.95
Radio/TV (Travel Info)	0.60
Radio/TV (Transit)	0.25

For the Entire Traveler Information Project -

Objective	**Potential Performance Rating (average rating)**
Travel time reduction	2.85
Service reliability improvements	1.90
Cost reduction	0.00
Safety/security improvements	2.60
Ridership/revenue increases	0.00
Emissions reductions	1.65

For Component Applications within the Traveler Information Project –

Component Application	**Composite Weighted Score (percentage contribution to Project impact**
Changeable Message Signs – highway	18%
Highway Advisory Radio	17%
Smart Kiosks/World-wide web	13%
Weather Advisory Radio – roadside	12%
Changeable Message Signs – parking	12%
Electronic Bulletin Boards/Text-TV	11%
Parking Advisory Radio	11%
Radio/TV	7%

(c) Advisory Committee Ranking of Projects and Applications

The Portland ITSEDP Advisory Committee reviewed staff scoring of ITS projects and applications and used the results to begin developing a prioritized regional ITS program of projects. The Committee relied on its own judgement and sense of regional needs, opportunities, resources, and realities in developing this ITS program. In doing so, it further condensed the list of projects by merging Fare Payment into Public Transit. As a first step, through discussion and debate, the Advisory Committee developed its own rank order of overarching ITS projects, as follows:

ITS Project	**Portland ITS Advisory Committee Ranking**

Public Transit (including Fare Payment)	1
Traveler Information	2
Traffic Management	3

Further, the Advisory Committee developed its own rankings for applications within each project. Along with the rankings, a deployment initiation timetable and recommended implementing entities were established for the Portland ITS Program of Projects. In order to have a more comprehensive list, in some cases the Advisory Committee included applications that had been previously dismissed. Typically, these were placed in an "unranked" category. By way of illustration, the Public Transit Project was described as follows:

Applications	**Component Rank**	**Begin Deployment**	**Deployment by**
Automated Vehicle Location/ GPS/Computer-aided Dispatch	1	before 2003	specific transit operators
Smart Cards	2	before 2003	specific transit operators
Smart Kiosks/WWW	3	before 2003	specific transit operators
EBB/Text TV	4	between 2003 and 2008	specific urban and intercity transit operators
On-Board Annunciators	unranked	before 2008 if feasible	specific transit operators

Applications	**Component Rank**	**Begin Deployment**	**Deployment by**
Passenger Counters	unranked	before 2008 if feasible	specific transit operators
Passenger Security Systems	unranked	before 2008 if feasible	specific transit operators
Transit Systems Management Center	unranked	before 2008 if feasible	specific transit operators
Traffic Signal Preemption	unranked	before 2008 if feasible	specific transit operators

All three overarching Portland ITS projects were similarly defined by the Advisory Committee.

This program was included in the final report of findings and recommendations.

4. Implementation and Next Steps

A number of presentations were made by GPCOG staff to Portland Area Comprehensive Transportation Study (PACTS, the Metropolitan Planning Organization for the Portland, Maine metropolitan area) committees and to MDOT officials on the outcome of the EDP study and on the study's recommendations.

One recommendation in the EDP report was to encourage Maine DOT to lead in the creation of a Maine ITS America chapter. The formation of a State ITS Chapter would provide a forum for MDOT staff, MPO staff, municipal engineers, transit providers, and interested private sector parties to cooperatively plan for and implement ITS in the State of Maine. It would provide a mechanism for professional and technical support and coordination to ITS project planners throughout the State. The Maine Department of Transportation (MDOT) is receptive to such collaboration and has recently formed an ITS Steering Committee to coordinate its efforts with those of GPCOG, the Maine Turnpike Authority, and others interested in ITS implementation.

The Greater Portland Council of Governments is taking a number of steps on its own to implement the recommendations of the EDP study. GPCOG is currently providing technical assistance to agencies interested in programming ITS projects within PACTS' Transportation Improvement Program. In addition, GPCOG hosted an ITS Stakeholders meeting on September 25, 1998 to discuss ways to implement the ITSEDP priorities in the Portland area.

GPCOG is also involved in the development of an ITS Service Plan for the Portland area. The U.S. Department of Transportation, as a result of the success of the EDP process and the area's multimodal focus, selected Portland, Maine to be the first location in the nation to undertake an ITS Service Plan.

The purpose of an ITS Service Plan is to integrate institutional partnerships and technical resources in a multimodal environment to promote the use of ITS in meeting the transportation needs of a region. The ITS Service Plan outlines services, actions and products to be provided by the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) to a metropolitan or rural area. This plan will help FHWA and FTA to better focus training opportunities and other resources to the needs of the Portland area.

The Greater Portland Transit District, or Metro, the largest transit provider in the region, is in the process of designing and installing electronic ("smart") kiosks on Forest Avenue, a major commuter corridor. This project is part of a wider effort, including more frequent service and improved passenger-waiting areas, to increase transit ridership on the corridor.

5. Applicability to Other Small and Medium Sized MPOs

Planning for ITS deployments is a process that is applicable to all small and medium sized MPOs. The MPOs should look into ways that ITS can help them solve their transportation problems. They should begin by making a list of transportation problems in their local area. Then they should educate themselves on the various ITS technologies, and think about which technologies can help solve local transportation problems. Then an analysis of ITS benefits and costs should be developed, followed by the placement of the most promising projects in the MPO's Long Range Plan and Transportation Improvement Program.

While MPO staff can undertake some of the work listed above, the best forum for ITS planning is a committee of stakeholders. This committee should consist of MPO staff, state department of transportation officials, FHWA and FTA representatives, local transit operators, municipal engineering and planning staff, emergency service providers, parking managers, business representatives, and interested private citizens.

Small and medium sized MPOs should feel free to contact the US Department of Transportation for assistance in developing and implementing ITS projects and programs. The USDOT is looking for areas to undertake an ITS Service Plan. Your FHWA Division Office ITS Specialist or your FTA Regional Office contact person would be happy to provide you with more information about an ITS Service Plan, ITS funding opportunities, and how to integrate ITS into local and regional transportation planning.

Acknowledgement and Appreciation:

Special recognition and appreciation are due Mr. Oliver Hesselborn, formerly of GPCOG staff and now with IBI Group in Boston, for his brilliant work in technical analysis, preparing and delivering various presentations, and developing graphical aids during development of Portland's Early Deployment Plan. Appreciation is also due to IBI Group for release of Mr. Hesselborn's time during the latter stages of EDP preparation.

Session #12

INCORPORATING IMPLEMENTATION OF ITS TECHNOLOGIES INTO LOCAL PLANNING PROCESSES

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ABSTRACT

What is the prevailing level of understanding of ITS methods, technology and benefits within communities about to become the recipient of those technologies? Given that the average citizen, as well as the average user, knows little of the beneficial aspects of ITS technology, what is the best way to approach informing private citizens, as well as potential system users?

Develop an organized process for promoting integration of ITS technologies and methodologies into existing, and future, border-related planning and project development activities. The process should include both public and private entities with interests at the Western Washington border with British Columbia, Canada.

Complete the necessary steps to update the region's Metropolitan and Regional Transportation Plans to include the ITS concept, potential applications, and implications for the region.

Develop a set of tools to educate the public about value-added aspects of avoiding costs of facility construction through the use of technology.

And, finally, Review Washington State Growth Management Act (GMA) comprehensive plans of the region's jurisdictions and recommend, where appropriate, adding language to identify the advantages and rationale of incorporating ITS options and benefits into those plans.

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In December, 1996 FHWA sponsored a symposium: *Linking Regional Planning and Operations For Effective ITS Deployment*. The intent of the symposium was to formulate recommendations for future research, and develop policy, legislation, and administrative actions to be considered in the interest of implementing ITS in a regional setting. The symposium also addressed how to best incorporate ITS deployment into standard regional and /or statewide planning procedures, processes and practices. Additionally, there was attention to "important linkages between regional transportation planning and operations of proposed and existing systems to enhance interagency and interjurisdictional information sharing."

Findings of the symposium included the following:

- A significant gulf exists between the traditional planning process and ITS deployment.
- ITS deployment initiatives offer opportunities to recast the planning and operations relationship.
- ITS is one of many developments that fundamentally affect how surface transportation systems are planned, managed, and financed.
- ITS and other developments will challenge regions and Metropolitan Planning Organizations (MPOs) to reinvent their process, and to better define the roles of planning and operating agencies.

Peter Briglia, project manager for the Washington State Department of Transportation Advanced Technology Branch, admits that "It's hard for a lot of us who built careers laying concrete and asphalt to just sort of give up and not believe that we can still build our way out of these problems." His statement provides insight into the very essence of why implementing ITS technologies, particularly in medium and small sized areas, may be more difficult than one would imagine.

Just as Mr. Briglia finds difficulty in giving up old perceptions, the public finds accommodating new technological advances even more daunting. Pete Briglia leads an effort in Washington State to implement ITS technology yet he, too, reflects the reluctance with which we leave familiar patterns behind. Philosophically speaking, there are two non-technical impediments to human acceptance of implementation of ITS technologies. The first is fear and suspicion associated with activity monitoring, fear of technology itself, and fear of some involuntary authoritarian control of the American driving habit that we have so clearly demonstrated a reluctance to give up. Some call this phenomenon the "Big Brother" syndrome.

The second is uncertainty that implementing ITS technology is the best use for public funds. The fact that technological advancement comes at a cost is not lost to most citizens. Whether it is worth the investment may well be a bigger question in the minds of citizens in more rural areas. Incorporating ITS implementation into local planning processes in a meaningful way will require a broad education and marketing process aimed at the perceptions of the audience. Many of us

rely on computers and other technology every day. We should not lose sight of the fact that only 40% of U.S. households have computers.

Generally ITS technology provides choices, saves time, reduces congestion and pollution, and makes both passenger and freight operations flow more smoothly in a number of ways. Information enables shippers to make modal choices, enables manufacturers to make inventory decisions, and enables border enforcement agencies to reduce time spent per visitor and make decisions regarding candidates for additional scrutiny. ITS technology allows improved and more efficient traffic management, traffic controls, vehicle safety, enables vehicle location, provides route guidance and substantial other driver information. ITS promotes equity across modes by enabling both commercial and passenger car access to system efficiencies and congestion avoidance. The benefits of ITS technology are well-understood by professionals with involvement in the many facets of intelligent transportation systems.

The much more difficult task, however, is to create a shift in the way transportation infrastructure and operational decisions are made at the local level, and change the way potential transportation solutions are viewed.

At the local level, every transportation decision should be considered in the light of how ITS or other technologies might offer economies and/or efficiencies. Theoretically, every state, county, and municipality should filter their transportation decisions through all possible ITS/technological solutions prior to making commitments for expenditure of hard-won traditional transportation dollars.

In some cases, it is possible to completely avoid infrastructure development or improvement costs by using ITS technology. Traditional roadway improvements, such as queuing lanes, capacity improvements, and turning lanes may be replaced by early warning through highway information systems, timed release of shipments and freeway on-ramp metering. These relatively low-cost investments have potential to accomplish the same net result as infrastructure-based capacity improvement. Some projects may benefit from a blend of traditional roadway engineering and ITS technology. Revised traditional thinking and methods that include preliminary assessments of ITS viability for projects, on a case-by-case basis, can lead to significant benefits.

Short- and long-range transportation plans of all a region's agencies should include reference to the cost savings and efficiencies offered through implementation of ITS technologies. Regional and metropolitan transportation plans as well as land use plans and transportation improvement programs (TIPs) should contain references to ITS technology and its benefits, require preliminary assessments of applicability, and call for implementation where use of the technology is found feasible and economical. Regional planning agencies, such as councils of government, regional transportation councils, metropolitan transportation organizations, and other similar coordinating bodies should work with states, counties, cities and ports to review existing plans of local jurisdictions. Plans should be reviewed to ensure they include references and preferences for inclusion of ITS technologies wherever and whenever feasible and desirable. They should develop guidance regarding the planning, integration, deployment, and continuing operational support of ITS at the local level.

Often, ITS is not represented as an option within the range of other transportation strategies and programs. This has resulted in a lack of information and clarity at the local level as to the potential long term benefits of ITS. ITS does fit in with other transportation projects and programs.

Three principal contexts are described in the ITS Handbook for ITS planning. Within that overall process are transportation improvement programs (TIPs), corridor, and sub-area plans. Additionally, however, statewide planning efforts such as those required under the growth management act of any state, as well as bi-national planing efforts should include these same provisions for consideration of IT technologies. The transportation plan prepared for a state or metropolitan area is a comprehensive, coordinated look at transportation requirements extending over at least a 20-year period. Corridor and sub-area transportation studies, including major investment studies and environmental studies relate to specific areal issues and offer opportunities for inclusion of technology assessment. Additionally, many decisions on appropriate transportation strategies are made at the corridor/sub-area level. Strategic assessments of ITS have been given various names in certain states or metropolitan areas, such as ITS strategic planning efforts, ITS strategic studies, or ITS early deployment planning studies.

For the Whatcom region these plans are characterized by multiple layers of plans and documents created through several separate and discreet planning efforts, all involving separate public involvement processes.

1991 Growth Management Act Comprehensive Plan Transportation Element

Under a 1991 Washington State Growth Management Act, rapidly growing and populous counties, along with their cities, are required to develop multi-element plans preparing for that growth. These “Comprehensive Plans” are to be written while accommodating early and frequent public participation while meeting goals of eliminating sprawl, protecting the natural environment, and providing adequate infrastructure to support growth. Comprehensive Plans must consist of specific chapters addressing the goals of the act. Among these requirements is a specific transportation chapter, or “element.” Transportation considerations required for the plan include consistency with the land use chapter; and additionally, facility and service needs such as existing facilities, level of service (LOS) standards, actions needed to meet LOS standards, traffic forecasts, and most significantly for this treatise, identification of system expansion needs and transportation system management needs to meet both current and future demands.

The 1991 Washington State Growth Management Act (GMA) has been challenged through every available venue including civil suits from both opponents and those finding fault with adequacy of GMA planning. Three Growth Management Hearings Boards, East, West, and Central Puget Sound, have reviewed submitted plans and found a full range of compliance from complete to nil. Whatcom County recently prevailed in a Washington State Supreme Court suit against the Western Growth Management Hearings Board where the court found determinations made by the board to be inappropriate. Through all the strife invoked by the GMA planning requirements;

transportation aspects of planning seemed to be least problematic. Regional Transportation Plans (RTPs) have been written and adopted, and accepted by the State.

These GMA Comprehensive Plan chapters, however, contain little reference to ITS. Further, the GMA itself, while alluding to demand management strategies, such as "increased public transportation service, ride sharing programs, demand management, and other transportation systems management strategies," does not directly address utilization of ITS in any way. This rather amazing short-coming is most likely the result of the newness of ITS technologies. Many of the methodologies and efficiencies included under the ITS umbrella are not any newer than Washington State growth management legislation. This is an unfortunate oversight. While retrospect is so often clear, more complete and effective plans would have resulted from including ITS evaluation as part of all new or large-scale construction or preservation project actions.

County and city comprehensive plan transportation chapters should be reviewed and where appropriate revisions made to accommodate assessment of ITS technologies.

Metropolitan Transportation Plan

The Intermodal Transportation Efficiency Act of 1991 establishes requirements for transportation planning by Metropolitan Planning Organizations (MPOs) including developing a Metropolitan Transportation Plan. A set of sixteen planning factors must be addressed within the plan. TEA-21, the Transportation Equity Act for the Twenty First Century, reduced the planning factors that must be addressed down to seven. Each of these pertinent factors, however should meet a technology test in that ITS should be considered as an alternative wherever and whenerver feasible.

Regional Transportation Plan, and local Transportation Improvement Programs

The Regional Transportation Plan, required as part of the planning activities associated with the Washington State Growth Management Act consists of a set of Guiding Principles and Policies to lead jurisdictions through transportation decision-making processes. The RTP should be reviewed for incorporation of ITS technology assessment.

There are roadblocks to incorporating such sweeping changes into planning and operational processes at the local level. Incorporating ITS technologies into traditional transportation thinking must occur at several levels before it can begin to realize its true efficiencies and cost savings potential. Education efforts should begin with agency (jurisdictional including state) interests. Those applying, or evaluating ITS technologies as a substitute for construction must believe in the effectiveness of replacing asphalt with technological efficiencies. Next in order are those that make and enforce jurisdictional policy. This would include the state legislature, county commissioners and council members, and city council members.

In most parts of the country, constrained budgets are more the norm than the exception. In testament to today's environment of minimizing taxes and opposition to new or added taxation, those agencies responsible for moving people and goods generally face considerable public scrutiny to maintain tight budgets. At least in the near future, lean times can be expected to continue if not increase. One way to trim transportation costs, while serving accumulating needs is to evaluate ITS technology as an alternative to more traditional types of transportation fixes.

Education is the key to successful broad-based application of Intelligent Transportation Systems. No economically- or politically-formulated transportation decision should be made without considering economies offered by ITS. The contemporary municipal atmosphere is charged with public opinion. Informing and educating the public about ITS can strongly affect transportation outcomes and the efficacy of implementing smart versus asphalt solutions.

The public should be educated, students should be educated, and educators should be informed. Educational goals should include a fundamental understanding of the intrinsic value of ITS technology, for a broad range of interests,

Actions should be taken to inform and educate.

Jurisdictions must communicate with other agencies using and applying technology, and publicize cost-saving attributes of that technology.

According to the Federal Highway Administration's Office of Traffic Management and ITS Applications, ITS is "the application of advanced sensor, computer, electronics, and communication technologies and management strategies - in an integrated manner – to increase the safety and efficiency of the surface transportation system."

The fundamental basis for future use of ITS technologies will be in how well they are received by users including passenger cars and commercial vehicle operations. For passenger operations, convenience, time savings, security, economics, and safety are among the most compelling reasons to find the use of ITS technologies desirable. Commercial vehicle operators, and drivers, have many of the same concerns, but economics is arguably the most often-cited reason for supporting ITS. Overall transportation system efficiency, safety and reduced time spent on regulatory issues are among the more important motivators for commercial operators. Commercial vehicle operations incur administrative burdens at a cost of $5 billion every year for the private sector alone. ITS technology offers solutions to all these negative aspects of travel for both people and goods.

ITS is structured around a set of " user services." There are currently about 30 user services defined for the ITS program. The purpose of defining user services is to relate ITS strategies (ITS projects and programs such as automatic vehicle location systems for transit) and technologies (hardware and software used to implement strategies) to specific user needs. User services represent a customer orientation rather than a facility or technology orientation. One of the difficulties with incorporating ITS into the planning process is that, often, ITS has been

represented as merely a collection of support technologies rather than a set of transportation strategies with specific objectives. Achieving public understanding of the benefits of ITS, its practicality and the everyday applicability of its benefits is a necessary component of public education.

Public education must consider that there are appreciable differences in the perception of the public based on their age or "generation." For purposes of discussion, the population of any given region may be divided into five groups or generations, each with its own character:

- Generation one is 75-80 years old. It's your mom or your grandma to whom technology is all a black box; mysterious and remote. She just does not get it and does not want to get it. She does, however, admire those who do.

- Generation two is 53-58 years old and is deeply and firmly ensconced in his professional life. He is afraid of, and perhaps embarrassed by, his lack of understanding of technology. He either just gets by, has expended effort to learn, or avoids technology all together. Like others unwilling to change, the analog addict finds excuses in unending supply. He has huge anxiety, is conservative, and is not in favor of technological solutions.

- Generation three is 31-36 years old and soaked in technology; understands it, uses it, wants it, needs it, and does not understand a world without it. Dr. DOS.

- Generation four is 9 to 14 years old. Almost any technology is a pop tart springing out of the toaster… its automatic, it's a convenience store with a key board, a natural part of life, a given.

- Generation five is 8 or less and destined to be the recipient of what happens today. These digital descendants will inherit the good, the bad, and the ugly. Our efforts today to build smart and fully use technology will pay dividends for this generation.

All the five generations must be treated and educated differently regarding the benefits, advantages, and "whys" of ITS technology.

The approach for educating the public must be tuned to the audience ("generation") and include recognizable advantages. This may be accomplished through the use of an audio-visual, multi-media "road show," along with more conservative presentation styles. Presentations will be made to any audiences available through service organizations, business clubs, unions, and other organized entities. Again, the program must be adjusted for the audience. The goal of these presentations is to inform a broad spectrum of the local public about the benefits of ITS technology in ways that make sense to them. Well informed citizens provide better input at public hearings.

The next phase of education is more difficult. Institutional education for local and state legislators with emphasis to local elected officials requires substantial effort. Most transportation plans referenced earlier in this paper require, in some form, approval or adoption by local elected

officials. Their clear understanding of ITS principles is a necessary predecessor of informed votes. Educating the users, at all levels is the key to effective and efficient integration of ITS technologies into local planning processes.

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