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RESPONDING TO THE CHANGING ENVIRONMENT

SUMMARY REPORT



STATE DEPARTMENT OF HIGHWAYS

AND PUBLIC TRANSPORTATION

STATE OF TEXAS

July 1976

McKinsey & Company, Inc.

July 2, 1976

Mr. B. L. DeBerry, Engineer-Director
State Department of Highways
and Public Transportation
Austin, Texas 78701

Dear Sir:

McKinsey & Company, Inc. was engaged by the State Department of Highways and Public Transportation to conduct a comprehensive and objective evaluation of the Department's highway program. With this letter we submit our report, Responding to the Changing Environment, summarizing the joint efforts of our Firm and the Department to increase the effectiveness of the highway program in the rapidly changing environment. This report marks the completion of more than 1 year of extensive work involving Department personnel at all levels and extending throughout the State's 25 highway districts and the Houston Urban Project. Many of the results of these efforts were periodically reported to you and the State Highway and Public Transportation Commission over the course of the study, and a summary of the overall effort was informally presented to the Commission on June 23, 1976. However, this report will more fully document the overall results and recommendations and will help place the study's achievements in the proper perspective.

This study came about as the Department became aware of serious problems in the planning and funding of highway construction brought on by a changing environment. Of particular concern was the apparently large and growing gap between anticipated revenues and the backlog of planned construction projects.

McKinsey's initial effort confirmed that the Department faced a real crisis in highway financing and system development. The backlog of projects that the Department had either identified as needs or made commitments to construct was far larger than previously believed, and future funding levels would be much lower. The result was a serious "needs/revenue gap." In fact, there was no reasonable hope that the backlog could ever be completed. Furthermore, within 6 - 7 years the Department might not be able even to continue maintaining the

system in an adequate state of repair. Clearly the situation called for a new approach to highway planning, and supporting Department policies, that would ensure maximum benefits for the level of funds available. The situation also called for a major improvement in the Department's revenue situation - and that would require immediate, decisive action by the legislature.

When the recommendations in this report have been implemented and legislation to provide some additional revenue has been enacted, the highway program will have a realistic, solid foundation for years to come. And, with an improved revenue position and a means of planning highways within funding constraints, the Department should be able to provide Texas with the best possible highway system for the available dollar.

The remainder of this letter summarizes the background of the study, the approach followed by the study team, the major results, and the organization of the report.

Background

Department managers had been considering for some time how best to respond to the problems of a changing environment: (1) the rapidly growing gap between needed highway construction and available revenue; (2) cost escalations caused by inflation, the desire for higher levels of design standards, and the attendant project slippage; and (3) increased public scrutiny of the highway programs, which brought the need to objectively demonstrate to the public the benefits of proposed highway projects. These problems had placed a heavy burden on Department managers to ensure that available funds were used most effectively for projects with maximum systemwide benefit and to demonstrate those benefits to the public and to local, Federal, and other State agencies.

However, these problems involved very complex relationships that were difficult to unravel. In view of the complexity of trying to resolve these problems and the potential benefits of an effective solution, Department officials decided to take on the task of reevaluating the Texas highway program, and we agreed to assist you in this effort.

Approach

To address this critical situation we embarked on a two-pronged approach. First, a systemwide evaluation of proposed highway plans was required to find solutions to the immediate, interrelated problems of a large project backlog, rapidly escalating costs, and lengthy project delays. Second, a thorough evaluation of the current financial outlook was required, and new financial solutions had to be developed to meet the revenue requirements of Texas' transportation system.

The study was organized as a joint effort by the State Department of Highways and Public Transportation and our Firm. Work began in June 1975 and continued through June 1976. The evaluation of highway plans and the analysis of the financial outlook were undertaken as separate but parallel activities, each with its own sequence of phases. This sequential approach provided for building an understanding of the problem and its seriousness at the outset, then developing and testing approaches to solving the problem and, finally, proceeding to large-scale implementation.

The study phases for the evaluation of highway plans were:

1. Overall diagnostic review of the Department. During this 2-month initial diagnosis, the team examined the wide range of problems affecting the highway program in order to understand their underlying causes, their interaction, and their impact on the highway program. The initial step in this phase was to review and analyze the policies, procedures, and practices employed by the Department in developing its construction plans. As part of this effort, the team developed a preliminary forecast of the funding outlook for the highway program, estimated the Department's needs/revenue gap, and assessed the implications of this outlook for future highway mobility. In addition, it analyzed in depth the major elements of the current planning and programming process, including cost and revenue forecasting techniques and existing design approaches, in order to isolate areas where change was needed.
2. Development of new techniques for first pilot districts. The study team began the development of new techniques by analyzing real slates of projects planned for the Houston area by District 12 and the Houston Urban Project. By focusing its attention on the specific details of the highway program's problems in the Houston area, the team hoped to develop realistic and practical solutions readily applicable throughout the State. During this time the team developed new approaches for scoping projects and measuring the performance and cost of project alternatives. It also refined and adapted a technique for the economic evaluation of highways.
3. Application in two additional pilot districts. The solutions and processes identified in the Houston area were applied to Districts 2 and 18, the Dallas/Fort Worth area, in order to confirm their value and to verify their impact on two of the State's largest districts. These efforts confirmed both the applicability and the value of the new processes, and a decision was made to implement the processes statewide.

4. Statewide implementation. The team, working with the Management Action Committee, a top management steering committee that you chaired, developed plans and an organization for several hundred participants to implement the effort throughout the State. Team members who had gained firsthand experience in working with the new processes in the pilot district served as advisors during the effort and participated directly in applying the new processes to the problems in each of the other districts. They also assisted in assembling the new composite slate of projects for the State by eliminating inconsistencies among the districts, ensuring that statewide concerns were given appropriate consideration, and balancing the various funding categories. The results were reviewed with the Management Action Committee at each important stage of development.

Simultaneously, the team approached the financial situation in three steps:

1. Detailed analysis of the funding outlook. The rapidly changing environment made it difficult to understand which forces were affecting the Department's existing and potential revenue sources. During this first step, then, the team constructed an analytical forecasting tool and developed a thorough understanding of the underlying trends affecting Departmental funds by exhaustively analyzing available data on changes in population, vehicle fleet characteristics, and Department expenditures. The team prepared a base forecast of the funding outlook, including tests of its sensitivity to changes in key variables, and reviewed it with the Management Action Committee and the Commission. During the course of this work, the team also uncovered several significant opportunities for improving the Department's cash management, and these were reviewed and approved for implementation.
2. Evaluation of alternative revenue sources. Using its new in-depth understanding of the financial situation, the team during this step developed both quantitative and qualitative screening criteria, which were discussed with the Department's top management and the Commission on several occasions. The team then evaluated alternative revenue sources against these criteria. It thoroughly analyzed the impact of changing the rate of taxation for existing sources of revenue, and it investigated new sources of revenue.
3. Development of alternative revenue packages. Finally, the team developed alternative revenue packages that met the established selection criteria. The specific near-term financial impact of each of the packages was estimated, and the packages were reviewed by the Department's top management and recommended to the Commission.

Throughout both aspects of the effort, specially selected Department professionals served as team members: they actively assisted in conducting the analysis, developing new tools and techniques, and guiding the work. In particular, members of the Highway Design, Transportation Planning, Finance, and Automation Divisions served as active members of the team. In addition, many other members of the State Department of Highways and Public Transportation participated, especially during the statewide implementation phase. The pilot teams in Districts 2, 12, 18, and the Houston Urban Project contributed extensively to the preliminary diagnosis of the problem and ensured successful implementation throughout the State by contributing full-time team members to the statewide team.

As you know, the Management Action Committee reviewed the study's results at important milestones and when necessary acted on the team's recommendations. This frequent top-management direction gave the study team the impetus to successfully complete its tasks. In addition, frequent workshop sessions with the State Highway and Public Transportation Commission kept the Commission fully informed of the study's progress and gave the Commissioners an opportunity to set the broad direction for the effort. Through this approach many knotty issues have already been dealt with, a number of tough decisions have been made, and many of the recommendations have been implemented during the course of this effort. As a result, the Department and the people of Texas are already starting to realize many of the benefits encompassed in this work.

Results

For the Department, the study has resulted in a better understanding of the causes of recent problems and, more important, the beginnings of a real solution.

The systemwide evaluation of highway plans that recognized the tight financial constraints has resulted in the Department (a) focusing the highway program on systemwide improvements offering major benefits while eliminating projects of lesser benefit, (b) scaling back the improvements scheduled for some large projects so that critical deficiencies can be corrected in several locations, and (c) planning improvements to eliminate potential gaps in the system. As a direct result of this effort, the Department has developed a slate of revised projects and new priorities that will allow a more complete highway system to be developed and that will provide substantially greater systemwide benefits for the available dollars.

The evaluation of the financial outlook and analysis of alternative revenue sources has permitted the Department to (a) reasonably estimate the funds it is likely to have available from existing revenue sources, (b) revise the size of its

future highway construction program to conform with the realities of future funding, (c) immediately undertake several steps to generate additional funds for construction in the near term, and (d) propose several technically sound solutions to the Department's long-term financial crises that employ new sources of inflation-protected revenue.

Specifically, the study:

1. Identified "true" needs/revenue gap. When the study began, the team conducted a preliminary evaluation of the backlog and found it valued at nearly \$11 billion - far higher than the earlier estimates of \$5.2 billion. The team also projected much lower levels of revenue than the Department had been anticipating. This early estimate indicated a needs/revenue gap of \$9 billion.

During the study, however, more refined estimates pointed to an even larger backlog: \$11.8 billion. Furthermore, with the current outlook for funding, only about \$1.9 billion in today's dollars would be available for constructing that backlog. The resulting needs/revenue gap totaled \$9.9 billion for the current backlog alone - and any future projects added to the backlog would enlarge that gap.

That gap had grave implications for the Department. The backlog of projects would never be completed. At the current funding level, significant construction could continue only for the next 6 - 7 years, and in subsequent years the Department would be unable even to maintain the system in an adequate state of repair.

2. Implemented new approach to highway planning. As a response to the needs/revenue gap, the Department now has a new approach to highway planning. With this approach, a funding level is first established for the entire State, and then projects submitted by the districts are selected on the basis of how much they contribute to the overall, state-wide system that can be built within the funds constraint. The aim of this system-oriented approach is to ensure Texas highway users the greatest possible benefits for the available dollars.
3. Developed workable 20-year plan. The new highway planning process was applied to give the Department a revised plan that will direct its design, planning, and construction activities over the next 20 years assuming a modest increase in revenues. Many projects previously planned for the State of Texas are included in the plan in a revised form; however,

others could not be included because they simply did not offer the most cost-effective use of the limited available funds. Should the legislature fail to provide additional revenue, the study team has identified a portion of the 20-year plan that is a practical program for constructing modest facilities and rehabilitating the existing highway system during the next 6 - 7 years before construction dollars are no longer available. The Department is now actively implementing the plan.

This 20-year plan will benefit highway users by giving them (1) a system in an adequate state of repair, (2) immediate solutions for existing problem areas, (3) a more complete system with fewer gaps, and (4) a 20-30 percent higher level of service than would have resulted from the same level of expenditure under the previous approach: reduced operating and maintenance costs, greater safety, less delay, and - for all but the rapidly growing central urban areas - a continuation of mobility at approximately current levels. The plan also provides the Department with a systematic means for distributing available funds among the districts. And, it will serve as a useful communications tool both within the Department itself and with the public.

4. Initiated short-term belt tightening. During the study, the team became aware of several opportunities to immediately improve the Department's revenue situation by reducing off-the-top expenses, imposing a moratorium on all right-of-way purchases, and improving cash management practices. The Department has already begun acting on some of these opportunities.
5. Produced four long-term revenue options. Finally, the team has developed four technically feasible revenue packages to give the Department a stable, long-term source of inflation-protected revenue. In various combinations, these packages include existing sources of revenue as well as the following new sources: motor vehicle sales tax, value-based license fees, and motor vehicle parts and accessories tax. It now appears likely that the packages will be considered by the legislature during its next session in the spring of 1977.

Organization of the Report

The report is intended to be an overview of our study that will bring the full year's efforts into focus, not only for those involved within the Department but also for others outside the Department who are interested in the problems facing the highway program. The report is organized as follows:

- ¶ Chapter 1 - The Crisis Facing the Texas Highway Program - describes the problems that emerged in the late 1960s and early 1970s and assesses the impact they would have had on Texas' highway transportation system had they gone unsolved.
- ¶ Chapter 2 - Changing the Way Highways are Planned - explains the limitations of the traditional approach to developing projects and suggests a new approach that views all projects as part of a larger system, always in the context of limited financial resources.
- ¶ Chapter 3 - Developing a Realistic System-Oriented Program - outlines the details of a process for applying the new system-oriented approach - a process that provides for establishing the program's funding constraints, defining a broad range of alternative designs for projects, and selecting projects on the basis of how much each improves the operation of the statewide highway network within the limitations imposed by funding constraints.
- ¶ Chapter 4 - Controlling the Program - describes a new, rigorous process for ensuring that all planning activities from project conception to contract letting are continuously directed toward efficiently and effectively constructing a realistic slate of projects.
- ¶ Chapter 5 - Increasing Available Revenue - outlines the steps the Department has begun to take toward solving its revenue problem, discussing first the Department's internal belt-tightening activities and then alternative solutions to the long-term problem that will require legislative action.
- ¶ Chapter 6 - The Results: A Solid Foundation for the Future - describes the results of all aspects of the effort, including the first statewide System Plan developed using the new process described in Chapter 3.
- ¶ Appendix - lists all major documents produced in the course of this effort. Because the final report is a summary of a full year's work, not every analysis can be fully reported here. The details of many analyses that could not be fully documented in this report can be found in the documents listed in the Appendix.

* * *

We believe the completion of this effort marks an important point in the history of the Department. The Department can now communicate to Texas' leaders the nature of the problems it is facing and can point to specific revenue alternatives that will help solve the financial crisis created by the rapidly changing environment. And, with a clear understanding of the revenue picture, the Department can focus its efforts on a manageable, 20-year slate of projects that is likely to provide the using public with a high return on its investment. More important, the Department now has new design and management processes that should enable it to continue making sound highway investment decisions within the context of available funding.

We have appreciated the opportunity to serve the State of Texas and the State Department of Highways and Public Transportation in this important effort. We want to particularly acknowledge the tremendous vision of the Department's senior management, which provided the impetus for such a massive attack on a complex series of problems requiring an enormous change in the Department's traditional processes. We are especially indebted to those members of the study team who have devoted substantial portions of the last year to this effort. In addition, we would like to thank you, Mr. DeBerry, for launching this effort and chairing the Management Action Committee; Mr. M.G. Goode, assistant engineer-director, who managed the statewide implementation; Mr. M.L. Yancey, assistant engineer-director, who guided the development of revenue alternatives; and the other members of the Management Action Committee, who through their thoughtful and dedicated leadership ensured the successful completion of the study.

Further, we express our appreciation to the State Highway and Public Transportation Commission - Mr. Reagan Houston, chairman, and Messrs. Dewitt C. Greer and Charles E. Simons - for their dedicated leadership and commitment to achieving lasting solutions for the highway program and for facing many complex issues and difficult decisions.

Respectfully submitted,

McKinsey & Company, Inc.

RESPONDING TO THE CHANGING ENVIRONMENT

STATE DEPARTMENT OF HIGHWAYS

AND PUBLIC TRANSPORTATION

STATE OF TEXAS

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RESPONDING TO THE CHANGING ENVIRONMENT

STATE DEPARTMENT OF HIGHWAYS

AND PUBLIC TRANSPORTATION

STATE OF TEXAS

1 - THE CRISIS FACING THE

TEXAS HIGHWAY PROGRAM

The mission of the Texas highway program has always been to provide an efficient highway transportation system of the highest quality. Since the program began in 1917, it has progressed toward that goal and in the process has created a huge network of State highways connecting Texas' vast rural land areas and multiple urban centers that is unparalleled elsewhere in the United States or in the world. Despite these accomplishments, the future of the Texas highway program is uncertain. Over the past few years, highway administrators have been confronted by a confusing array of new developments that has significantly changed the once-stable environment and raised serious questions about the continued success of the program. This chapter describes how this situation evolved and discusses its implications for the highway program.

A RECORD OF
ACCOMPLISHMENT

Texas launched its ambitious highway program with the rallying cry of "get the farmer out of the mud." On April 14, 1917, the Thirty-fifth Legislature created the Texas Highway Department and allocated vehicle registration fees to the Department rather than to the counties, whose responsibilities for road construction the State was then taking over.* In 1923 the Thirty-eighth Legislature passed laws that firmly established the use of a motor vehicle fuel tax for highway construction.** This legislation created the first substantial revenue source for the

* - General Laws of Texas, Thirty-fifth Legislature, Regular Session, 1917, Chapter 190, p. 416-427 (April 4, 1917).

** - General Laws of Texas, Thirty-eighth Legislature, Regular Session, 1923, Chapter 134, p. 275-277 (March 24, 1923).

highway program, enabling State transportation analysts to establish a rational basis for highway system planning. In effect, it initiated the modern approach to highway planning.

Subsequent legislation firmly established the Department's steady supply of highway user tax revenue for highway development. On November 6, 1946, an amendment to the Texas Constitution, known as "The Good Roads Amendment," dedicated these sources of revenue for the "sole purpose of acquiring rights-of-way, constructing, maintaining, and policing such public roadways."* In 1956, the Federal Aid to Interstate Highways Act gave still another boost to the highway program by providing an additional reliable source of revenue: Federal taxes would be collected from road users in every state, deposited in the Federal Highway Trust Fund, and returned to the states as matching funds to be used for certain types of construction.**

With this State and Federal support, Texas has constructed a vast system of State highways serving both rural and urban populations that has not been equaled anywhere in the world. And, Texas' share of the Interstate Highway System is larger than any other state's - a whopping 3,215 miles. Approximately 74 percent of all highway travel in Texas is on the State system. The Texas highway system today totals more than 71,000 miles - 168,000 lane miles - of highway that is valued in 1975 dollars at more than \$35 billion. To construct this highway system, the expenditures in real terms have been immense. During the last 20 years (1956-1975) more than \$17 billion in 1975 dollars have been expended and more than 19,000 miles of highway have been added.

Texas has pioneered highway development in both rural and urban areas. Texas' Farm-to-Market and Ranch-to-Market road system, created and partially financed by the Colson-Briscoe Act of 1949,*** is unique. This road system recognizes Texas' special need for adequate transportation services for its widely dispersed agricultural industries and the inability of sparsely settled

* - Texas Constitution, Article VII, Sec. 7-a, Amendment (November 6, 1946).

** - Federal-Aid Highway Act of 1956, c. 462, 70, stat. 374 (June 29, 1956).

*** - General and Special Laws, Texas, Fifty-first Legislature, Regular Session, 1949, Chapter 51, p. 85-86 (March 24, 1949).

Chart 1

TEXAS HIGHWAY TRAVEL

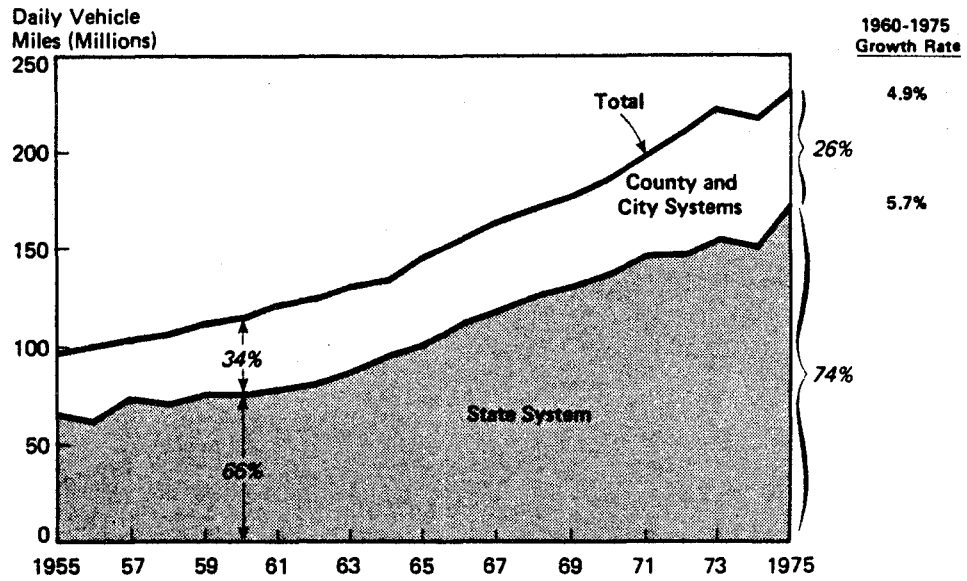
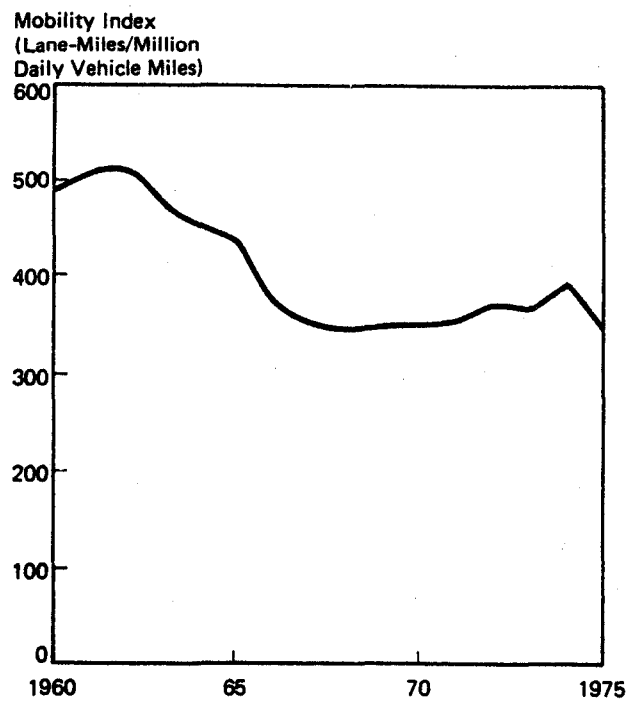


Chart 2

MOBILITY ON URBAN STATE SYSTEM



counties to adequately finance such an ambitious system of obvious benefit to the economic welfare of the total State. In the urban areas, the highway program has sought to support the growth and industrialization of Texas cities. One of the State's first limited-access freeway facilities was the Gulf Freeway in Houston, which opened in 1951 utilizing an abandoned railroad right-of-way. Today the Gulf Freeway serves the huge petrochemical industry along the Houston Ship Channel and is designated as part of Interstate Highway 45 connecting the seaport of Galveston to Houston and points north.

Finally, the Texas highway program is more than just a functional achievement; it has become an aesthetic one. Texas is thought to have constructed the first official roadside park in the nation on SH 71 between Smithville and West Point and has built countless more since the early 1930s. Although not all of its projects meet this distinction, the program has consistently won awards for highway beautification, landscaping, and other amenities. For example, in 1967 the Department received a beautification citation of merit for its wildflower program from the U.S. Department of Transportation.

The Texas highway system today is a striking demonstration of the results attainable through a combination of modern technology, effective administration, and ample reliable funding. It is a state system of roads and highways unequalled in size or quality. Approximately 1,055 communities over 200 in population are served by the highway system, many without any other form of transportation. And, the system is highly efficient in moving people and goods, as evidenced by the fact that 99 percent of all surface travel within Texas is by motor vehicle.

SIGNS OF A CRISIS

By the end of the 1960s, even while highway development efforts continued on an unprecedented scale, problems began to emerge. Several of them seemed to suggest an approaching crisis.

Increasing Traffic Volume

By the late 1960s, the State found itself struggling to keep pace with increases in vehicle travel. Between 1955 and 1969 total travel on the State system more than doubled, from 64 million to 129 million daily vehicle miles, and at the same time accounted for a growing proportion of the State's total travel (Chart 1). This tremendous increase in travel in turn created serious congestion problems, particularly in urban areas. During the same period, urban travel on the State system grew from less than 35 percent to nearly 47 percent of total travel, resulting in a decline in urban mobility (Chart 2). As a consequence, the vast majority of the State highway program's planned projects were designed to deal chiefly with capacity needs.

Chart 3

TEXAS CONSTRUCTION COST INDEX

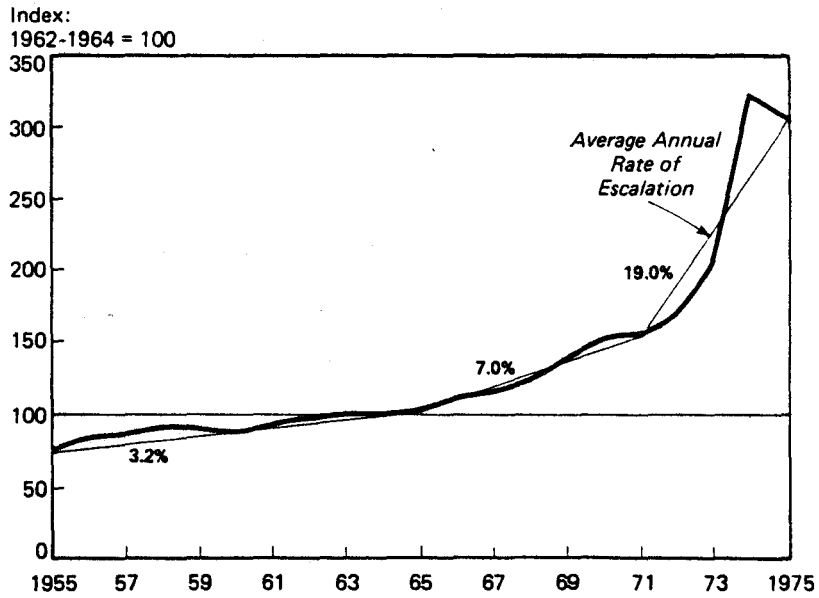
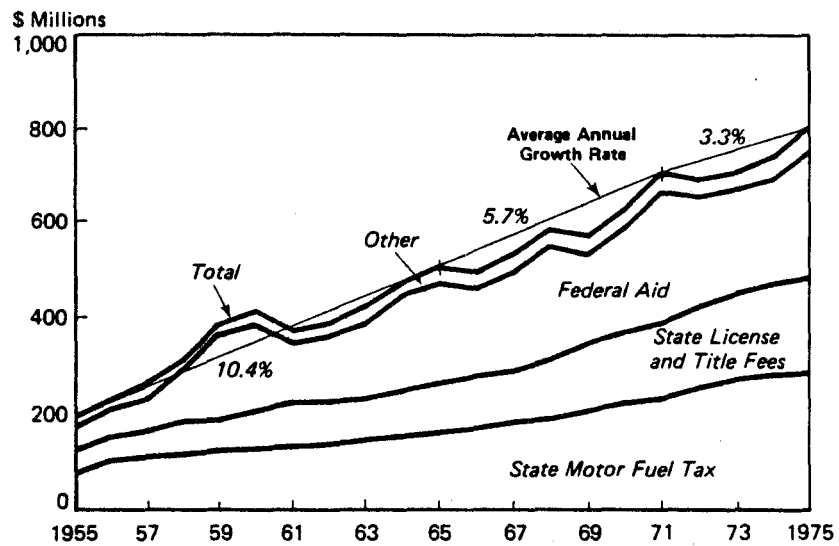


Chart 4

SOURCE OF FUNDS FOR STATE HIGHWAYS



Rising Costs

During the late 1960s and early 1970s, costs rose rapidly throughout the highway program. After a long period of relatively stable prices, the Texas Construction Cost Index began climbing, gradually at first and then at an alarmingly rapid rate (Chart 3). Whereas construction costs increased an average of 3.2 percent between 1955 and 1965, the annual rate of increase between 1965 and 1971 rose to 7.0 percent, and between 1971 and 1975 the rate soared to an average of 19.0 percent. As a result of this inflation, the cost for a project planned in 1971 was doubled by 1975, and the cost of a project planned in 1965 was a full three times higher in 1975, just 10 years later.

Leveling Off of Revenue Growth

Until recently the Department was able to rely on a steadily rising level of revenue to keep pace with ever-increasing transportation needs and with inflation (Chart 4). During the past 2 decades, automobiles increased in numbers, weight, and fuel consumption. One result was a direct increase in revenue from licensing fees, which are based on vehicle weight. In addition, of course, heavier cars burn more fuel, so increases in vehicle weight generally reduced miles per gallon. Fuel efficiency was further reduced by the increased use of air conditioners, inefficient antipollution devices, and increasingly higher travel speeds. As a growing number of cars consumed more fuel per mile, and as Texans drove more miles each year on the State's expanding highway system, revenue from fuel taxes also increased. As a result, revenues from State sources grew at an average rate of 6 to 7 percent per year. Because that rate far outstripped the rate of inflation, funds were available to meet the increasing highway needs.

But by 1968 the relationship was reversing: fewer effective dollars were becoming available to meet the requirements of a still-growing population of highway users. Inflation, which during most of the 1960s averaged a low 3 percent annually, was beginning to rise. The tax base (size of vehicle fleet and number of gallons consumed) was not increasing at the same rate.

Infrequent changes in the tax rate compounded the effect of this trend. Since fuel taxes are based on gallonage consumption rather than price, their growth is dependent on continuing growth in fuel consumption or on regular increases in the tax rate, but the last State fuel tax increase occurred in 1955. Furthermore, the last change in registration fees was in 1957. In addition, a number of forces were acting to divert the available funds from new highway construction. Within the Department, the increased cost of operating and maintaining the existing system was limiting the number of dollars available for construction and right-of-way purchases. On the outside, the Department of Public Safety was requiring

Chart 5

STATE HIGHWAY EXPENDITURES FOR CONSTRUCTION AND ROW

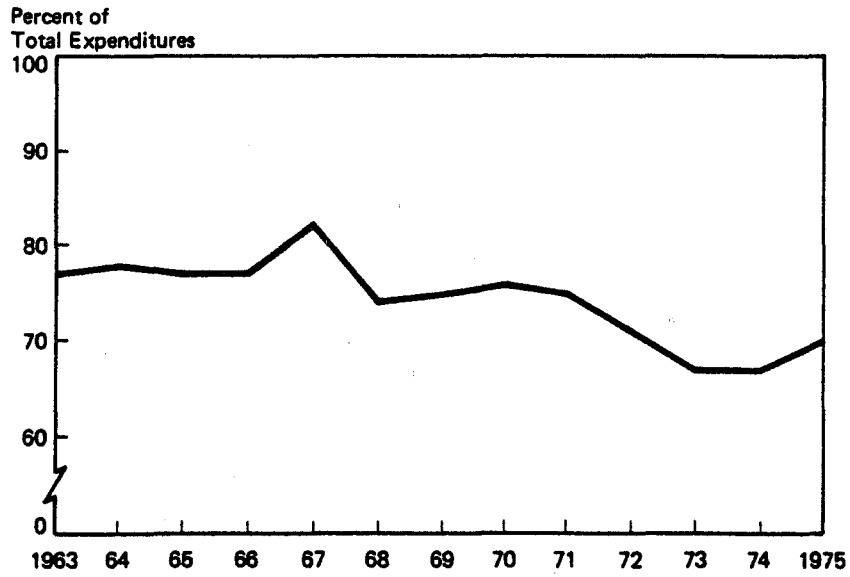
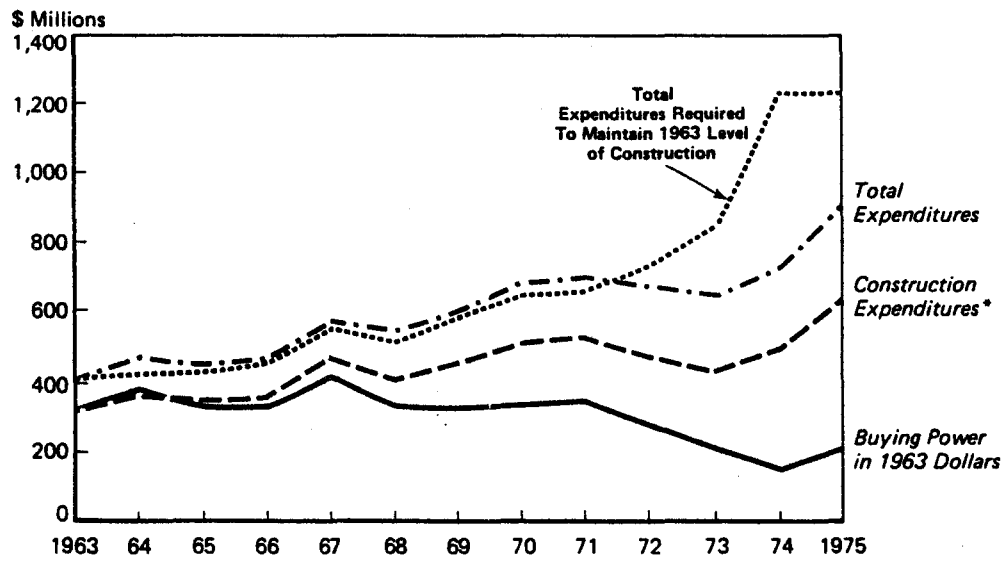


Chart 6

BUYING POWER OF CONSTRUCTION FUNDS



* - Including ROW acquisition and rehabilitation

a greater share of highway funds, thus reducing funds available for the highway program. As a result, expenditures available for construction and right-of-way began to decline (Chart 5).

The combined effect of inflation and the diversion of funds to nonconstruction programs has reduced the purchasing power of available construction funds to less than half the 1963 level (Chart 6). In fact, funds would have to have increased by more than \$300 million in 1975 just to have maintained 1963 purchasing power.

Furthermore, the level of future revenue is now highly uncertain. The recent threat of fuel unavailability has brought Federal pressure for dramatically increased fuel efficiency. The Federal Government has sought to reduce fuel consumption by lowering the speed limit to 55 miles per hour.* More specifically, the Energy Policy and Conservation Act of 1975** requires that 1980 model-year vehicles achieve fuel efficiencies 40 percent better than the efficiencies of 1974 model-year vehicles. To meet that requirement, the automobile industry has undertaken a twofold approach to improving fuel efficiency. First, it has emphasized the production of lighter vehicles; second, it has undertaken across-the-board improvements in engineering and design, which have improved the efficiency of vehicles in all weight categories. This emphasis on fuel efficiency will eventually affect the major sources of State highway revenue. As vehicles become more fuel efficient, State fuel tax revenues are likely to decline. Incoming revenue from the Federal Government could also be in jeopardy: a decline in fuel taxes collected by the Federal Government will likely affect the monies returned to the states under the Federal-Aid Highway Act. Finally, as more vehicles of lighter weight are introduced into the fleet, license fee revenues from passenger vehicles are likely to decline if the basis for determining fees is not changed.

Growing Frustration

The cumulative effect of these pressures was a rising level of community and staff frustration. Many highway projects that had been announced publicly were falling years behind schedule. As a result, many property owners along publicly announced new routes were left holding property that could not be either developed or disposed of, but that required tax payments for extended periods of time. When hardship resulted, the State purchased the property, tying up significant sums of money

* - Federal-Aid Highway Amendments 1974, National Maximum Speed Limit, P.L. 93-643, Section 114 (A): 88 stat. 2286 (January 4, 1975).

** - Energy Policy and Conservation Act, P.L. 94-163, Section 502 (A)(1): 89, stat. 871, p. 902 (December 22, 1975).

on projects increasingly unlikely to be built for many years. And, when a project finally did approach the construction stage, much of the early engineering work had to be redone to accommodate changing needs and design policies as well as new environmental requirements. Between 1960 and 1975, the average time from project initiation to contract letting more than doubled, from slightly more than 3 years to nearly 8 years, even for projects for which funds were available. By 1975 the backlog contained projects in very advanced stages of planning valued at more than \$3 billion, many of which probably could not be constructed for 10 years or more - if ever.

At the same time, communities were demanding more facilities to serve the growing Texas population. For example, in June 1975 a delegation from Houston requested that the State Highway and Public Transportation Commission expedite the construction of projects already in the planning stages that totaled approximately \$2.5 billion. And, the State Highway and Public Transportation Commission received requests for additional construction in 1975 totaling more than \$2 billion.

The momentum of the highway program was clearly slowing. The increased number of residents who appeared before the Commission reflected the communities' frustrations, while the Commissioners themselves felt the frustration of being unable to promise with certainty the completion of many projects.

BLEAK OUTLOOK FOR THE FUTURE

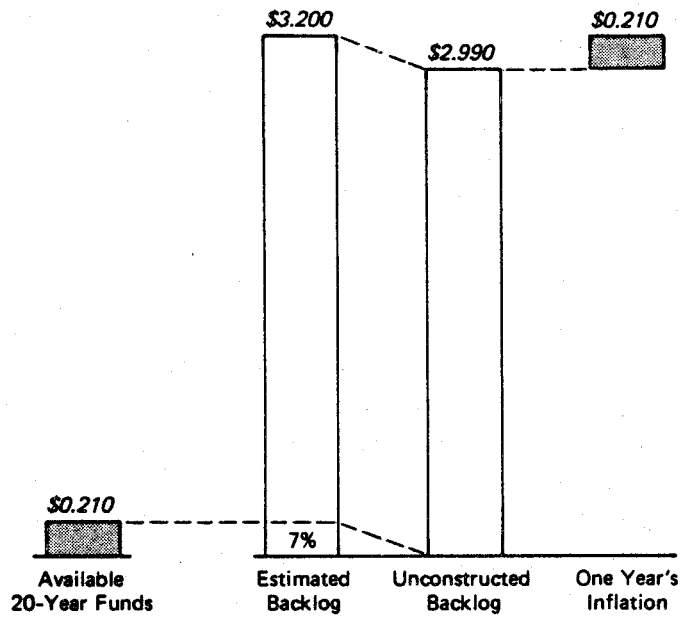
Despite the visible signs of trouble, there was no consensus, even among highway professionals, on the magnitude of the problem and on what action should be taken, if any. Some held the view that there were few real causes for concern, citing the still-growing highway system as evidence. Others argued that, even if there were a short-term problem, either inflation would subside and revenues would not decline substantially or the legislature would surely come willingly to the aid of the program with increases in the gasoline tax. Still others were increasingly apprehensive about the growing backlog of projects.

Against this background of uncertainty, the joint State Department of Highways and Public Transportation/McKinsey & Company project team undertook a preliminary analysis to gain an understanding of the forces acting on the highway program and to assess their potential impact. This preliminary analysis confirmed that the problem was indeed a real one and that the outlook for the future was far from bright. The State's existing backlog of committed projects was found to be valued at nearly \$11 billion in 1975 dollars - up from previous estimates of \$5.2 billion - and that figure included no allowance for future projects that would

BACKLOG/FUNDS COMPARISON

HOUSTON DISTRICTS

(Billions of 1975 Dollars)



undoubtedly be requested. Furthermore, public transit seemed unlikely to have any near-term effect on overall highway needs. An examination of trends in funding indicated that funding levels in the future would be much lower. The funding for construction expected over the next 20 years with current sources of revenue and levels of taxation would almost certainly be less than \$2 billion in 1975 dollars, and even large increases in gasoline taxes would not close the gap between needs and revenue because of the declining rate of fuel consumption. And, by the early 1980s Texas would be unable to meet State matching requirements for Federal highway programs, further reducing the amount of revenue available to meet State needs. As a result, Texas' "needs/revenue gap" was estimated to be approximately \$9 billion and growing. More highway dollars simply would not be available to rescue the program, yet construction costs would continue to escalate, inflating the cost of the State's already large backlog of projects. In fact, unless some action were taken, the backlog of planned projects would continue to grow faster than the available funds.

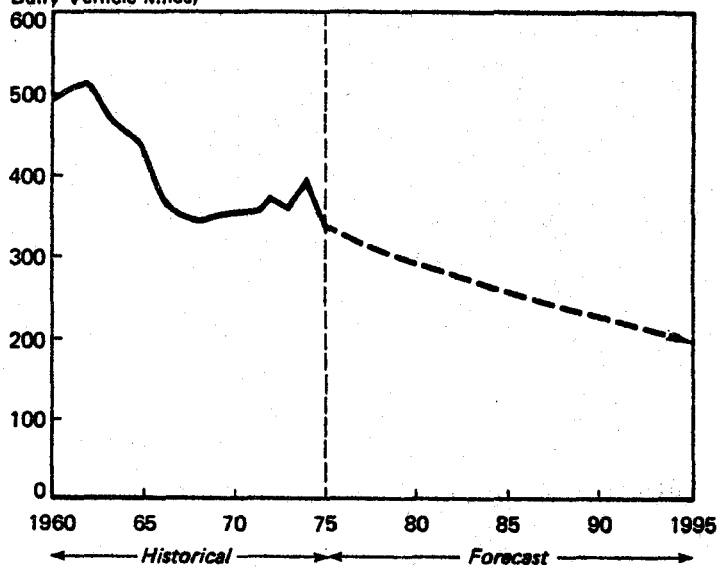
The impact of these trends on the already congested urban highway system could be seen in the projects planned by District 12 and the Houston Urban Project, covering the eight-county greater Houston area (Chart 7). When the historical proportion of departmental expenditure in the greater Houston area was extrapolated into the future assuming the current revenue outlook, expenditures valued at approximately \$210 million were expected to be available for a 20-year period. At that level the Houston area - which had accomplished so much over the years - would be able to construct only 7 percent of the districts' \$3.2 billion backlog. The remaining projects, totaling nearly \$3 billion, would be left unconstructed. At current rates of inflation, the entire 20-year expenditure would be only slightly more than 1 year's inflation on the remaining backlog.

The implications of this analysis were serious. Even with no new commitments and aggressively controlled cost escalation, many committed projects could probably never be financed. If this were true, much of the backlog would never be built. Yet the design and selection of projects for many routes were based on the assumption that other parts of the highway system would eventually be in place. Aggravating this situation was the tendency to start many projects in the inventory, rather than to complete entire routes as single units, in order to reduce the pressures created by various local groups to construct their favored projects. The effect on the highway program and on the performance of the highway system would be damaging:

- ¶ An incomplete system. With projects started on many routes but few completed, the system would be left fragmented. Many benefits from investments already made - at great public expense - would not be realized without a completed system.

MOBILITY ON URBAN STATE SYSTEM

Mobility Index
(Lane-Miles/Million
Daily Vehicle Miles)



- ¶ Inefficient use of funds. Funds would have been spent for projects that would not be completed in the foreseeable future. Right-of-way would have been acquired and design efforts begun on projects that could not be completed for lack of sufficient funds for construction. These investments in effect would never yield returns to the taxpaying public.
- ¶ Further slippage in project schedules. Even for those projects that could be built, substantial delays would occur since funds would likely be well below the original targets by which projects had been programmed.
- ¶ Physical deterioration of the system. Without sufficient funds, Texas would not be able to maintain the existing system in an adequate state of repair. By the middle 1980s, the \$35 billion highway system would begin to deteriorate.
- ¶ Continued decline in mobility. Finally, the decline in mobility that began in the early 1960s would not be reversed. Mobility would continue to decline (Chart 8).

If Texas were to continue to improve - or even maintain - its highway system, something had to be done to increase the effectiveness of the available highway dollars and to develop an understanding of the need for additional highway funding. This would not be easy because the Department had already demonstrated that it was an effective public works organization and the people of Texas had expressed strong opposition to tax increases of any kind.

THE CHALLENGE

In view of the results of the preliminary analysis, the joint study team began an intensive effort to reevaluate the existing highway program. Its objectives were twofold:

- ¶ To find solutions to the immediate, interrelated problems of a large project backlog, rapidly escalating costs, and lengthy project delays by fundamentally changing the way the State of Texas planned and built highways
- ¶ To thoroughly evaluate the current financial outlook and to seek financial solutions for meeting the revenue requirements of Texas' transportation system.

The study team sought changes that would reduce frustration both within the Department and among the general public and would lead to a functioning, balanced, and complete highway system.

Reaching these objectives would not be a simple task. The highway system is a complex network fashioned by thousands of individual decisions and millions of pieces of data, and this complexity would pose analytical problems. In addition, it would be difficult for highway planners who had accomplished so much in the past to review their present and future performance critically and to admit that, unless something were done, much less would be accomplished in the future. Furthermore, the rapidly changing environment would make it difficult to forecast future revenues based on historical trends, and creativity would be required to find ways of providing revenue that would effectively keep pace with inflation.

The remainder of this report describes how the challenge is being met. It required a two-pronged approach: one side was the development of a more limited, balanced means of planning a highway system while the other was the increasing of available revenue. Subsequent chapters describe this approach and the processes and procedures that were developed to control and implement it.

2 - CHANGING THE WAY HIGHWAYS ARE PLANNED

The Texas highway program's initial success was achieved through the dedicated efforts of talented, practical engineers employing the best of technologies. Planners and designers devoted efforts to building a system of the highest quality, envisioned in an unwritten "master plan" that centered on the State's metropolitan freeway systems and extended to important interregional routes connecting the State's far-flung centers of agriculture and industry. For example, it was assumed that many interregional routes would ultimately be developed to at least a minimum 4-lane standard; among these were the US 59 - US 77 corridor from the Texas-Arkansas border in the north to the Rio Grande valley in the south. Few ever doubted that the plan would be completed - until forced to do so by the realities of limited funding and rising costs. It was only then that the limitations of the traditional approach to highway design became apparent.

This chapter describes the traditional, project-oriented approach; shows how this traditional approach led to the problems outlined in Chapter 1; and suggests how a new planning approach can provide greater benefits from the highway system as a whole.

THE TRADITIONAL PROJECT-ORIENTED APPROACH

In Texas, as in most states, planners and designers approached their objective of building a safe, efficient, and complete highway system by constructing, on a project-by-project basis, the highest quality pieces of the system. This project-oriented approach to highway development was carried out through a planning process that involved essentially five steps.

1. Identify desired improvements in the State highway system. Proposed improvements in the highway system generally began with: a public request in the form of a delegation appearing before the Commission; correspondence from concerned citizens; formal public hearings; or discussions among local elected officials, community leaders, State legislators, and the appropriate district engineer. Once a potential improvement was identified, the Commission assessed the need for this improvement relative to other proposed improvements and authorized planning through one of four possible stages: (I) advanced planning or a feasibility study; (II) location surveys and the determination of right-of-way; (III) the preparation of right-of-way data; and (IV) plans, specifications, and estimates (PS & E).

2. Design projects in response to the desired improvements. A planning authorization automatically triggered the development of a response. Each project was designed to meet the Department's explicit criteria regarding safety, capacity, and structural adequacy - not only for today's conditions but also for those forecast to exist 20 years following construction.
3. Begin active planning on projects. In preparation for construction, project planning was actively begun. The scope of the planning effort on any project depended on the Commission's authorization and would include, as appropriate, route studies, detailed designs, formal public hearings, the preparation of environmental impact data, and the protection of right-of-way.
4. Program projects for construction. Before a specific project was let, and generally before it was authorized to PS & E, it was combined with other projects into a proposed construction program. Projects were combined so that the total cost of the program was indirectly related to anticipated sums of State and Federal highway funds for a 2- to 3-year period. The general procedure for selecting projects was to divide the anticipated funds among the State's 25 districts, allowing each of the district engineers to select projects which totaled that district's allotted funds. The Commission then approved the size and content of the overall program and in this way attempted to control the number and size of projects in the project development pipeline. Once a project was included in a program, or "financed," it was considered eligible for right-of-way acquisition and contract letting and, if not already at the PS & E stage of planning, was immediately authorized to proceed to that stage.
5. Schedule projects for construction. As funds became available, programmed projects that had completed the PS & E stage and therefore had satisfied any environmental regulations, right-of-way requirements, or Federal Highway Administration (FHWA) directives were selected and scheduled for construction. The engineer-director set priorities for the letting schedule after considering the recommendations of the district engineers on quantitative technical measures (safety, capacity, structural integrity), as well as on more qualitative issues (environmental, political, commercial, and social).

This project-by-project approach was highly effective in the early stages of the highway program, as evidenced by the accomplishments discussed in Chapter 1. But it rested on the assumption that sufficient funding would be available to construct all planned projects and that a complete system eventually would result.

When, in the early 1970s, funding growth slowed, project lead time doubled, and cost escalation rates tripled, it became apparent that this assumption was no longer valid. This realization in turn revealed the limitations of the traditional approach to highway planning.

LIMITATIONS OF THE TRADITIONAL APPROACH

A major reason for the State's mammoth backlog of unconstructed projects was found to be the planning process itself and its inability to adapt to the rapidly changing environment. By authorizing numerous projects, requiring broad-scoped designs for them, and allowing large numbers of projects to reach the detailed design stage, without regard to available funding, the traditional planning approach was creating a highway program so large in size and scope that it could never be completed. Thus, the State was faced with an increasingly large and unmanageable backlog - one that totaled an estimated \$11 billion by 1975.

Too Many Projects Authorized

Because an argument could be made for almost any improvement in the highway system, the Commission found it difficult to refuse any reasonable request by the public. Whenever interested parties could muster sufficient support to persuasively argue that a desired improvement was attractive from the affected community's point of view, the Commission generally authorized the project.

During the 1960s there was little motivation to critically assess the validity and relative necessity of a proposed improvement that would correct a highway deficiency. Rather, because the Department had a revenue source that was growing during a period of relatively low inflation and therefore was expanding in real terms, there appeared to be few projects desired by the public that the Department could not afford to build. In fact, the Department sometimes lacked a sufficient supply of projects in the development pipeline to effectively employ construction funds as they became available.

Furthermore, the Department generally failed to evaluate proposed improvements in relation to the highway system as a whole. Decisions were made without rigorous knowledge of the total number and estimated cost of projects planned elsewhere on the highway system and what effect the proposed project might have on other projects already being planned.

Therefore, the Commission turned down very few projects. It did occasionally specify that projects would be built only "when traffic volumes warranted" or "when funds became available" - a device it used more frequently as the symptoms of the

financial crisis became apparent. Nevertheless, through a series of somewhat arbitrary, separate decisions regarding highway adequacy, planning was begun on a large number of projects even if construction was not anticipated in the near future.

Large, Rigid
Responses Required

The Department's approach to developing designs for the authorized projects could be described as deterministic - meaning that the possible range of solutions was largely predetermined by the Department's own strict standards, policies, and procedures.

Because of Department procedures, a designer often had to propose a large, costly design where a simpler design might have been possible. For example, the State Highway and Public Transportation Commission sometimes dictated a free-way or 4-lane divided design regardless of whether traffic volume or other considerations made that scope necessary.

In addition, Department policy dictated that proposed projects meet not only current traffic needs but also needs projected 20 years into the future. By forcing a designer to size a facility for far-distant needs, a large number of high-capacity designs were proposed for projects that would not need that scope for many years.

Finally, some of the Department's own standards and practices precluded creative, low-cost solutions to highway needs. For example, designers were not always free to vary median widths, shoulder widths, or design speeds below fixed standards, which were often set above accepted national standards.* Furthermore, the high standards established for the Interstate Highway System often influenced the design of projects on lightly traveled routes of lesser importance as planners, accustomed to designing Interstate facilities, included many of the same features.

Thus, designs were developed following rigid criteria. This design process had its advantages, particularly since the criteria could be applied readily and uniformly throughout all districts in the State and would ensure that certain Federal design requirements for Interstate highways were met. Nevertheless, because the criteria focused on the type and quality of the design rather than on its cost, they

* - The American Association of State Highway and Transportation Officials (AASHTO) sets standards for highway design that are generally accepted as the national standards by state and Federal highway administrators. In fact, the Federal Highway Administration has adopted these standards for all federally participating projects.

inevitably led to large numbers of expensive solutions. In Houston, Dallas, Fort Worth, and San Antonio, for example, the vast majority of backlogged projects are freeways, and some are large facilities that will probably not even approach their design capacity for 15 - 20 years. By forcing high-cost designs for almost all proposed projects, the Department's deterministic approach greatly enlarged the cost of the backlog.

A secondary effect of this deterministic approach was that it limited the role of communities in determining the scope of projects in their area. Even when local groups favored modest designs for authorized projects, established design criteria typically prevailed. Ironically, while a community could not limit the scope of a project, it could broaden the scope. Because funding was not a specific consideration during the design of projects, many costly features and amenities could be included after the fixed design standard had been met if their inclusion would help gain design acceptance and local approval at the public hearings.

Too Many Detailed Designs Prepared

By the 1970s, the Department's control over the number and cost of projects in the PS & E stage of development had proved to be ineffective. A growing number of projects were being held at that stage because funds were not available to construct the projects as scheduled.

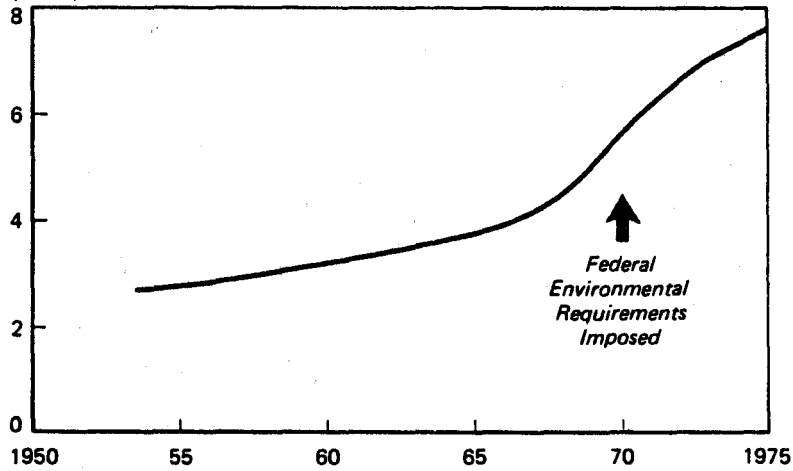
The Department's right-of-way policy contributed to the large number of projects in the final design stage. Under current Departmental policy, counties share with the State the cost of acquiring the necessary right-of-way.* Frequently, portions of projects were programmed to permit the Department to begin early right-of-way acquisition and to encourage a county to raise the funds necessary to purchase its share of the right-of-way (usually by a bond issue). This policy was established to ensure the timely acquisition of right-of-way and to test the local commitment to constructing a requested project. But this policy also had the effect of initiating detailed planning on a large number of projects.

However, the Department's major problem was in not accounting for the effects of longer lead times and inflation on its programming process. The Department's traditional programming process worked well during the 1960s when inflation was low and project development lead times were short. However, lead times soared after the mid-1960s when the Department first expanded public involvement in its planning and later when Federal environmental requirements

* - Except on Interstate projects, for which right-of-way is purchased entirely with State and Federal funds.

PROJECT DEVELOPMENT TIME

Time From Project
Initiation Until
Contract Letting
(Years)



Source: State Department of Highways and Public Transportation records

were imposed (Chart 9). As a result, many programmed projects could not be readied for contract during a program's life (generally 2 years) even if the early stages of planning were already completed when a project was programmed.

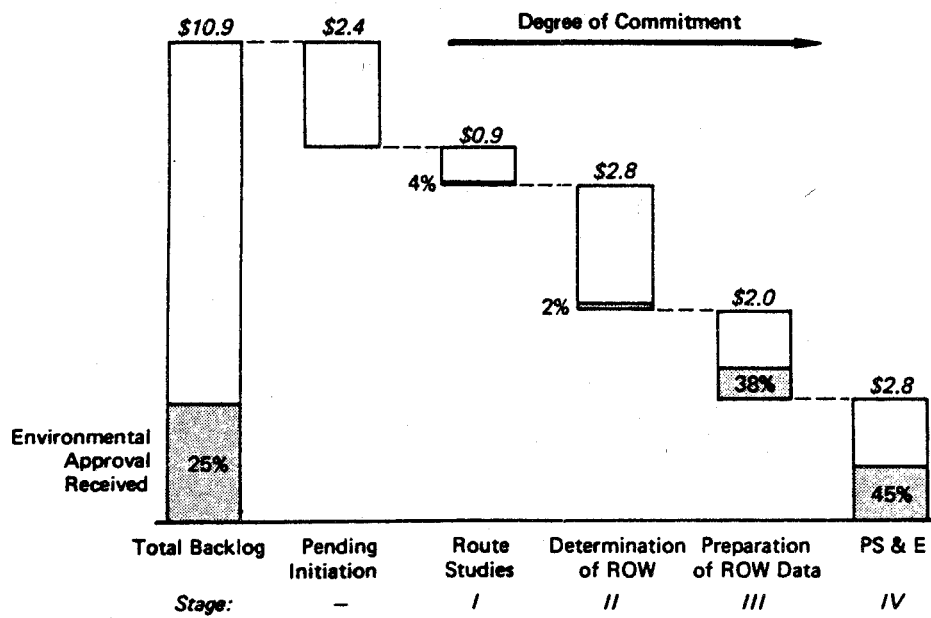
By the late 1960s, too few projects were completing the PS & E stage. This was attributable not only to the lengthened project lead times but also to the proliferation of Federal funding categories, each with different criteria, which made it difficult to have projects ready to meet these varying requirements. Therefore, for a brief period the Department included more projects in each program than could actually be built with the funds estimated to be available in the hope that enough projects would reach the final design stage. As a result, detailed planning was initiated on a large number of projects, and for a brief time a reasonable supply of ready-to-let projects was ensured.

But by the 1970s, the supply grew to an enormous size because the Department had not considered the effects of inflation on its estimates of funding. Under traditional procedures, a program's size was established by estimating the approximate amount of money to be available for construction over a specific time period (generally 2 years). This estimate was prepared without explicit regard for the effect of inflation on the buying power of the future dollars. The future dollars were simply totaled, and projects were selected using then-current cost estimates to form a program totaling the same amount. (The Department did sometimes set aside a portion of the program for "overruns," but this amount was not analytically established on inflation expectations and was frequently later allocated to new projects added to the program.) However, because of inflation, future dollars would buy less and could build fewer projects than were originally included. Thus, more projects were being programmed and advanced to the PS & E stage than could be constructed within the program's 2-year horizon. Completely designed projects were left waiting to be let to contract, resulting in wasted design efforts, premature acquisition of right-of-way, and broken commitments.

Another problem in the Department's programming process was that projects left unconstructed after the available dollars were expended were not included in the subsequent program. The project development process might have remained in better balance if the unconstructed projects from previous programs had been reestimated and included in the next program. Instead, the programming process began anew, matching the estimated costs of a totally new slate of projects with an anticipated funding sum. As a result, the unconstructed projects from the earlier year remained unconstructed - and the new program probably also contained more projects than could be constructed within that year's funding constraint.

PROJECT DEVELOPMENT STATUS

(Billions of 1975 Dollars)



The leftover designed projects continued to grow both in number as more programs were created and in size as inflation continued unabated. By 1975 nearly \$3.0 billion in projects were authorized to the PS & E stage (Chart 10). This total represented a massive overcommitment on the part of the Department because projects in this final stage generally heightened the expectation both inside and outside the Department. And, it represented a waste of design effort: because this large backlog of designed projects could not be built for many years, new design standards and environmental regulations frequently made original designs obsolete, and designs had to be redone. Furthermore, the Department's right-of-way inventory on new locations had grown to a total cost of nearly \$200 million, tying up funds that could not be used to construct critically needed projects.

Unlimited Funding Assumed

It was after projects had been authorized, designed, and incorporated into a construction program that funding really became a consideration - and then only for scheduling purposes. The Department operated on the underlying assumption that sufficient funding would eventually be available to complete each high-quality response added to the inventory. Consequently, project design was determined by a fixed standard of quality and was not influenced by the amount of funding available. Furthermore, time was not a major factor in the planning process, nor was there any explicit deadline for completing the program.

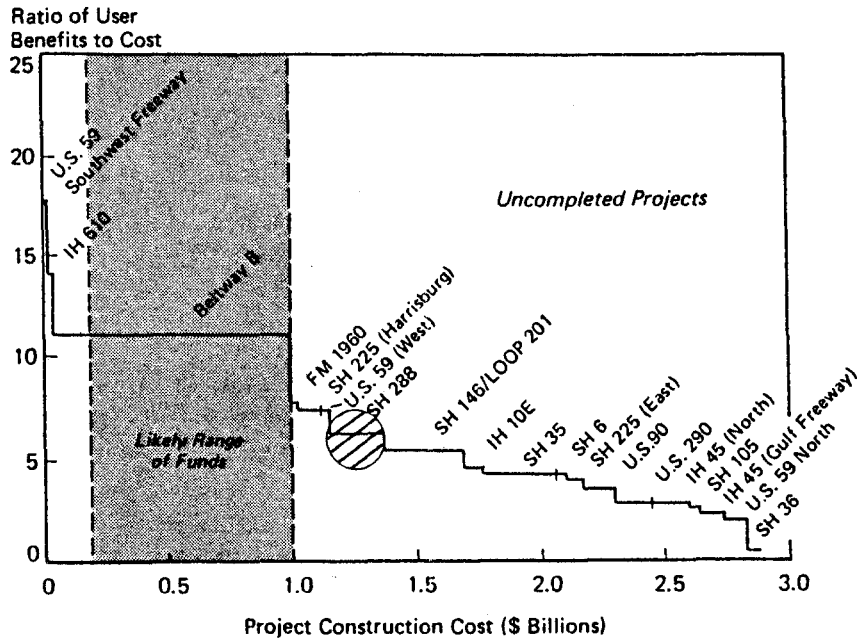
In fact, the Department's assumption of unlimited funding proved to be the major shortcoming in the planning process. The Department failed to establish a financial constraint on the size of the highway program while adhering to its rigid design process, which forced large-scale project designs. At the same time, inflation rose at a rapid rate; between 1971 and 1975 inflation alone doubled the cost of projects in the backlog. The combined effect of inflation and the Department's assumption was to create a backlog of projects out of all proportion to the available funds. This situation in turn created a kind of "perpetual motion" planning process. Projects were authorized as the public made requests to the Department, many projects were designed in detail, and some projects were removed and constructed as funds became available, but the dollar value of the projects remaining to be built grew ever larger.

The Houston metropolitan area illustrates the overall effect of this project-oriented planning process. In that area, projects totaling \$3.2 billion were planned, but funds in the range of only \$210 million to \$1 billion were likely to be available over approximately 20 years. If projects were to be constructed out of the highway inventory according to how greatly they benefited highway

BENEFIT/COST RATIO: PROJECT-BY-PROJECT APPROACH

Houston Districts Project Backlog

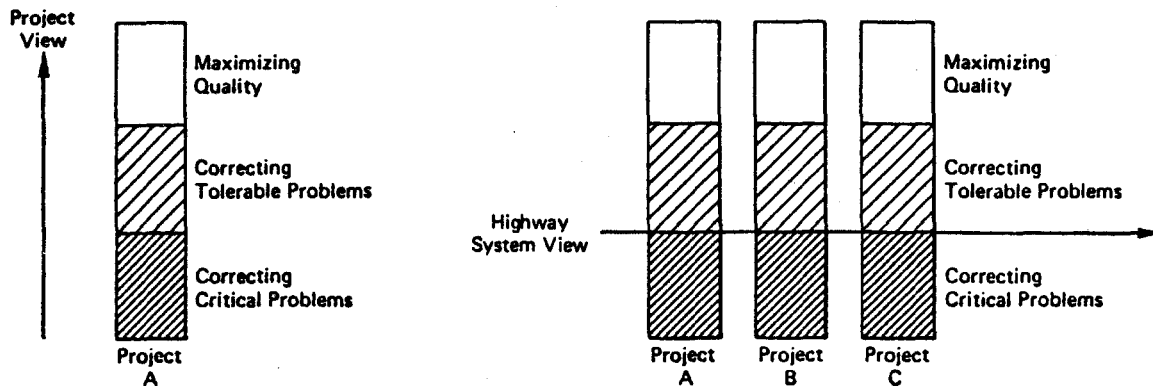
EXAMPLE



TWO BASIC VIEWS OF THE HIGHWAY PROGRAM

1. Project View – Maximize the benefits from each individual project

2. Highway System View – Maximize the benefits from the highway system



users, many projects would be incomplete after 20 years, leaving numerous gaps in the area's highway system (Chart 11). In addition, substantial investments in portions of the system would be generating few benefits because critical links would be missing. As one example, the freeway development on SH 288 from downtown Houston to Lake Barbara in the south would be left uncompleted, thereby reducing the value of those portions of SH 288 already under construction. Although right-of-way has been acquired, design efforts begun, and grading, excavation, and structures completed in several locations, the public would realize little value from this activity even after 20 years because the entire project would not have been completed.

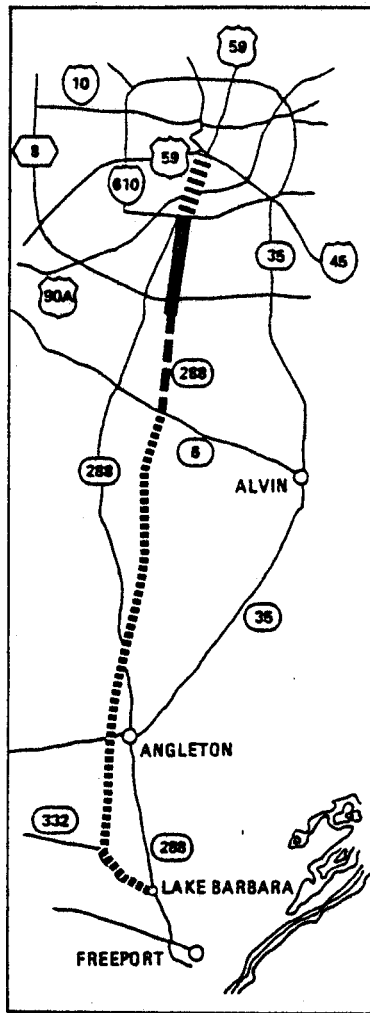
NEEDED: A SYSTEM-ORIENTED APPROACH

Today the realities of limited funding and rising costs create a different environment and force a less ambitious but more realistic objective: to develop a balanced system within a foreseeable time horizon - a system that can be funded and controlled. With funds for highway construction limited and a large backlog of deficiencies uncorrected, the State can no longer construct "ultimate" - and costly - facilities on a project-by-project basis in accordance with fixed highway system performance. Instead, Texas needs to adopt a more modest approach - one that attempts to do the best possible job with the money that is likely to be available. This in turn implies that Texas should not build toward an "ideal" highway system to be completed in the distant future, but instead should seek to develop a practical system that will be reasonably complete at any given time. To do that, Texas must focus on maximizing system benefits rather than individual project benefits. The objective of the highway program has to be redefined, from "construct needed projects over an unlimited time horizon" to "develop a balanced system within a foreseeable time horizon - a system that can be funded and controlled."

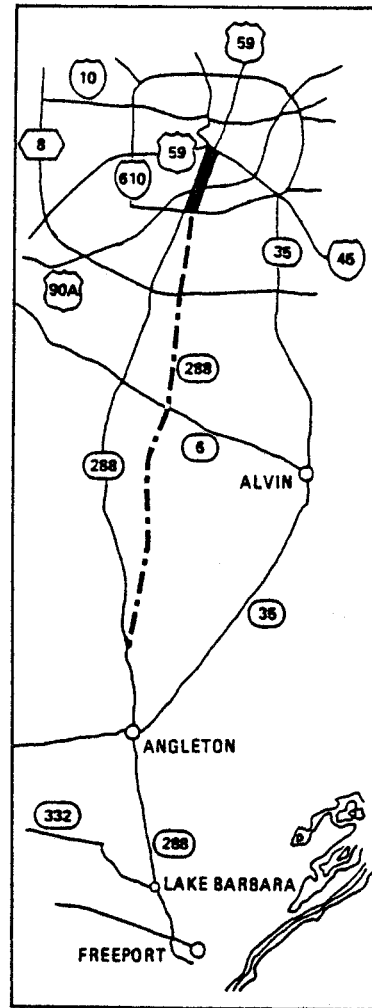
The need to design for maximum system benefits requires a shift in focus from the traditional "project view" to a broader "highway system view." This view recognizes that, in a situation of limited funding, greater value may be obtained by allocating funds in a balanced manner rather than concentrating them in a few problem areas. In other words, by implementing modest solutions to critical problems in several locations, the State is likely to realize greater benefits from its highway expenditures than by completing ultimate solutions in a few locations (Chart 12).

ALTERNATIVE PROJECTS FOR SH 288

"CADILLAC" for \$222 Million



"FORD" for \$82 Million



	4-Lane Freeway
=====	8-Lane Freeway
-----	6-Lane Freeway
.....	4-Lane Freeway
-----	4-Lane Expressway
- - - - -	2-Lane Expressway

An example will illustrate what can be achieved when a project is approached using the highway system view. Route SH 288 from US 59 in downtown Houston to near Lake Barbara, which connects Houston to the growing seaport and industrial complex in Freeport, was considered inadequate for growing traffic needs. To replace the existing facility, which was primarily 2-lane highway, new freeway construction costing about \$222 million was proposed. However, an analysis of the function of the route and the volume of traffic it would serve suggested that new freeway would not actually be required over the entire length of the route for several years. Rather, the area of most critical need is near downtown Houston where existing traffic volumes are highest (25,000 to 35,000 average daily traffic, compared with 7,500 on southern portions of the route) and a significant investment has already been made in preparation for construction.

Because a full freeway will not be needed in the near term, other possible design alternatives should be open to the designer. A comparison of two possible alternatives suggests the range of possibilities (Chart 13).

1. "Cadillac." Building a full freeway as currently planned would cost \$222 million and would accommodate traffic for more than 20 years.
2. "Ford." Constructing 8 lanes of the full 14-lane freeway near downtown Houston, building 4-lane and 2-lane expressway facilities to the south, and in some locations utilizing part of the existing 2-lane facility would cost about \$82 million. Except for rush-hour peaks near the downtown Houston area, this would adequately serve projected traffic for at least 10 to 15 years.

From a project viewpoint, the \$222 million "Cadillac" freeway would be the best solution because it would serve a larger volume of traffic and would probably have less congestion and fewer accidents than the "Ford" alternative. However, the highway system view led to a different conclusion, since it took into account the fact that any portion of these funds not used on SH 288 could be applied to deficiencies on other routes throughout the State. The same \$222 million could buy nearly three freeway and expressway combination improvements at \$82 million each. And while the full freeway would result in higher total user benefits for SH 288, total statewide user benefits for the highway program would be considerably higher under the combination alternative since deficiencies in more locations could be corrected (Chart 14). For example, by reducing the scope of some projects, many more projects could be constructed in Houston with funds likely to be available - including SH 288 (Chart 15). If funding were available to correct all deficiencies, then the \$222 million ultimate solution might be justified. But with

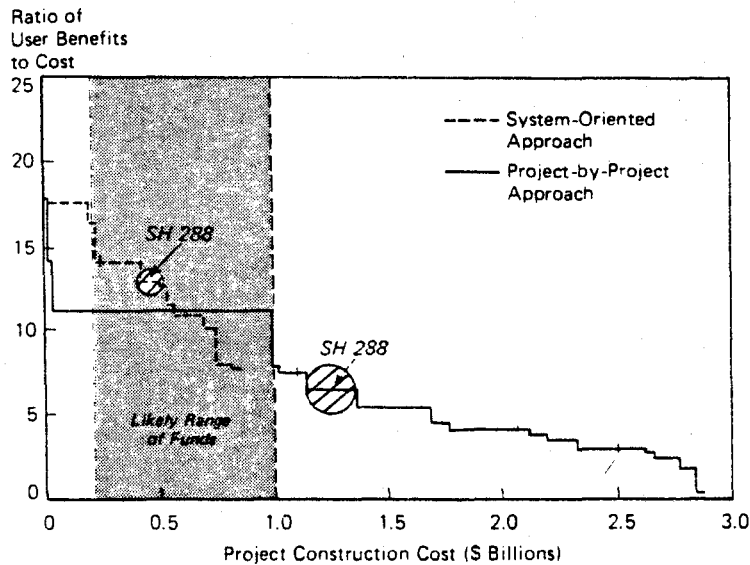
SYSTEM PLANNING WITH LIMITED FUNDS

Example: SH 288

(From US 59 in Houston to Lake Barbara)

Design Alternative		Project View (\$ Millions)				Highway System View (\$ Millions)					
Scope	Cost (1975 \$ Millions)	Accident Savings (All Severities)	Congestion Savings	Vehicle Operating Savings	Total User Benefits	Number of Projects Financed by \$222 Million	System Accident Savings	System Congestion Savings	System Vehicle Operating Savings	System Total User Benefits	Ratio of User Benefits to Cost
"CADILLAC" As proposed 14F, 8F, 6F, 4F	\$222	\$56 (6,500 fewer incidents in 1990)	\$713 (65,750 vehicle-hours daily in 1990)	\$60	\$824	1.0	\$56 (6,500 fewer incidents in 1990)	\$ 713 (65,750 vehicle-hours daily in 1990)	\$ 60	\$ 824	6.3
"FORD" Downscoped 8F, 4E, 2E, 2C	\$ 82	\$31 (3,775 fewer incidents in 1990)	\$538 (50,000 vehicle-hours daily in 1990)	\$50	\$618	2.7	\$83 (10,200 fewer incidents in 1990)	\$1,453 (135,000 vehicle-hours daily in 1990)	\$135	\$1,668	12.8

BENEFIT/COST RATIO: SYSTEM-ORIENTED APPROACH



many projects competing for funds, it clearly makes sense to buy three "Fords" instead of one "Cadillac." By so doing, the same funds can be used to purchase many more times the amount of basic - albeit more modest - transportation.

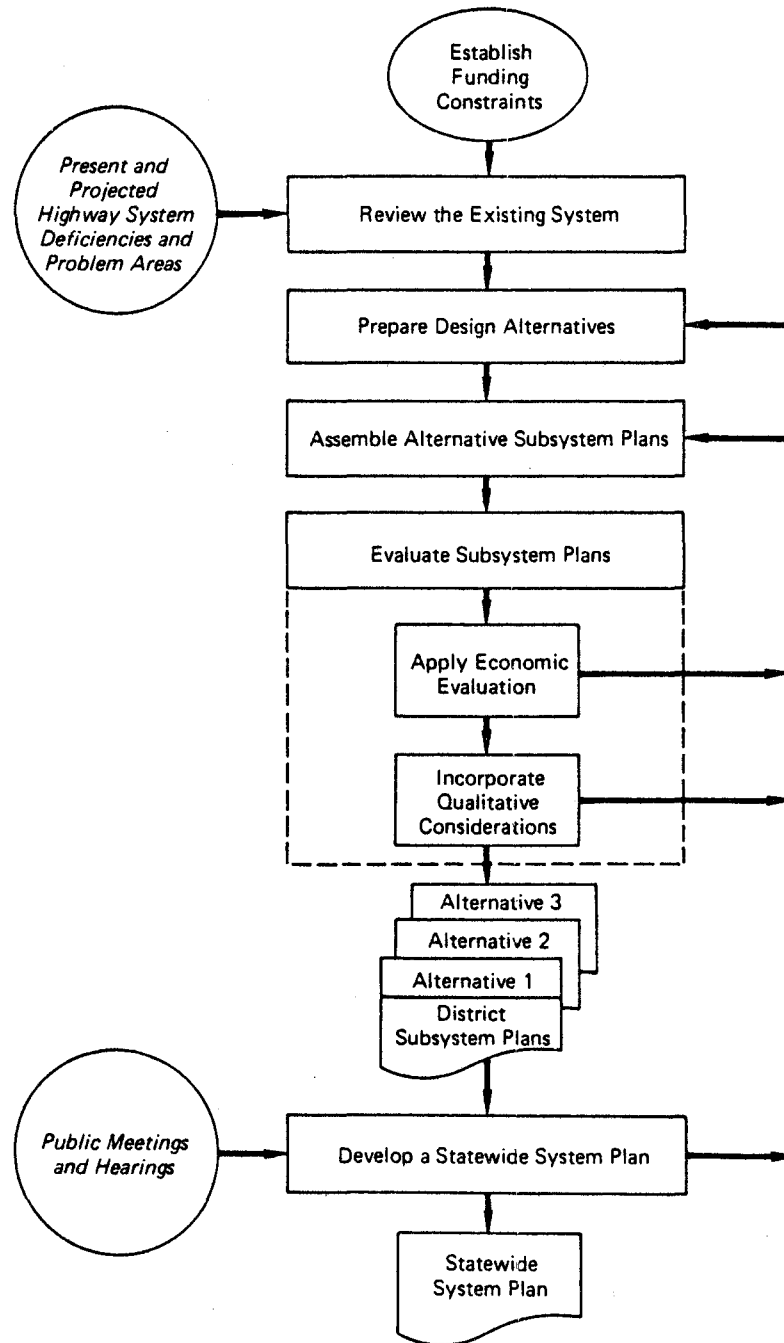
Implementing a system-oriented approach to highway planning will require a new planning methodology with the following key tasks:

- ¶ Developing a realistic, system-oriented program. The Department will need a technique for establishing the program's funding constraints and then, within the limitations imposed by those constraints, for defining a broad range of alternative designs for projects, evaluating the various highway systems those projects could form, and selecting projects on the basis of how much each improves the operation of the statewide highway network.

- ¶ Controlling the program. The Department will also need a rigorous process of control to ensure that all planning activities are continuously directed toward the task of constructing a reasonably complete highway system within a finite time period.

The techniques and policies developed to accomplish these tasks will be described in the two chapters that follow.

MAJOR STEPS IN DEVELOPING A STATEWIDE SYSTEM PLAN



3 - DEVELOPING A REALISTIC
SYSTEM-ORIENTED PROGRAM

With the realities of limited funding and rising costs forcing a less ambitious but more realistic approach to planning the highway system, Texas needs a rigorous, systematic process for applying the new system-oriented approach. The aim of this process should be to develop a highway program that will maximize the effectiveness of scarce highway construction dollars and therefore result in the best possible system from the standpoint of completeness and of total benefits to the using public. And, the process should not only be valuable during the current, intensive review of the Department's problems but should also form the nucleus of the Department's planning activities for many years to come. To meet this need the study team developed and refined a process during the joint study effort,* and this process can now form the basis for realistic, system-oriented planning in the future.

Because the Texas highway system is so large, detailed analysis of the system in its entirety by a small, centralized study group would be virtually impossible. Consequently, the study team developed a planning process that could be carried out largely at the district level, with the resulting plans subsequently compiled to form a statewide highway system.** The process consists of six steps (Chart 16), some of which may be iterated. First, the Department establishes realistic funding constraints both for the statewide program and for each district. These constraints will directly influence the size and scope of a project from the time it is proposed. Second, each district thoroughly reviews its portion of the existing highway system in order to estimate the size of the existing backlog of planned construction and to identify existing and future problem areas. Third, the district develops a broad range of alternative designs to address the subsystem's problem areas. This step entails reducing or "downscoping" existing projects to bring them into line with the realities of today's more limited funding. Fourth, from the array of alternative project designs, the district assembles several alternative subsystem plans that seek to maximize systemwide benefits. Fifth, the districts evaluate the alternative subsystem plans both quantitatively and qualitatively before ultimately selecting a preferred subsystem plan for each

* - A summary of the results of the initial application of this process is discussed in Chapter 6.

** - Applying the Systems Approach to the Texas Highway Program: Applications Guide, manual, February 1976.

district. And finally, the Department consolidates the subsystem plans into a system plan for the entire State that reflects statewide considerations and that conforms to statewide funding constraints. Although known public desires will undoubtedly be directly incorporated by district officials into the subsystem plans, it is at this point that the public will be explicitly involved in the decision-making process through public hearings and meetings with local elected officials.

Although the process will be conducted primarily at the district level, it will be appropriately guided by important statewide objectives for the highway system. These objectives, which will be established by senior Department management and the Commission before the effort begins, will help ensure that the districts do not lose sight of the Department's statewide obligations and will foster the development of a coherent, unified statewide plan.

For the first application of the new planning process, Department management and the study team established three initial objectives. First, the existing highway system should be maintained in an adequate state of repair. The State's massive investment in the existing highway system should be protected so that tax dollars already spent can earn their maximum return for the highway user. Second, major existing transportation problems should, whenever possible, be solved. The Department has a commitment to serve the current users of the highway system who, through direct payment of users' taxes, have reason to expect that existing problems will be addressed before plans are made to serve more speculative transportation needs that might arise from future developments. Third, the State's "Backbone" transportation system should be emphasized. Emphasizing the Backbone System recognizes that the Department has a priority obligation to provide basic interregional transportation throughout the State.

At the outset of the study, Texas had no designated Backbone System. For this reason the study team developed a Backbone System consisting of 7,190 center-line miles of the State's critical interregional links between major cities (i. e., exceeding 50,000 persons) and of those major lifelines of commerce currently carrying high proportions of interregional commercial truck traffic (Chart 17). This system was reviewed by the Department's senior management and the Commission, who endorsed its use during the first application of the new process.

The Backbone System will be given priority in the construction, reconstruction, and maintenance of facilities because it represents the Department's first obligation to provide Texas with a statewide transportation system. This priority does not imply that projects on other routes in the State will not receive attention nor does it imply that all Backbone routes will be constructed to any arbitrary scope such as a minimum standard of 4-lane divided facilities. (Establishing scope standards would result in a new deterministic process with many of the problems described in Chapter 2.) Backbone routes will vary in scope as traffic

volumes warrant, meaning that some will probably remain 2-lane conventional facilities. The priority will simply help ensure that in times of scarce highway funds the Department gives adequate attention to its statewide responsibilities. Therefore, if two projects, one serving primarily local needs and the other a part of the Backbone System, are competing for scarce funds and if both projects are otherwise equal in their relative merit, the project on the Backbone System will probably be chosen.

The remainder of this chapter discusses in greater detail each of the six steps toward developing a realistic, system-oriented highway program within the context of statewide objectives.

ESTABLISHING FUNDING CONSTRAINTS

For the new highway program to be realistic, the Department must immediately focus on establishing funding constraints, first for the State as a whole and then for the districts.

Establish Statewide Funding Constraints

In order to establish a realistic funding constraint for the highway program, funds must be projected to a specific, controllable time horizon. Therefore, a horizon had to be established. Previously, the Department had selected and scheduled already designed projects on the basis of funds forecast over a 2-year horizon. While this may have been appropriate in the past, a longer time horizon is needed if funding levels are to be used to influence the design of projects. In fact, because of the long lead times associated with planning and designing projects, a period shorter than 15 years would probably be unreasonable. On the other hand, a period longer than, for example, 25 years would result in forecasts that were highly uncertain in later years. Thus, 20 years was selected as a practical planning horizon for the highway program - practical because, for example, it has taken about 20 years to fully complete the IH 610 loop around Houston. The 20-year horizon offers the advantage of being long enough to permit planning for a reasonably complete system yet short enough to permit at least educated guesses about the future.

With the fund horizon set, the statewide funding target can be established. Establishing the level of the statewide target requires a sophisticated analytical tool that can accurately forecast future revenues in the rapidly changing environment. To meet that need, a computer model, the Highway Funds Forecasting

Model (HIFUND),* was developed. (The model is described more fully in Chapter 5.) During the course of the study, this model was used to establish a base forecast of the Department's current funding outlook;** at any time the Department can use the tool to forecast its funding outlook over the planning horizon. A detailed analysis of the model's output reveals both the overall level of available funds and the size of the constraints created by various State and Federal laws and regulations that restrict expenditures to specific categories of projects.

The base forecast, of course, expresses the 20-year funding target in today's dollars. Because of inflation, the buying power of these dollars will not be as great in the future as currently, and it is important that this effect is explicitly considered. The effect that inflation will have on the buying power of that funding target can be determined by calculating the present value of those dollars. With knowledge of the funding likely to be available in each year and with an estimate of how much the buying power of these dollars will decline, the present value of the future dollars of revenue can be reached by a simple calculation. This involves applying an estimate of the decline in buying power (e. g., 7 percent per year) to the dollars of revenue in each year. The present value of the future revenue is simply the sum of these equivalent dollars over the planning horizon. The result of these computations is a single number of construction dollars that can be used to construct a highway system within the planning horizon, which can be compared with today's costs of potential highway projects to determine how many can be built or "bought" within the period - the program's size.***

Set Target Funding Levels for Districts

Because the complexity of the highway system requires that system planning be conducted by the districts, it is imperative that the financial realities facing the Department be translated to the district level. To accomplish this, the Department will establish three levels of possible funding for each district. These levels will relate generally to the overall level of expected State funds but will

* - Guide to the Highway Funds Forecasting Model, manual in two volumes, April 1976.

** - Understanding the Funding Outlook: The Base Forecast, memorandum, May 7, 1976.

*** - This estimate of available 20-year construction funds is, of course, subject to change as events bring new insights about the important assumptions. The method for dealing with change is described in Chapter 4.

not be rigidly tied to three specific forecasts of total future Departmental funding. Rather, the relative size of the levels will vary between districts and will be used to explore various alternative construction programs that could be constructed within each district at each funding target. By evaluating potential expenditures in this way, the Department will be able to learn which projects on the highway system offer the greatest contribution to improving the overall performance of the highway network. When the subsystem plans submitted by the districts are consolidated into the statewide plan, projects from the subsystem plans will be selected so that they conform to the statewide funding constraints based on the financial outlook.

This method is an important break with traditional Departmental policy in three ways. First, financial constraints will be firmly established at the earliest stages of the planning process rather than at the end as in the traditional process. Financial constraints will directly influence the scope of projects because projects will be selected for inclusion in the funds-constrained system plan on the basis of their cost and relative contribution to the performance of the system. Thus, projects will begin the development cycle more closely tied to realistic expectations and will be designed at a cost that would result in timely construction without wasted design efforts.

Second, funds will be allocated to the districts in a way that should maximize statewide benefits. In the past, funds were allocated during the programming process on the basis of a formula* that frequently resulted in projects being developed on portions of the system that were not the most critically deficient. This arbitrary method of authorizing project development undoubtedly prevented the Department from receiving the maximum effectiveness from its highway dollar. The new approach, by asking each district to plan for three target funding levels, will make it possible for the Department to select from the combinations of projects proposed at each funding level, the statewide slate that best meets Texas' transportation needs while remaining within the State's overall funding limitations.

Third, the traditional funding categories (e. g., Interstate, Farm-to-Market, Federal-Aid Primary) will be set aside until the later stages of planning. Each district will be assigned a single target number at each funding level rather than a separate target number for each major funding category. This will permit each district to develop subsystem plans without an inefficient and arbitrary allocation of funds to the various types of highways within the district. Instead, the districts will be free to develop plans that best meet the needs of the local

* - In recent years a district's allocation was generally based 30 percent on population, 30 percent on geographic area, 30 percent on total daily vehicle miles, and 10 percent on the construction cost index.

highway networks. Categorical funding constraints will be addressed only when the statewide plan is being prepared. This change rests on the assumption that, even though the districts will ignore the categorical constraints, the combined contents of the diverse district plans will probably contain an acceptable proportion of projects in each category.* (Should this not be the case, adjustments will have to be made in the district plans.)

The specific funding targets for each district will be tied in a simple fashion to the base forecast in discounted dollars of construction and right-of-way funds available to the Department over the next 20 years. Each district's targets will be set by the engineer-director, exercising his own judgment within broad guidelines based on the traditional allocation formula as applied to the base forecast. The objective will be to assign the districts planning targets that will result in the development of plans over a reasonable range of funding levels. Therefore, targets will be set considering the circumstances in each district that might affect that district's capacity to effectively employ funds, such as the relative cost of construction, the size of the existing backlog of projects, and the proportion of costly Interstate highway remaining to be constructed.

REVIEWING THE EXISTING SYSTEM

The entire system planning process is based on a thorough review of the existing system. The review will begin with a careful analysis of the existing backlog of projects followed by the identification of the most critically deficient portions of the highway network.

Review the Backlog

A thorough analysis of the existing backlog will serve several functions. First, a realistic estimate of the backlog of committed projects, coupled with the funding targets, will determine the degree to which a district's planned program must be reduced or downsized. Second, a thorough analysis will identify commitments that the Department has made to individuals or organizations outside the Department to construct specific projects. Third, this analysis will provide a checklist of projects that will form the basic "building blocks" to be used in piecing together alternative systems. This checklist will help ensure

* - During the first application of the process, this assumption proved to be reasonably correct, with only minor adjustments required.

that design alternatives are prepared for projects at all important locations in the subsystem. This checklist will also help identify, upon completion of the system plan, where public commitments could not be fulfilled and where proposed projects have been substantially altered.

Each district will prepare a complete inventory of committed projects. A committed project is one that a member of the public could reasonably expect to be constructed because of (1) a discrete action taken by the Department (e.g., a minute order of the Commission, public speeches, the construction of the first stage of a project); (2) the existence of a "gap" - a short section of unimproved highway on an otherwise improved highway; or (3) the expectation that a facility will be maintained at a safe level of operation, without recurring periods of intense congestion. This list of committed projects will be likely to include virtually all of the important proposed projects in the district and therefore will adequately serve as the foundation for subsequent steps in the planning process. In listing the projects, the districts should also establish a current cost estimate (in today's dollars) for both right-of-way purchase and construction.

Identify "Hot Spots"

After finishing its catalog of committed projects, the districts will turn to identifying "hot spots", or highly critical problem areas that currently exist. A hot spot is a current problem area that has highly serious implications for operations, safety, or mobility and for which it is dramatically apparent that a solution is needed immediately. These hot spots may be the result of a variety of problems, including poor safety conditions, insufficient peak hour capacity, too few ramps, substandard geometrics, or burdensome maintenance requirements. Identifying these hot spots is particularly important for two reasons. First, any proposed subsystem plan should probably address the district's trouble spots, especially because they exist today rather than being problems forecast to occur in the future. Second, these problem areas are likely to be highly visible to the public and will require careful attention if the plan is to be responsive to public desires.

The process of identifying hot spots is relatively straightforward. Each district's managers should be able to readily reach consensus on the locations of hot spots from available data on accident rates, maintenance expenditures, and average daily traffic volumes, and from their personal familiarity with the highway system. These problem areas that are readily identifiable from available data are called "technical hot spots." After lists of technical hot spots are prepared, each district will review the backlog to be sure that the district has a proposed project to address the problems at each technical hot spot. If the backlog does not address one of these hot spots, a project will be developed for that hot spot and added to the backlog.

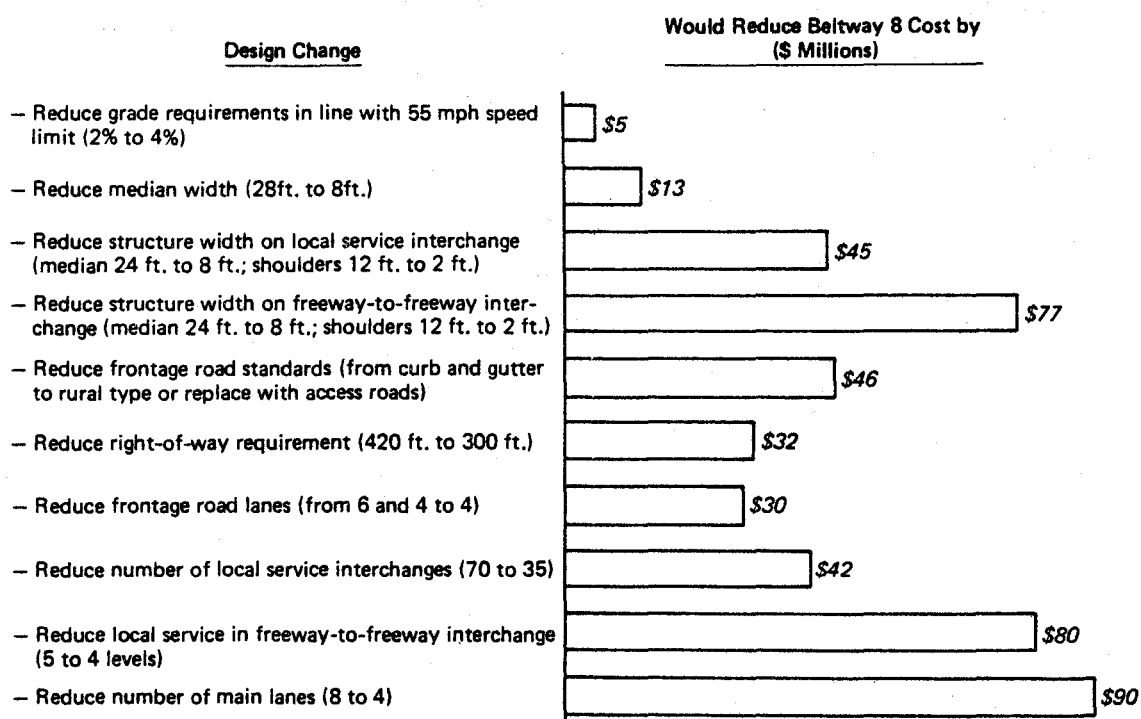
The district will also compile a list of "local political hot spots" - those locations in the highway network that receive demonstrable public support or opposition. The public is frequently well aware of technically deficient aspects of the system and probably will have tried to draw the Department's attention to these locations. Identifying these local political hot spots will help ensure that the district does not overlook critical technical problems. In addition, the list of local political hot spots will later help make the Department aware of any locally sensitive problem areas that the completed statewide system plan might be unable to correct.

PREPARING DESIGN ALTERNATIVES

Because of the enormous size of the backlog in relation to the available funding, alternative designs will have to be developed for almost all projects in the backlog. A very few projects will probably be built as proposed, and others will be deferred beyond the 20-year period, but the greatest number will require modification (e. g. , at least some form of downscoping).

The task will be to develop a wide range of alternative designs that can be considered for inclusion in the subsystem plans. Specifically, this range will have to include low-cost design alternatives. Every dollar eliminated from one project permits more money to be spent on projects in other locations that otherwise could not have been funded but are likely to provide greater return. Conversely, the inclusion of projects whose costs are unnecessarily high prevents improvements in other locations and makes it impossible to maximize system benefits. Furthermore, only by knowing the benefits that are likely to result from these low-cost alternatives can the incremental value of additional expenditures be evaluated.

Designing low-cost projects requires a departure from the traditional, deterministic approach to highway design that was discussed in Chapter 2. First, a full range of designs of differing scope should be considered regardless of whether the proposed designs meet the Department's traditional 20-year traffic service criteria. This may mean considering, for example, the relative merits of 6-lane freeway, 4-lane freeway, 4-lane expressway, and 4-lane conventional designs all for the same location. Second, no component of a project, regardless of whether it meets former conventions of design, will now be included automatically. Thus, when proposing a full range of designs, it will not be sufficient to propose, for example, a number of freeways of different scope but each with a customary design, perhaps including a 70-foot median. The range of alternatives

LOWER COST DESIGN ALTERNATIVES

must also include freeways that have narrower medians and fewer overpasses. The relative advantages of, for example, a 70-foot median over a 46-foot median will be weighed during the next step, the evaluation of alternative subsystem plans. If spending construction dollars for a 70-foot median results in more value than spending those dollars elsewhere in the system, then the 70-foot median could properly be included in the subsystem plan. But to limit the consideration of a feasible alternative because it does not meet traditional design standards could force the expenditure of dollars that might buy more for the public somewhere else in the system.

Therefore, it is imperative that the Department examine each project in the backlog by asking questions such as:

- ‡ How real is the need for additional capacity (lane miles) in this corridor now? In 1995?
- ‡ How serious a safety or service problem really exists as a result of sub-standard geometrics?
- ‡ Would the proposed project result in local system imbalance? For example, are two 4-lane freeways merging to form one 6-lane facility?
- ‡ Would it be cheaper to provide additional capacity (lane miles) by widening existing routes, rather than constructing a new facility? By utilizing structurally reinforced shoulders and restriping the traffic lanes to narrower widths? By metering ramps?
- ‡ What would be the impact of eliminating certain movements from proposed interchanges or eliminating some interchanges altogether? Of constructing a narrower median with a concrete median barrier?
- ‡ Can the first stage of the project be built and the remainder deferred indefinitely without increasing the cost of the first stage?

Asking these kinds of questions should enable the districts to identify lower cost design alternatives for backlog projects. For example, in Houston, the study team learned that the massive cost of constructing Beltway 8, the \$957 million circumferential freeway loop planned to interconnect Houston's suburban communities, could be reduced in many ways (Chart 18) - although the cost was still substantial (\$441 million for a 4-lane expressway and \$213 million for a 6-lane conventional).*

* - Progress Review IV: Reviewing Overall Schedule and Revised Plans for Houston, visual presentation, November 26, 1975.

In Dallas the study team learned that applying this questioning approach could effectively reduce the cost of expanding US 75, the Central Expressway (one of the State's most heavily traveled freeways) from \$143 million to \$71.6 million. The team learned that it was possible to widen the existing 4- and 6-lane facility to 6 and 8 lanes without resorting to extremely costly elevated lanes. That could be done by purchasing small amounts of additional right-of-way and making use of retaining walls. The resulting facility would provide more than 80 percent of the benefits of the original 8- and 10-lane elevated proposal but would cost only half as much.

After preparing a wide range of low-cost designs, the districts will be ready to use these designs as building blocks for assembling alternative subsystem plans.

ASSEMBLING ALTERNATIVE SUBSYSTEM PLANS

In this step, designers will develop for each district alternative 20-year plans to meet each of the district's three funding levels. Because assembling alternative subsystem plans is largely a trial-and-error process, this step may result in the preparation of many subsystem plans for each funding level. Each of these plans will have to meet its assigned funding constraint, and each will be directed toward achieving a high level of benefits in relation to cost.

The primary benefits of the highway system are delay savings, accident or safety savings, vehicle operating savings, and maintenance savings.

1. Delay savings: Building or expanding a highway adds capacity to the network, which reduces congestion and enables users to travel faster. Faster travel results in a time savings for the users, which, by applying an appropriate value for people's time, can be expressed in dollar terms. The expanded facility also benefits the users of adjacent highways since the new facility draws some traffic away from these parallel facilities, thereby reducing their congestion and increasing travel speed. Therefore, delay savings encompasses savings on both new and adjacent facilities. Of the four types of savings, delay savings is normally the greatest.
2. Accident savings: Certain highway improvements can reduce accidents. Freeways, for example, have relatively low accident rates compared to conventional facilities; when a freeway replaces a conventional highway, the likely result is fewer accidents and a cost savings for the using public.
3. Operating savings: Vehicle operating costs are influenced by the size and scope of the facility traveled. As traffic loads increase and congestion becomes significant, stop-and-go driving conditions develop.

Such conditions result in higher operating costs than would be incurred driving at steady speeds. Similarly, very high speeds increase operating costs.

4. Maintenance savings: The Department's maintenance expenses differ according to the type and, of course, the length of a facility. Maintenance savings are the difference in maintenance costs associated with facilities of different types and lengths. Unlike the other three types of benefits, which accrue to the highway user, maintenance savings are of primary importance to the Department.

The process of maximizing system benefits is a complicated one that involves considering and trading off numerous possible projects and combinations of projects. By preparing a range of candidate subsystem plans that can later be evaluated, planners help ensure that the plan selected is truly the best from the standpoint of benefits provided.

There are no simple decision rules or formulas for generating subsystem plans, and planners' judgment will play a key role. However, the joint study team, in the course of its own analyses, confirmed that two straightforward guidelines for generating highway system plans could move a system toward a higher level of total benefits:

- ¶ Seek system balance
- ¶ Provide for system continuity.

Seek System Balance

In selecting various projects for a candidate subsystem plan, planners should balance the projected quality of service - in terms of safety, vehicle operating efficiency, and the general flow of vehicle traffic - throughout the network. This does not necessarily mean that mobility should be uniform throughout the subsystem or district, for it may be desirable to maintain higher mobility in rural areas than in urban areas, as has been the practice in the past. However, total benefits are likely to be higher if similar urban or rural routes are designed to provide similar mobility than if one route is designed to perform exceptionally well and, because of funds limitations, the second route is not improved at all. In the same manner, the scope and concept of various projects should be influenced by the goal of maintaining a reasonably uniform standard of safety. A balanced level of safety is likely to result in more total benefits for the dollars invested than will a network

in which some routes are very safe and others have extremely high accident rates. In short, designing for system balance is based upon the theory that "spreading the wealth" generally results in more benefits for a given level of funding.

Provide for
System Continuity

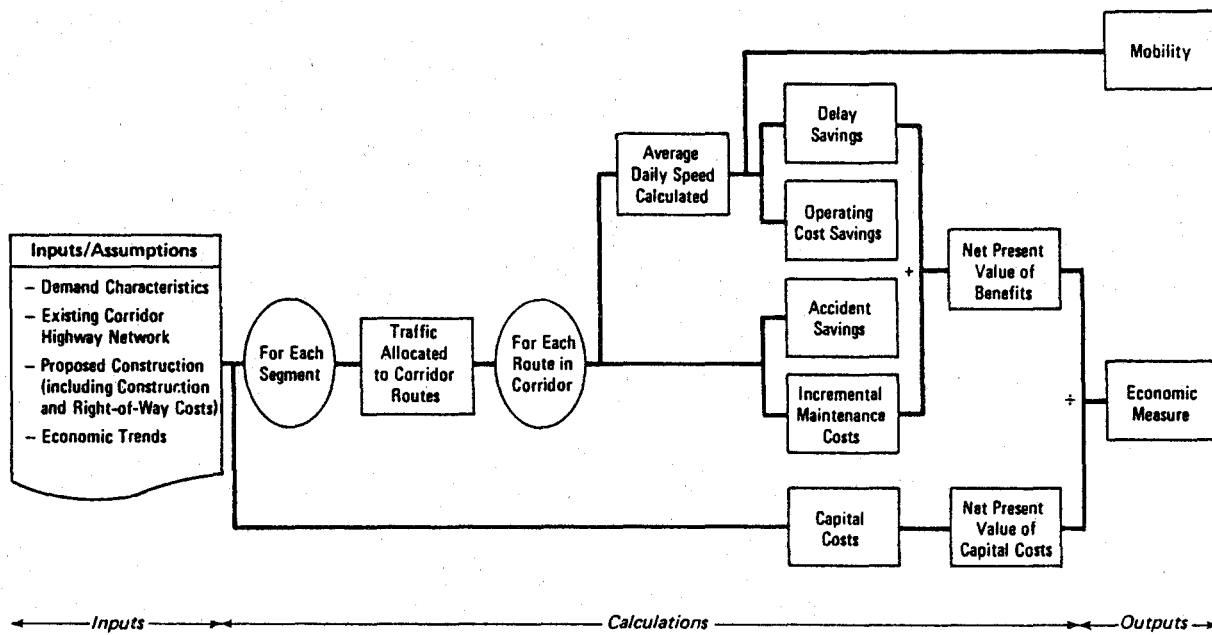
In addition to proposing projects that will result in a balanced level of service throughout the subsystem, planners should attempt to close all gaps in the existing highway network. One fully completed route is likely to offer more system benefits than two half-completed routes. This guideline is important in seeking to maximize system benefits because of the relatively large improvement that can be realized for a given level of investment. In many locations on the highway network, substantial sums of money may already have been spent, but the full benefits cannot be realized because critical links are not yet completed. Completing these links may entail relatively small additional investments, yet the incremental benefits are likely to be large because the full benefits of the entire investment can then be realized. For example, a 2-lane conventional highway connecting long segments of a 4-lane freeway can create such a severe bottleneck that vehicles are forced to travel under stop-and-go conditions on significant portions of the 4-lane freeway while waiting to pass through the 2-lane section of the route. Constructing the missing link would permit faster and safer travel not only on the segment that was formerly the bottleneck but also on much of the original freeway.

The process of generating alternative subsystems that provide for system balance and continuity at relatively low cost focuses on allocating highway funds in the most productive manner throughout the system. It thus should result in a group of candidate subsystem plans that offer a high level of benefits. However, it will be unclear at this point which plans or parts of plans contribute most to the goal of maximizing system benefits. That can be determined only by explicitly weighing the benefits received by the public from various highway system features against their costs. This task will be accomplished in the evaluation of candidate plans.

EVALUATING
SUBSYSTEM PLANS

At this point each district will have generated a range of candidate plans, one for each target funding level. In order to select the candidate plan for each level that maximizes subsystem benefits, each district will need to define as precisely as possible the benefits and costs of each plan so that plans can be evaluated in relation to one another. Quantitative measures of benefits will become useful at

SCHEMATIC OF HIGHWAY ECONOMIC EVALUATION MODEL



this point for comparing the likely impact of proposed plans. However, subsystem plans will also result in certain nonquantifiable benefits, and these will also have to be weighed at this stage. Thus, candidate plans will be selected through a process that combines both quantitative and qualitative judgments.

Apply Economic Evaluation

In recent years, the State Department of Highways and Public Transportation has introduced analytical techniques that permit more accurate evaluation of a proposed project's likely contribution to the highway system. To further improve the Department's capability to evaluate the economics of proposed highway projects, the computer-based Highway Economic Evaluation Model (HEEM)* developed by McKinsey & Company was adapted to the Texas highway system (Chart 19). The model calculates the four types of incremental benefits resulting from a proposed project - delay, accident, operating, and maintenance savings - and relates them to the costs of constructing the project. Through this process, it develops a ratio of benefits to capital costs that provides a basic measure of the project's, or group of projects', relative contribution to the highway system. The model also forecasts the mobility, or average travel speed, likely to result after the proposed projects are constructed.

An important characteristic of this model is that it evaluates the cost effectiveness of alternative highway solutions on a corridor basis. In other words, in evaluating the benefits of expanding a particular route, it takes into account the impact of such a decision on traffic loads, and hence travel time or delay savings, on adjacent routes. Since highway improvements on any route do affect adjacent routes, this characteristic represents a major improvement in methodology over most earlier techniques.

* - Guide to the Highway Economic Evaluation Model, User's Copy, manual, February 1976.

Progress Review II: Developing Tools for Better Highway Program Management, visual presentation, September 17, 1975.

A second important characteristic of HEEM is that it takes into account the time value of benefits. Because the benefits of a highway improvement accrue to the using public year after year, their value must be considered over the reasonable life of the highway. Benefits received in the future are not as valuable as the same benefits received today. Benefits and costs, therefore, are discounted at an appropriate rate over the assumed life of the highway. This characteristic also results in a more accurate picture of a project's economic value.

The economic analysis provided by HEEM will be helpful to designers and planners in two ways. First, it will enable them to identify those subsystem plans that provide the highest level of total benefits and the greatest mobility. It thus will provide a quantitative basis for selecting the best plan from among the several candidate plans for a subsystem. Second, the model will be useful for identifying the most cost-effective projects for a given location in the network. This will make it possible to isolate high-value portions of the various plans being evaluated and, by reiterating the previous step, to recombine them in a new plan offering even greater benefits than the plans previously developed.

The information obtained by running HEEM can be a powerful tool for analyzing highway subsystem alternatives. However, the user must be aware of the assumptions on which the model's calculations are based. In particular, projections of future traffic volumes are very important when applying HEEM, and care must be taken when comparing projects to ensure that each project has been evaluated using traffic projections based on consistent assumptions of population and land use. As with the results on many engineering calculations, judgment must be applied in using and interpreting the results of economic analysis.

Incorporate Qualitative Considerations

Economic analysis - although valuable - will not provide a full understanding of the likely impact of various candidate plans. Other, nonquantifiable factors must also be considered. It is at this point, for example, that the Department's overall objectives, described earlier in this chapter, will be incorporated into the system development process. As much as possible, the districts should give preference to candidate plans that are in line with the Department's objectives - plans that address hot spots on the existing system, for example, or plans that would contribute to the performance of the Backbone System.

While defining the costs and benefits of various plans, a district may develop new insights into the attractiveness of some aspects of the plans. The result might be a reiteration of one or both of the previous two steps as new design alternatives are developed for some projects and new subsystem plans are prepared.

Ultimately, the districts, using both the economic and noneconomic assessments of candidate plans, will select a final set of plans to be submitted as input to the statewide plan. Since the decision is not likely to be clear and simple, judgment will play a key part, and the districts will have to rely heavily on the professional wisdom and insight of engineers who have a thorough understanding of the existing system and of the significant local issues. The selection process will be one of openly questioning the attributes of each plan. Each district should ask, "Do we prefer Plan A or Plan B - and why?" This kind of questioning will ultimately lead to a preferred alternative at each given funding level that appears to best achieve the district's objectives for the highway system.

After selecting a preferred plan at each funding level, the districts will assign priorities to the projects in the plan. These priorities will indicate in what order the projects should be constructed and which projects should probably be added or subtracted if a particular funding target is changed. Because it could prove difficult to rank projects in a discrete order, the district engineer may want to establish three priority categories - high, medium, and low - reflecting approximately equal proportions of the target funding level. Some projects are likely to fall easily into either the high-priority or the low-priority category; most will require a more difficult, judgmental decision based primarily on qualitative factors.

The selection of district system plans will mark the completion of the first five steps in the new approach to highway planning. The central element of this new methodology at the district level is the shift from a project-by-project approach to a systems approach in which alternatives are selected on the basis of their relative costs and benefits, always within the limits of available funds.

DEVELOPING A STATEWIDE SYSTEM PLAN

In the final step of this process, the Department will integrate the districts' candidate plans into a single statewide plan that will ensure the construction of a continuous, balanced network for the entire State.

Possible statewide highway plans will be analyzed in much the same manner as the district subsystems, that is, from the standpoint of the benefits they provide. Certain benefits, however, will be given greater weight in this evaluation than they were at the district system level. For example, the primary focus of this analysis will be on the Backbone routes because they form the State's inter-regional transportation system, which is clearly a State rather than a local objective. In addition, the analysis at the State level will differ somewhat from district system analyses in that it will use few quantitative measures. Although possible in concept, a quantitative evaluation of statewide systems would be quite difficult because of the large number of variables involved. However, an approach that uses the more qualitative assessments of system balance and system continuity can be helpful in considering the potential benefits of proposed statewide plans.

This analysis will be complicated by the need to meet the categorical funding constraints imposed by State and Federal regulations, which specify that some funds can be used only for well-defined types of projects on particular portions of the highway system. In addition to remaining within the statewide funding constraint, the statewide plan will have to meet the separate funding targets for project categories such as Interstate, Federal-Aid Primary, and Federal-Aid Secondary. As explained earlier, this method assumes that the variety of plans submitted by the districts will ensure an appropriate number of projects in each category; if this is not the case, an adjustment will have to be made at either the State or the district level.

The process of integrating district plans into a statewide plan that produces a high level of statewide benefits and meets the categorical funding constraints will undoubtedly require trading off specific projects and groups of projects. In this process judgments will have to be made on the relative importance of projects at the margin. One aid in making these judgments will be the priorities established by the districts themselves after developing their candidate plans. Economic analysis will also be useful, as will information gathered during discussions with district staffs during their preparation of system plans. The actual funding level assigned to each district will reflect the tradeoffs made in developing a State plan. As a result, all districts are not likely to receive the same level of funding. For example, a district whose plans contained a greater number of projects considered essential for the State system might be funded at approximately the intermediate funding level, while a district with fewer essential projects might be funded at the lowest funding level.

The development of a statewide plan will be carried out at the headquarters of the State Department of Highways and Public Transportation, since planners at this level can maintain the broad perspective needed to balance statewide needs with those of individual counties and subsystems. However, the final selection of a statewide system plan will appropriately require the significant involvement of persons from outside the Department. Therefore, after the Department has completed a draft of the statewide system plan, public discussions of the plans will be held through formal proceedings such as public hearings; meetings with local elected officials and regional planning organizations; and public appearances by members of the Commission, the Department's senior management, and the district engineers. Presenting a tentative statewide plan rather than a myriad combination of possible local subsystem plans will help focus public discussion on realistic solutions. At this point, too, the Department will want to use its list of local political hot spots to determine which local issues probably cannot be addressed by the statewide plan within the financial constraints so that it can begin the important task of informing the public.

This 6-step iterative process ensures that available dollars are used most effectively - and at the same time illustrates the additional benefits that would be possible at higher funding levels. It provides a rational method for distributing funds among the districts and a means of encouraging personnel at all levels to adopt a statewide perspective.

Through this process, a slate of projects will be developed that can be funded and constructed within the 20-year planning period. As will be discussed in the following chapter, this slate, called the System Plan, will provide the basic tool for guiding and controlling highway development.

4 - CONTROLLING THE PROGRAM

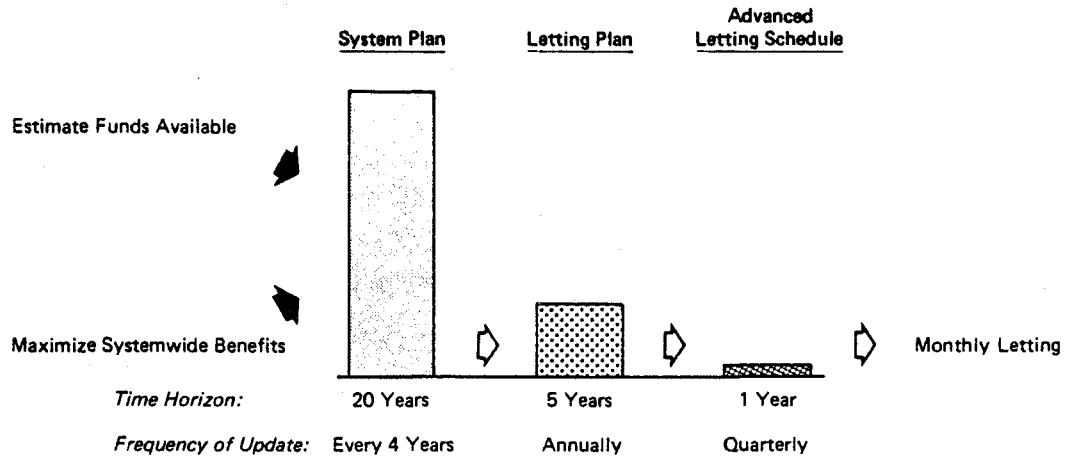
The future effectiveness of the Texas highway program depends on the Department having a means for monitoring the status of the State highway system's selected plan, as well as explicit policies designed to ensure that, despite any pressures the Department encounters during its day-to-day work, the techniques of planning from a systemwide point of view are rigorously applied and the planned system remains within realistic constraints. This chapter discusses these important aspects of controlling the highway program.

DEVELOPING AND UPDATING CONTROL DOCUMENTS

The study team developed three control documents to ensure that commitments, plans, and work efforts will match financial realities and that Departmental efforts will be focused on the Department's basic mission and most important projects. These documents will provide for a systematic progression of project activities within anticipated funding constraints. They are:

- ¶ The System Plan: The slate of projects selected to become the planned highway system within the 20-year funding constraint. The System Plan will serve as the focus of the program and will prevent the diversion of resources away from the Department's basic mission: a complete highway system within a finite period. As such, it will be the Department's long-term planning tool and basic control document.
- ¶ The Letting Plan: Those projects from the System Plan that rank highest in priority and can be constructed in the first 5 years of the System Plan. The Letting Plan will form the basis for directly managing and controlling the near-term detailed design activity and the right-of-way program. It will complement the System Plan by serving as a control document over a shorter term.
- ¶ The Advance Letting Schedule: The projects ready and planned for letting within the next year. This document will be the Department's short-term vehicle for managing and controlling the letting functions.

NEW CONTROL DOCUMENTS



Control Document	System Plan	Letting Plan	Advance Letting Schedule
Key Elements	<ul style="list-style-type: none"> – Identifies most desirable system improvement projects and their scope and concept in light of funding constraints and systemwide benefits 	<ul style="list-style-type: none"> – Defines high priority projects that should proceed to letting within the next 5-year period given the known funding constraints 	<ul style="list-style-type: none"> – Identifies specific projects that are ready and planned to be let within the next year
Purpose	<ul style="list-style-type: none"> – Provides for a reasonably complete, functioning network that maximizes systemwide benefits within finite time period and funding outlook – Provides a mechanism for recording decisions and communicating intentions of the Department – Limits work activities to projects that are likely to be financed 	<ul style="list-style-type: none"> – Focuses work efforts on the most critical projects so that they may proceed to letting as soon as practical – Prevents diversion of scarce design and planning resources to projects that cannot be constructed for many years 	<ul style="list-style-type: none"> – Provides a vehicle for managing and controlling letting functions
Project Activity	<ul style="list-style-type: none"> – Location surveys and determination of ROW data – Project design, route, and environmental studies 	<ul style="list-style-type: none"> – PS & E – Preparation of ROW data 	<ul style="list-style-type: none"> – Submission of plans for final review and approval

Chart 20 illustrates the interrelationship of these three documents.* The remainder of this chapter describes the purpose, use, development, and updating of each of these documents.

The System Plan

The System Plan will define the breadth of the highway program's activity by listing those specific projects on which planning will be conducted. Each project in the document will be described in terms of its scope, current cost, and important features such as the lane, median, and shoulder widths of a typical section. This description also will indicate any provision for subsequent expansion during the period and any extraordinary construction requirements such as special grading or the relocation of a railroad. Furthermore, the System Plan will adhere to projected funding constraints in each category of available funds (Interstate, Federal-Aid Primary, Federal-Aid Secondary, Farm-to-Market, etc.).

All planning activity will be controlled by the System Plan. Accordingly, Department management and the Commission has implemented specific policies to ensure adherence to the plan. These policies include the following:

- ‡ Only projects within the System Plan will be considered for advancement to letting
- ‡ Design efforts will be discontinued and the plans "mothballed" on projects not included in the System Plan
- ‡ Detailed designs and plans for projects must adhere to the current cost and project descriptions stated in the System Plan.

Application of these policies should reduce the State Department of Highways and Public Transportation's activity to a finite, controllable number of projects. On the other hand, failure to administer these policies effectively could result in renewed growth in the highway backlog, the misuse of badly needed dollars, and consequently a less effective highway system for Texas.

* - In addition to these control documents, other documents previously prominent in the planning process, in particular the Federal Needs Estimates, will continue to be used to satisfy Federal regulatory requirements for reporting the level of highway need. Only the System Plan, however, will contain all projects actually planned to be constructed during the 20-year period.

ILLUSTRATIVE

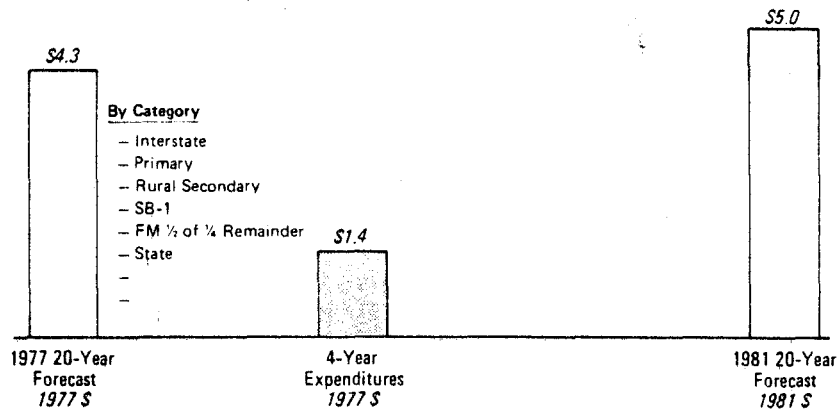
UPDATING THE SYSTEM PLAN

Performed Every 4 Years

Example: Composite Plan for All Systems

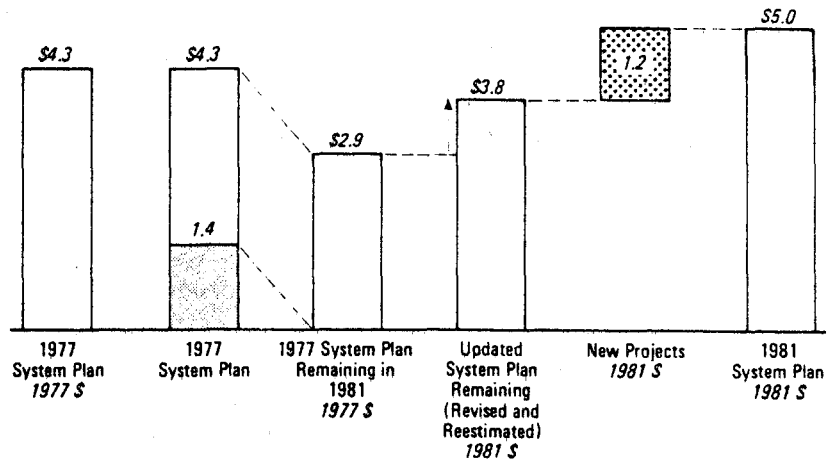
(\$ Billions)

Funds



System Plan

Projects Selected for Systemwide Benefits



The System Plan will be a composite of subsystem plans prepared by the district engineers as part of the system development process described in Chapter 3. As that chapter explains, subsystem plans will be submitted for review to the engineer-director and his staff and then consolidated with emphasis on statewide considerations to form a System Plan. The draft System Plan will then be reviewed publicly. Finally, the engineer-director will recommend a final version of the plan to the Commission for formal approval.

The method for updating the plan will carefully avoid the pitfalls of the traditional programming process described in Chapter 2. It will explicitly take into account the effects of inflation by estimating both revenues and project costs in plan-year dollars. It will also carry forward uncompleted projects for inclusion in the new System Plan. Thus, at the end of the 4-year cycle, projects let during the period will be subtracted from the original plan, the remaining projects will be reestimated (and revised if necessary) in the new plan-year's dollars, a funds forecast will be made for the upcoming 20 years, and finally new projects will be selected to make up the difference between the reestimated remaining projects and the new funds forecast (Chart 21).

Because it is a new document, the System Plan will probably be revised at least once over the next 2 years to (1) incorporate further refinements resulting from further internal analyses as well as from explicit public involvement, and (2) reflect new information on the funding outlook after the legislature meets in early 1977. Over the longer term, the plan should become relatively stable, and a review and updating approximately every 4 years should be sufficient. At the time of each updating, a new estimate of available funds will be made and the plan will be extended to include an additional block of projects. Thus, the 20-year time horizon will be maintained.

The updated System Plan will be prepared in much the same way as the original plan; that is, subsystem plans will be reviewed and consolidated by the engineer-director and ultimately approved by the Commission.

The Letting Plan

The Letting Plan will focus work efforts on the most critical projects so that they can proceed to letting as soon as practical. Only projects included in the Letting Plan will be permitted to advance to PS & E, and normal right-of-way procurement will generally be permitted only on projects within the Letting Plan. In this way the Letting Plan will prevent plans from being completed so early that they will have to be redone in light of the new design standards and environmental regulations that will undoubtedly be promulgated in the future - a common occurrence in the last 5 years. It will also keep significant sums

ILLUSTRATIVE

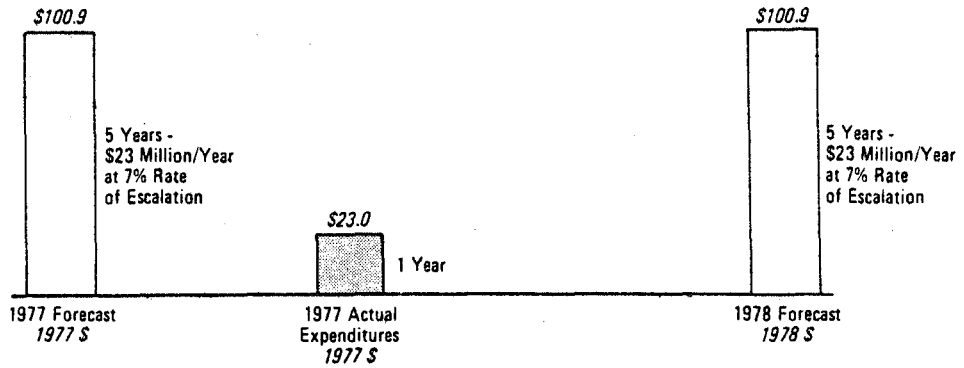
UPDATING THE LETTING PLAN

Performed Annually

Example: FM SB-1 Projects

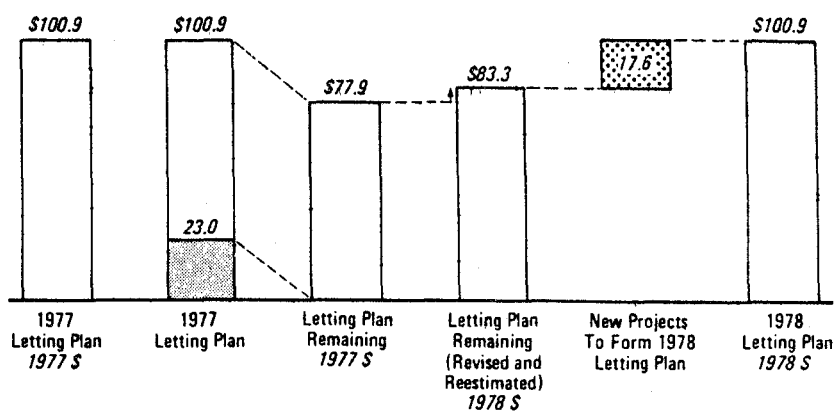
(\$ Millions)

Funds



Letting Plan

Projects Drawn From System Plan



of money from being spent on the premature acquisition of right-of-way for projects that cannot be constructed until far into the future - allowing the money to be used to complete facilities already under way.

Candidate projects will be selected by the district engineers from projects with both a high priority in the System Plan and a reasonable probability of completing PS & E during the 5-year period. These candidate projects will be reviewed by the engineer-director and recommended for approval to the Commission. Projects within the plan will generally be scheduled so that the highest priority projects are constructed first, although some minor adjustments in scheduling priority may be required to satisfy short-term financial and timing constraints.

The Letting Plan will be updated in a fashion similar to the System Plan, but on an annual cycle: projects will be selected that, in plan-year dollars, total the funds forecast for 5 years in each funding category. At the end of the first year, projects let during the period will be subtracted from the original plan, the remaining projects will be reestimated (and revised if necessary) in the next year's dollars, a new funds forecast will be made for the upcoming 5 years, and finally new projects will be selected to make up the difference between the reestimated remaining projects and the new funds forecast (Chart 22).

The annual approval of the Letting Plan will be the most direct form of top-management direction for the Commission. This plan should directly reflect the Commission's highest priorities because those projects included in the Letting Plan will be the focus of the detailed design, right-of-way procurement, and construction activity during the upcoming 5 years. Obviously, unless a project is included in the Letting Plan, it will have little chance of being constructed during the next 5 years. For this reason, changes in the Letting Plan (rather than the System Plan) would be most likely to have significant near-term impact on the highway construction program and on the associated manpower requirements and operating budgets.

The Advance Letting Schedule

The Advance Letting Schedule will identify those specific projects that are ready and planned to be let within the next year, thereby providing a vehicle for managing and controlling the letting functions. Consequently, the Advance Letting Schedule will be closely tied to short-term forecasts of available funds in each project category. It will include projects sufficient to form 12 months of monthly lettings and will be the primary vehicle by which the Department communicates its priorities for preparing plans for submission, final review, and

ILLUSTRATIVE

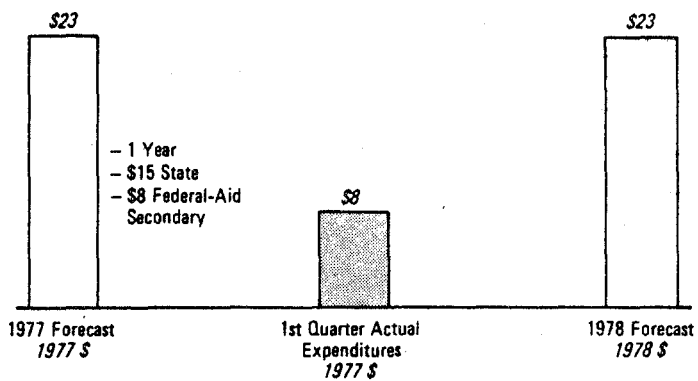
UPDATING THE ADVANCE LETTING SCHEDULE

Performed Quarterly

Example: FM SB-1 Projects

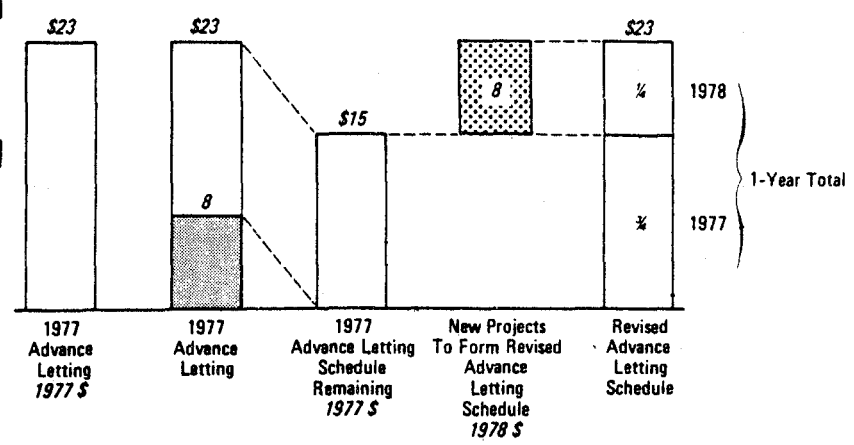
(\$ Millions)

Funds



Advance Letting Schedule

Projects Drawn From the Letting Plan



approval. It will therefore be a prime indicator for guiding final design activities in the districts and for managing the review and approval process at the Highway Design Division in Austin. In addition, the Advance Letting Schedule will assist the Department in annually informing the Federal Highway Administration of its plans for letting federally participating projects, as required by Federal regulations.

In developing the Advance Letting Schedule, a forecast of the funds available in the next four quarters will be made for each project category, and projects will be selected from the Letting Plan that total the amount of the forecast. These projects will have virtually completed PS & E and can be expected to receive approval by all regulatory bodies affecting each project. At the end of the first quarter, projects let during the period will be subtracted from the original schedule, and the remaining projects totaled. Then a new funds forecast will be made for the upcoming four quarters, and new projects will be selected to make up the difference between the remaining projects and the new funds forecast (Chart 23).

The schedule will appropriately be developed by the highway design engineer because he is responsible for the final review of plans prior to construction. It will then be reviewed by the assistant engineer-director and recommended for approval. The schedule will be approved annually by the Commission at the same time it approves the Letting Plan. During the intervening three quarters, the Advance Letting Schedule will be approved by the engineer-director, who will inform the Commission only of significant deviations from the original plan.

RESPONDING TO DAILY PRESSURES FOR CHANGE

The Department, even after it has carefully developed and communicated a highway system plan and instituted a formal method of control, can expect almost daily pressure to change the plan. This pressure will probably be caused by a belief that the level of funds actually available will be higher than forecast, and the pressure will almost always be to increase the number of projects in the plan. Failure to deal with this pressure will almost certainly result in the gradual addition of projects and, ultimately, in a large backlog.

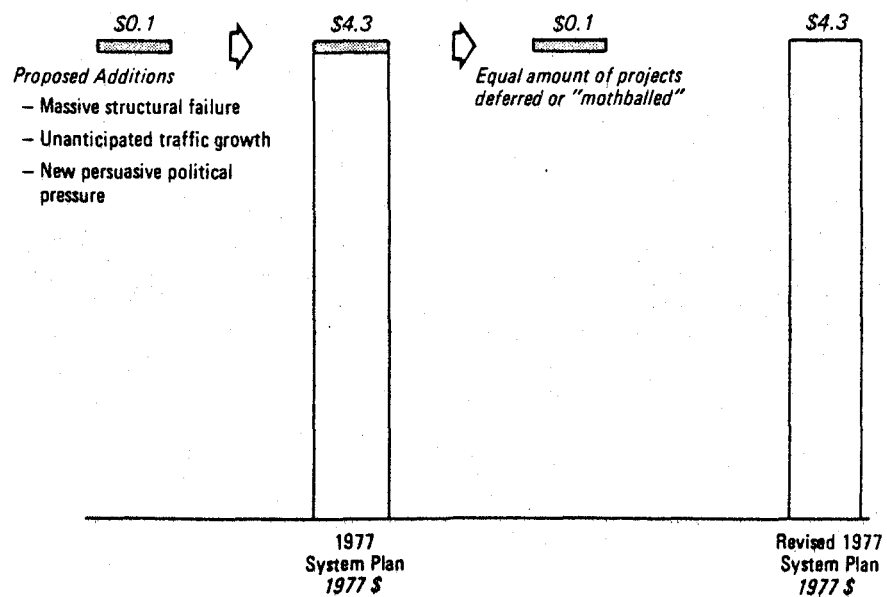
It is important that any changes in the plan be made systematically and after careful consideration rather than in the course of daily work. Therefore, in meeting those pressures, the Department should insist that established funding constraints be respected. And, unless the forecasts prove to be seriously in error, it should wait until the regularly scheduled update to make any revisions in the assumed level of funding.

INTERIM UPDATING OF THE SYSTEM PLAN

Performed if Change Becomes Critical

Example: Composite Plan for all Systems

(\$ Billions)



Maintain Strict Adherence
To Funds Constraints

Top management will have to continually ensure that the funding constraints established for the planned system are being strictly adhered to. The key to maintaining a realistic highway program will be the playing of a "constant sum" game. This means that the Department must treat the expected level of funding as a constant sum; any changes in the program slate will have to be made within the constraints of that sum. Additions to the plan will have to be offset in equal dollar amounts by deletions in some other part of the system. For example, interim additions to the System Plan may well become necessary because of an unexpected structural failure requiring large sums of money, unanticipated traffic growth demanding attention, or new persuasive political pressure for changing project priorities. If such additions are required, they will have to be counter-balanced by project deferrals (Chart 24), with the Commission explicitly identifying and approving both additions and deferrals. If this occurs, deferred projects will be dropped from active planning - consistent with the policies established for all projects not included in the System Plan.

Maintaining the discipline of a constant sum will not be easy. It will require firm decisions to exclude many projects that appear to be needed but simply cannot be built because of limited funding. Making decisions on projects that fall on the margin will be especially difficult, and the temptation will arise to avoid such decisions with the rationalization that "a few extra" will not matter relative to the total plan. However, several decisions of this type clearly will matter. They will make it impossible to draw a boundary on the program and, as a result, will permit the program to grow to an uncontrollable size. For this reason, the Department must give constant attention to maintaining the integrity of each of the document's constraints. The engineer-director and his staff will assume this responsibility.

The discipline of maintaining the funding constraint will be advantageous, especially for the Commission, in dealing with local and regional planning bodies and with political representatives. Formerly, delegations would come to the Department with requests for great numbers of large-scale projects - requests so extensive that they provided little useable information for the Department in determining priorities for the more modest projects it could actually construct. A constant funding sum, however, should bring requesters to understand that funds are limited, every request cannot be met, and tradeoffs in size and quality must be made among projects. With this understanding, delegations are more likely to make reasonable requests and provide meaningful information on actual project priorities. The effectiveness of this approach, however, will rest

on a clear understanding that the funds constraint will be maintained. If the funding constraint is firmly established, requesters are likely to direct their efforts away from attempts to circumvent or eliminate the funding constraint and toward the necessary project tradeoffs.

Hold Funds Forecast
Adjustments Until Regular Reviews

Realistic funding forecasts will be the cornerstone of the new highway program controls. Because the forecasts will determine the number and scope of projects that can be included in the System Plan, they will affect the size of the program's entire activity. The more accurate the forecasts, the better the quality of the planning decision that goes into the development of the System Plan.

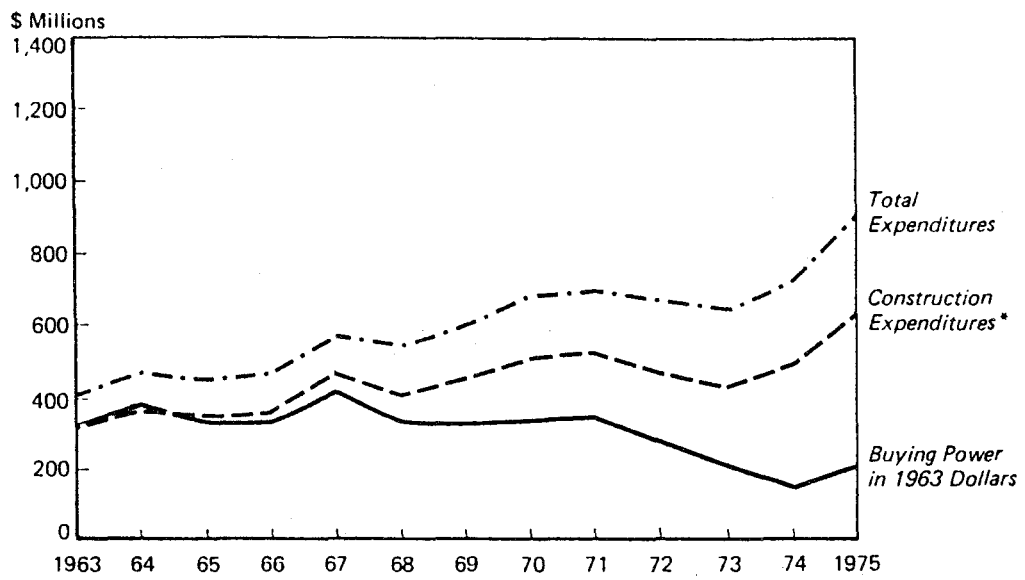
While establishing a realistic funds constraint at the outset of the planning process is critical, it is not sufficient. Funds forecasts are likely to change as time passes, and these changes will directly affect the slate of projects outlined in each of the control documents. The existing slates have a dollar cost equal to the funds constraint that was established when the slate was prepared. Thus, if funds are forecast to increase, the length of time expected to be required for completion of any of the three slates will decline (for example, to less than 20 years for the System Plan); conversely, if the expected funding level drops, the required time period will lengthen.

The System Plan, Letting Plan, and Advance Letting Schedule will need to be regularly reevaluated in light of such changes. Consequently, the members of top management, including the engineer-director and the assistant engineer-directors, should conduct a quarterly review of the funds forecast in order to monitor the impact of changes on the length of the program outlined in each document. Furthermore, because the effects of changes in the revenue outlook cannot be grasped intuitively, management should request that this review be based on a detailed analysis carried out using a quantitative tool such as the HIFUND model. This will require that the Department actively maintain its capability to monitor changes in the funding outlook and that it extend its capability for doing high-quality financial analysis.

The product of this quarterly review will be an estimate of the number of years required to complete the System Plan, Letting Plan, and Advance Letting Schedule. If - and only if - that number deviates from a reasonable range, perhaps from 15 to 25 years for the System Plan and from 3 to 7 years for the Letting Plan, should a new slate of projects be immediately selected to match the new funding constraint. As long as that number remains within an acceptable range, the Department should defer any changes proposed in the project slate until the next regularly scheduled update.

The study team created tools for effectively managing the highway program. If these methods are diligently employed, it is unlikely that the Texas highway program will ever again grow far out of balance with realistic estimates of available financial resources.

BUYING POWER OF CONSTRUCTION FUNDS



* - Including ROW acquisition and rehabilitation

5 - INCREASING AVAILABLE REVENUE

Much of the early success of the Texas highway program can be attributed to sources of funding that were both ample and predictable. Because the Department could predict future revenue levels with reasonable certainty, it was able to plan and make commitments for large-scale projects requiring long lead times. Furthermore, revenue levels were rising faster than the rate of inflation, ensuring ample funds to help meet Texas' growing needs for highway transportation.

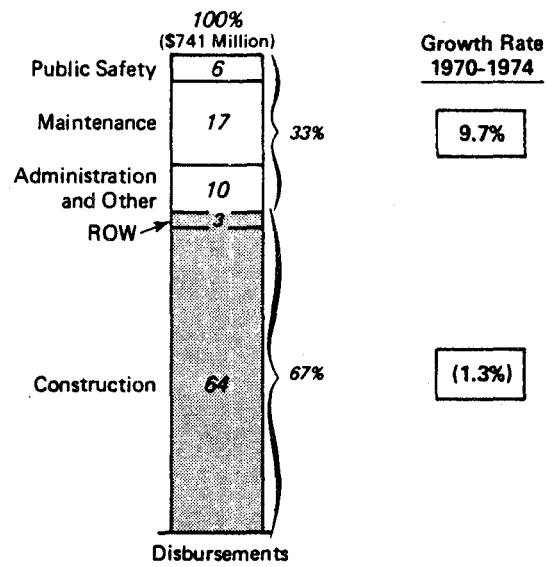
However, by the late 1960s the traditional sources of funding - while still predictable - could no longer keep pace with the inflation in construction costs. As a result, the purchasing power of the Department's budget began to decline (Chart 25). And, by the 1970s the revenue sources were becoming increasingly unpredictable. The threat of fuel unavailability and new trends in the fuel efficiency and weight characteristics of the vehicle fleet promised to make the revenue outlook highly uncertain.

If Texas is to continue to meet the increasing needs for highway transportation, simply changing the way highways are planned - while essential - will not be sufficient. Ways will have to be found to increase available revenue. Immediate belt-tightening policies should help squeeze additional revenue from existing sources, alleviating the most immediate financial pressure. But if the Department is to balance its commitments with its revenues, maintain its credibility, and make the best use of available funds, it will need a permanent solution in the form of a reasonably reliable long-term source of funds. To illustrate the situation, major construction projects can now take up to 10 years to develop from conception to completion. During this time, the Department invests the time and efforts of highway planners and engineers, at significant cost. At the same time, the counties involved initiate efforts to acquire the necessary right-of-way, and city and private developers incorporate the Department's commitments into their own land-use plans. Finally, from the initial planning stages on, the public comes to expect that the project will eventually become part of their highway system. The Department will want to be confident that the level and timing of funds will allow it to complete such projects as planned before it becomes committed to them.

This chapter outlines the steps the Department has begun to take toward solving its revenue problem. It discusses first the Department's internal belt-tightening activities and then alternative solutions to the long-term problem that will require legislative action.

STATE HIGHWAY FUND DISBURSEMENT PROFILE

(1974)



ADOPTING IMMEDIATE
BELT-TIGHTENING POLICIES

During the past year, the Department, like any organization facing a financial squeeze, began to take a close look at its internal processes and procedures to ensure that the available funds were being used efficiently and effectively. In addition to the project with McKinsey, the Department was separately attempting to improve its financial situation, primarily through personnel reductions. As part of the study effort, the joint study team examined ways to improve the Department's immediate financial situation by reducing "off-the-top" expenses, halting right-of-way purchases, and improving cash management.

Reduce Off-
The-Top Expenses

The Department's off-the-top expenses consist primarily of expenses for the Department of Public Safety (DPS), highway maintenance, and administration. However, the Department of Public Safety, although funded through the Department, is not actually under the Department's control: currently the legislature determines the DPS budget. In reviewing its internal budget, the Department could only attempt to reduce those expenses actually under its control.

Off-the-top expenditures, which accounted for about one-third of all State Highway Fund (SHF) disbursements, were growing faster than total revenue (Chart 26). The result was a decline in the funds available for construction and right-of-way expenditures.

One key element of off-the-top expenses - personnel - had already been reduced. This decline was a result of the sharp decline in real construction that began about 1969; since fewer miles of highway were being constructed, fewer employees were required. From its peak work force of about 20,000 full-time equivalent employees in fiscal 1969, the Department had undergone a gradual decline in total manpower, and by the close of fiscal 1974, 18,115 employees were on the Department's payroll.

However, faced with the budgetary squeeze, the Department began to contract its payroll further, seeking to gain the most from a smaller but equally productive staff. By March 31, 1976, the Department had contracted by more than 2,600 additional employees to an average payroll of 15,452 and had firm plans to reduce the staff by approximately 600 more employees by the end of fiscal 1976.

Despite this belt tightening, the total nonconstruction budget for the Department did not decline. In fact, the 1976 budget (excluding disbursements for the

DPS) increased to \$230 million from 1975 actual expenditures of \$225 million. This increase was the result of continuing inflation in the cost of materials and supplies as well as a continuing increase in the average cost of an employee.

In addition to reducing personnel-related expenditures, the Department deferred the 1975 Safety and Betterment Program, an annual expenditure for pavement repair projects using thin overlays and for minor safety projects. This action increased the funds available for major construction by approximately \$40 million. However, Safety and Betterment expenditures cannot be deferred for very long without significant deterioration of the highway system.

When the joint study team examined off-the-top expenses, it became clear that even though further belt-tightening opportunities probably existed - especially in the management of maintenance operations - these opportunities alone were not great enough to counteract the effects of inflation. Furthermore, expenses for the Department of Public Safety, which the Department could not control, grew from \$58 million in 1975 to \$65 million in the 1976 budget. DPS expenses would have to be addressed as part of the search for long-term solutions to the revenue problem.

Declare a Moratorium on
Right-of-Way Purchases

Throughout the decline in real construction in the early 1970s, the acquisition of right-of-way had continued largely unabated. This occurred partly because the Department itself continued to respond to the momentum of the 1960s, when projects were scarce relative to the available funds and right-of-way purchases were made as quickly as possible so that projects could be constructed. Furthermore, the counties, the Department's partner in these purchases, also continued to purchase right-of-way in the hopes that projects within their boundaries could be built before funding ran out. After years of urging the counties to speed up their purchase of right-of-way, the Department found it difficult to tell them just the opposite.

The study team took a careful look at the Department's right-of-way inventory and discovered that as of July 1975 more than 30 percent of all right-of-way purchased in the last decade was still in inventory awaiting construction. The inventory at that time was estimated to have cost the Department approximately \$114 million and to have a total cost of \$200 million when county and Federal participation was included. At the historical ten-to-one ratio of right-of-way to construction cost, approximately \$2 billion of construction could be built on the inventory. Thus it was likely that sufficient right-of-way was already on hand to support near-term construction. This was especially true because the study team's preliminary financial analyses had shown that only about 17 percent of the projects in the \$11 billion backlog could probably be built. Therefore, if right-of-way acquisition continued, it was quite possible that land was being purchased that could not be used at all given the Department's existing sources of revenue.

Because every dollar spent on right-of-way that could not be used for many years meant one fewer dollar for near-term construction, it became clear that the acquisition of right-of-way should be temporarily terminated. Accordingly, on December 19, 1975, by Minute Order #70800, the Commission declared a moratorium on the purchase of all right-of-way except for those few projects where the Department was confident that near-term financing was available. In this way the Commission hoped to significantly reduce the Department's right-of-way expenditures from the 1975 level of \$28 million and thereby immediately make available an additional \$10 to \$15 million annually for critically needed construction.

Improve Cash Management

In the process of developing a preliminary financial forecast, the study team discovered several potential improvements in the Department's management of funds. The improvements would speed up the inflow of funds that were arriving slowly or were "frozen" in the existing cash system and would improve the management of funds outflow. The effect would be an increase in the average balance of the State Highway Fund, which either could be used for new construction or could be retained in the Fund where it would collect interest. Given the Department's objective of making the most efficient use of available revenues, the potential cash management improvements seemed to be well worth pursuing.

Six specific improvements were proposed:*

1. Speed up motor fuel tax collection: Reduce the average delay in motor fuel tax collection from 40 days to 25 days by requiring that the tax on fuel sold by a refiner during any month be received by the state comptroller on the 10th of the following month instead of on the 25th. Because the current due date is established by law, legislative approval would be required for this change. Further reduce the delay by having the comptroller deposit approximately 70 percent of the tax directly into the State Highway Fund before distributing commissions and refunds and then deposit in 10 days any portion of the tax remaining after commissions and refunds. Currently the comptroller distributes commissions and refunds first and then distributes all of the Department's share of the tax to the fund 10 days later. Thirty percent of the motor fuel tax would always be sufficient to cover commissions and refunds.

* - Progress Review I: Scoping the Needs/Revenue Gap, visual presentation, July 31, 1975.

2. Speed up registration fee collection: Require that fees be remitted to the comptroller within 10 days after the end of the collection week. By aggressively enforcing this requirement, the average collection time should be approximately 11 days - a reduction of 15 days from recent experience. This recommendation recognizes the impracticality of existing regulations, which require the remittance of fees on the Monday following the collection week, although no penalty is imposed on remittance delays of up to 60 days, and a penalty of only 10 percent per year is imposed for even longer delays.
3. Speed up the processing of vouchers to FHWA: Prepare monthly vouchers requesting reimbursement from the Federal Highway Administration as soon as the district engineers have approved the estimates of completed construction costs. This improvement in internal processing should reduce delay by 8 days. Further, delays could be reduced by 2 additional days by having district engineers communicate their approval of the estimates through the Department's remote computer terminals rather than by mail.
4. Apply early for preliminary engineering reimbursement: Receive reimbursement from the Federal government for preliminary engineering expenses as they are accrued. This proposed procedure would free funds that are presently frozen because the Department does not ordinarily apply for preliminary engineering reimbursement until after a project has been let to contract.
5. Obtain Trust Fund 927 reimbursement during construction: Under existing procedures, before any project can be constructed jointly by the State and a local government, the local government must deposit its share of the cost in Trust Fund 927. The Department then constructs the project using its own funds and receives reimbursement from Trust Fund 927 after the project is completed. This opportunity would allow the Department to obtain an 80 to 90 percent reimbursement from Trust Fund 927 each month as work progressed. The balance of the reimbursement would be received when construction was completed and any adjustments to the project's cost were made.
6. Revise contractor progress payment system: Issue progress payments to contractors on the same date each month. Under existing procedures, progress payments are processed any time between the 1st and the 14th of the month and are paid on the day they are processed. However, because the state treasurer cannot be sure when the progress payments will be made, he must remove the full amount of the month's payments

SUMMARY OF CASH MANAGEMENT IMPROVEMENT OPPORTUNITIES

<u>Opportunity</u>	<u>One-Time Gain</u>		<u>Interest Gain per Year*</u>
1. Speed up motor fuel tax collection	\$15,400,000	or	(\$ 924,000)
2. Speed up license fee collection			473,000
3. Speed up vouchers to FHWA			276,000
4. Apply early for preliminary engineering reimbursement	600,000		
5. Obtain Trust Fund 927 reimbursement during construction	14,000,000	or	(840,000)
6. Revise contractor progress payment system			473,000
Total	\$30,000,000		\$1,222,000

* - Assuming 6% annual interest rate

from interest-bearing deposits on the 1st of the month. Under the proposed procedure, all payments to contractors would be made on the same date - perhaps the 8th of each month. The Department's funds could be left in interest-bearing deposits until that time and could collect the maximum possible interest.

These cash management opportunities offered the Department significant short-term funds. Successful implementation of these six opportunities would result in a one-time gain of approximately \$30 million and annual interest savings of more than \$1 million (Chart 27). Accordingly, the Department embarked upon a program to gain the full potential of these opportunities, focusing first on the changes that could be made internally (speeding up vouchers to FHWA, applying for preliminary engineering reimbursements, and obtaining Trust Fund 927 reimbursements during construction) while deferring any action on those opportunities that significantly affect parties outside the Department until after an examination of potential long-term sources of revenue.

Although the belt-tightening efforts promised significant short-term revenue, it was clear that none of the policy improvements would be able to provide substantial revenue over the long term. If the Department hoped to sustain its historical level of effort, it would have to find substantial, reliable new sources of revenue.

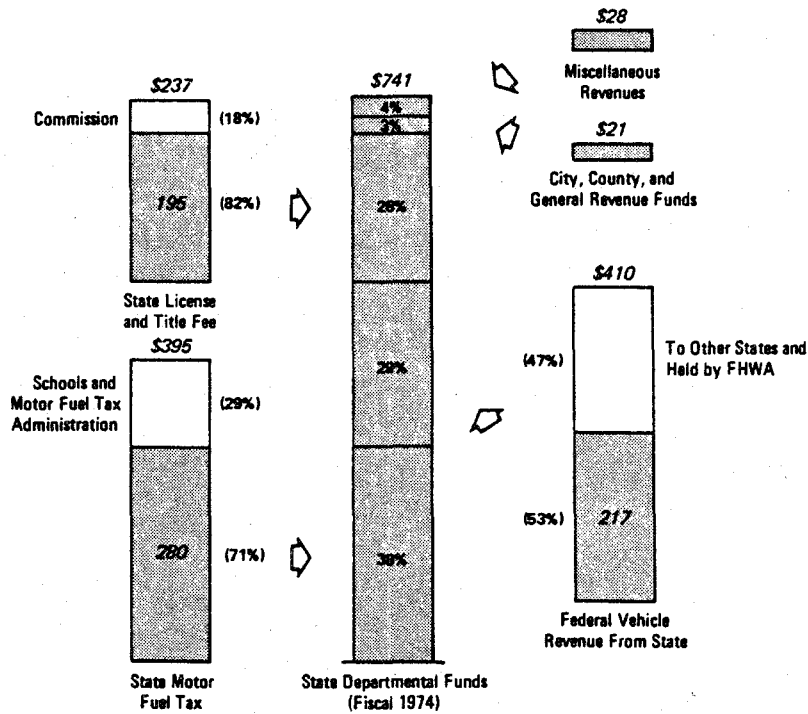
SEEKING NEW SOURCES OF REVENUE

At the outset it was apparent that seeking new sources of revenue would be a difficult analytical task for several reasons. The rapidly changing environment made it difficult to understand which forces were affecting the Department's existing and potential revenue sources. The Department lacked a readily usable analytical tool for forecasting future funding levels and calculating the effect of proposed changes in revenue collection on the level of available funds. Finally, the Department lacked a set of quantitative and qualitative criteria against which to measure the relative attractiveness of proposals.

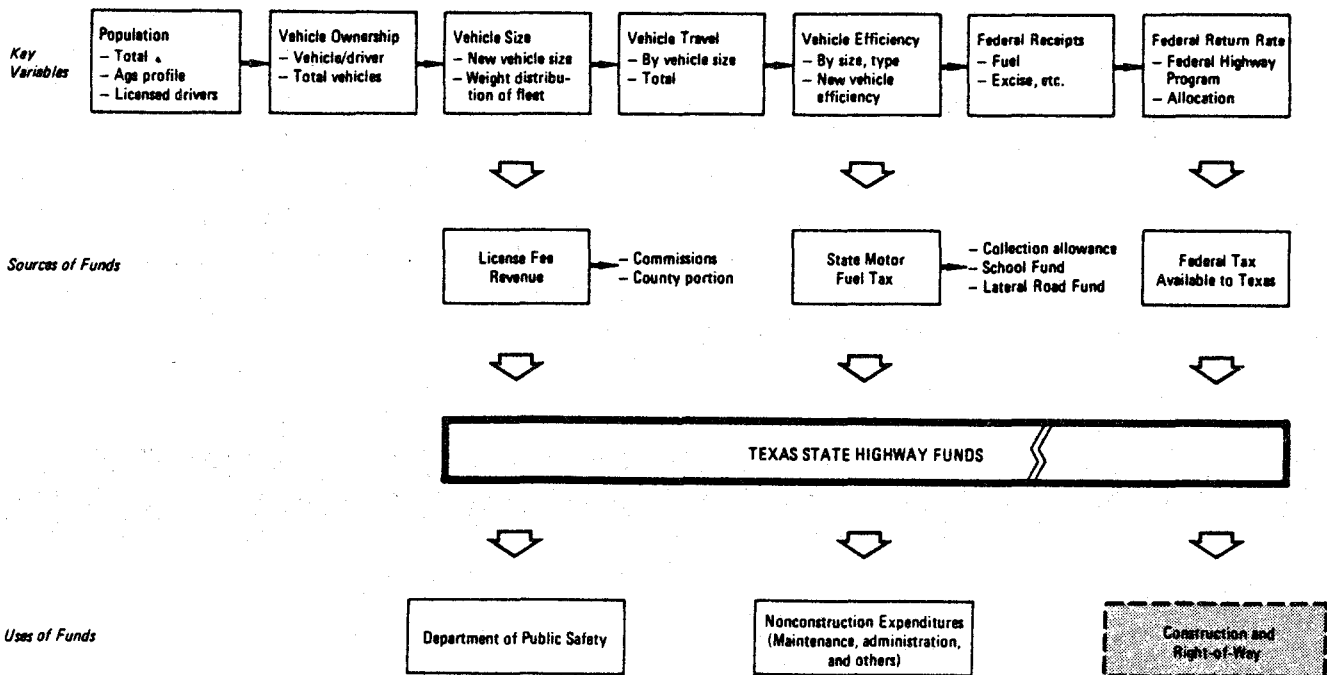
Thus, the study team set out first to construct a computer model that would serve as an analytical forecasting tool and would also provide, through its base forecast, a thorough understanding of the underlying trends affecting Departmental funding. The team then worked closely with the Commission to set selection criteria and to test alternative revenue sources against the criteria before finally selecting a preferred revenue package.

SOURCES OF DEPARTMENTAL FUNDS

(\$ Millions)



SIMPLIFIED SCHEMATIC OF HIFUND METHODOLOGY



Develop a
Forecasting Tool

As long as revenues were rising, the Department could forecast funding levels simply by extrapolating from historical trends. This method was adequate because all major parameters were reasonably predictable and continuous. Furthermore, the method was simple enough to be done by manual calculation.

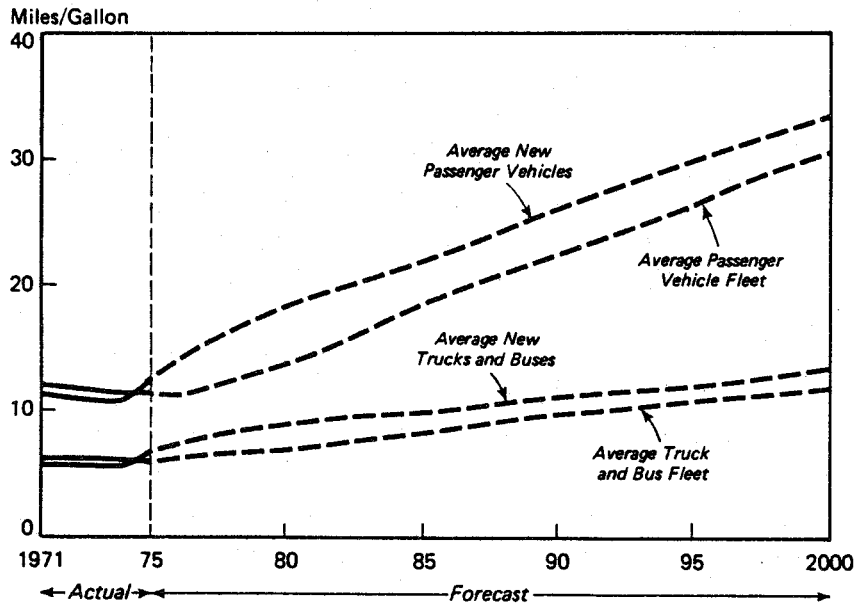
In the new, rapidly changing environment, funds could no longer be forecast accurately from past trends. The changing environment was affecting virtually all of the Department's five sources of revenue: weight-based registration and title fees; gallonage-based State fuel tax; Federal taxes returned to the State; contributions from cities, counties, and the General Revenue Fund; and miscellaneous sources such as depository interest and the sales tax on lubricants (Chart 28).

The introduction of lighter cars in the 1974 model year, which was a response to the threat to fuel unavailability, dramatically altered past trends in vehicle weight and fuel consumption; this break in the trend made projections from past data of little value. Furthermore, other dramatic changes were likely in upcoming years. For example, if aluminum and plastics widely replaced steel in automobiles, the result would be another significant change in vehicle weight trends. Finally, as the funding environment became more complex, manual analysis was likely to become impossible because of the time and effort involved.

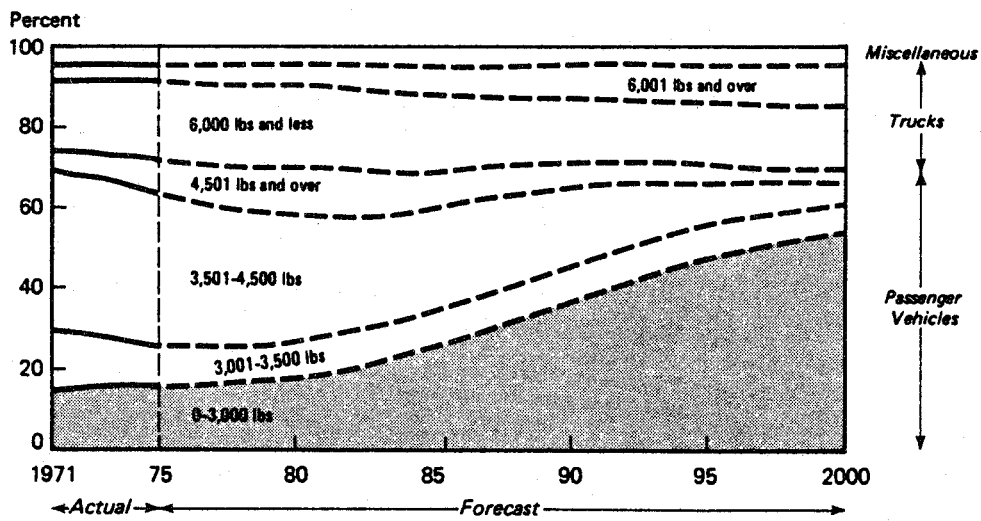
A sophisticated computer model, however, could make relatively dependable projections of future funding levels, and it would not be limited by the cumbersome process of manual calculation. A computer model could incorporate any factor that could be quantified. Therefore, it could bring into the funding projection a far greater number of factors and events that influence funding levels, and it could analyze these factors in greater detail. With a model, even subtle changes in the funding environment could be reflected in the long-range forecasts.

The scope and speed of analysis possible with a computer model would also give the Department the capability for sensitivity analysis. By altering key variables and assumptions, the Department would be able to test the sensitivity of its funds forecasts to almost any conceivable change in the funding environment - especially to changes in the rate or basis of highway user taxes - and to foresee its financial position in almost any possible scenario.

VEHICLE FUEL EFFICIENCY



RELATIVE DISTRIBUTION OF VEHICLE WEIGHT CATEGORIES IN THE FLEET



Accordingly, the study team constructed a computer tool called the Highway Funds Forecasting Model.* Rather than being based on past trends pertaining directly to revenues and expenditures, HIFUND is based on the fundamental parameter that determines those revenues and expenditures - the driving population. By building from this base, the model projects revenues and then applies those revenues to the Department's most basic expenditures (Chart 29). It can then indicate the level of funding that would remain to be used for construction of the Department's backlog of projects and how that level will change under different scenarios.

Understand the Base Forecast

HIFUND was first applied in the development of a base forecast.** This forecast gives new insights into the forces affecting the revenue sources. It also details the level of funding that would be available if existing sources of revenue were left unchanged - and it is against this "status quo" funds forecast that new revenue proposals will be evaluated.

HIFUND's projections are based on projections of the driving population and the resulting vehicle fleet because it is the driving population that ultimately determines both the size of the fleet and its composition.

The base forecast anticipates a decrease in the rate at which the vehicle fleet will grow. Although the population of Texas is expected to continue growing, available data suggests that the rate of vehicle ownership will decline and the growth in the proportion of eligible drivers actually holding licenses will level off.

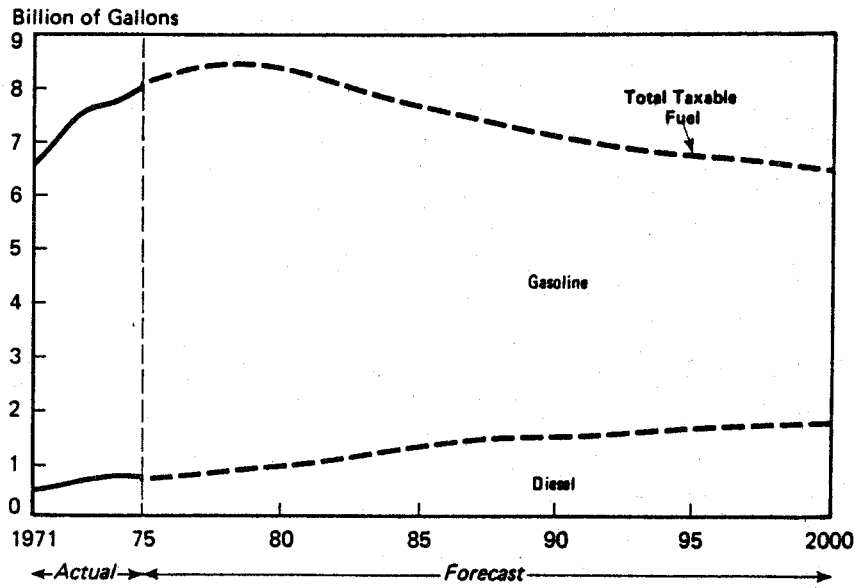
Furthermore, the vehicle fleet is projected to become much more fuel efficient (Chart 30). This new efficiency will be due in large part to an increasing proportion of lighter-weight vehicles (Chart 31). The shift in fleet composition,

* - Guide to the Highway Funds Forecasting Model, manual in two volumes, April 1976.

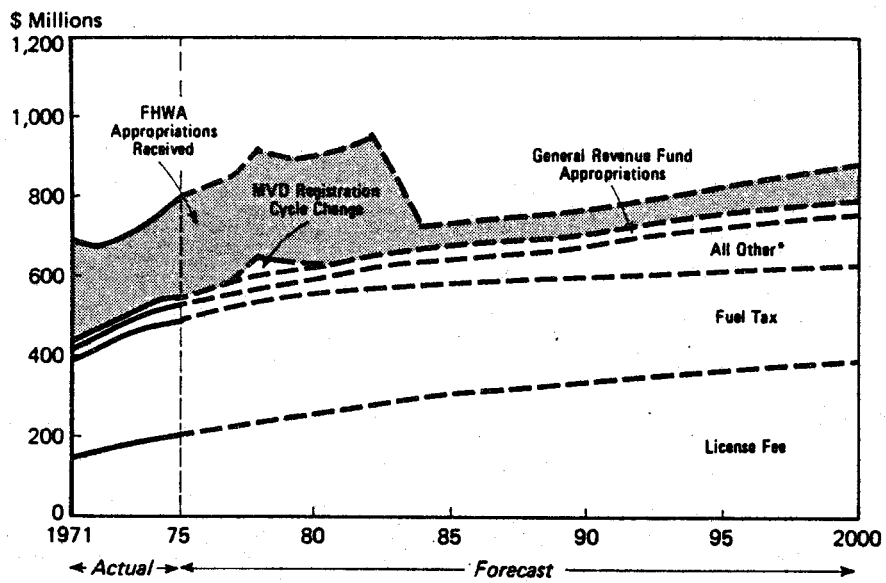
Progress Review II: Developing Tools for Better Highway Program Management, visual presentation, September 17, 1975.

** - Understanding the Funding Outlook: The Base Forecast, memorandum, May 7, 1976.

TAXABLE FUEL CONSUMPTION



DEPARTMENTAL REVENUES



* - Includes sales tax on lubricants; interest receipts; net title fees; office, sundry, and advertising fees; beautification, railroad grade crossing, and coastal waterway funds; county funds; city and other funds

however, will be compounded by across-the-board engineering and design changes, such as electronic ignitions, radial tires, and fuel injection, that tend to save fuel in vehicles of all weight categories.

The substantial increase in lighter weight vehicles is expected to result in a gradual decline in license fee revenues from passenger vehicles. However, this decline will be offset somewhat by a relatively sharp increase in license fees from heavy trucks. The net result is expected to be a leveling off in the growth rate for total license fees.

The trend toward lighter and more fuel-efficient vehicles is also expected to affect fuel tax revenues. Because the fleet will still be growing, even if at a slower rate, annual vehicle miles were projected to continue to increase. Nevertheless, that increase will not be enough to maintain the steady increase in fuel consumption experienced in the past. Fuel consumption is expected to peak around 1978 and to decline thereafter (Chart 32). State fuel tax revenues, which are based on a fixed rate per gallon, are expected to follow a similar pattern of decline.

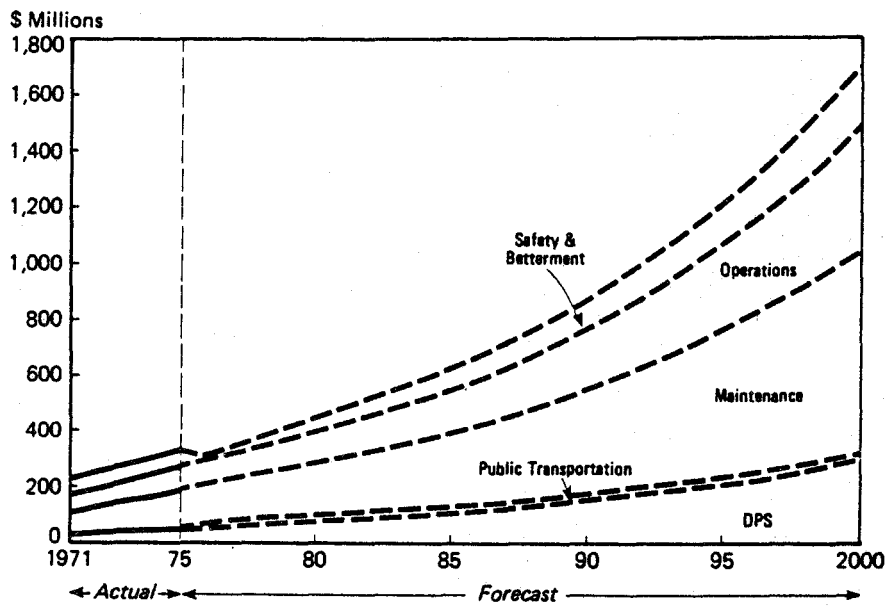
Although the fuel tax collected by the Federal government will also decline, total receipts from Texas to the Federal government will remain relatively stable because of substantial increases in Federal excise tax and Federal taxes on road rubber, oil, and parts and accessories. Therefore, assuming that a Federal-Aid Highway Act continues and that the historical average rate of return (53 percent) is maintained, the amount of revenue available to the State through the Federal Highway Administration will remain at approximately current levels.

However, under the Federal-Aid Highway Act, these funds are available to the State only if matched by funds derived from State Highway Fund receipts. The HIFUND projection shows that matching these funds will become increasingly problematic. The level of FHWA funds projected to be received by the State drops sharply after the early 1980s because of the lack of adequate State matching funds (Chart 33).

The HIFUND base forecast assumes that the Department will continue to meet its expenditures according to current priorities, that is, the Department of Public Safety and operations (including maintenance) will be funded before construction. Further, it assumes that expenditure for the DPS and for operations will grow at the rate of inflation from their budgeted 1976 base value (Chart 34). The forecast also assumes that many of the belt-tightening policies discussed previously have already been implemented.

REQUIRED DEPARTMENTAL EXPENDITURES*

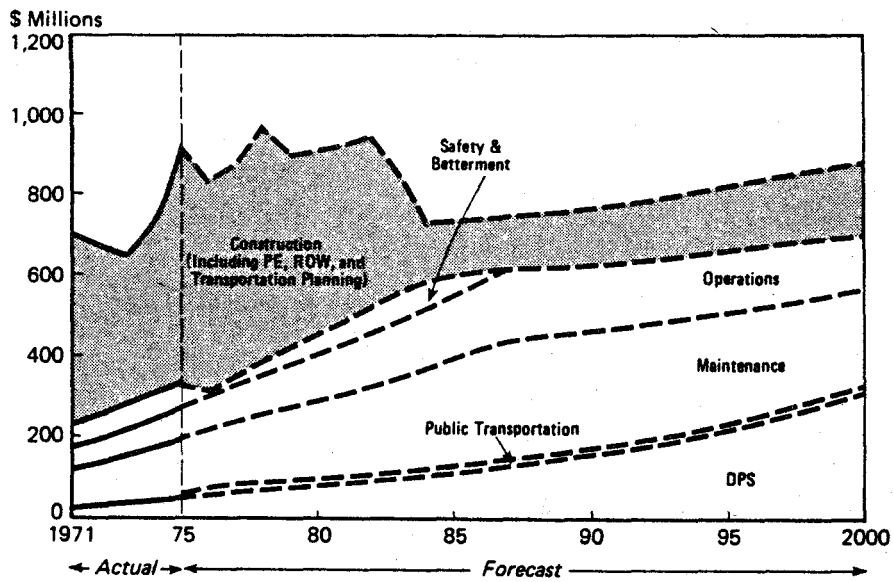
Chart 34



* - Assuming 7% inflation and no change from 1976 budget levels in real terms

DEPARTMENTAL EXPENDITURES

Chart 35



On the basis of these assumptions, HIFUND projects that nonconstruction expenditures will soon demand all available State revenues. The base case indicates that:

- ¶ By 1981 no construction funds will be available for 100 percent State projects
- ¶ By 1982 State funds will be insufficient to match any FHWA Urban Systems funds
- ¶ By 1985 State funds will be insufficient to match any FHWA funds. *

From 1985 on, the only construction activities in the State will be on Farm-to-Market projects, which are funded from the General Revenue Fund and a specially allocated portion of the State gasoline tax, and on Federal-Aid Urban Systems projects, which by then are assumed to be supported by additional city matching funds (Chart 35).

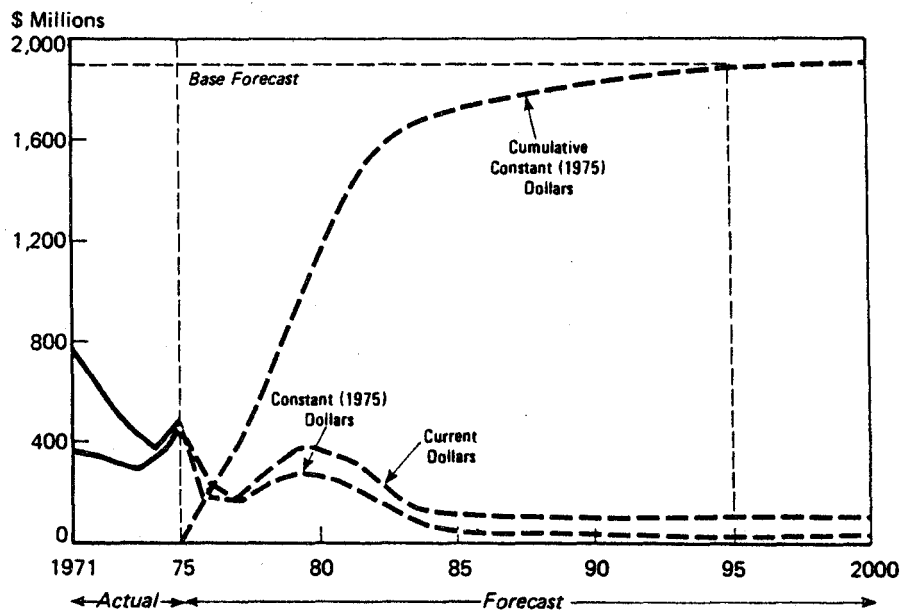
Furthermore, the forecast shows that available revenues will eventually fall short of meeting even the most basic expenditures. Safety and Betterment programs will be cut back in 1984 and eliminated in 1987; operations will be cut back in 1987 and by the end of the century will be reduced to 30 percent of what is required.

Before funds would again be available for matching FHWA monies and supporting 100 percent State-funded construction, the Department would have to raise substantial additional funds to first provide for operations and Safety and Betterment. By 1995, the cumulative shortage of Departmental receipts will amount to more than \$1.3 billion in terms of constant 1975 dollars, with most of this shortfall taken from maintenance and Safety and Betterment.

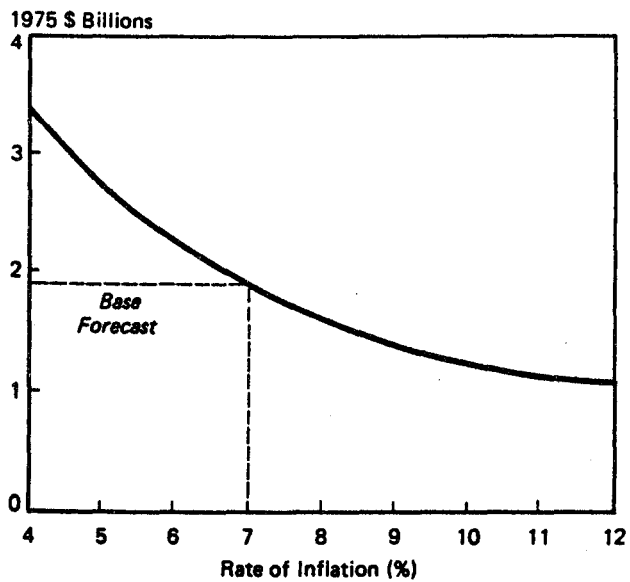
The Department's construction backlog is valued in terms of constant 1975 dollars. Therefore, to show the impact of the projected funds shortfall on backlog construction, the funds available each year for backlog reduction have been discounted at the projected rate of inflation to represent annual backlog reduction funds in constant 1975 dollars (Chart 36). The results indicate that the level of funds available in constant dollars each year will be significantly below historical levels during the next 5 years and will decline even more sharply in the early 1980s.

* - Except Federal-Aid Secondary Funds that can be matched with the General Revenue Fund appropriation for new Farm-to-Market projects.

FUNDS AVAILABLE FOR BACKLOG REDUCTION



EFFECT OF INFLATION ON BACKLOG REDUCTION FUNDS



Furthermore, because almost no construction funds will be available after the early 1980s*, the cumulative backlog reduction funds in 1975 dollars fall far short of the amount necessary to fund the current backlog. The base forecast confirms that, even if the Department effects short-term belt-tightening policies, a cumulative total of only \$1.9 billion in constant 1975 dollars will be available from 1976 to the end of 1995 to reduce the backlog, currently valued at approximately \$11 billion.

Existing sources of revenue seemed to promise a dismal future for construction efforts in the State. When the results of the base forecast were tested, the study team found that reasonable changes in the magnitude of most key assumptions had only a marginal effect on results. Changes in the anticipated rate of inflation did have an impact on the funds available (Chart 37), but no change in the funding outlook was likely to result in a level of funding that could approach the value of today's backlog.

However, changes in the tax rate or structure could have a significant effect on the future availability of funding. The study team next turned its attention toward developing screening criteria for the evaluation of such changes.

Establish Screening Criteria

Alternative sources of additional revenue could be proposed in virtually infinite variety and number. If the study team were to eventually settle on a specific set of proposals, it would need to evaluate each possible source of revenue against a uniform set of screening criteria. These criteria would have to fall into two categories. First, quantitative standards were needed against which to measure the absolute size of the revenue stream from each proposal (e.g., would the proposal generate "enough" revenue). HIFUND would be used to estimate the size of a potential revenue stream, and the stream would then be measured against these criteria. Second, a set of qualitative criteria would be needed to reflect the preference for Texas' traditional way of generating highway revenue and to acknowledge existing political forces, which presumably reflect the desires of the Texas public.

* - Although Urban Systems Funds are forecast to be received during this period, they are not applied against the backlog because Urban Systems projects are not typically on the State Highway System.

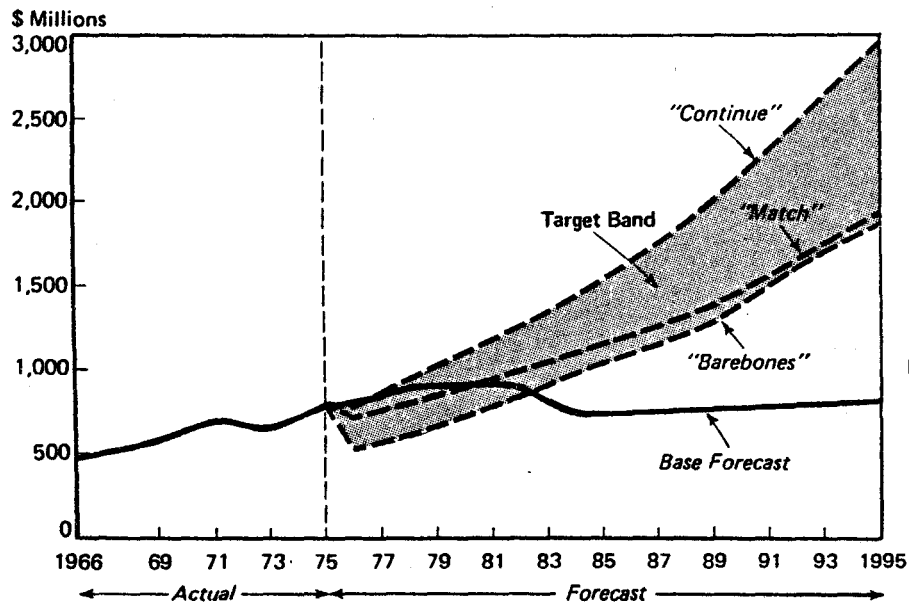
The team first identified three levels of revenue that could reasonably form the quantitative criteria. These were:

1. "Barebones." A Barebones level of funding would satisfy the minimum State commitment to highway transportation by simply maintaining the existing system in an acceptable state of repair. This would entail both basic maintenance (e.g., repairing pot holes) and the more extensive rehabilitation to be funded out of the construction budget (e.g., strengthening existing pavement surfaces through the use of thick overlays). This level of funding would not provide for new or expanded facilities anywhere on the highway system. Barebones would represent the minimum acceptable level of funding.
2. "Match." The Match level would ensure that Texas had sufficient matching funds to obtain all Federal funds expected to be available. This level would ensure that the maximum amount of Federal highway user taxes collected in Texas would be returned to the State.
3. "Continue." This level of funding would be sufficient to sustain the most recent 3-year average expenditures for construction in real terms, but would acknowledge that, at a time when belt tightening was being demanded throughout the State, it was probably politically unreasonable to expand the construction effort. It would therefore represent the maximum level of funding considered feasible.

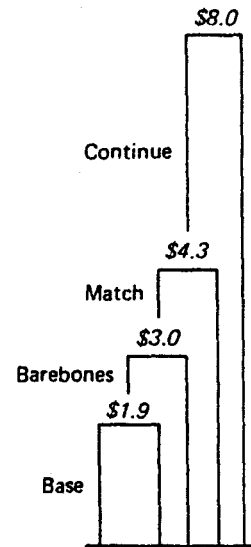
The Barebones level was carefully analyzed using a new computer model developed during the study, the Highway Rehabilitation Forecasting Model (REHAB).^{*} This model helps to determine future rehabilitation requirements using basic data available to the Department for each of five geographic regions on total lane miles, pavement age, the expected life of each pavement type, and the rehabilitation cost per lane mile by pavement type. The model's output indicated that significant expenditures will be required - over and above regular maintenance operations - simply to repair the existing system as it wears out. The forecast of annual expenditures for rehabilitation at first appeared large relative to recent historical levels of rehabilitation expenditure, but with a closer look the reason became apparent. The highway network is now relatively young and needs little repair, but in just a few years, when many of the facilities constructed during the boom years of the 1960s begin to wear out, rehabilitation needs will be much more extensive. In fact, the total rehabilitation requirement

* - Guide to Highway Rehabilitation Forecasting Model, manual, May 24, 1976.

TARGET REVENUE BAND



Funds Applied To Backlog
(Billions of 1975 Dollars)



for the next 20 years will be about \$3 billion in 1975 dollars - significantly higher than the \$1.9 billion estimated to be available from existing revenue sources for both new construction and rehabilitation.

The Match level will, of course, be even larger. The HIFUND forecast discussed earlier shows that, assuming the continuation of a Federal-Aid Highway Act, Texas will forego \$1.5 billion in Federal aid over the next 20 years without additional State revenue to provide matching funds. However, any State revenue that becomes available will first be required to meet the shortfall in critical nonconstruction expenditures (e.g., regular maintenance and operations) before funds can be allotted to match Federal funds. Nearly \$1.5 billion in additional State revenue will be required to fully match the available Federal funds. If all Federal funds are matched, approximately \$4.3 billion in 1975 dollars will be available over the next 20 years to reduce the Department's project backlog.

As expected, the Continue level represents by far the largest revenue stream. Construction over the most recent 3-year period averaged \$400 million per year in 1975 dollars. Thus, if the Department were to achieve a level of revenue that would provide \$400 million per year for reducing the backlog, \$8.0 billion would be available in 1975 dollars over the next 20 years.

Taken together, these three levels of funding seem to indicate a reasonable target range for evaluating future funding. To meet the quantitative criteria, a revenue source will have to provide a stream of revenue valued in 1975 dollars at between \$3.0 billion, the Barebones level, and \$8.0 billion, the Continue level. In addition, the source will have to provide a "permanent" solution, meaning that the revenue stream will have to remain within the target band throughout a 20-year time horizon.

Although the team considered this target range reasonable, it did find that significant increases in revenue will be required to achieve levels within the targeted band (Chart 38). A steadily increasing source of revenue will be necessary to keep pace with the growth in both construction and nonconstruction expenditures caused by inflation. Revenues will have to almost double during the next 10 years to sustain the Continue level of construction.

Quantitative criteria alone were not sufficient for the study team to satisfactorily evaluate potential revenue sources. The team also settled on five qualitative criteria that could be meaningfully applied against each proposal:

1. Tax highway users. Texas, as well as most other states in the United States, has a long history of taxing the users of transportation services to pay for new facilities. This method of taxation is also preferred by most economists on theoretical grounds. Preferably, then, a new source of revenue would be levied against highway users.

2. Provide inflation protection. The failure of existing sources of revenue to grow with inflation is one of the primary causes of the crisis facing the highway program. A preferred revenue alternative would generally grow at the same rate as prices in the Texas economy.
3. Minimize interaction with other agencies. Many agencies in State government face crises similar to those of the State Department of Highways and Public Transportation. For this reason, a preferred revenue alternative would not seek to transfer funds directly away from another agency, nor would it compete for another agency's traditional sources of additional funds.
4. Minimize the appearance of a large, abrupt tax increase. Texas citizens have indicated directly or indirectly that they do not want an increase in the rate of taxation during the next few years. Any revenue source that resulted in an abrupt near-term tax increase would lack political viability.
5. Provide a vehicle to potentially take advantage of State surplus. The State of Texas is expected to experience a substantial surplus in the General Revenue Fund during the upcoming 2-year period. Because the highway program is a reasonable candidate for these surplus State monies, a desirable revenue alternative would permit the legislature to allocate revenue from an existing source to the State Highway Fund up to the amount of the expected State surplus.

The study team reviewed these criteria with the senior management of the Department and with the Commission.* After receiving their agreement that the quantitative and qualitative criteria generally characterized the Department's revenue objectives, the study team began to apply the criteria to potential revenue sources.

Test Alternative
Revenue Sources

Beginning with the full range of alternative revenue sources that had been proposed before the Texas public, the team first narrowed the range to include

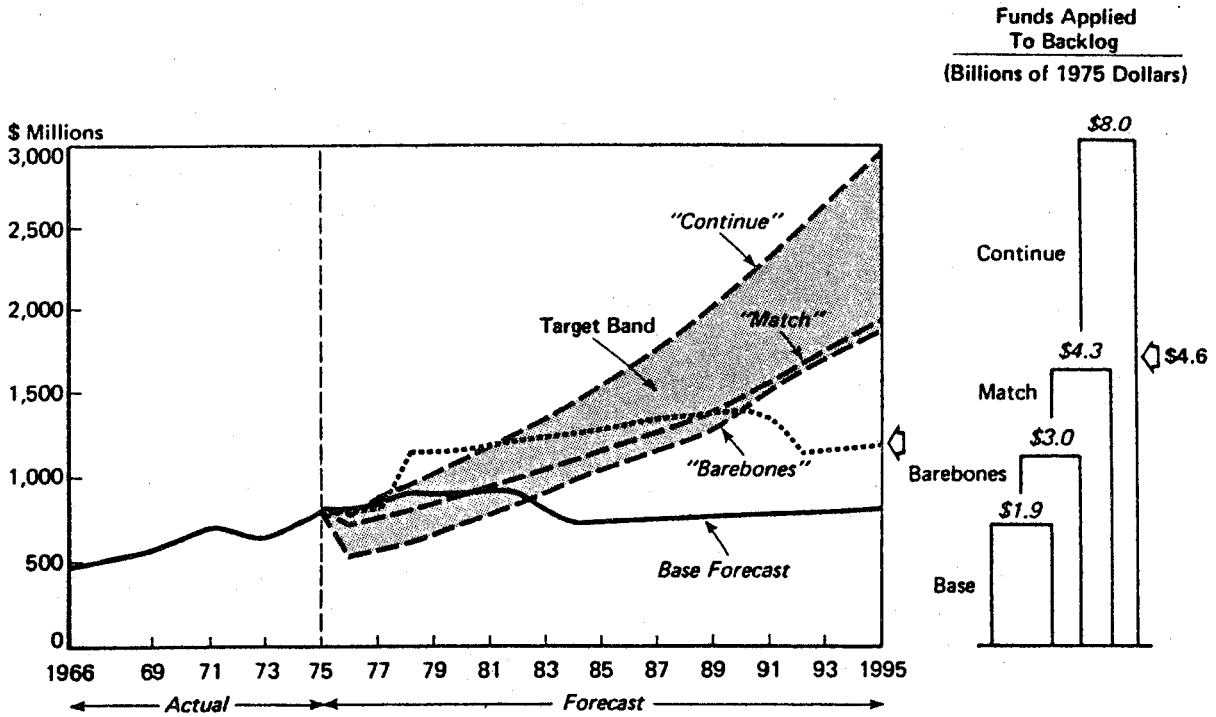
* - Progress Review V: Examining the Financial Situation: Implications and Alternatives, visual presentation, December 22, 1975.

APPLICATION OF PREFERENCE CRITERIA

Revenue Source / Preference Criteria	Eliminate DPS From SHF	License Fees		Motor Fuel Taxes		Sales Taxes		Special Funds	Refinery Tax
		Increasing Fixed Rate on Weight Basis	Adjusting Basis To Change in Vehicle Value	Increasing Fixed Rate of Tax/Gallon	Adjusting Rate on Basis of Price	Transferring Motor Vehicle Sales Tax to SHF (currently based on vehicle price)	Transferring Parts Sales Tax to SHF (currently based on price)	Revenue Sharing, General Fund Allocation, or Grants	
Tax highway users	✓	✓	✓	✓	✓	✓	✓	×	×
Provide inflation protection	✓	×	✓	×	✓	✓	✓	×	×
Minimize interaction with other agencies	×	✓	✓	×	×	✓	✓	✓	×
Minimize appearance of large, abrupt tax increase	✓	×	✓	×	✓	✓	✓	✓	×
Provide vehicle to potentially take advantage of State surplus	✓	×	×	×	×	✓	✓	✓	×

✓ = Satisfies Criteria × = Does Not Satisfy Criteria

DOUBLE FIXED RATE OF LICENSE FEES IN 1978



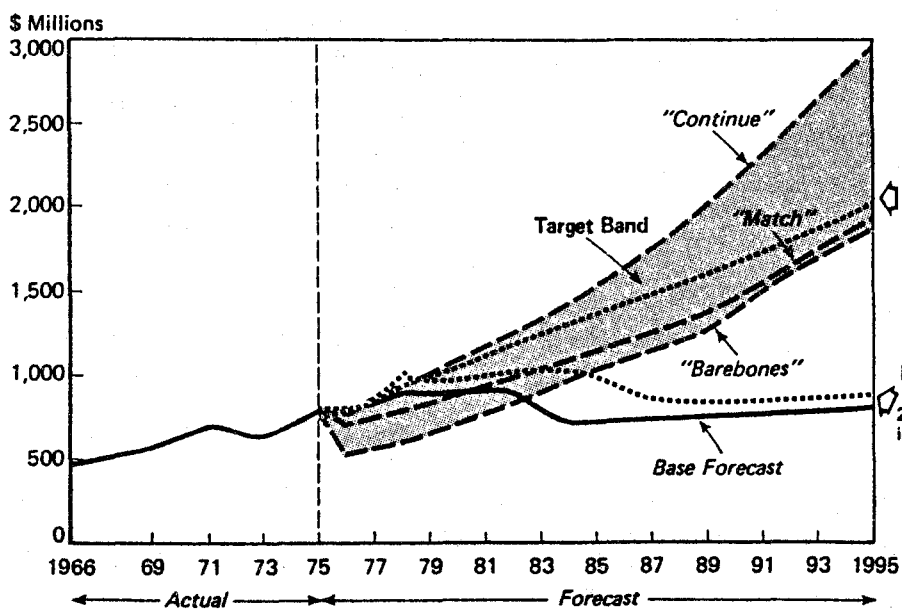
only the nine sources of revenue that seemed to offer technical solutions to the financial crisis. The qualitative and quantitative screening criteria were then applied to these nine alternative sources. Of the nine, five failed to satisfy two or more of the screening criteria (Chart 39).

1. Increase fixed rate of license fees. Increasing the existing weight-based license fees failed to satisfy three of the qualitative screening criteria. First, it would probably be characterized as a large, abrupt tax increase. Second, it would not provide a vehicle for taking advantage of the State surplus because license fees currently flow directly into the Department's State Highway Fund rather than into the State's General Revenue Fund. Finally, it would not provide protection against inflation. This is in part because the fee is based on vehicle weight, which is expected to decline. As the base forecast shows, even though the vehicle fleet will continue to grow, total license fees will probably grow more slowly than inflation because of the forecast shift to lighter weight vehicles. In addition, simply by being a fixed fee, this source of revenue would not adjust automatically to inflation. The fee on each vehicle would gradually decline in buying power - just as it had during the 1960s and early 1970s - until another fee increase would be required to again readjust the fee to a new inflated level of prices. This readjustment would have to be made many times if the highway program were to be protected from inflation. Thus, increasing the fixed rate of license fees did not offer a permanent hedge against inflation.

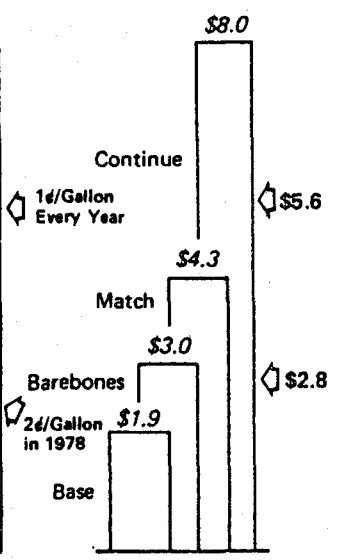
Furthermore, because this revenue source is not protected against inflation, it failed to meet the quantitative criteria even with license fees stepped up to twice their present levels in 1978 (Chart 40). Although this 100 percent increase in fees, when combined with other existing revenue sources, would generate \$4.6 billion in funds available to reduce the backlog, it would fail to provide a permanent solution. In about 12 years the State would be unable to match all Federal funds, and in about 15 years even the Barebones funding level would not be met.

2. Increase fixed gallonage rate of motor fuel tax. Increasing the motor fuel tax was a popular solution to the financial crisis among many of the State's officials and in the press. Part of this popularity was due to the common misconception that fuel taxes are the Department's primary source of revenue. In fact, fuel taxes provide only about 38 percent of the Department's revenue (as shown in Chart 28 facing page 5 - 7). And in addition, increasing the tax on motor fuels failed to meet several criteria. This alternative would directly affect another agency, the schools, because one quarter of the fuel tax is constitutionally dedicated to the schools. Therefore, any increase in fuel tax would require a decision by the

INCREASE FIXED GALLONAGE RATE OF MOTOR FUEL TAX



Funds Applied To Backlog
(Billions of 1975 Dollars)

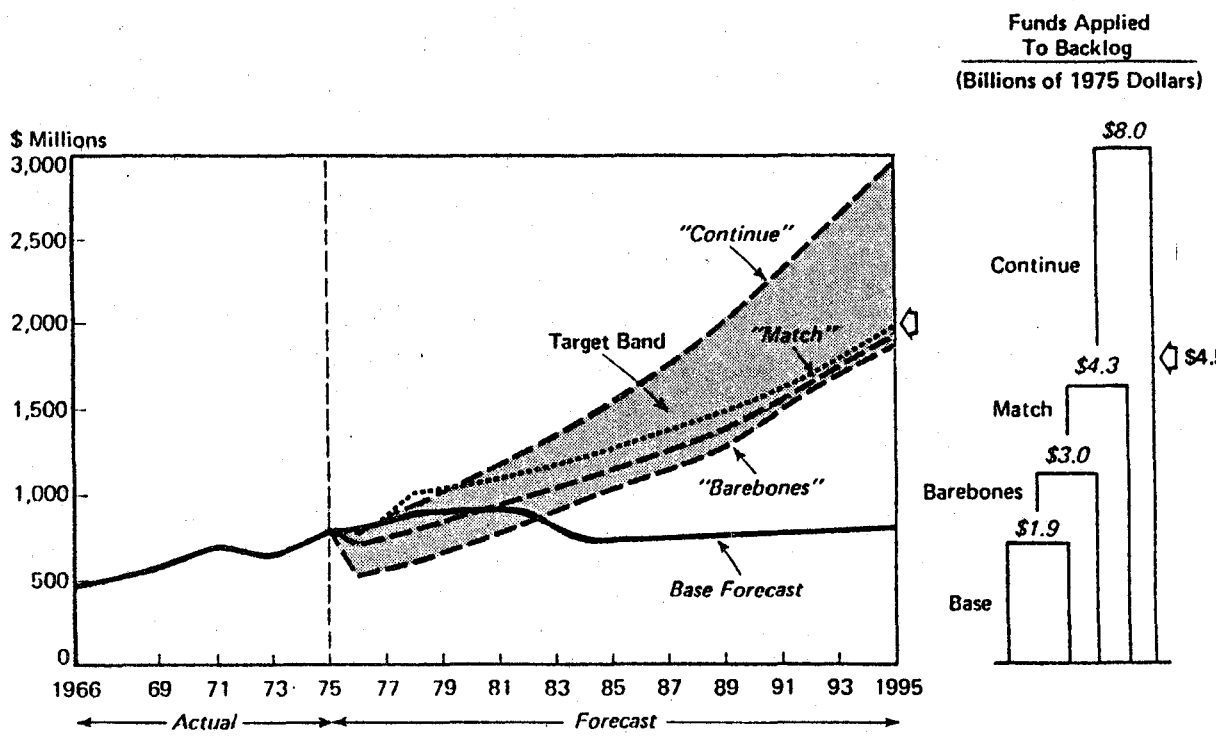


legislature either to increase revenue for both the highway program and the schools or to seek a constitutional amendment that would permit all of any increase to go to the highway program. In addition, increasing the fuel tax would pose many of the same problems as increasing license fees. It too would be considered an abrupt tax increase, and it would not take advantage of the State surplus because fuel taxes, like license fees, flow directly into the State Highway Fund. And, a fuel tax increase would offer even less protection against inflation than a license fee increase. The tax base for license fees will still be growing, even if at a slower rate than inflation; in contrast, fuel taxes are levied on a base that is expected to decline. As the base forecast shows, gasoline consumption can be expected to peak in Texas in about 1978 and to decline thereafter. Furthermore, the motor fuel tax, like license fees, is set at a fixed rate, which means that the revenue generated would decline in buying power and the rate would require periodic adjustment to keep pace with inflation. This alternative, then, would have two problems: a declining tax base and a fixed rate that would gradually decline in buying power.

Against the quantitative measures, the fuel tax alternative also failed. An increase of 2 cents per gallon in fuel tax would not provide for construction at even the Barebones level, and the ability to match Federal funds would be extended only by about 3 years. In fact, an increase of 1 cent per gallon each year would be required to achieve target revenue levels (Chart 41).

3. Increase fuel tax on the basis of price. This alternative also failed to meet two of the criteria. An increase in fuel tax under a price-based scheme would still require interaction with the schools, which are constitutionally entitled to a portion of motor fuel taxes. And, because the fuel tax is an existing State Highway Fund source, it would not provide a vehicle for taking advantage of the State surplus. However, this alternative probably would provide a measure of inflation protection by being tied to the rise and fall of prices, and it would minimize the appearance of an abrupt tax increase. Under this proposal, the basis of taxation would be shifted from a flat rate per gallon to a percentage of the wholesale price of fuel. No direct tax increase would be included in the legislation. Rather, the existing tax on gasoline of 5 cents per gallon would be restated as, for example, a 10.87 percent tax on the average wholesale price of gasoline, assumed to be 46 cents per gallon. Because 10.87 percent of 46 cents is 5 cents, the tax would remain at 5 cents per gallon until the wholesale price of fuel rose or fell. The rate of fuel taxation would be held constant. The tax would probably not be perceived as an abrupt tax increase and would be an "increase in taxes" only in the sense that the State's general sales tax is an

INCREASE MOTOR FUEL TAX ON THE BASIS OF PRICE



* - Assuming fuel tax is 10.87% of wholesale price and wholesale fuel prices increase at 7% per year

"increase in taxes" when the price of an item goes from \$1.00 to \$1.25 and the 4 percent State sales tax brings the State 5 cents instead of 4. And, because this fuel tax would be tied to the price of fuel, which is generally expected to move upward at least with the overall rate of inflation, the revenue stream would have inflation protection.

This alternative, when combined with existing tax sources, could be expected to generate approximately \$4.5 billion in funds available for reducing the backlog and to meet the Match level of funding throughout the 20-year period (Chart 42). Of course, the level of revenue that this alternative would generate depends on the price of fuel, and the forecast of future fuel prices is complicated by the likelihood that the OPEC nations will continue to intervene in the market for petroleum products. Therefore, the quantitative estimates of this alternative's revenue potential are highly uncertain.

4. Seek special funds. Seeking special appropriations of funds from the legislature, whether in the form of unrestricted revenue sharing from the Federal government or of a grant or allocation from the General Revenue Fund, failed to satisfy two criteria. First, this revenue source would not come from a tax on highway users and would therefore violate the "users pay as they go" premise of the State's highway program. Second, this source of revenue could not be expected to provide long-term inflation protection. Special grants by the legislature are by nature temporary decisions that must be reviewed during each legislative session. At each session the grant would have to be increased to keep pace with inflation, unless some specific inflation-protected source of State general revenue could be earmarked for this purpose. Thus, such grants should be viewed only as temporary sources of potential revenue.

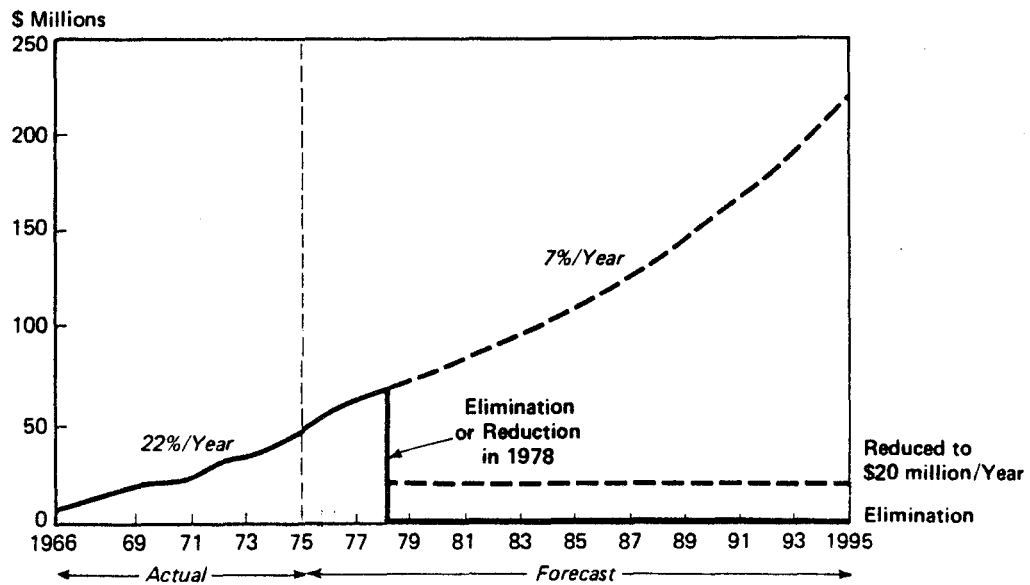
5. Enact refinery tax. A number of refinery tax proposals had been discussed publicly in Texas. Although the proposals varied in many respects, each would have levied a fixed rate per gallon on one or more refined petroleum products produced in Texas. Such a refinery tax proposal failed to satisfy all five of the qualitative criteria. First, it would not be strictly a highway user tax because the tax would be exported to users of fuel for other forms of transportation as well as to users in other states. Second, this tax would involve a fixed rate and, because the production of refined petroleum products is likely to decrease in the long run, the probability of a declining tax base. The combination of these two features would give the refinery tax very little protection against inflation. Third, a refinery tax would likely result in direct interaction with other agencies because the revenue

APPLICATION OF PREFERENCE CRITERIA

Revenue Source Preference Criteria	Eliminate DPS From SHF	License Fees		Motor Fuel Taxes		Sales Taxes		Special Funds Revenue Sharing, General Fund Allocation, or Grants	Refinery Tax
		Increasing Fixed Rate on Weight Basis	Adjusting Basis To Change in Vehicle Value	Increasing Fixed Rate of Tax/Gallon	Adjusting Rate on Basis of Price	Transferring Motor Vehicle Sales Tax to SHF (currently based on vehicle price)	Transferring Parts Sales Tax to SHF (currently based on price)		
Tax highway users	✓	✓	✓	✓	✓	✓	✓	×	×
Provide inflation protection	✓	×	✓	×	✓	✓	✓	×	×
Minimize interaction with other agencies	×	✓	✓	×	×	✓	✓	✓	×
Minimize appearance of large, abrupt tax increase	✓	×	✓	×	✓	✓	✓	✓	×
Provide vehicle to potentially take advantage of State surplus	✓	×	×	×	×	✓	✓	✓	×

✓ = Satisfies Criteria × = Does Not Satisfy Criteria

DEPARTMENT OF PUBLIC SAFETY SHARE



from this source would probably be greater than could be reasonably allocated to the State Highway Fund. For example, with a tax rate of 5 cents per gallon, revenue might be as high as \$1.2 billion annually. Fourth, the refinery tax would be an abrupt tax increase and, fifth, as a new tax it would not take advantage of the State surplus.

On the basis of the screening criteria, the study team eliminated these five alternatives and shifted its emphasis to the four revenue sources that promised to satisfy most of the long-term revenue objectives (Chart 43). It carefully evaluated both the quantitative and qualitative characteristics of each potential revenue source.

1. Eliminate funding of the Department of Public Safety from the SHF.

Eliminating the Department of Public Safety funding from the State Highway Fund would be a logical extension of the Department's efforts to reduce off-the-top expenses. By funding the DPS from another source, the Department would free a substantial amount of existing tax revenue for construction use. Either the entire DPS budget or that portion of the budget in excess of some fixed ceiling (e.g., \$20 million) could be funded from the General Revenue Fund. This alternative would provide a vehicle for taking advantage of the surplus in the General Revenue Fund. Furthermore, no tax increase would be required because the approximately \$65 million budgeted for the DPS in 1977 would be well below the level of the anticipated State surplus. Most important, this alternative would offer protection against inflation. By relieving the State Highway Fund of the upward pressure of the DPS budget, which increased an average of 22 percent each year between 1966 and 1975, this alternative would result in substantial revenues for the Department over the next 20 years (Chart 44). However, it would also entail direct interaction with the Department of Public Safety.

This alternative alone would not increase revenues to the target band. However, it would increase backlog reduction funds to a total of \$2.7 billion and would delay the unavailability of Federal matching funds by approximately 2 years.

2. Adjust basis of license fees to the change in vehicle value and tie truck license fees to inflation index. The study team believed that basing license fees on the change in vehicle value would overcome two of the problems associated with simply increasing the existing fixed license fee rates. The team knew that automobile values had increased in the past essentially at the overall rate of inflation. Thus, tying the level of automobile license fees to the value of the fleet would ensure inflation protection. And, the team believed a formula for establishing the license fee rate could be devised that would minimize the

VALUE-BASED LICENSE FEE CALCULATION

(1976 Model Year, 2,500 Lb Auto)

EXAMPLE

$$\begin{aligned}
 \text{License Fee in 1980} &= \text{License Fee in 1977} + \text{Tax Rate} \times \left[\text{Average Wholesale Value of Same Age Auto in 1979} - \text{Average Wholesale Value of Same Age Auto in 1977} \right] \\
 &= \$12.30 + .01 \times [\$1,129 - \$996] \\
 &= \$12.30 + \$1.33 \\
 &= \$13.63
 \end{aligned}$$

Base-Year Value (circled around \$996)

VALUE-BASED LICENSE FEE SCHEDULE*

Passenger Cars 3,000 Lbs or Less

EXAMPLE

Auto Year	Fiscal Year									
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
70	\$12.30	\$12.44	\$12.53	\$12.57	\$12.57	\$12.57	\$12.56	\$12.52	\$12.50	\$12.47
71	12.30	12.49	12.61	12.67	12.67	12.66	12.64	12.60	12.57	12.53
72	12.30	12.56	12.71	12.79	12.80	12.78	12.75	12.70	12.66	12.61
73	12.30	12.65	12.85	12.95	12.97	12.94	12.91	12.84	12.78	12.72
74	12.30	12.78	13.04	13.17	13.19	13.16	13.12	13.03	12.94	12.86
75	12.30	12.94	13.30	13.46	13.49	13.45	13.39	13.28	13.16	13.05
76	12.30	13.16	13.63	13.85	13.89	13.84	13.75	13.61	13.45	13.30
77	12.30	13.44	14.07	14.36	14.43	14.36	14.23	14.04	13.84	13.64
78	12.30	13.82	14.66	15.05	15.14	15.06	14.87	14.62	14.35	14.09
79		14.33	15.45	15.97	16.09	15.98	15.73	15.39	15.04	14.69
80			16.51	17.19	17.36	17.20	16.87	16.43	15.95	15.49
81				18.83	19.05	18.84	18.39	17.81	17.18	16.56
82					21.30	21.02	20.42	19.64	18.81	17.99
83						23.93	23.12	22.09	20.98	19.88
84							26.73	25.35	23.88	22.41
85								29.71	27.74	25.78
86									32.89	30.27
87										36.27

* - Assuming 6% annual increase in average vehicle value and a 1% tax rate

effects of any increase in taxes. The team developed a license fee scheme that retained the weight-based structure and weight categories currently used for automobiles but added to the existing rate a tax based on the average increase in the value of all cars of the same age and weight category. Rather than taxing the total value of the automobile, the scheme taxed only the change in value over a base-year value. In addition, it was flexible in that the size of the tax increment could be controlled by the tax rate. Under this scheme, truck license fees would be tied to a specified index of inflation and would therefore increase in direct proportion to the the rate of inflation. Trucks would continue to provide 30 - 40 percent of all license fees. An example calculation for automobiles is shown in Chart 45. The example uses a 1 percent tax rate, but any tax rate could be chosen, and the scheme could be implemented in any future year. This scheme would not be seen as an abrupt tax increase because at any reasonable tax rate it would result in a license fee schedule that only gradually increases license fees from the existing weight-based rate (Chart 46). One drawback to this license fee alternative is that it could not take advantage of the available State surplus.

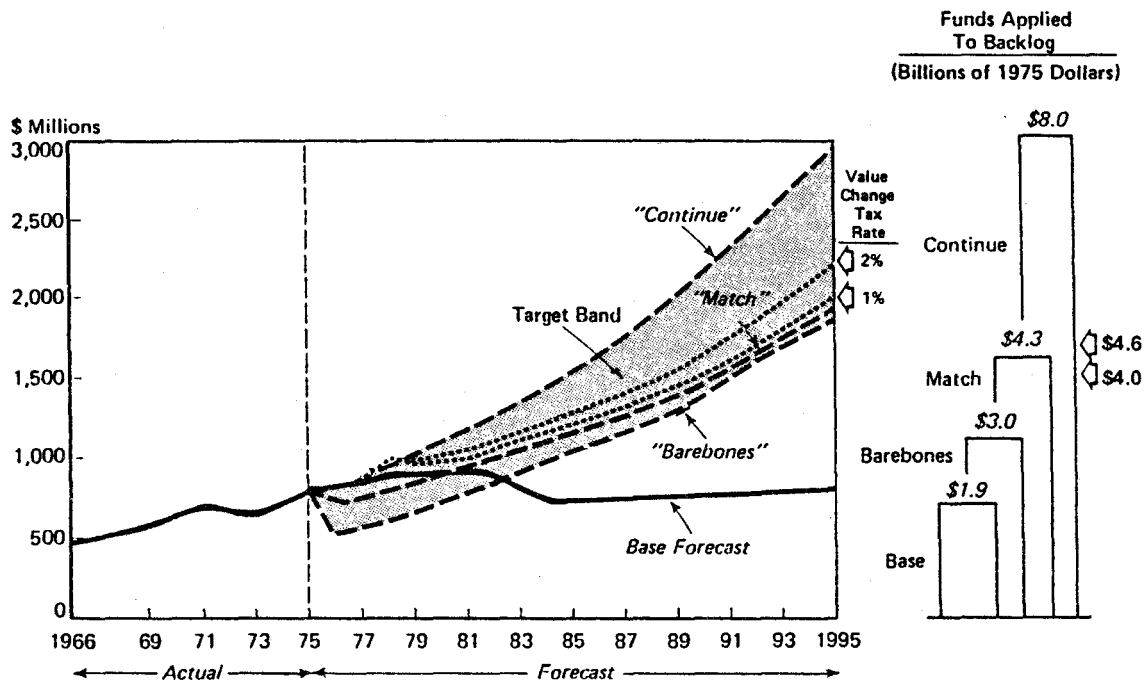
This license fee proposal would meet the quantitative criteria: if enacted in 1978, it would produce revenues that would stay within the target band and would result in \$4.0 billion in backlog reduction funds with a 1 percent tax rate and \$4.6 billion with a 2 percent rate (Chart 47).

3. Transfer Motor Vehicle Sales Tax to SHF.* The proposed transfer of the State's existing motor vehicle sales tax to the State Highway Fund met all of the qualitative criteria. Because this sales tax is an existing tax flowing into the General Revenue Fund, the proposed transfer would both avoid a tax increase and take advantage of the State surplus. And, because no agency has a direct claim on 75 percent of the revenue (the available School Fund receives 25 percent of the tax), interaction with other agencies would be minimized. This alternative would tax highway users directly when a vehicle was purchased and would provide inflation protection because the average price of new vehicles is expected to rise with inflation.

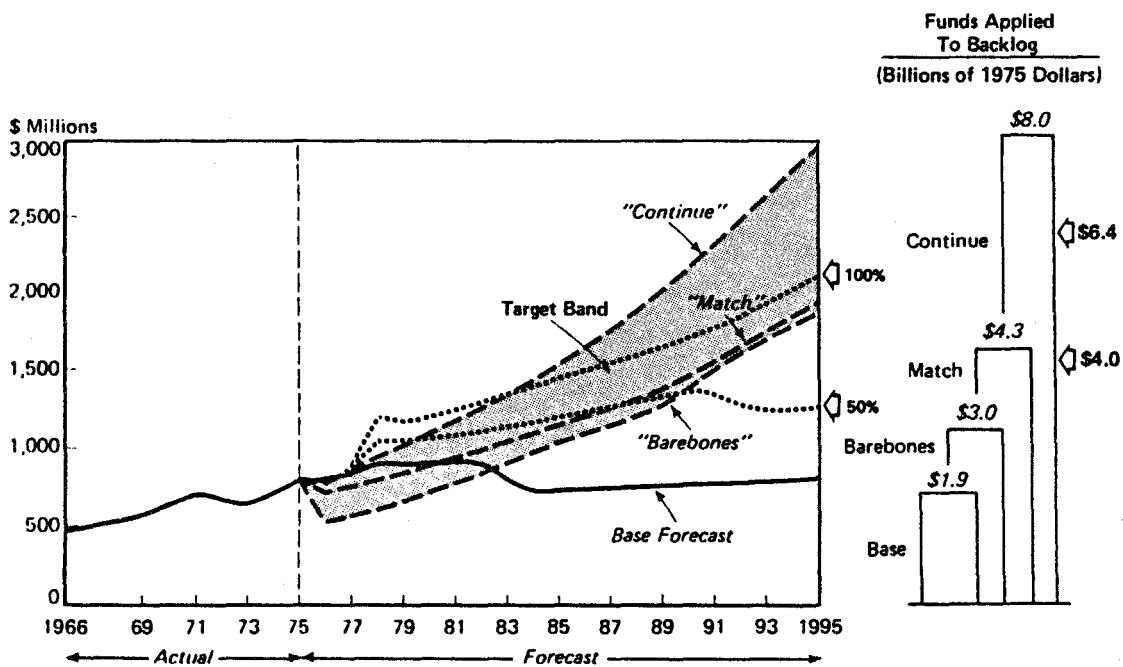
The motor vehicle sales tax would provide a large and growing source of additional revenue. However, the success of this proposal in meeting the quantitative criteria would depend on how much of the motor vehicle

* - Considering Revenue Alternatives: Motor Vehicle Sales Tax, visual presentation, March 16, 1976.

**ADJUST BASIS OF AUTO LICENSE FEE TO CHANGE IN VEHICLE VALUE
AND TIE TRUCK LICENSE FEE TO INFLATION INDEX**



MOTOR VEHICLE SALES TAX* TRANSFERRED TO SHF



* - Assuming 6% annual vehicle price escalation

sales tax was allocated to the State Highway Fund (Chart 48). If the SHF received 100 percent, the revenue stream generated would exceed the Match level for at least 20 years. But receipt of a lesser amount, such as 50 percent, would probably be insufficient.

4. Transfer vehicle parts and accessories sales tax to State Highway Fund. This proposal also met all of the qualitative screening criteria. The sales tax on motor vehicle parts and accessories is a tax on highway users, and transferring this tax to the State Highway Fund would not entail a tax increase. Because it is an existing tax flowing into the General Revenue Fund, it would provide a vehicle for taking advantage of the State surplus. It would require no interaction with any other agency and would provide inflation protection because the prices of parts and accessories, like the prices of vehicles, are expected to increase with inflation.

Estimating the quantitative value of this proposal is somewhat difficult because revenue from the State's existing general sales tax on motor vehicle parts and accessories is not separated from other sales tax revenue. However, preliminary estimates suggest that transferring this tax to the State Highway Fund would provide a small but growing source of additional revenue that would generate approximately \$45 million in 1978, but that this tax alone would not provide sufficient revenue to reach the target band.

After fully evaluating each of the revenue sources, the study team was certain that no single source would be sufficient to meet the Department's long-term funding needs. Therefore, the team next turned its attention to selecting desirable revenue packages.

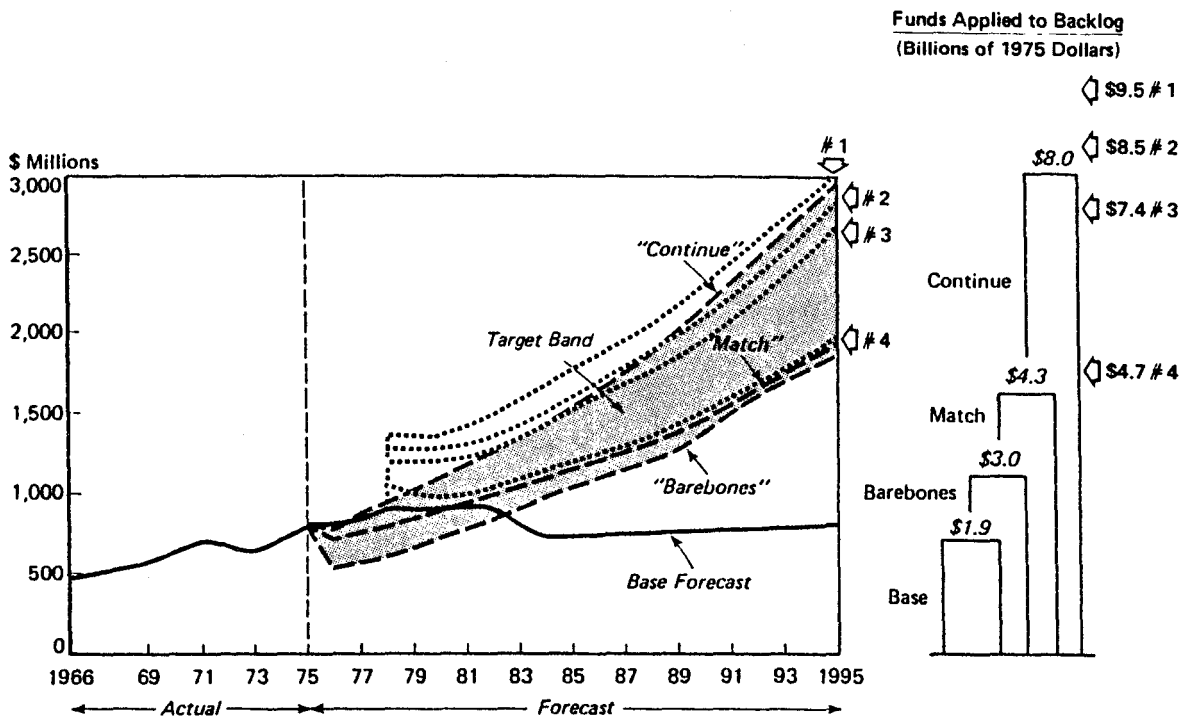
Select a Preferred Revenue Package

The Commission carefully considered the results of the study team's technical evaluation of alternative sources of revenue and concluded that the preferred revenue package would ultimately reflect political as well as technical factors. For this reason, the Commission itself could not legislate or even authoritatively propose the "final solution" to the financial crisis. Rather, using primarily technical criteria, it would have to select several alternative packages that were likely to meet the various political needs of Texas' political leaders - the Governor and the legislature.

COMBINATION REVENUE PACKAGES

	Additional Funds for Departmental Uses (\$ Millions)			
	FY1977	FY1978	FY1979	FY1980
Combination Revenue Package 1				
- Fix DPS at \$20 million/year	-	\$ 50	\$ 55	\$ 60
- Include motor vehicle sales tax (100%)	-	270	298	325
- Include parts and accessories sales tax	-	45	49	53
- Include revenue sharing	-	100	100	-
- Include value-based license fee plan	-	-	-	23
Total	-	\$465	\$502	\$461
Combination Revenue Package 2				
- Fix DPS at \$20 million/year	-	\$ 50	\$ 55	\$ 60
- Include motor vehicle sales tax (75%)	-	203	223	244
- Include parts and accessories sales tax	-	45	49	53
- Include revenue sharing	-	100	100	-
- Include value-based license fee plan	-	-	-	23
Total	-	\$398	\$427	\$380
Combination Revenue Package 3				
- Fix DPS at \$20 million/year	-	\$ 50	\$ 55	\$ 60
- Include motor vehicle sales tax (50%)	-	135	149	163
- Include parts and accessories sales tax	-	45	49	53
- Include revenue sharing	-	100	100	-
- Include value-based license fee plan	-	-	-	23
Total	-	\$330	\$353	\$299
Combination Revenue Package 4				
- Fix DPS at \$20 million/year	-	\$ 50	\$ 55	\$ 60
- Include revenue sharing	-	100	100	-
- Include value-based license fee plan	-	-	-	23
Total	-	\$150	\$155	\$ 83

COMBINATION REVENUE PACKAGES



The Commission concluded that, to be acceptable, a package would have to achieve at least the Match level of revenue and to provide a lasting solution to the Department's financial crisis. Four combination revenue packages were developed to meet this need (Chart 49).

- ¶ Combination Revenue Package 1. This package combines all four of the revenue sources that satisfactorily met the qualitative criteria. Because the plan for adjusting the license fee basis would require significant administrative preparation, its implementation is assumed to be deferred until 1980, with the State's share of Federal revenue sharing allocated to the SHF in the interim. When implemented, the new license fee plan is assumed to tax the change in vehicle value at a rate of 1 percent.

This package is designed to take full advantage of all the potential revenue sources, making it an "ideal" solution. The package's advantage is that it provides a vehicle for taking maximum advantage of a significant share of the State surplus while laying a solid foundation for long-term inflation protection. Its disadvantage is that, because 100 percent of the motor vehicle sales tax would be transferred to the SHF, the legislature would be required either to reduce funding to the schools, which currently receive 25 percent of the motor vehicle sales tax, or to find another source of school funding.

- ¶ Combination Revenue Package 2. This package is identical to Package 1 except that the proportion of motor vehicle sales tax that would be transferred to the SHF is reduced to 75 percent, which eliminates any infringement on school funding.
- ¶ Combination Revenue Package 3. Combination Package 3 is a more modest version of Packages 1 and 2. All of the acceptable revenue sources are included, but the proportion of motor vehicle sales tax that would be allocated to the SHF is reduced to 50 percent.
- ¶ Combination Revenue Package 4. This final combination eliminates both the motor vehicle sales tax and the parts and accessories tax and thereby significantly reduces available revenue. Only the license fee plan remains in the package to produce any long-term source of additional revenue. (As in the other combination packages, the Department of Public Safety's share is reduced, but that would not provide the Department with any additional inflow of funds.)

The effect of adopting any of the possible combination packages was studied in comparison to the quantitative criteria (Chart 50). Combination Package 1 would provide the highest level of revenue, \$9.5 billion. Package 2 would result

PREFERRED REVENUE SOURCES

Rank	Revenue Source	Considerations	Recommendation
1	Transferring Motor Vehicle Sales Tax to SHF	<ul style="list-style-type: none"> - Transfers already established tax - Yields substantial near-term revenues - Provides a vehicle to transfer State surplus to SHF - Provides inflation protection 	<ul style="list-style-type: none"> - Support strongly; particularly if substantial near-term increase is acceptable
2	Adjusting Basis of License Fees to Vehicle Value	<ul style="list-style-type: none"> - Provides a gradual transition into additional revenues, but it is additional tax - Provides inflation protection 	<ul style="list-style-type: none"> - Support strongly; as long-term solution
3	Eliminating DPS from SHF	<ul style="list-style-type: none"> - Provides some near-term revenue - Eliminates a growing off-the-top expense - Provides a vehicle to transfer a small amount of State surplus to SHF - Support to eliminate DPS from SHF already expressed 	<ul style="list-style-type: none"> - Continue to emphasize elimination from SHF
4	Transferring Parts Sales Tax to SHF	<ul style="list-style-type: none"> - Provides some near-term revenue and growing - Provides a vehicle to transfer a small amount of State surplus to SHF - Requires some administrative changes 	<ul style="list-style-type: none"> - Suggest as source, but do not emphasize
5	Seeking Special Funds: Revenue Sharing	<ul style="list-style-type: none"> - Provides a one-time shot in arm during transition to license fee scheme - Does not provide a lasting solution 	<ul style="list-style-type: none"> - Accept, but do not recommend

in \$8.5 billion for application against the backlog, and Package 3 would offer \$7.4 billion. Each of the first three plans, then, would result in a flow of funds that would fall securely in the upper part of the target band. Only Combination Revenue Package 4 would result in a flow that risked failing to meet the Commission's objectives of attaining at least a Match level of funding and providing a lasting solution. This package would result in \$4.7 billion in revenue and in each year would very closely approximate the Match level of funding - the level that the Commission set as a minimum.

An essential characteristic of each of the four plans is the inflation protection that the new sources of revenue would provide. Accordingly, the study team strongly recommended that any revenue package include a major source of inflation-protected revenue, either a significant portion of the motor vehicle sales tax or the adjustment in the basis of license fees. Furthermore, the technical evaluation of the potential revenue sources suggested a ranking of preferred sources (Chart 51). This ranking was presented to the Commission as a basis for responding to the questions that can be expected to arise when the legislature and interested citizens begin discussing these proposed packages.*

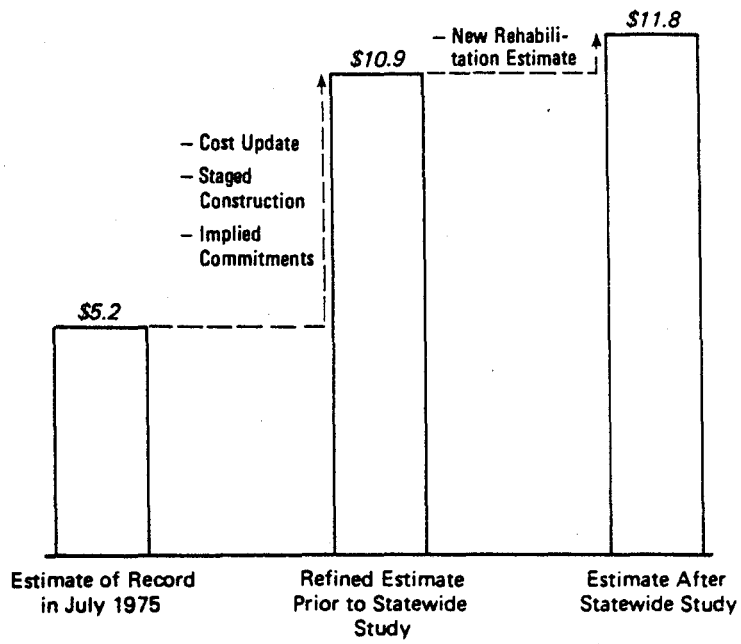
The Commission accepted the four packages as vehicles for communicating technical solutions to Texas' political leadership. Selecting and implementing one of these solutions will be the responsibility of Texas' governor and legislature - a task that can not be fully completed until the legislature meets again during the spring of 1977.

The study team successfully tackled both the short-term and long-term needs for increasing available revenues. The team thoroughly studied the existing situation, developed new tools to better analyze and understand existing and potential revenue sources, and identified viable solutions to the Department's financial crisis. The Commission and Department managers did their share by making many tough decisions along the way and by being ready to authoritatively present alternatives for solving the Department's problems to the public and to Texas' political leadership.

* - Selecting a Recommended Revenue Package, visual presentation, May 4, 1976.

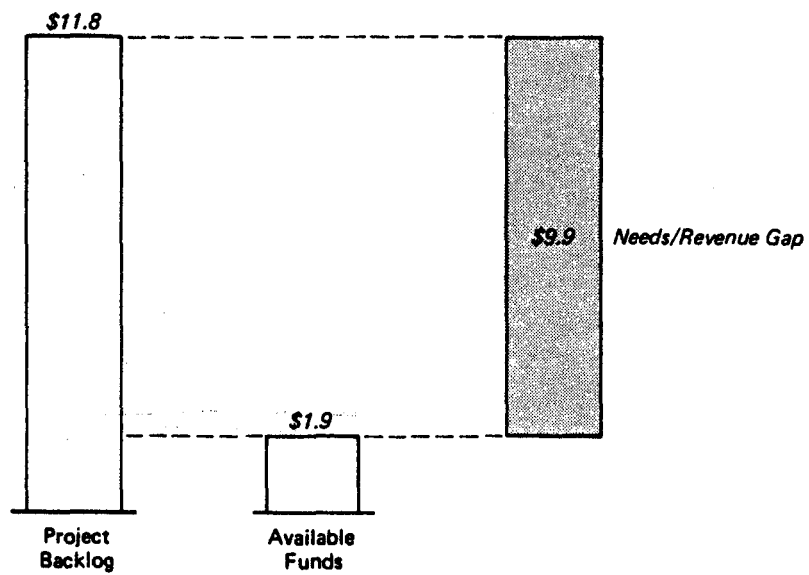
COST OF BACKLOGGED PROJECTS

(Billions of 1975 Dollars)



BACKLOG/FUNDS COMPARISON

(Billions of 1975 Dollars)



6 - THE RESULT:

A SOLID FOUNDATION FOR THE FUTURE

Over the past year, the two-pronged approach described in this report has largely been completed. The result of this effort has been to produce a sound basis on which the Department can develop and maintain, within the changing environment, a viable highway program for Texas' future. The Department now has a realistic understanding of the gap it faces between highway needs and available revenues. It has a new approach to highway planning that should result in the maximum benefits for available funds. As a result of this approach, it has a revised highway plan for the next 20 years that can be constructed with expected revenues. Finally, the Department now has a clear picture of its revenue situation; furthermore, that position is improving because of short-term belt tightening but, more important, because long-term solutions to the revenue problem are under active consideration by Texas' political leaders.

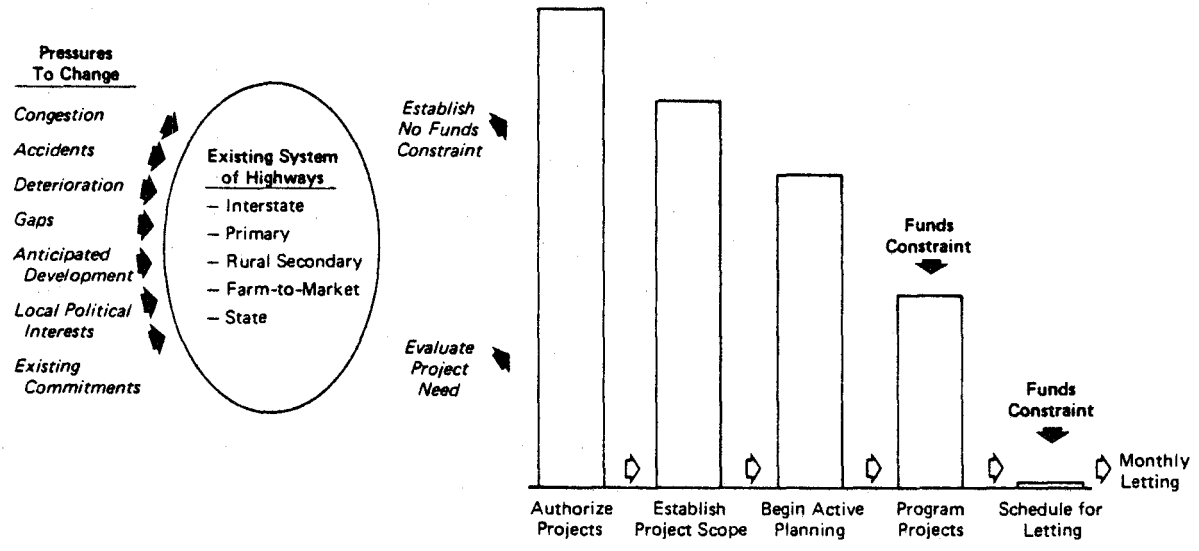
The results of this effort - those already achieved as well as those anticipated - are described more fully in this chapter.

"TRUE" NEEDS/ REVENUE GAP IDENTIFIED

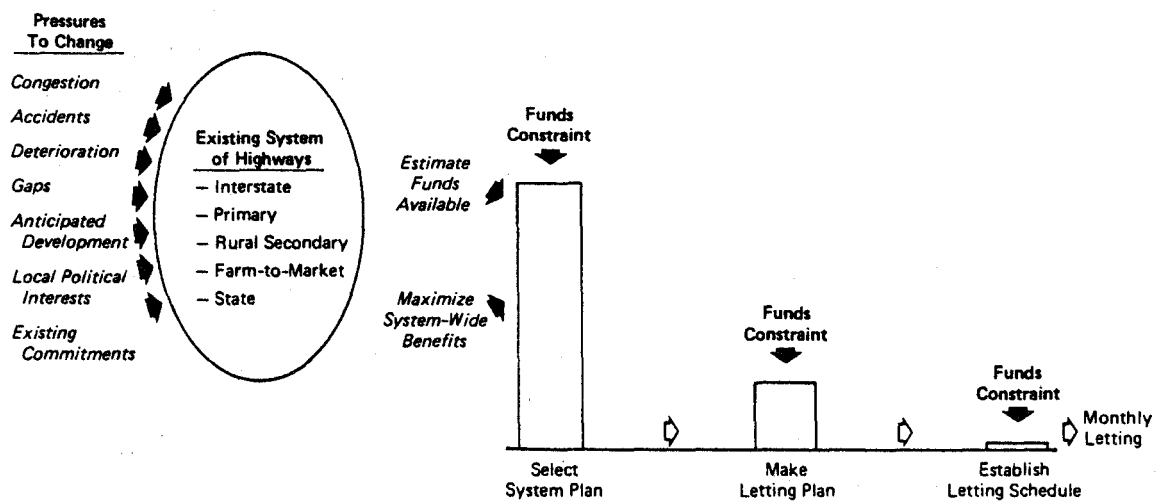
One of the first visible signs of trouble for the Department was the apparent gap between the backlog of projects designed to meet identified highway needs and the level of revenue expected to be available. At the outset of the study, the joint study team conducted a preliminary analysis, which gave some indication of the magnitude of the problem: the backlog of committed projects was found to be valued at nearly \$11 billion in 1975 dollars - much higher than the earlier estimate of \$5.2 billion. At the same time, the team's preliminary analysis of trends in funding indicated that future funding levels would be lower than past levels and would almost certainly be less than \$2 billion in 1975 dollars.

In the course of the study, one of the team's tasks was to develop a more complete assessment of the magnitude and implications of the needs/revenue gap. A district-by-district review of the Department's backlog of committed projects revealed that the backlog actually totaled \$11.8 billion - a \$900 million increase over the \$10.9 billion preliminary estimate made at the study's outset (Chart 52). Much of this increase was attributed to more careful analysis of the Department's future obligations for rehabilitating the existing system. More important, however, the review confirmed that the Department's backlog was

TRADITIONAL PROJECT-BY-PROJECT APPROACH



NEW SYSTEMS-ORIENTED APPROACH



real - that it consisted of specific, committed projects that could be discretely identified both by cost and by origin of commitment. The team also found that with the current outlook for funding only about \$1.9 billion in today's dollars would be available for the highway construction program over the next 20 years. At that level, construction will be possible only in the next 6 - 7 years, and afterwards the Department will not even be able to maintain the system in an adequate state of repair. Clearly, the Department faces a tremendous gap between highway needs and available funds - a gap of at least \$9.9 billion (Chart 53) for the current backlog alone - and any future projects added to the backlog will only widen the gap.

NEW APPROACH TO HIGHWAY PLANNING IMPLEMENTED

One essential response to the needs/revenue gap was, of course, the development of a fundamentally changed approach to highway planning. As a result of this effort, the State of Texas has been left with a more effective, better controlled process for making critical planning decisions.

In the past, the planning philosophy had been to authorize projects as they were requested by the public and to plan projects as if all the money needed to construct them were available. Many of these projects would be programmed, detailed planning and design would begin, and a few projects would be constructed as funds became available (Chart 54). It was a project-by-project approach.

That approach has now been replaced by a new system-oriented approach - one that recognizes that funds are limited and that the State Department of Highways and Public Transportation cannot meet all possible highway needs. It also recognizes that solutions designed within the context of limited funds can - and must - be significantly different from those designed as if unlimited funds were available. Now, funding constraints influence planning decisions at the earliest possible stage in the process (Chart 55).

Supporting this change in approach is a large body of new policy and technique. Funds forecasting has been improved with the assistance of a computer model and the close involvement of top management. A second computer model has been developed to assist the Department in judging the relative merits of alternative projects competing for scarce funds. And, systematic methodology has been developed - supported by changes in design policy - that permits the evaluation of a wide range of transportation solutions using new, more accurate measures of effectiveness and that provides for high-level review from a state-wide perspective.

Accompanying this body of new policy and technique is a new system of control documents: the System Plan, the Letting Plan, and the Advance Letting Schedule. Of these documents, the most important is the System Plan, because it is the long-term tool for controlling all of the Department's project development activity.

This new approach to highway planning has been endorsed by the Department and should be formally approved by the State Highway and Public Transportation Commission.

WORKABLE 20-YEAR PLAN DEVELOPED

In addition to providing the Department with a new process for highway planning, the study team applied the process to develop a System Plan for the Department's use. The State of Texas now has a construction plan that provides the greatest possible system benefits for the funds likely to be available over the next 20 years.

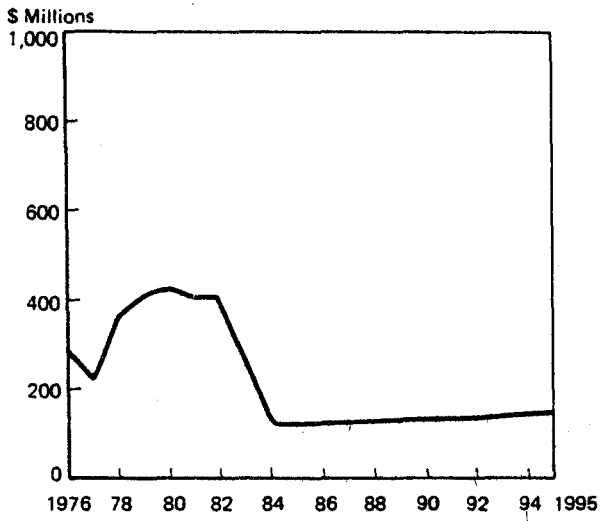
To accomplish this task, the Department actually prepared two System Plans. The first of these plans was based on the current funding outlook, Level I. It presents a realistic program for effectively utilizing the revenues available from the Department's existing sources of revenue assuming no change in the current rate or basis of taxation. The second is based on expanded funding, Level II, and has been prepared assuming a modest increase in long-term sources of revenues that would bring the Department \$4.3 billion in today's dollars over the next 20 years.

Both of these plans were prepared for important reasons. The Level I plan recognizes the Department's obligation to effectively manage its resources and to efficiently discharge its responsibilities at the funding level presently established by the legislature's provision of revenues. As such, it is a practical plan for constructing modest facilities and rehabilitating the existing highway system during the next 6 - 7 years before construction dollars are no longer available. The plan demonstrates the Department's determination to gain full benefit from the scarce highway dollars by specifically identifying the scope and location of projects that it would choose to build during this period. The Level II plan illustrates the value of additional highway dollars by showing where additional improvements to the system can be made. It also suggests the proper form of

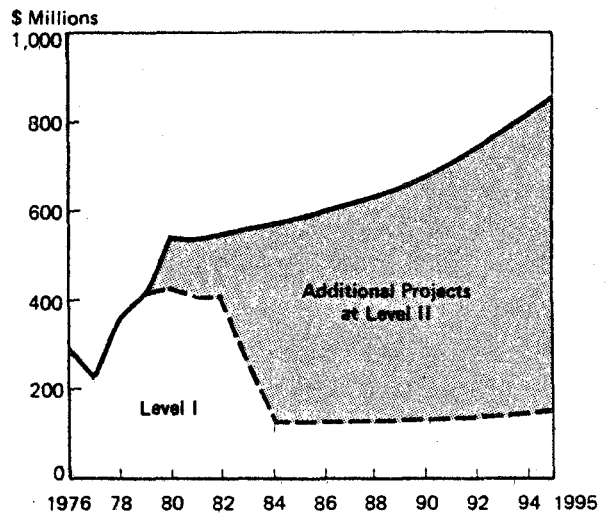
ILLUSTRATIVE

VOLUME OF PROJECTS AT EACH FUNDING LEVEL

Level I: Current Funding Outlook



Level II: Expanded Funding



a long-term program for meeting the continuing transportation needs of Texas should the legislature choose to adopt a long-term revenue solution. Nevertheless, this second plan also demonstrates the reality that it will be virtually impossible to construct - even at reduced scope - all of the committed projects presently in the State's backlog.

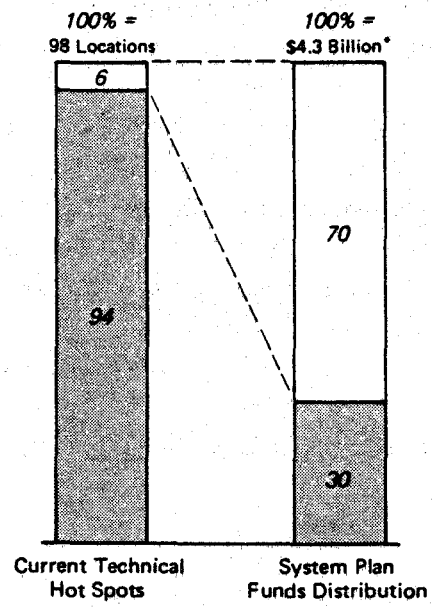
However, from a practical point of view the study team created a single System Plan. During the course of its analyses, the team realized that the Level I plan based on the current funding outlook consists primarily of those projects from the Level II plan that are most critical and would be constructed first (Chart 56).^{*} Of course, a few projects would change in scope if the current funding outlook were to continue, but the vast majority would remain the same. Thus, the Department can begin following the plans immediately with the knowledge that project decisions made today are probably correct even though the legislature will not have an opportunity to formally consider the proposed revenue packages until it convenes in the spring of 1977.

In preparing these plans, the study team undertook a massive statewide effort using the new planning approach described in Chapter 3. It began by analyzing the State highway system network, district by district. The focus of the effort was on developing plans in line with the State's objectives: providing a Backbone transportation system for Texas and addressing major existing problems (including gaps in the system) while maintaining the system in an adequate state of repair. The district plans were then reviewed from a statewide perspective and consolidated into the two State highway system plans. Each of these plans met its funding constraints both at the overall level and for the various funding categories.

The System Plan, of course, is not yet in its final form. The State Highway and Public Transportation Commission has reviewed the plan in workshop sessions and has specifically endorsed the plan's emphasis on the performance of Texas' Backbone System. Nevertheless, the final decisions have not been made with regard to the appropriate funding target, and the public - including local and regional governmental officials - has not had an opportunity to thoroughly discuss their views on the specific projects selected for the System Plan.

* - Projects in the Level I plan will probably form the basis for the first 5-year Letting Plan as described in Chapter 4.

PROPORTION OF HOT SPOTS ADDRESSED



* - 1975 dollars

Public discussions will be held by the Department during the coming months, both formally through public hearings and regional planning organization proceedings and informally through talks and speeches by the Department's senior management and district engineers. These discussions, as well as actions by the legislature, will undoubtedly result in some modifications to the existing system plan. Therefore, the System Plan will probably not be finalized until the late spring of 1977. And, of course, even in its "final" form the plan will be subject to revision both on a regularly scheduled basis and in response to changes in the environment.

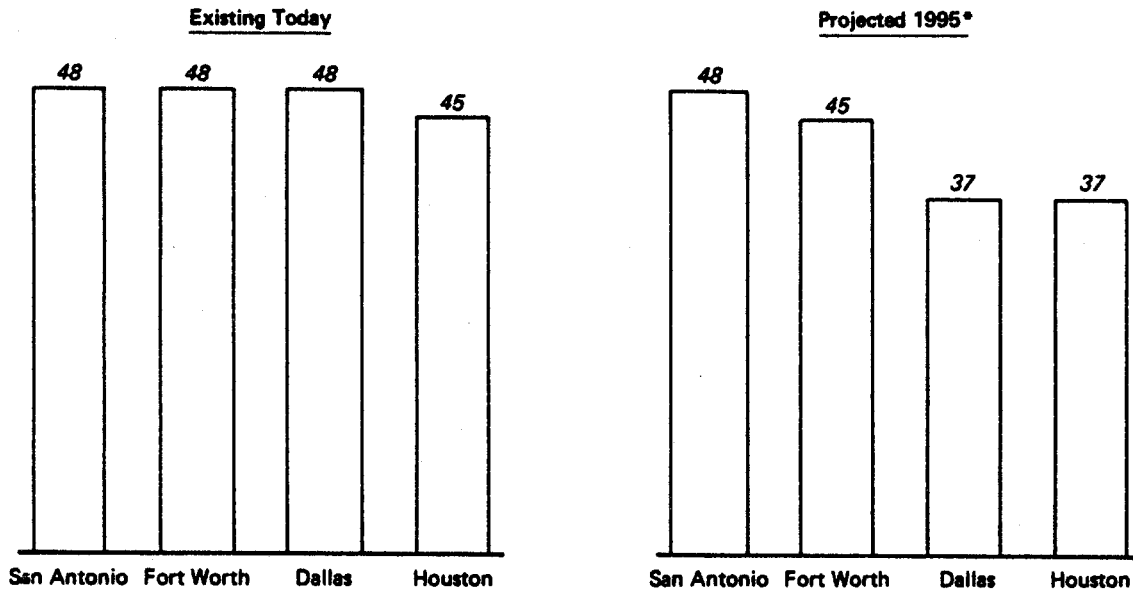
Implementing the current System Plan should produce a number of specific, very significant benefits for the State's highway users. These include:

1. Immediate solutions for hot spots. Addressing existing problem areas is one of the primary objectives behind the plan. For example, in the urban areas, near-term operational improvements are planned to meet critical existing problems on the Katy Freeway (IH 10) in Houston, the Eastex Freeway (US 59) also in Houston, SH 360 in Arlington, and US 75/SPUR 503 between Sherman and Denison. Under the previous approach, these improvements probably would have been either not constructed or delayed for years. Improvements are also planned at critical locations in outlying areas. For example, revised projects are planned on the US 59 bypass of Cleveland and on SPUR 240/US 277 in Eagle Pass. The System Plan, by applying 30 percent of its resources to the task, addresses virtually all - 94 percent - of the State's current technical hot spots (Chart 57), leaving only those for which no economical solution could be found.
2. A more complete system with fewer gaps. As explained in Chapter 3, a substantial improvement in mobility can often be realized by completing small gaps or eliminating bottleneck sections, both of which can restrict the flow of traffic or create unsafe conditions. The System Plan includes projects to complete many routes, all of which probably would not have been completed under the previous approach; examples include facilities on US 59 between Texarkana and Nacogdoches, on IH 37 between San Antonio and Corpus Christi, and on US 287 near Alvord and Estelline. It should be noted that US 59, IH 37, and US 287 are part of the State's Backbone System; their inclusion in the plan also reflects the Department's emphasis on the Backbone System in order to maximize benefits to the entire State.
3. A higher level of service. The planned system is expected to result in 20 to 30 percent more service than could have been expected from the

ILLUSTRATIVE

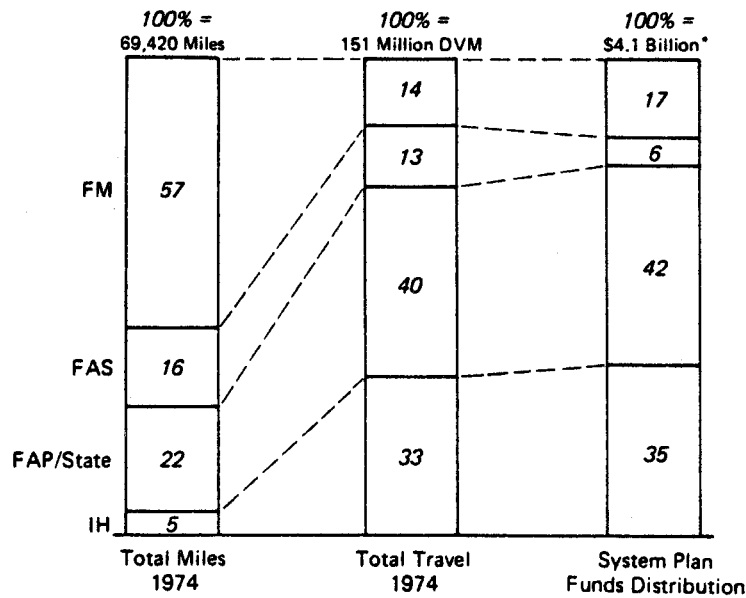
MOBILITY IN URBAN DISTRICTS

(Average Speed in Miles per Hour)



* - Assuming current land use projections and unconstrained traffic forecasts

DISTRIBUTION OF FUNDS BY CATEGORY



* - Analysis excludes Urban System funding

same level of expenditure under the previous approach - service measured in reduced operating and maintenance costs, greater safety, and less delay - for the available dollars. For example, the revised plan for the Houston districts increases benefits by approximately 20 percent and significantly improves system mobility over what otherwise would have been provided.* Increases within the 20 to 30 percent range have also been confirmed in Dallas, Fort Worth, and San Antonio. Furthermore, with the planned system, mobility should be maintained near today's level in all but the rapidly growing central urban areas (Chart 58).

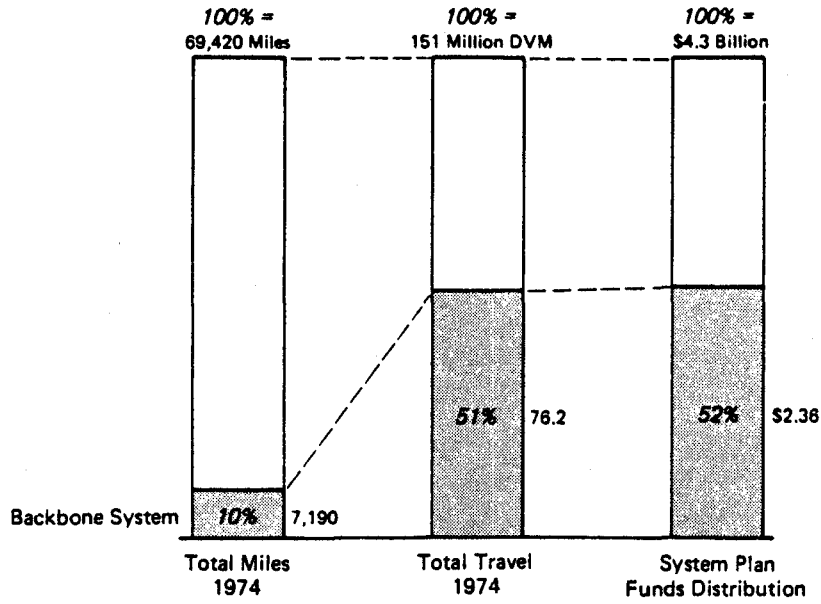
While the current System Plan should bring substantial benefits to highway users, a plan also benefits the Department. First, the process of developing a plan should ensure the reasonable distribution of funds among districts. As explained in Chapter 3, with the new system-oriented approach, each district's candidate plans are evaluated in terms of their contribution to overall system performance. It follows that each district receives funds in accordance with the number and scope of its plans included in the State plan. Funds distribution then, is the result of the process of selecting projects - it is not a predetermined input on the "correct" allocation that would affect the selection process.

The results of this distribution method appear rational by most objective technical measures. In the System Plan, for example, distribution is roughly proportionate to travel on the State's highway system categories (Chart 59), and on the Backbone System (Chart 60). Urban districts do receive more funding from the System Plan than from the traditional allocation formula; however, the new urban funding level is in line with the amount of revenue derived from urban areas and is probably also in line with other indicators such as miles traveled (Chart 61).

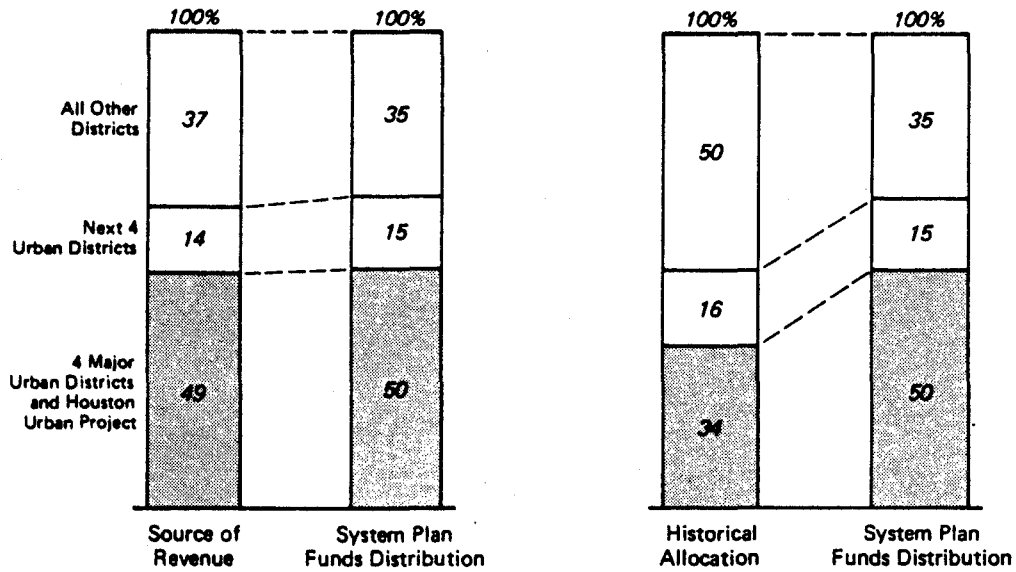
Another benefit is that the System Plan offers an effective device for communication both within and outside the Department. Having a plan ensures that all members of the Department understand what projects are to be constructed and what priority these projects have. Furthermore, the Department is now better able to convey the implications of the proposed highway system to the public. During meetings with local and regional authorities in the coming months, the System Plan will provide a new perspective on the total highway system. Projects can be discussed in terms of their relationship to the whole system rather than as isolated, individual project decisions. The System Plan will present a clearer picture of what is likely to be constructed during the

* - Progress Review III: Reviewing Alternative Subsystem Plans for Houston Districts, visual presentation, October 22, 1975.

DISTRIBUTION OF FUNDS TO BACKBONE SYSTEM



DISTRIBUTION OF FUNDS TO URBAN DISTRICTS



next 20 years. And, the new quantitative measures - especially mobility - that were used in developing the plan will make it easier to explain the impact of planning decisions on the functioning of the highway system. Equipped with the System Plan - and with the increased knowledge and improved techniques that came about as the System Plan was developed - the Department should be able to effectively convey the systemwide implications of funding levels. These systemwide implications can be presented to Texas' political decision makers, especially members of the Texas Legislature, enabling them to more fully understand and evaluate their funding decisions.

The System Plan alone now guides all of the Department's design, planning, and letting activities. Some of the projects previously planned by the Department are included in the System Plan in a revised form, and work on these projects continues. For example, the new IH 35/US 290 interchange in Austin, originally estimated to cost \$27 million, has been replanned to cost only approximately \$11 million yet is still expected to meet traffic needs for years to come (Chart 62). That project is included in the July 1976 letting. Other examples of significantly revised projects in the System Plan include IH 635 in Dallas from the IH 635/IH 35E interchange west to SH 121 ; US 54 in El Paso; Kell Freeway in Wichita Falls; and US 67, the East-West Freeway, in San Angelo.

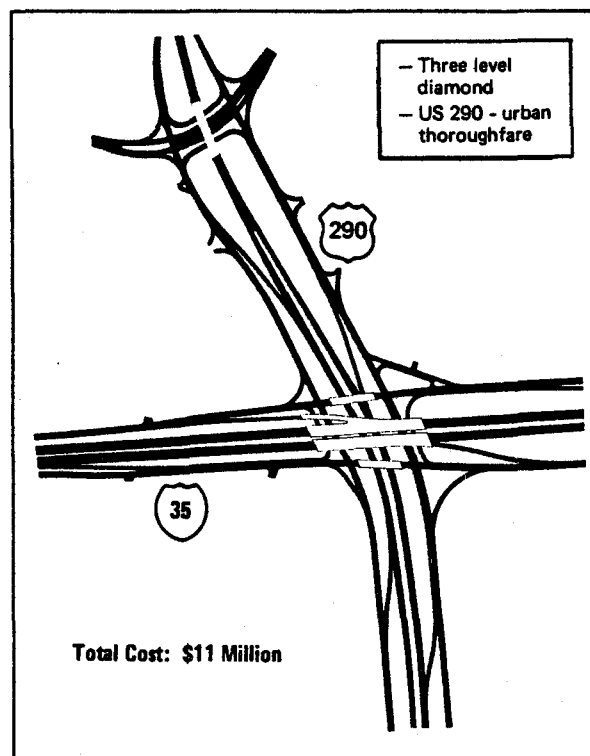
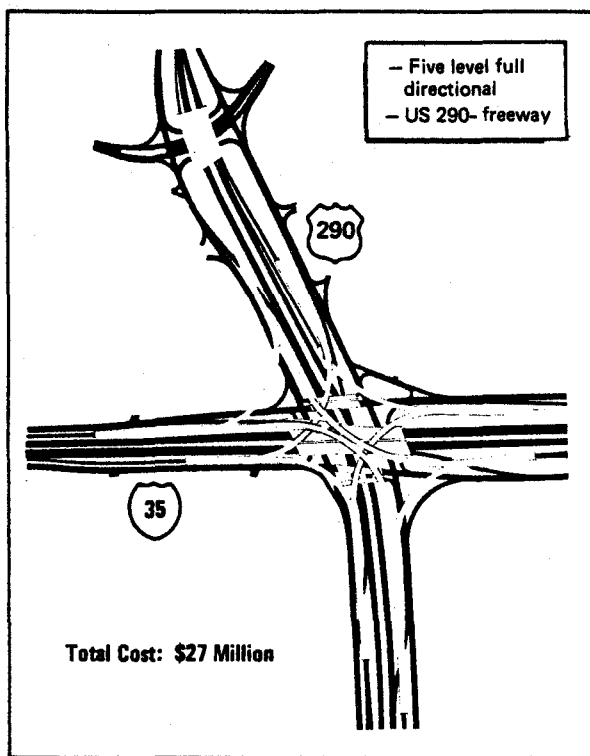
Because of funds limitations and the large number and size of competing projects, some projects could not be included in the System Plan, and all work on them has been indefinitely postponed. These include Beltway 8 in Houston, the Northside-Southwest Freeway in Fort Worth, Loop 9 in Dallas, and portions of IH 27 between Lubbock and Amarillo.

SHORT-TERM BELT TIGHTENING INITIATED

The thrust of the study team's effort was toward finding long-term solutions to the Department's problems. However, during the course of its work, the team became aware of opportunities to immediately improve the Department's financial position by further reducing off-the-top expenses, declaring a moratorium on right-of-way purchases, and improving cash management.

Several of the belt-tightening opportunities have already been implemented. The Department has continued to reduce its total level of manpower and has implemented one of the cash management proposals, the change in reimbursement procedures from Trust Fund 927, resulting in a gain of \$12 million. The Commission several months ago declared a moratorium on the purchase of all

IH 35/US 290 INTERCHANGE



right-of-way except for those few projects for which the Department was confident that near-term financing was available.* This moratorium should significantly reduce the Department's right-of-way expenditures from the 1975 level of \$28 million and thereby immediately make available an additional \$10 to \$15 million for critically needed construction. Furthermore, as a result of the new understanding of funding sources developed by the study team, the State comptroller has made an upward adjustment in the revenues attributed to the State lubricant sales tax. This has increased revenues to the State Highway Fund for the current fiscal year by approximately \$2.5 million.

Nevertheless, more remains to be done. Five other cash management opportunities await implementation, and the Department should be able to find further significant improvement opportunities in its management of routine maintenance operations - the Department's largest single nonconstruction expense.

FOUR LONG-TERM REVENUE OPTIONS PRODUCED

One of the initial problems the study team faced in seeking revenue solutions was that the rapidly changing environment made it difficult to understand which forces were affecting the Department's existing and potential revenue sources. Its first effort, then, was to identify and develop a thorough understanding of those forces. For example, it is now clear that the fundamental cause of the financial crisis is the lack of a stable source of inflation-protected revenue. Existing sources of highway revenue no longer provide this inflation protection, and some sources - like the gasoline tax - are likely to deflate rather than inflate in the not-too-distant future. The Department has also learned that finding solutions to the financial crisis will not be easy. Simple belt tightening on nonconstruction expenditures, although extremely helpful in the short term, will not solve the fundamental long-term problem, nor will moderate increases in the tax rate such as increasing the gasoline tax by 2 cents per gallon. Rather, significant legislative changes will be required to establish new inflation-protected sources of revenue.

Accordingly, the study team developed four technically feasible revenue packages, which were accepted by the Commission on May 4, 1976. The revenue packages employ, in addition to the current revenue sources, three new sources of inflation-protected revenue: motor vehicle sales tax, value-based license fees, and motor vehicle parts and accessories tax. It now appears likely that the

* - Minute Order #70800, December 19, 1975.

legislature will seriously consider these alternative packages during its next session. And, the Department appears to be in an excellent position to support the legislative deliberations. With the HIFUND computer model, the Department can quickly analyze the impact of proposed changes in the revenue packages, and Department personnel are now developing the analytical expertise to take full advantage of the financial data base that the model provides. Of course, selecting and implementing one of these alternatives will be the responsibility of the governor and the legislature - a task that cannot be fully completed until the legislature meets again in the spring of 1977.

The State Department of Highways and Public Transportation can now turn its attention to the future with confidence that the highway program has a realistic, solid foundation. With an improved revenue position and a means of planning highways within funding constraints, the Department should be able to provide Texas with the best possible highway system for the available dollar. And, the Department should be able to share with the public its own improved understanding of the problems and challenges it faces and to offer realistic solutions.

RESPONDING TO THE CHANGING ENVIRONMENTSUMMARY OF MAJOR DOCUMENTS*

<u>Title of Document</u>	<u>Description</u>	<u>Type</u>	<u>Date**</u>
Responding to the Changing Environment	Outlines the symptoms of problems facing the Department and describes the proposed approach of a study to seek solutions	Memorandum	March 26, 1975
Progress Review I: Scoping the "Needs/Revenue" Gap	Presents preliminary findings from diagnostic phase and contains recommendations for improving cash management	Visual	July 16, 1975
Progress Review I: Responding to the Changing Environment	Details preliminary findings from diagnostic phase and recommendations for improving cash management for the State Highway and Public Transportation Commission	Visual	July 31, 1975
Progress Review II: Developing Tools for Better Highway Program Management	Introduces the concept, methodology, and preliminary results of a funds forecasting model (HIFUND) and presents an economic approach and computer model (HEEM) for analyzing highway design alternatives using SH 288 and SH 35 as examples	Visual	September 17, 1975
Defining a New Direction for the Highway Program: The Financial Outlook	Highlights the key findings regarding the financial outlook and illustrates the implications for highway system development for Governor Dolph Briscoe	Visual	October 7, 1975
Progress Review III: Reviewing Alternative Sub-system Plans for Houston Districts	Reviews first application of system-oriented approach using the Houston districts as examples	Visual	October 22, 1975
Progress Review IV: Reviewing Overall Schedule and Revised Plans for Houston	Describes the study's overall schedule, presents proposals for more effective public communications, and illustrates the system-oriented approach using the Houston districts as examples	Visual	November 26, 1975
Progress Review V: Examining the Financial Situation: Implications and Alternatives	Presents a revised funds forecast and its implications for major project categories, sets target funding levels, and evaluates alternative sources of additional revenue	Visual	December 22, 1975
Assuming Responsibility for Public Transportation	Reviews key findings and recommendations for making the transition into the Department's new public transportation responsibilities	Memorandum with visual	December 22, 1975
Progress Review VI: Reviewing Revised Plans for Dallas and Fort Worth	Details the preliminary results of the application of the system-oriented approach to Dallas and Fort Worth	Visual	February 3, 1976

* - All listed documents, including visual presentations, were produced, bound, and distributed by McKinsey & Company for the use of appropriate employees and representatives of the State Department of Highways and Public Transportation, State of Texas.

** - The analyses contained in these documents were made as the study's final findings and conclusions were evolving. As a result, some of the early analyses have been superceded by later work. Where similar analyses can be found in this list, the most recent analysis is suggested for reference.

McKinsey & Company, Inc.

Title of Document	Description	Type	Date
Applying the Systems Approach to the Texas Highway Program: Applications Guide	Outlines the program and analytical steps required to implement statewide the systems engineering approach to planning and to begin development of a statewide plan	Manual	February 1976
Guide to the Highway Economic Evaluation Model, User's Copy*	Describes the concept and technique of economic analysis of highways and explains how the computer model (HEEM) is used	Manual	February 1976
Deriving HEEM's Assumptions for Texas	Documents the source of key data for the Highway Economic Evaluation Model (HEEM) and highlights the need for further data refinement	Visual	February 1976
Presenting District System Plans to the Management Action Committee: Review Session Arrangements	Outlines the format to be followed to allow effective integration of district system plans into consistent statewide system plans	Memorandum	March 11, 1976
Considering Revenue Alternatives: Motor Vehicle Sales Tax	Illustrates the impact on highway financing of allocating the motor vehicle sales tax to the State Highway Fund	Visual	March 16, 1976
Progress Review VII: Reviewing Subsystem Plans for Dallas and Fort Worth	Presents refined results of the application of the system-oriented approach to Dallas and Fort Worth	Visual	March 31, 1976
Guide to the Highway Funds Forecasting Model	Documents the funds forecasting model, details the model's concept and methodology, and instructs the model's users	Manual (Two Volumes)	April 1976
Selecting a Recommended Revenue Package	Suggests specific alternative sources of additional revenue for the highway program	Visual	May 4, 1976
Understanding the Funding Outlook: The Base Forecast	Highlights briefly the current revenue outlook and the fundamental forces affecting it, and serves as a supplement to the <u>Guide to the Highway Funds Forecasting Model</u>	Memorandum	May 7, 1976
Guide to the Highway Rehabilitation Forecasting Model	Describes the methodology and computer model (REHAB) for forecasting future rehabilitation requirements and suggests how such forecasts could be used	Manual	May 24, 1976
Ensuring Effective Control of the Highway Program	Outlines policies and procedures for controlling the highway program in a fashion consistent with the system-oriented approach	Visual	June 1, 1976
Developing Statewide System Plans	Contains materials used during a workshop that reviewed the proposed statewide system plan	Visual	June 1, 1976
Guide to the Highway Economic Evaluation Model, Programmer's Copy	Describes the concept and technique of the economic analysis of highways; explains how the model is used; and provides flow charts, listings, specific calculations, and instructions for updating the model	Manual	June 1976
Responding to the Changing Environment: A Summary	Summarizes the findings of the entire study for the Department's use in communicating study results both to members of the Department and to the public	Visual	June 23, 1976

* - Additional copies were prepared by the State Department of Highways and Public Transportation.