# Management Study
# Final Report

DEPARTMENT OF TRANSPORTATION
STATE OF MAINE

September 30, 1980



Ernst & Whinney
SYDEC

# MANAGEMENT STUDY

PREPARED FOR
MAINE DEPARTMENT OF TRANSPORTATION

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# PREFACE

This report is organized into eight chapters, the first dealing with recommended changes in MDOT organization and management and the last, with recommended program levels. The intervening chapters contain findings and recommendations associated with each of the six bureaus under the Phase one reorganization plan:

- Finance and Administration
- Common Carrier Transportation
- Planning
- Project Development
- Construction
- Maintenance and Operations

A reader interested primarily in one area, say Maintenance and Operations, should first read Chapter 1 dealing with the overall organization and management of the Department. This is a preferred approach because the remaining chapters essentially follow the proposed framework recommended in Chapter 1.

Within each chapter, the report is organized simply. After a brief introductory narrative, recommendations are stated in boldface type followed by supporting rationale and other brief supporting data and analyses. Often, additional recommendations are contained within the text. These are underlined for emphasis. Most often they represent the recommended means of accomplishing the primary objective given earlier. Because this is a management study, its reporting emphasizes results. Hundreds of pages of data and analysis support the recommendations and can be made available.

This management study of the Department, focused on the Highway Program, represents a very intensive effort. Over 3,500 hours were expended during the sixteen weeks from project initiation to submission of the final report. This effort was expended in project management; extensive interviews; preparation of interview notes; data collection; follow-up discussions; travel; documentation of issues, findings, and recommendations; and meetings with the Advisory Committee and senior State officials.

Extensive interviews were conducted with all senior personnel (except several division engineers and directors of some non-highway operations), as well as individuals at other levels. Interview teams usually

consisted of two or three individuals whose analysis responsibilities were in the areas of organization and management, program cost effectiveness, or program value analysis. A concerted effort was made during the interview process to obtain data which could be used to analyze the effectiveness and efficiency of MDOT programs and activities. Much of the data was analyzed using computer programs developed specifically for this purpose by the study team for computer analysis by the Computer Services Division of MDOT.

Following each interview, comprehensive interview notes were prepared according to a prescribed format. These interview notes were returned confidentially to the interviewee. This enabled the interviewee to validate information and to correct misunderstandings or misinterpretations by the interview team. This process was extremely well-received by most employees, who noted it was their first opportunity ever to share in the data information-validation process.

Strictly speaking, extensive data are required to do a thorough job of determining cost effectiveness and efficiency of the line and staff units of MDOT. In some cases, these data were available. In others, they were not. In the latter case, reasonable surrogates were used to develop an approximation of unit cost effectiveness and efficiency. In those cases, more reliance was placed on a broadened interview base covering the subject of interest.

The study team visited several district offices. Roads of all classifications were traveled and DOT crews were observed at work. Visits were made to the Materials and Research Division in Bangor and to the City of Portland. Interviews were held with a dozen city and town officials representing a cross-section of size and interest. Other agencies such as the Department of Environmental Protection and the Federal Highway Administration also were interviewed.

Three meetings were held with the Advisory Committee--once at the beginning of the project, once after key issues had been identified and findings documented, and once following submissions of the draft final report. Feedback was also obtained from senior MDOT personnel who reviewed preliminary findings and recommendations in substantial detail.

We were not surprised to find dedicated employees throughout the Department--employees who months or years before had identified problem areas and sought ways to correct them. We found productivity generally to be good, probably above average for a typical state DOT. Where a distinct productivity problem exists or where it would appear that there is room for considerable improvement, we developed recommendations which we believe would bring about improvements and in many cases stretch limited dollars further.

It should be noted that the management study did not include an evaluation of revenue forecasts, a determination of potential revenue "shortfall," or an exhaustive assessment of alternative program levels.

The primary thrust of the effort was toward cost effectiveness of programs and efficiency and effectiveness of MDOT administration and management. Thus, the recommendations will help guide the delivery of transportation services and the setting of program levels in the next biennium and into the decade. Also, the study team recognized the reduced revenue/escalating costs problem confronting the Department and therefore was sensitive to identifying areas where cut-backs or deferral of certain programs could be tolerated in the short run. However, the extent of our financial analysis was to make such assessments at an aggregated level, without knowledge of the extent of the projected financial problem or a detailed analysis of its consequences.

* * * * * *

The study team is very appreciative of the support and counsel of the Advisory Committee:

Members:

Rodney Scribner, Commissioner, Finance and Administration
George Campbell, Commissioner, Transportation
Jerome Emerson, Maine Senate
George Carroll, Maine House of Representatives
Annee Tara, Governor's Representative

Observers:

Ralph Leonard, Associated General Contractors & Maine Good Roads Association
John Melrose, Maine Municipal Association
Helen Ginder, Legislative Staff
Barbara Gottschalk, Audit & Program Review Committee Staff.

Commissioner Campbell, Deputy Commissioner Webster, and former Acting Commissioner Luettich have been particularly generous with their time and insights. They assured that facilities and resources were made available to the study team, and by so doing, they have greatly enhanced our work. Finally, we appreciate the candor, sincerity, open-mindedness, and assistance of the many individuals who participated in the interviews, data collection, and review efforts.

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# EXECUTIVE SUMMARY

The rapidly deteriorating financial position of the highway program is well-known in Augusta and throughout the State of Maine. It continues to receive high priority attention from the Administration and the Legislature. Appointment of the Governor's Special Task Force on Highway and Bridge Financing in August 1979 to study the extent and nature of the State's financial dilemma is indicative of the level of commitment to find solutions to this major problem. The task force made recommendations which, as expected, were not unanimously endorsed--particularly those pertaining to increasing motor fuel taxes. The Governor, moreover, has repeatedly pledged not to raise taxes of any kind, and this position apparently has widespread support among the citizens of the State.

The causes of the financial situation in Maine transportation are generally well-known. They have evolved incrementally since the 1960s and have become increasingly serious since 1974. Fundamentally, Maine is a non-growth state in the sense of population and employment--perhaps absolutely, certainly relative to southern, southwestern, and certain western states. It is likely (and obviously desirable) that Maine continue to grow in the sense of "Gross State Product" and personal income. But even assuming that growth does occur, it is highly unlikely that it will overcome opposite trends in revenues which reasonably could be associated with the State's responsibilities to provide transportation facilities and services.

Primary changes in recent years which precipitated lower-than-expected yields from motor fuel taxes and widened the gap between highway needs and expenditures include:

- Extremely high cost increases for petroleum products. In the case of gasoline, higher prices have had a dampening effect on sales at the pump and in the case of asphalt and similar petroleum-based construction products, costs have soared.

- Excessive inflation of the economy, in general. Inflationary impacts have hit the construction industry particularly hard: the National Highway Construction Price Index has almost tripled between 1969 and 1979, from 112 to 308 (1967 base = 100). (Fortunately, Maine has been one of the least impacted among the states on highway construction costs, as its 1979

composite construction price index was 215. Still, highway construction labor and materials costing $1.00 in 1969 cost more than $2.00 in 1979.)

- National energy conservation programs. Auto efficiency increases of 50 percent by 1985 are required by the Energy Policy and Conservation Act of 1975. States are threatened with the loss of Federal highway aid if the 55 mph speed limit is not enforced. Voluntary fuel conservation by the driving public, such as the reduction of unnecessary trips, has had an impact on fuel sales. In fact, conservation at the pump in Maine is higher than the national average.

Indeed, Maine, like most other states, already has felt the revenue of lower gasoline sales and lower gasoline tax revenues through the combination of less vehicle use and more efficient vehicles, i.e., more miles per gallon per vehicle. It presently is estimated that the eight percent reduction nationally in gasoline sales is due about half to reduced use and about half to increased fuel efficiency. This will become more pronounced in the future, particularly for the remainder of the 1980s.

Still, the production of more fuel efficient vehicles, including diesel-powered cars as well as trucks, is not yet in full effect. And starting in 1984, the first large-scale production and sale of electrically-powered cars will come to market. These vehicles, of course, will pay no gallonage tax.

Thus, presently and into the future, the revenue picture for Maine from its traditional highway user taxes can only be termed bleak. Few expect these debilitating effects to subside appreciably in the short or long run.

The cost-revenue crisis experienced by Maine is very similar to that of a majority of the states. Only a few rely to a significant extent on general revenues for highway purposes, although financial assistance from the general fund has been a growing practice in a number of states in the last several years (i.e., since the oil embargo of 1973-74). Only a few states with sizeable receipts from crude oil production or rapidly expanding economies can afford to allocate general revenue funds to a State activity such as highways, which traditionally has had its own source of dedicated funding. Clearly, the State of Maine is not now or in the foreseeable future in a position to allocate substantial general revenue funds for highway purposes. Neither can most states.

As a result, Maine faces a threshold question of whether or not to continue a less and less meaningful policy of a dedicated highway fund, but much more importantly, it faces over the next several years a major policy question of restructuring its tax base and rates in order to continue its accepted responsibility for providing transportation facilities and services.

## INTRODUCTION TO THE MANAGEMENT STUDY

Clearly, it is the anticipated transportation revenue shortfall which is driving the Legislature and the Administration to insist that MDOT organization, management, and program delivery efficiencies be aggressively sought out and implemented. Before the Legislature will set the wheels in motion to extricate the Department from its financial dilemma, a clear confirmation of or move toward a more cost-effective and efficient MDOT operation must occur. Changes, if required, must be more than cosmetic; they must represent a bona fide assurance to the public that MDOT has reached an optimum organization, management, and program delivery capability.

The Department has made changes in recent years in order to cut expenditures. For example: (a) there are over 900 fewer highway employees now than in 1967, the peak year of Highway Department employment, and a freeze on new hiring continues; several senior and middle-managers currently staff two or more positions simultaneously; (b) there were substantial cutbacks in 1979--80 winter season plowing and sanding operations--a feature designed to save expensive overtime wages. So far, the policy has not backfired, but the winter was mild. Some feel a severe winter will cause problems even if the winter maintenance policy to "provide reasonable passage for a prudent driver" is accomplished; (c) projects have been deferred, and shifts from reconstruction to maintenance projects have attempted to stretch the highway dollar.

Still, numerous, sometimes more drastic options continue to be raised and discussed. It is clear that until they are independently investigated and the MDOT organization, management, and delivery systems are either exonerated or changed, the Legislature and the Administration will not be willing to take additional steps toward resolving the revenue side of the problem. Basically, there are three approaches to attacking this problem:

1. Increase revenues from existing sources and/or identify and develop new revenue sources, including an overhaul of the gas tax structure.

2. Make major program reductions, cutting operations and deferring substantial portions of the maintenance and improvement programs.

3. Increase productivity in the delivery of programs and services, thus stretching limited dollars further.

Of course, two or more approaches may be, and often are, tried simultaneously.

A first cut has been made at the first item above, namely, the Report of the Task Force on Highway and Bridge Financing. Progress also has been made on the second and third items, but the Legislature and the Administration need assurance that the organization and administration of the Department and its ability to provide programs and services is honed to the sharpest possible edge. Only after this determination is made will the Legislature resolve in earnest to solve the financial problem.

The results of this study are designed to provide the State with the information and specific recommendations it needs to ensure the efficiency and effectiveness of MDOT administration and the cost effectiveness of its programs, and to make informed judgments about future program funding levels. The study team has reviewed and analyzed the organizational structure of the Department from the standpoint of reporting relationships, delegation of authority and levels of decision-making and responsibility. It also assessed the current programs, their objectives, their cost effectiveness, and the consequences of reduced program funding.

As noted elsewhere, the study did not directly address the issues of funding adequacy, new sources of revenue, revision of the gasoline tax structure, or the amount of the purported "shortfall". However, the assessment of programs and the consideration of program levels necessitated an understanding and review of MDOT finances as an adjunct activity. The review was thus conducted on an aggregated basis sufficient to generally evaluate the consequences of reduced buying power throughout FY 1981 and the succeeding biennium.

The final report contains many recommendations designed to improve the efficiency and cost effectiveness of MDOT activities. Many will save money in the short run, although the amounts generally are not large. Some will cost money to implement, largely offsetting the gains. It is felt, however, that each recommendation will measurably contribute to a more productive Department over the long run (e.g., beyond three years) without incurring debilitating costs now when they can least be afforded.

The executive summary only highlights certain recommendations, e.g., not all recommendations contained in the body of the final report are included here. Rather, key findings and recommendations from seven issue areas are presented. These issue areas are:

- Organization and Management
- Program Levels
- Administration and Financial Management Systems
- Productivity in Project Development, Construction, and Operations and Maintenance

- Level and Number of Engineer Positions
- Contracting Out for Services
- Legal Services

These areas have received the most notoriety both before and during the study and thus deserve the attention of the executive summary. For a thorough understanding of the breadth and depth of the effort, however, the reader is encouraged to study the recommendations contained in the body of the final report.

The exhibit on the following page lists all primary recommendations for each chapter of the final report. The exhibit thus serves as an index for the reader interested in a global perspective of the areas which were evaluated and recommended for change.

## ORGANIZATION AND MANAGEMENT

The organizational structure of MDOT has served the Department well since its initiation in the early 1970's as a department of transportation. Consequently, recommended organization changes do not represent or require a major upheaval in the Department.

Still, problems were noted which seem to be primarily a function of organizational inadequacies. For example, directors of the three major activities dealing mostly with the highway program are three levels removed from the Commissioner. Day-to-day management of the major components of these operations (e.g., Location and Survey, Design, Right-of-Way, Materials and Research, Highway Construction, Bridge Construction, and division offices) are four levels removed from the Commissioner. In addition, the current structure results in nearly 80 percent of MDOT employees (excluding over 1500 crew) reporting through only one of the seven bureau directors. This results in an uneven division of control and responsibility among directors and in more top managers than seem to be required. The extent to which authority is delegated downward in the organization and the nature of some MDOT standard operating procedures further removes control from the Commissioner.

A new, simplified organization is recommended for the Department along with modifications in some general management practices. The basic functional division of work is retained, and in most instances, subunits are transferred intact to another bureau. Nearly all of the top management positions which are eliminated are either vacant at present or may be restructured into the new organization.

Reorganization of the Department is recommended in two phases. Phase one, shown in the following exhibit, assigns overall responsibility for managing internal operations and the external affairs of the Department to the Commissioner and one Deputy Commissioner (both unclassified positions). Supporting them would be four staff offices to assist in policy development, equal opportunity and internal audit, monitoring and

1. ORGANIZATION AND MANAGEMENT

The MDOT organization structure should be simplified to provide for a Commissioner, one Deputy Commissioner, and six bureaus headed by Directors.

Staff offices to the Commissioner should include equal opportunity, internal audit, policy analysis, and legal services.

Responsibilities for financial and administrative management should be consolidated in a Bureau of Finance and Administration.

Responsibilities for project development, maintenance, and operations of non-highway modes should be consolidated in a Bureau of Common Carrier Transportation.

Responsibilities for system planning, transportation safety, and program development should be consolidated in the Bureau of Planning.

Project development should be elevated to bureau status.

The Construction division should be elevated to bureau status.

The Maintenance and Operations division should be elevated to bureau status.

Legislative prescriptions of DOT organizational structure should be repealed.

2. FINANCE AND ADMINISTRATION

The Director of Finance and Administration should develop a formal management system of planning, reporting, and evaluation to use as the basis for managing the bureau.

The Financial Management division should be assigned total financial responsibility and be reorganized to effectively carry out that responsibility.

Develop a multi-year operations program and financial plan and an annual budgeting system which will integrate program planning with financial, personnel, and capital requirements plans and budgets to result in a comprehensive MDOT management plan.

2. FINANCE AND ADMINISTRATION (continued)

The assistant director of Finance and Administration with the assistance of the director of the Computer Services Division should adopt certain administrative practices which will enhance the effectiveness of the Division's operations and improve its accountability.

Organize the Business Services Division to provide comprehensive support services in an efficient and cost-effective manner and protect MDOT assets and records against loss or misuse.

Motor Transport Services should utilize its data collection and inventory control computer system more effectively.

The assignment of vehicles and equipment should be the explicit responsibility of Motor Transport Services.

Appropriate functions should be consolidated into a single Personnel and Training Division within the Bureau of Administrative Services.

To reduce the number of positions requiring a civil engineer, the MDOT should carefully review those jobs which do not require a majority of the employee's time in actual engineering work.

3. BUREAU OF COMMON CARRIER TRANSPORTATION

The Bureau of Common Carrier Transportation should institute a system of internal contracts for work performed on common carrier projects by other bureaus in MDOT to ensure managerial and budgetary control.

Checkpoint meetings should be consolidated for common carrier projects and should be chaired by the director of Common Carrier Transportation.

Personnel responsible for aeronautics project development should be transferred to the MDOT main office in Augusta.

Aeronautics business policies should be reviewed to ensure consistency with industry practices and to minimize appropriations requirements.

4. BUREAU OF PLANNING

System planning functions should be routinely performed by the Bureau of Planning.

The senior environmental position in the Department should be located in the System Planning Division with responsibilities for overall environmental policy and planning for the Department and leadership of a department-wide environmental policy committee.

An additional environmental position should be created within the Program Development Division.

State-subsidized common carriers should be removed from regulation by the Public Utilities Commission.

The Department should pursue the use of Urban Mass Transportation Administration Section 3 monies to assist in financing the Maine State Ferry Improvement Program.

5. PROJECT DEVELOPMENT

MDOT should continue efforts to develop meaningful and efficient management information systems.

The process for developing the research program in the Materials and Research Division should be revised.

Increase University of Maine (ORONO) involvement in Materials and Research Division research efforts.

The Right-of-Way Division should consider adopting FHWA-approved minimum payment procedures and value finding appraisal techniques as applicable.

MDOT should improve the utilization and efficiency of survey crews.

Management responsibilities should be delegated within the Bureau of Project Development to free the Director for other managerial duties and to develop management expertise at lower levels.

An environmental study group should be created within the Location section.

5. PROJECT DEVELOPMENT (continued)

Responsibility for acquisition of State and Federal permits should be transferred from the Design division to the Environmental Study Group in the Location and Survey division.

6. CONSTRUCTION

MDOT should strengthen the policy of limiting staff leave during the construction season.

Implement an employee rotation program to improve the design skills of the Construction Engineering staff.

MDOT should implement systems and procedures to improve management and control of construction activities.

7. MAINTENANCE AND OPERATIONS

The Maintenance and Operations Bureau should use the planning and control system recommended in the Jorgensen report as it was originally designed.

Performance standards should be reviewed periodically and updated as necessary.

Develop more useful measures of work accomplishment.

The Bureau of Maintenance and Operations should review snow and ice control activities to improve productivity and to examine the feasibility of greater use of contracted services.

8. MDOT PROGRAM LEVELS

MDOT should maintain its current level of bridge improvement projects under the Highway and Bridge Improvement Program.

MDOT should continue the current level of effort of the Bridge Construction Program.

MDOT should work to relax the more stringent Federal standards that govern the use of Federal aid to town bridge improvements.

8. MDOT PROGRAM LEVELS

The highway improvement effort under the Highway and Bridge Improvement Program should be maintained.

MDOT should maintain its policy of not lapsing available Federal aid. Maximum advantage should be taken of Federal aid transfer provisions in order to mold Federal aid to Maine's highway requirements.

The State should conduct a thorough evaluation of its highway safety activities to determine their cost effectiveness and to identify ways to reverse the steadily increasing accident rate.

MDOT should develop a policy regarding the optimal level of State highway maintenance. The policy objective should be to minimize overall public costs, i.e., highway-user costs as well as MDOT costs.

MDOT should review the paving cycle standards for the maintenance paving program. In the interim, funding of the program should be increased to provide for a paving cycle of seven to eight years.

MDOT should increase the overall bridge maintenance staff and equalize staff levels among districts.

MDOT should eliminate all redundant bridges for which it is responsible.

Maintenance of town way bridges should be the responsibility of the towns.

Construction, management, and maintenance of highway safety rest areas should become the responsibility of the Bureau of Parks and Recreation, Department of Conservation and/or individual towns.

The Traffic Services Division should maintain the current level of pavement striping.

MDOT should reexamine its current truck weight limitations and its truck permit fees to determine if the economic benefits to the State outweigh the added cost of highway construction and maintenance resulting from the limitations.

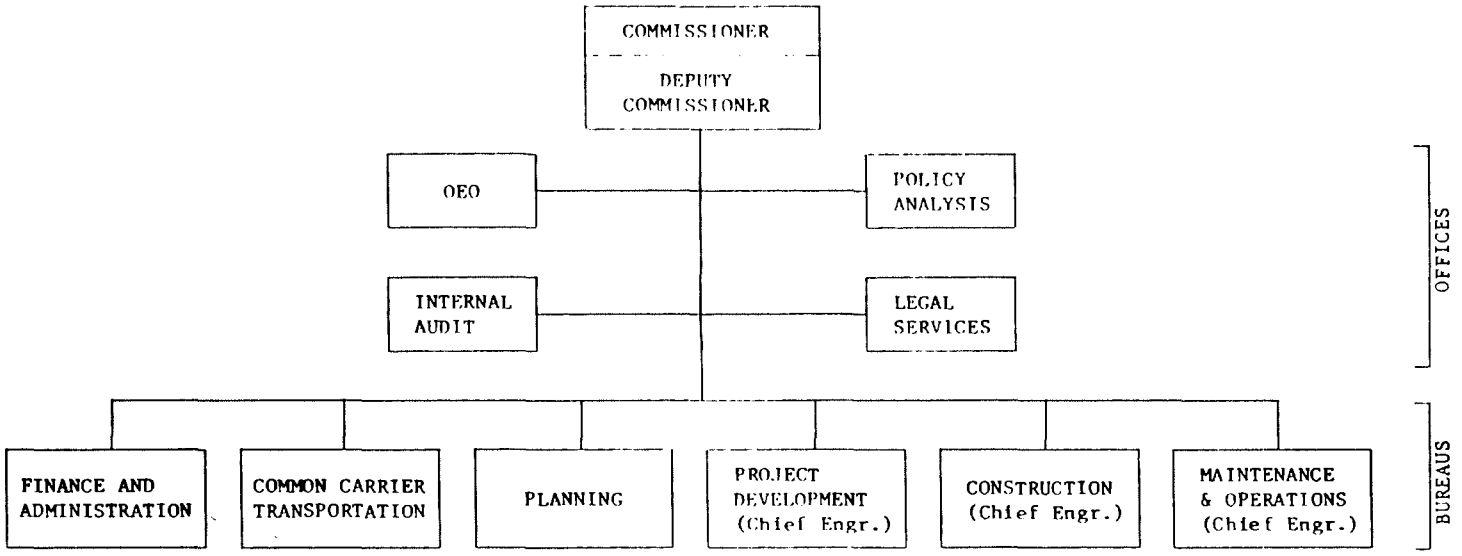
8. MDOT PROGRAM LEVELS (continued)

MDOT and towns should jointly revise the State Aid Program to enhance its effectiveness in fulfilling highway improvement requirements.

The Special State Aid Program should be terminated.

The Town Road Improvement Program should be terminated.

# PHASE ONE REORGANIZATION




Approximate Staff Levels:

| | | | | | |
|---|---|---|---|---|---|
| 170 | 78 | 47 | 366 | 177 | 178 +1533 crew |

Total: 2549

compliance responsibilities, and provision of legal counsel. Six bureau directors, each with similar levels of responsibility, would manage the major functions of the Department. The effect of this change is to elevate those individuals who now have direct responsibility for major functions of the Department and to eliminate intermediate levels of top management which primarily have coordinative responsibilities.

An important advantage of the recommended structure is that it can accommodate program growth, particularly in non-highway modes, as well as refinement or modest restructuring within the functional bureaus without significant organizational upheaval in the future. For example, the second phase of the reorganization involves consolidation of the Bureaus of Project Development and Construction. (The director of the Bureau of Project Development would then serve as chief engineer.) This would facilitate improvement in the problem of staff utilization due to the seasonal nature of construction work. Also, in the last decade, specialization of young engineers has reached the point where it substantially inhibits either permanent or temporarly lateral movement and upward mobility. The only other significant aspect of Phase two reorganization is to reassign the functions of the Materials and Research Division to the units it now supports most directly--Design, Construction, and Planning.

There is no increase in cost associated with the reorganization. In fact, there is an annual savings of over $50,000 associated with reduced senior management personnel. However, this is offset by the recommended addition of several middle and lower personnel in various units of the organization, e.g., paralegal assistance, environmental planner, and transportation planners. The Offices of Equal Opportunity, Internal Audit, Policy Analysis, and Legal Services would be staffed from current departmental positions for the most part. The Office of Internal Audit should be set up to operate independently of those organizational elements and programs it must review. Otherwise, it may be subject to pressures and biases which could influence its decisions and compromise its objectivity and independence.

Formation of the Office of Policy Analysis would have two distinct advantages: (1) It would no longer require the Commissioner or Deputy Commissioner to circumvent the chain of command in order to obtain necessary assistance, and (2) it would no longer require personnel to interrupt their day-to-day operating responsibilities to conduct the requested analysis. The duties of this office would generally include activities which are not routine occurrences, but rather are one-time intensive analyses to determine policy direction for the Department. Examples include legislative liaison and analysis of proposed legislation; benefit cost analysis of capital facility replacement and alternative rehabilitation and maintenance policies; analysis of alternative fare, tariff, and subsidy policies and the implication of operating or contracting for the operations of ferry and other public transportation services; and periodic evaluation of program cost effectiveness.

As can be seen in the reorganization plan, most responsibilities for non-highway modes should be consolidated in a Bureau of Common Carrier Transportation. In order to retain modal identities, it is recommended that each of the modes be identified as a division. Since the MDOT does

not currently operate or maintain public transportation or freight facilities, the duties of these divisions will involve only project development and grant administration. Accordingly, they should be staffed with only one or two individuals. The remaining responsibilities of this bureau are for maintenance and operation of the Augusta airport, the Maine State pier and the State ferry service. Each of these currently is assigned a manager, and each should contine as a division in the new Bureau of Common Carrier Transportation in a manner comparable to highway maintenance field divisions.

Responsibilities for transportation safety currently are assigned to the Bureau of Safety. That bureau should be eliminated because some of the functions are more appropriately performed by other units and the number of personnel required to perform the safety functions does not merit bureau status relative to the scope of responsibility of the other bureaus in the Department. Transferring safety functions intact to appropriate units of MDOT and other State agencies will not have a derogatory effect on safety programs.

One of the most important aspects of the Department's ability to provide transportation programs and services under a severe budget constraint is the management acumen of MDOT leaders. Accelerated training of senior and middle management personnel is a necessity. Also, emphasis should be placed on new employees having a management or business orientation, if possible. While engineering requirements should predominate, MDOT programs of the 1980s will increasingly require management know-how and skills in its application. Only rarely do individuals inherently possess such skills, and tenure alone is not enough.

## PROGRAM LEVELS

As part of our management study of the Department, we made a critical examination of the appropriateness and worth of various programs, the level of effort that is required of each to continue to maintain an efficient and safe highway system, and ways in which the programs could be enhanced to achieve their objectives in a more cost effective way. As a result of this examination, we have recommended increases or decreases in the activity levels and funding of programs, revision of program delivery procedures, transfer of programs to other State agencies or towns, termination of some programs, and performance of research that will enhance the cost effectiveness of MDOT's operations.

A summary of our recommendations by MDOT program is presented in the following exhibit. The exhibit also represents the implications of our recommendations for MDOT funding requirements. The bottom line is that a level of funding, about equal in current dollars to that of the current biennium, will be needed in the next biennium. Implementation of our recommendations will require an increase in program expenditures of less than one-half of one percent ($1.2 million) over the current MDOT biennial budget. (This funding level is exclusive of savings and costs that would result from our recommendations regarding MDOT organization and opertational efficiency.)

SUMMARY OF PROGRAM LEVEL RECOMMENDATIONS

| PROGRAM | RECOMMENDED CHANGE FROM THE CURRENT BIENNIUM PROGRAM | |
|---|---|---|
| | Recommended Change | Cost of Change [1] |
| Radio Operations | No change | -0- |
| State Aid Construction | Changes in program delivery/ administration [2] | -0- |
| Special State Aid | Terminate program | ($500,000) |
| Access Roads | No change | -0- |
| Island Town Refunds | No change | -0- |
| Bridge Maintenance | o Increase staff<br>o Transfer responsibility of town way bridges, covered bridges<br>o Eliminate redundant bridges | $100,000 [3] |
| Picnic Areas | Transfer financial and perhaps total responsibility to another State agency and/or towns [1] | ($800,000) [4] |
| Traffic Services | Retain pavement striping reduction already implemented by MDOT for biennial cost savings of $900,000 | -0- [5] |
| Summer Maintenance | Increase paving cycle to 8 years until more accurate cycle can be determined | $4,000,000 [6] |
| Town Way Bridge Improvements | Lobby for more flexible Federal standards | -0- |
| Town Road Improvements | Terminate program | ($1,600,000) |
| Winter Maintenance | No change | -0- |
| Highway Safety | Reevaluate cost-effectiveness of program components | -0- |

SUMMARY OF PROGRAM LEVEL RECOMMENDATIONS (Continued)

| PROGRAM | RECOMMENDED CHANGE FROM THE CURRENT BIENNIUM PROGRAM | |
|---|---|---|
| | Recommended Change | Cost of Change |
| Compensation | No change | -0- |
| Grade Crossing Protection | No change | -0- |
| Abolish, Alter/Reconstruct Railroad Crossings | No change | -0- |
| Bridge Construction and Bridge Projects Under the Highway & Bridge Improvement Program | No change; current funding level is adequate to meet needs | -0- |
| Highway Improvements Under the Highway & Bridge Improvement Program | No change; current funding level is adequate to meet needs | -0- |
| Total - All Programs | | $1,200,000 |

1/ "Cost of change" is the difference between our recommended program levels and the levels for the current biennium. The cost change is stated in terms of current--FY 80 and FY 81--dollars; no account has been made for inflation.

2/ Changes will result in the ability to improve a significantly larger number of miles with no additional funding.

3/ An increase in staff level could reduce bridge deterioration rates and thus lead to long-run bridge improvement cost savings. Cost to increase staff ($400,000) is largely offset by other recommended reductions in bridge maintenance responsibility.

4/ Cost change includes a reduction in picnic area policing activities which are part of the Traffic Services budget.

5/ Because this action has already been implemented by MDOT, no change in program level would result from our recommendation.

6/ Ultimate program level to be determined upon completion of recommended study which would establish the optimal highway condition MDOT should maintain.

At the same time, a shift in resources among programs is warranted. In particular, we recommend that the maintenance paving budget be increased by about 30 percent, or $4.0 million. Without the additional paving capability this would provide, MDOT may incur substantial long-run costs, as neglected highways deteriorate to a condition requiring reconstruction rather than repaving to restore. The cost of reconstruction is more than ten times the cost of repaving.

The recommended increase in the maintenance paving budget is offset by recommended decreases in other programs. The most significant changes, in terms of funding requirements, are the recommendations to terminate the Special State Aid and the Town Road Improvement programs. It also has been recommended that responsibility for picnic areas along highways be transferred to another State agency or to town governments.

Some recommendations that result in no change to MDOT funding requirements are nonetheless important. Several changes in the way the State Aid Construction program is administered--changing the funding formula and expenditure policy, increasing flexibility in use of funds, more active consideration of lower design options--would significantly increase the mileage of highway improvements that could be accomplished within a constant budget. The changes also could better direct resources to areas of need and would result in a more equitable program. Similarly, the recommendation to implement a concerted effort to relax Federal standards governing Town Way bridge improvements could substantially increase MDOT's capability to meet the increasing requirement for bridge rehabilitation and replacement within the current budget. The finding that the highway and bridge improvement programs are currently adequate to meet short-term requirements also is significant. While not saving MDOT any money, the results provide much needed documentation of requirements for these major programs.

As per the study's scope of services, we have not projected revenues for the next biennium to determine whether they will be sufficient to provide for the program levels which are recommended. It is nonetheless clear that the existing revenue structure will not be able to provide for program requirements over the long run. The gallonage gasoline tax, eroded by energy conservation measures, will not be able to keep pace with increases in revenue requirements resulting from inflation alone. As a consequence, we recommend that MDOT begin now to lay the foundation for the development of a new revenue structure for the transportation program.

In the interim, should MDOT find that revenues are not sufficient to provide for desired program levels, we recommend adoption of a policy that protects the existing highway system to the extent possible until adequate revenues are forthcoming. This would be accomplished through a selective maintenance and capital improvement effort aimed at preventing the loss of highway base and bridge structures. The policy should include provision for capital improvements at least to the extent that Federal funds would not be lapsed. The capital improvements also would emphasize protection of the existing system. Implementation of resurfacing and rehabilitation projects as opposed to new construction and reconstruction projects would predominate.

The basis of our recommended policy direction is that capital improvements--new construction, reconstruction, and replacement of

highways and bridges--can be deferred at lesser eventual cost than would be incurred by substantial reductions in the maintenance-oriented efforts. This policy recognizes that insufficient revenues and the consequent deferral of highway activities will impose costs on the State. The potential costs include (a) a decrease in the highway system's condition and performance, (b) increased highway user costs associated with the reduced highway condition, (c) increased improvement costs to restore neglected highways and bridges, and (d) loss of purchasing power and stimulation to the State economy resulting from deferred use of Federal aid. The objective of the policy is to minimize these costs. For example, the cost per mile of maintenance paving is about $9,000; the cost of one mile of reconstruction on the State Highway System ranges from $400,000 to $1,000,000 or more. This means: (1) if maintenance is deferred to where reconstruction is required, the eventual cost is substantial; (2) despite Federal aid, maintenance dollars can be stretched much further than capital improvement dollars. Thus, a higher level of overall condition and performance can be retained by emphasizing maintenance-oriented efforts.

The following exhibit illustrates the policy direction we are recommending for coping with a short-term revenue problem. It presents, by program, the type of action that may be required. It also indicates the types of consequences that could result from implementation of such actions. The consequences are stated largely in qualitative terms. A more accurate determination of actions and consequences would require an accurate estimate of expected revenues in the next biennium and a detailed analysis of individual projects that may have to be deferred. Neither of these requirements was part of our management study scope of services. Consequently, we cannot present specific program actions to be taken or estimates of the magnitude of costs that may be associated with them. To Maine's advantage is the relatively good current condition of its highway system. This will mitigate the costs that may result from short-term program reductions.

## ADMINISTRATION AND FINANCIAL MANAGEMENT SYSTEMS

Responsibilities for financial and administrative management should be consolidated in the Bureau of Finance and Administration. All non-operational support service functions (business services) should be responsible to one administrative authority, although some staff may be physically located within operating units. Staff assigned to finance and administrative functions should be trained in business management and/or accounting. This organizational modification should improve the overall coordination and delivery of financial and administrative services, ensure compliance with accounting and administrative policies and regulations, and afford the business staff greater opportunity for advancement. The changes necessary to implement these recommendations may be easily accommodated because, with the exception of financial planning and management, business and administrative services currently are being delivered relatively effectively.

There are several reasons for centralizing financial, business, and administrative services, the most important of which is the cost

# ILLUSTRATION OF PROGRAM POLICY DESIGNED TO COPE WITH SHORT-TERM REVENUE INSUFFICIENCY

| PROGRAM | RECOMMENDED ACTION IF REVENUES ARE INSUFFICIENT TO PROVIDE FOR RECOMMENDED PROGRAMS | COMMENTS ON REDUCED PROGRAM LEVEL |
|---|---|---|
| Radio Operations | No change. | ---- |
| State Aid Construction | Defer changes in program delivery and restrict projects to those needed to avoid loss of base. | Changes in program delivery will increase the use of the joint fund account. Postponement of the changes will reduce the demand on State revenues. Restricting projects could eliminate some requests for funding. For example, a 20 percent reduction could mean a $2,600,000 reduction in program funding requirements. The cost associated with this reduction is a potentially higher ultimate improvement cost as the highways continue to deteriorate. |
| Special State Aid | Terminate program. | Action is recommended regardless of revenue situation. |
| Access Roads | No change. | ---- |
| Island Town Refunds | No change. | ---- |
| Bridge Maintenance | Delay increase in staff. | This would reduce program requirements by about $400,000. Slower bridge deterioration rates that would result from increasing staff would be delayed. Given that it will take several years for the reduced deterioration rates to be achieved, the short-term effect of delaying staff increases will be small. |
| Picnic Areas | Transfer financial and perhaps total responsibility to another State agency and/or towns. | Action recommended regardless of revenue situation. |
| Traffic Services | Further reduce pavement striping. | MDOT Currently stripes only numbered highways and highways with ADT >600. If highways with ADT <1,000 were temporarily not striped, annual striping requirements would be reduced by about 1,500 centerline miles and $650,000. Given results of MDOT and national studies on pavement striping, the effect on safety should be small. |
| Summer Maintenance | Reduce maintenance paving to minimum required to avoid loss of base. | Based on available data, it appears that the recommended eight-year paving cycle is needed to avoid loss of base. Thus, no cutback is recommended insofar as revenues permit. If a cutback is necessitated, substantial additional costs may be incurred in the long run. For example, a paving cycle of nine years would require deferment of 100 miles of highway annually. If this deferment leads to loss of base, reconstruction rather than paving may be required to restore the highway at a cost at least ten times greater. |
| Town Way Bridge Improvements | Defer all bridge improvements that are not needed to eliminate an immediate danger to users and that are not needed to avoid a major disruption to traffic<br><br>Avoid lapsing Federal aid. | Replacement or rehabilitation of many of these bridges may be deferred without additional cost to MDOT other than that caused by inflation. Posting use limitations and periodic inspection could ensure safe use of bridges scheduled for improvements. In some cases, closing of bridges may be feasible and appropriate if a reasonable alternate route is available. This approach could, for example, reduce short-term program needs by 50 percent or $1,500,000. |

(Continued)

| PROGRAM | RECOMMENDED ACTION IF REVENUES ARE INSUFFICIENT TO PROVIDE FOR RECOMMENDED PROGRAMS | CONSEQUENCES OF REDUCED PROGRAM LEVEL |
|---|---|---|
| Town Road Improvements | Terminate program. | Action is recommended regardless of revenue situation. |
| Winter Maintenance | No change | ---- |
| Highway Safety | Fund at minimum level needed to ensure Federal funds are not lapsed. | A short-term reduction in delivery of safety efforts under this program would have, in our opinion, only a minor effect on highway safety. Some loss of stimulus to the State economy would be experienced by deferring the use of Federal aid. |
| Compensation | No change | ---- |
| Grade Crossing Protection and Abolish, Alter/ Reconstruct Railroad Crossings | Fund at minimum level needed to ensure Federal funds are not lapsed. Fund projects that contribute to the objective of avoiding loss of highway base. | To avoid lapsing Federal aid for these two programs will require additional matching funds of about $150,000. The possible reduction in the program levels with this policy is about $500,000. Also, to the extent possible, available funds should be used to contribute to avoiding the loss of highway base--resurfacing or reconstruction of crossing approaches may be eligible for crossing protection funding. The reduction in crossing improvements that these policies may cause will have a negligible adverse effect on crossing accidents in Maine (10 to 12 per year) and the nature of the improvements being made. Of the projects scheduled to be implemented under this crossing protection program in FY 80 and FY 81, over 70 percent were not the scene scene of any accident between 1974 and 1978, the years for which data were provided. Also, despite the 90 percent Federal funding, deferred use of the Federal funds whould have less economic impact on the State than deferment of other Federal aid. This is because the projects are capital rather than labor intensive. |
| Bridge Construction and Bridge Projects Under the Highway and Bridge Improvement Program | Fund to level that would avoid loss of structure (i.e., where deferred improvement would mean replacement rather than rehabilitation).<br><br>Fund replacement projects that are necessary (a) to eliminate an immediate safety hazard and (b) to avoid significant traffic disruption if the bridges were closed.<br><br>Avoid lapse of federal funds. | To avoid lapsing of Federal aid will require about $1,200,000 in matching funds during FY 82 and FY 83. This could reduce total program expenditures in the next biennium by 75 percent of the current biennium level, or around $22,000,000. Implementation of the recommendations regarding ensuring loss of base and avoiding immediate safety hazard and major traffic disruption will mean deferment of bridge projects. Deferment would necessitate increased inspection frequency and posting of bridges for which deferment of improvements is feasible. Some bridges may have to be closed and traffic diverted if this is possible without major traffic disruption. |

(Continued)

| PROGRAM | RECOMMENDED ACTION IF REVENUES ARE INSUFFICIENT TO PROVIDE FOR RECOMMENDED PROGRAMS | CONSEQUENCES OF REDUCED PROGRAM LEVEL |
|---|---|---|
| Highway Improvements Under the Highway and Bridge Improvement Program | Fund resurfacing projects required to avoid loss of base.<br><br>Avoid lapsing of Federal aid.<br><br>Defer safety improvements associated with resurfacing projects insofar as this does not jeopardize federal aid eligibility.<br><br>Defer rehabilitation and reconstruction projects unless they are needed to eliminate an immediate safety hazard that cannot be addressed with posting and/or detours. Substitute rehabilitation for reconstruction wherever possible.<br><br>Generally, do not fund projects that improve as opposed to maintain/preserve the existing highway system, i.e., new construction, widening, eliminating poor horizontal and vertical alignment, etc.<br><br>Defer bikeway projects and traffic operation improvements that are not meant to remedy a high accident location situation. | Funding (match) required to avoid lapsing Federal aid is about $3,000,000. Limiting new funding to this level would result in about a 75% reduction in the improvement program as budgeted in FY 80 and FY 81, or about $35,000,000.<br><br>The long-term costs associated with a major program reduction would be (a) deferment of some safety improvements (e.g., guard rail installation, shoulder paving), (b) loss of Federal aid purchasing power due to inflation, (c) deferment of State economy stimulation from Federal aid, (d) increased costs of ultimate improvements to be made insofar as additional deterioration occurs and stopgap measures employed. Also, deferred use of Federal aid will require a substantial State revenues lump sum subsequent to the FY 82/83 biennium to avoid lapsing the Federal aid. |



1/ Estimates of program funding reductions represent total costs and thus include Federal and local shares as well as the State share. Also, much of the State share of capital improvement programs is funded with bond issues as opposed to current (gas tax) revenues. Consequently, estimated program level reductions do not represent estimated reductions in current State revenue requirements.

savings for minimizing duplicative services and operating inefficiencies. Also, certain functions by their very nature should be assigned to a central authority. These include personnel, accounting and finance, and data processing. Special technical skills and professional staff which are not usually available in operating bureaus or subunits are needed to effectively deliver the services.

The financial staff and supervisors are dedicated to MDOT and are exacting in their work. They are precise in accounting and reconciling accounts and in assuring that there is adequate support (to the extent required by management) for all expenditures. They organize budgets according to traditional procedures and issue monthly financial reports requested by management.

However, present financial managers have limited authority and responsibility over accounting matters. Detailed accounting ledgers are maintained by other bureaus and divisions; project cost accounting is assigned to the Bureau of Project Development, accounts receivable and collection responsibilities are vested in numerous units; and assets are not all accounted for. In addition, the accounting procedures are not sufficient to ensure that detailed cost records reconcile to control accounts consistently; the State encumbrance accounting system is not used to reflect all outstanding encumbrances; contractor payments are processed with statements prepared by resident engineers; appropriation accounts are not reconciled monthly; and accounting for Federal funds is not adequate.

Strong, decisive financial leadership is needed to provide assurances to management, the Legislature, and the public that the funds entrusted to MDOT are being spent for their intended purposes and protected against misuse. People generally assume that authority and responsibility is inherent in any financial unit. That authority includes custody and control of assets, financial planning and management, accounting and financial reporting, cost accounting, and cash management.

It is evident that finance-related duties are being undertaken by non-finance interests. Continued financial management as it currently exists will adversely impact MDOT's ability to control costs and to properly manage projects. Unless stronger financial management is forthcoming, the Federal Highway Administration could withhold participation in highway programs and the State could be exposed to criticism resulting from insufficient support for expenditures and inadequate accounting for assets and funds. Fortunately, no such problems have been encountered.

## PRODUCTIVITY IN PROJECT DEVELOPMENT, CONSTRUCTION, AND OPERATIONS AND MAINTENANCE

The majority of the programs and services provided by MDOT are delivered through the functions of the Bureaus of Project Development, Construction, and Operations and Maintenance. Selected activities in each of these areas were analyzed to the extent data were available to determine the efficiency and cost effectiveness of programs and services. In some cases, there were excellent standards by which to judge MDOT productivity; in other situations, analytical surrogates had to be developed; in still

other areas, comparisons could be made with similar functions in other states, although this approach is fraught with complications.

The exhibit on the following page shows a ten-year MDOT contract award history in number of projects, actual contract award value, and average contract value per project in constant dollars. It also compares the staff levels in project development and construction activities to contract construction dollar volume over the period. Total contract value in constant dollars has been gradually decreasing along with staff levels. The average size of construction projects, measured by the contract award value in constant dollars, has also declined in the last ten years. This has been partially due to a trend away from new construction to more rehabilitation and resurfacing projects.

No substantial indicators of mismanagement or lack of innovation in resolving problems were found during the analysis of project development and construction activities. Instead, the recommendations point to areas where small efficiencies may be realized in the short run and where improvements in systems and procedures may lead to long-run savings and benefits. One may recall that in the Phase one reorganization plan, no substantial modifications in either bureau are necessary from an overall organization and management sense. However, Phase two reorganization would combine project development and construction activities into a single bureau with highway and bridge construction becoming divisions of the Bureau. Phase two would also dissolve the Materials and Research Division, reassigning its testing and inspection functions to other appropriate divisions of the Bureau of Project Development and its research functions to the Bureau of Planning.

A substantial contribution to the efficiency and effectiveness of project development and construction activities is due to the capabilities of management. In turn, managers need meaningful, up-to-date, and reliable information on which to base decisions and evaluate programs and services. MDOT has made gradual improvements in management information systems in recent years, and these efforts should continue, particularly efforts which may be implemented without great costs. They include:

- An accelerated development of the Project Identification Number (PIN) system. The PIN system will provide a single, unique number for each project and thus will allow information from various subsystems (such as the advertising schedule, project funding system, project accounting system and TINIS) to be more readily combined for analysis and improved managerial control.

- Implement a manual system of periodic reporting of major activities by division and, if appropriate, by section. Periodic reports summarizing staffing fluctuations, relevant output statistics, activities performed, and any other relevant information should be required from each division or section.

- Develop improved automated management reporting. Except for the bridge design section, which has its own system, managers

TEN-YEAR MDOT CONTRACT AWARD HISTORY:
PROJECT DEVELOPMENT AND CONSTRUCTION PERSONNEL

| Calendar Year | Number of Projects | Contract $ Value | Average Contract Value Per Project | Average Contract Value Per Project (1967 $) 4/ | Number of Personnel in Project Development Division 5/ | Number of Personnel in Construction Division |
|---|---|---|---|---|---|---|
| 1971 | 96 | $27,838,000 | $285,200 | $216,100 | 445 | 261 |
| 1972 | 93 | 33,092,000 | 355,800 | 257,800 | 425 | 246 |
| 1973 | 87 | 33,619,000 | 386,400 | 254,200 | 415 | 241 |
| 1974 1/ | 65 | 21,989,000 | 338,300 | 167,500 | 383 | 222 |
| 1975 2/ | 88 | 33,800,000 | 384,100 | 188,300 | 360 | 193 |
| 1976 3/ | 65 | 23,333,000 | 359,000 | 180,400 | 355 | 175 |
| 1977 | 105 | 33,626,000 | 320,200 | 148,200 | 359 | 177 |
| 1978 | 118 | 43,385,000 | 367,700 | 138,800 | 362 | 171 |
| 1979 | 106 | 46,007,000 | 434,000 | 140,900 | 374 | 167 |
| 1980 (thru 6/30) | 30 | 14,184,000 | 472,800 | 153,600 | 367 | 158 |

1/ Slow down due to 1973-74 energy crisis (Federal dollars frozen).

2/ A single interstate project had a contract value of over $5.0 million.

3/ There was a 4-month moratorium on advertising projects during calendar 1976.

4/ Based on Price Trend Index for Federal Aid Highway Construction, Highway Statistics, 1978.

5/ Figures from 1977 to present include project scheduling activities. Also includes non-contract personnel, beginning with 18 in 1971 and gradually increasing to 44 in 1980.

receive little routine information from computer services that helps them manage staff resources or projects. Improvements to the management reporting system would allow section and division managers to routinely monitor staffing levels and project activities.

- Revise function and activity codes. Inadequacies in the current function and activity coding scheme has led to the development of a more detailed, but separate, activity reporting system in the Bridge Design section, with a similar system under development in the Highway Design section. A revision to the codes should provide for a separation of activities by section, more relevant detail for activities performed within each section, and common usage by all units of MDOT.

- Continue to improve the project advertising schedule. Additional enhancements to the schedule include developing standardized procedures for obtaining accurate and complete information; developing the schedule so that lists can be generated of projects nearing milestone target dates and so that exception reports of projects behind schedule can be generated; and developing the capability of summarizing the estimated and actual time intervals between milestones.

In summary, MDOT should continue the development of procedures to improve management and control of project development and construction activities.

One of the most difficult areas to ensure efficiency and cost effectiveness is in the management of survey crews. On the other hand, it is extremely important that surveying activities not impede progress on construction jobs nor hold up preliminary engineering early in the project development process. On the other hand, surveying which occurs too far in advance of subsequent preliminary engineering work has the potential for being wasted, or at least, may require redoing.

There are a number of elements contributing to the difficulty of an efficient and effective surveying operation. Because of the nature of the work, the survey crews are geographically dispersed around the State. With an average staff size of about 70, plus seven crews reporting to the Bureau of Maintenance and Operations in the districts, MDOT is thus expending over $6,000 per day (salaries and fringes) on surveying activities. These activities are difficult to control efficiently because of their inherently decentralized operation. Also, projects are extremely variable in terms of their nature and scope. Weather is of continual concern to surveying operations. And the mix of the survey staff fluctuates substantially due to the use of seasonal hires, temporary in-house assignments, and contract crews, contributing to the management challenge.

There are potential efficiencies to be gained through better coordination and utilization of survey personnel from the Location and Survey Division and the survey crews located at the district level. MDOT should consider reassigning district survey crews to the Location and

Survey Division so that survey responsibilities for preliminary engineering and construction on all highway systems and for all MDOT programs can profit from centralized and coordinated scheduling. This practice is partially in effect in one district, and it appears to be working well.

MDOT should continue to monitor and improve the utilization of survey crews on "rain days." Ensuring the conscientious productivity of survey crews when inclement weather prevents field work is a universal problem of the engineering and construction communities. At a minimum, however, survey crews should not be paid a full day's wages if they are idle for significant portions of the day waiting for the weather to clear. Current MDOT management intent is that district offices maintain a backlog of appropriate work, crew chiefs or others conduct training programs to upgrade the competence of crew members, or other such useful diversions be developed in order to reduce the actual survey crew downtime.

According to MDOT personnel, survey activities are almost complete (as of August 1980) on the first FY 80--83 four-year plan. This apparently was done to ensure that location and survey work would produce a continual backlog feeding the design process. The concept is a good one; the level of the backlog is subject to question, however. And there is some disagreement among MDOT managers as to the extent of the backlog. Regardless, however, the precaution is to carefully control surveying activities according to anticipated program levels. This is because survey initiates the preliminary engineering process and thus impacts the expenditure of design and other preliminary engineering resources down the line.

The Bureau of Construction is primarily reponsible for overseeing contract construction activities. Although involved in the planning and development of projects, the construction staff's duties largely begin following the award of a contract. These duties include preconstruction conferences with contractors and surety companies, coordination with utilities and railroads, project inspection, preparation of invoices for contractor payments, and review of project expenditures.

Staffing levels in the Bureau of Construction have declined from 261 in 1971 to 158 in 1980, a decrease of almost 40 percent. One of the basic issues that has been raised is whether changes in staff size have been consistent with change in the size and types of construction projects. Other issues of concern include the productivity of the staff and their utilization during the winter months.

As can be seen from a previous exhibit, total construction activity as measured by constant dollar award value has declined slightly over the last ten years. During this period, the trend has been away from new construction in favor of more resurfacing projects, particularly in the latter years. Generally speaking, for all types of highway, bridge, and miscellaneous projects, there has been a shift from new construction projects to those involving resurfacing, rehabilitation, and/or improvements of existing facilities. The study team conducted an analysis to determine if changes in staff size have been consistent with this shift in project type. This analysis involved an assessment of the ratio of

construction engineering costs to contract award values for a sample of projects. Results indicate that the portion of construction engineering costs out of total contract award tends to be more a function of project type than project size. Comparisons with other states tend to confirm this fact, as well as the reasonableness of the MDOT ratios. However, the proportion of construction engineering costs for certain types of projects tend to be higher than the FHWA national standard of 15 percent. States whose construction conditions are similar to Maine, however, typically experience higher than average construction engineering costs.

A comparison of the trend in staff levels in the Bureau of Construction to estimated construction engineering costs indicates that changes in staff levels appear to be consistent with changes in the amount of construction engineering activity. Based on these measures, then, the cost effectiveness of the Bureau of Construction has remained relatively constant as the size of the construction program and the mix of projects has changed.

The study team also examined utilization of construction engineering staff during the construction season. A comprehensive review of activities showed that a considerable amount of time is spent on leave and vacation during the construction season. In fact, the average construction employee is spending almost three weeks each construction season on leave and/or vacation. Thus, MDOT should strengthen the policy of limiting staff leave during the construction season. With only moderate action, e.g., cutting summer vacation/leave allowed by one-half, a 5 percent productivity increase is possible, other things remaining equal.

The study team believes that MDOT should implement an employee rotation program to improve the design skills of the construction engineering staff. This would facilitate the utilization of the construction staff in the winter months--a major problem at MDOT. Although the construction staff is utilized to some degree in project development activities during the off-season, their involvement could be increased.

It is recommended that MDOT take a two-step approach to improving the utilization of the construction engineering staff in the winter months. The first is to begin a program of voluntary employee rotation, in which construciton personnel would transfer to Augusta for two or three year tours in the Design Division. The primary benefit of this program would be the enhancement of the skills of the construction personnel so they could be better utilized on design projects in the winter months after returning to their remote location. This program would also give the staff a broader perspective and exposure that might enhance their opportunities for advancement within MDOT. If employee responses to such a program are not positive, MDOT should consider incentives to attract them. In the private sector, such moves often mean greater long-term benefits and promotions.

The second part of the recommended approach is to implement a short-term rotation program for a greater number of employees. This program should be mandatory for employees at appropriate staff levels, and should include shorter tours (perhaps three or four weeks) in Augusta on an annual or bi-annual basis. These tours should focus on orienting staff to the specific projects they will be assigned to and could also include training sessions in specific areas as needed.

The issue of cost effectiveness in the Bureau of Maintenance and Operations has been one of continual evaluation. In 1976, a consulting firm conducted a comprehensive examination of the Bureau, which encompassing highway maintenance, bridge maintenance, State aid construction, and traffic services. They found that the Bureau was generally operating efficiently and that the implementation of a recommended system for planning and control would ensure a continued and improved cost effective operation. In the current management study, the study team evaluated current operations of the Bureau and determined the extent to which the recommendations of the prior report had been implemented.

The study team examined time sheet records for fiscal year 1980 which provide weekly summaries of the amount of work accomplished by crew assigned to different maintenance activities. Over 14,000 observations were obtained for 36 specific activities in the general areas of surface and shoulder maintenance, roadside and drainage, traffic services, and snow and ice control. A statistical analysis was conducted to determine the significance, if any, of discrepancies between actual productivities and established performance standards. Results indicated that maintenance activities are generally being performed efficiently, and in those cases where inefficiencies are identified, the significance is relatively minor. However, three activities indicated productivities considerably below the established standard: stockpiling salt, snowfencing, and snowplowing.

The possible inefficiencies in these areas deserve special attention since they comprise a significant portion of the Bureau's budget. Also, because labor cost includes a substantial amount of overtime pay, any improvements in productivity directly translate into a cost savings. To improve productivity, a comprehensive examination of the current snow and ice operation should be conducted to identify problems and their solutions. One possible problem identified as a result of the analysis is the apparent use of larger-than-necessary crews for activities such as snowplowing. Although the total work accomplishment increases with the crew size, the productivity per crew member diminishes. Consequently, there appears to exist an opportunity for cost reduction through better crew assignments. However, factors such as equipment availability, breakdowns, etc., should be thoroughly examined to determine if there are other underlying causes.

A second issue examined using the same data is whether productivity levels vary significantly by field division. While it was found that discrepancies do exist in the productivities among field divisions for certain specific activities, the primary issues is whether some divisions have consistently higher or lower productivity levels than others. A statistical analysis showed that there are no significant differences in productivities among divisions.

The study team also examined work records kept by foremen of maintenance crews which describe the activities performed, the number of personnel assigned to the activity, and the number of hours worked on a daily basis. A sample of over 3600 observations was used for this analysis. The results show that the use of less-than-standard crew sizes does not appear to be a major factor contributing to lack of productivity.

In general, other factors, including the use of larger than standard size crews, seem to be the primary causes of poor productivity for those activities in which productivity problems exist.

The basic conclusion to be derived from these analyses is that, with the exception of previously-noted activities related to snow and ice control, the Bureau of Maintenance and Operations is generally performing efficiently. In fact, in many cases, the productivity is substantially greater than would normally be expected according to the established performance standards. This is exemplary considering the many problems facing the Bureau and the Department as a whole: reduced staff levels, budget restrictions, morale, and so forth.

## LEVEL AND NUMBER OF ENGINEERS

The question is often asked of the MDOT: "Are there too many engineers in the Department?" The answer is technically yes, but it is important to recognize some key qualifiers. It would appear that a few engineers are excess only in the sense that they occupy positions which do not require a professional engineer capability. In other words, if those position descriptions were rewritten to more closely reflect the actual function, a civil engineer would not be required.

Also, it is informative to note that there are four different classifications of "engineers," and the layperson often confuses them. Definitions and number of individuals by classification in June 1980 are as follows:

- Civil Engineers (127)--registered professional engineers, classes I through V
- Assistant Engineers (30)--graduates of an accredited college, usually with a degree in civil engineering
- Engineering Technicians (359)--technical specialists who may have formal training (but rarely a degree) in engineering and who often have considerable experience in highway construction and maintenance, classes I through V
- Engineering Aides (70)--provide technical support functions.

Criticisms of "too many engineers" generally involve only the civil engineer category (127 individuals), as it is these individuals who form the administrative cadre of the Department and who consequently draw the higher salaries.

Civil engineer positions represent 12 percent of all non-crew employees. This is a generally appropriate level for the size Department, the functions it serves, and its organizational composition. There has been a decline since 1973 in both civil engineers and engineering technicians, although the decline is most marked by engineering technicians

in the construction area. There has been a concomitant drop in civil engineers in construction activities in the same period.

In the course of the study, a sample of civil engineers in all major segments of MDOT were interviewed to discuss their programs, functions, and the required use of engineering knowledge. It was determined that some of those positions required little or no civil engineering expertise. Indeed, some of the positions could be filled with planners, grant administrators, computer programming supervisors, or other appropriate non-engineering personnel. The approach recommended to correct this situation is as follows: 1) on an individual job basis, carefully identify those positions which do not require a civil engineer; 2) encourage the incumbents to transfer to civil engineering positions which become available through attrition and retirements; 3) reclassify those positions which do not require civil engineers, specify appropriate qualifications and attach commensurate salary ranges. In other words, this recommendation may be implemented incrementally with little damage to individuals and with ultimate savings to the Department.

It should be reiterated that the study team did not find that overall MDOT engineering staffing levels were excessive. Indeed, it would appear that MDOT has done a conscientious job of accomplishing a reduction in force as the construction program has dwindled over the decade.

## CONTRACTING OUT FOR SERVICES

There are three main areas in which MDOT contracts out for services: construction projects, professional services such as engineering design and surveying work, and certain elements of winter and summer maintenance. The management study examined each of these areas, although lack of data and time in some cases prevented a detailed assessment.

All construction projects, with the exception of a few small activities handled by the Bureau of Maintenance and Operations, are contracted out to private sector construction companies. This is the case in virtually all states--particularly for new construction and major reconstruction projects. Construction inspection is also conducted by in-house forces in most states, as is the case in Maine. However, in situations where State personnel have been reduced, some construction inspection work is contracted out. Some states feel that the use of consultants for construction inspection activities is cost effective because it evens out seasonality problems. This is particularly the case for states which have severe winter weather and a concomitant slow-down in construction activities.

Design consultants have been used by the Highway and Bridge Design sections of MDOT for the last several years. Consultant use is often limited to final design activities and to projects considered "clean," i.e., ones that do not require much interdepartmental coordination or that do not involve politically or environmentally sensitive issues. Consultants are also used for projects requiring special expertise not available in house. However, in no case does design consultant use exceed 50 percent of total preliminary engineering activities for a given project.

A brief history of consultant activities in highway and bridge design is shown in the exhibit on the following page. As can be seen, out of nearly 400 highway and bridge contracts awarded in the last five years, only 21 have been partially designed by consultants. Estimated consultant fees for these projects total about $1.3 million, but nearly two-thirds of this was accounted for by two exceptionally large and complex projects.

The study team compared the use of design consultants in Maine with that of three other states. New York DOT uses consultants for about 50 percent or more of their design work. Each district has a director who reviews the five-year work program and determines what projects can be designed in house. Those that cannot are handled either by the central DOT headquarters or by design consultants. Pennsylvania contracts between 60 and 75 percent of all engineering design work to consultants. In the last fiscal year, 92 of the largest design assignments went to consulting engineers for estimated fees of about $11 million. PENNDOT is committed to keeping staff levels at a minimum, which precipitates the large use of outside design consultants. The State of Ohio contracts almost all design work--probably more than any other state. Design engineers in the districts primarily handle small jobs, but consultants do all the large ones. This policy is precipitated by the dwindling in-house capability due to a hiring freeze and substantial cuts in new construction and reconstruction.

Contracting out for design services in Maine is not out of line. It would appear that use of design consultants has been judicious and in keeping with the level and sophistication of design requirements over the last few years.

Contract survey crews were employed in 1977, 1978, and 1979 at an average cost of about $250,000 annually. Contract survey crew employment extended almost over the entire year, including some marginally productive winter months. This fact raises the issue of whether MDOT was paying for relatively inefficient contract crew operations due to weather conditions at least for a portion of 1978 and 1979. At any rate, given the reduced MDOT construction program level and the likelihood of its continuance at a low level in the short run, there appears to be little need for contract survey crews until the construction program picks up substantially.

The analysis of contract activities in the maintenance area indicates the need to examine the feasibility of possible greater use of contracted services for winter maintenance. MDOT currently contracts private snowplowing and sanding for only four road segments; consequently, comparative data are insufficient to develop a substantive MDOT policy. However, a preliminary cost comparison between MDOT winter maintenance crews and private contractors shows that the MDOT cost per mile is generally less than contractor cost, although not always. Many variables come into play and there may be differences which are unaccounted for in the type and use of roadways involved in the comparison.

About 40 percent of the snow and ice removal responsibilities by the New York DOT is contracted to municipalities. Summer maintenance,

HIGHWAY AND BRIDGE DESIGN CONTRACTS

| Calendar Year | Total Highway and Bridge Contracts Awarded | Projects Designed by Consultants | Estimated Consultant Fee |
|---|---|---|---|
| 1980 1/ | not available | 9 | $217,000 2/3/ |
| 1979 | 100 | 9 | 671,700 4/ |
| 1978 | 101 | 2 | 400,000 5/ |
| 1977 | 89 | 1 | not available |
| 1976 | 56 | 0 | 0 |

1/ Through August 12, 1980

2/ There are currently 14 highway and bridge design contracts (in addition to those in the table) with an estimated fee of $683,500

3/ In addition, there are $164,000 of consultant agreements in effect for rest area projects, most of which entail design of buildings

4/ Includes a $394,000 preliminary engineering and environmental assessment study for the Bangor-Brewer project

5/ Primarily one project

except for some bridge painting, is done exclusively in-house. In Pennsylvania, snow removal is all done in-house except for portions of interstate systems. However, PENNDOT has recently signed agreements with many municipalities whereby they will remove snow from State highways within their boundaries. Approximately 90 percent of summer maintenance is done by in-house forces, although there is a State policy toward support of the private sector construction industry. It is generally felt in Pennsylvania that contractors are cost competitive with DOT forces for certain types of summer maintenance, including plant mix paving, work with epoxy surfaces, pipe cleaning, herbicide spraying, and maintenance of rest area buildings. In Ohio, many maintenance activities are done by contractors, as the legislature limits funds available for in-house maintenance. The State handles most snow and ice plowing and removal, crack sealing, litter pick-up, pothole patching, some bridge surface patching, and mowing. A State study of contrct mowing showed that contractors were cost competitive under minimum three-year contracts (so that equipment costs could be recouped). However, because the legislature has restricted use of such three-year contracts, in-house forces are being expanded to handle the mowing responsibilities.

It is felt that with greater use of contractors and a different method of payment (currently fixed price, regardless of the amount of snowfall), contractor costs could be more competitive with MDOT costs. For example, the City of Portland relies heavily on private contractors for snow removal and pays an hourly rate. Based on its own analysis, the City has concluded that this arrangement is cost effective. MDOT should, therefore, capitalize on the potential cost savings through an analysis and evaluation of the possibilities.

Within reason, there seems to be little concern that the private sector could absorb a substantial increase in any of the contracting services noted. From the available data, however, MDOT would seem to be contracting out an appropriate level of services. The possible exception is in the winter maintenance area, where it is recommended that MDOT expand its experience and carefully appraise the consequences of a greater share of the work going to the private sector.

## LEGAL SERVICES

MDOT has a serious problem in the staffing and operation of the Legal Services Division. The Division lost three attorneys during the last year, and two more are expected to retire during the coming year. At issue is the proper level of professional and support staffing, given existing and anticipated workloads, and the proper approach to defending the Department in new or specialized areas of the law. The Division presently does not perform its assigned responsibilities adequately and, once properly organized, should be assigned additional responsibilities.

No extensive change is recommended organizationally, merely the redesignation as the Office of Legal Services, still reporting directly to the Commissioner. However, the Office should function as a legal team and

the conceded conflicts and relatively low morale should be corrected through internal reorganization and personnel changes as necessary.

Staff levels and the type of experience required in the Office of Legal Services should be established based on a systematic analysis of existing and anticipated workloads. Written descriptions of the responsibilities of this Office should be developed in consultation with the Commissioner, and work categories should be developed so that time charges can be made properly in order to analyze workload and establish ratings of efficiency.

The major legal problem that the Department presently faces and is not adequately prepared to handle is tort claims. Tort claims is a relatively new area of law for public sector attorneys and presently pending and near-future cases are likely to establish precedents in case law which will largely govern cases in the future. Because the legal office presently has no staff experienced in tort claims cases, the Department should retain (at least temporarily) outside counsel to handle tort claims cases and should either assign or recruit at least two attorneys to work with outside counsel in order to be trained and obtain experience. This is an area of utmost importance involving potentially large claims against the State. (A tort claims summary in July, 1980, included 38 claims totaling $5,235,835, seven of which involved claims from $300,000 to $1,250,000 and totaling $4,825,000.)

Title searches, abstracting, and preparing documents for eminent domain proceedings can and should be done by paralegal personnel under the supervision of a trained and experienced attorney. The Department already has authorization to hire paralegal personnel; present vacancies and future openings occurring by retirement, attrition, or personnel reassignment should be filled with paralegal personnel. An increasing amount of acquisition is in the form of small strip takings--reflecting the change in emphasis of the highway program from new construction to reconstruction or rehabilitation of the existing system. The increasing workload is evidenced below. (The heaviest hearing schedule is from May to November.):

| | 1978 | 1979 | 1980* |
|---|---|---|---|
| Cases Set for Hearing | 58 | 147 | 48 |
| Cases Pending December 31 | 179 | 199 | -- |
| Cases Pending June 30 | -- | -- | 233 |

Through June, 1980.

Paralegal personnel, under proper supervision will perform much of the legal work required, and at a lower cost to the Department.

The Office of Legal Services should be responsible for the investigations associated with both Worker's Compensation cases involving Department employees and for tort claims. Investigation of these claims, including training of Departmental field personnel in documentation of accidents, is key to minimizing the liability of the Department and is very important in the preparation of cases which go to administrative hearing or

trial. (The State recently contracted with a private firm to perform Workers Compensation functions, excepting litigation, for all departments on a one-year trial basis. This will greatly relieve the Office temporarily and should enable it to turn its attention to some of the other problems.)

Finally, title documentation, including cases handled in the last several years should be put into record form for ready retrieval--either microfilmed or computerized. Currently, closed cases are stored in the State archives and are not readily accessible, so that there are at least some cases where new 40-yer title searches are made on properties which have been analyzed in relatively recent years.

## CONCLUSION

In all, Maine has a relatively good Department of Transportation and highway system. Despite the lack of formal management training, senior and middle-level managers are doing a competent, generally cost effective, and efficient job delivering transportation programs and services, except as noted. Still, major changes in transportation now and into the future will require basic changes in program structure, Departmental reorganization, and financial innovation. Department executives must always be willing to question their operations and entertain new ideas.

Implementing all the recommendations in the study would require a level of funding approximately equal (in current dollars) to that of the current biennium. To the extent that such revenue will not be available, we have indicated, by program, ways in which the Department could cope with a "shortfall." Essentially, we have recommended a direction for MDOT to take if confronting insufficient revenues. How far in the direction indicated MDOT must go to stay within available funds is not stated. This is dependent on the magnitude of fuiture revenues available.

There is no question that Maine will need increased revenues for transportation facilities and services in the future. There is also little question that the State will have to restructure its tax base in order to accomplish minimum levels of transportation service. Planning and analysis should begin now to lay the foundation for a comprehensive overhaul of the tax structure. Meanwhile, the Department should implement as many recommendations as is feasible in order to make the recommended improvements in operational efficiency and cost effectiveness.

# 1. ORGANIZATION AND MANAGEMENT

Based upon the review of MDOT organizational structure and management practices, a new, simplified organization is recommended for the Department along with modifications in some general management practices.

The recommended organizational structure does not represent or require a major upheaval of the Department. The basic functional division of work is retained, and in most instances, subunits are transferred intact to another bureau. Nearly all of the top management positions which are eliminated are either vacant at present or may be restructured into the new organization.

An important advantage of the recommended structure is that it can accommodate program growth, particularly in non-highway modes, as well as refinement or modest restructuring within the functional bureaus without significant organizational upheaval in the future. For example, several functions which are candidates for subsequent changes to achieve further economies are identified in this report, but should be subjected to more careful scrutiny and evaluation by top management before any restructuring is implemented.

The discussion in this chapter is organized around the staff offices to the Commissioner and the six bureaus (subsequently five, in phase two reorganization) which are recommended for the Department. Subsequent chapters present recommendations for improving the management of functions which would be performed within each of the bureaus.

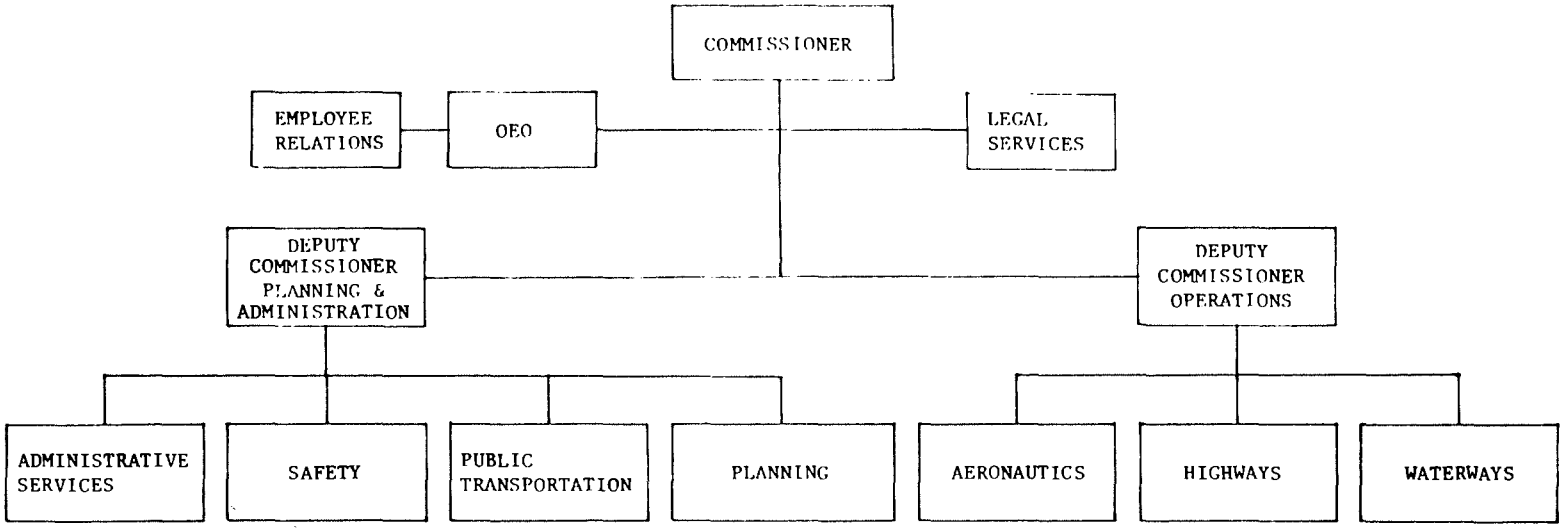
* * * * * *

RECOMMENDATION: THE MDOT ORGANIZATION STRUCTURE SHOULD BE SIMPLIFIED TO PROVIDE FOR A COMMISSIONER, ONE DEPUTY COMMISSIONER, AND SIX BUREAUS HEADED BY DIRECTORS.

The current MDOT organization structure provides for a large number of senior managers, yet results in 91% of the DOT employees reporting through one of seven bureau directors (78% if crew is not counted). This results in an uneven division of control and responsibility among Directors and in more top Managers than seem to be required (see Exhibit 1-1). Reorganization of the Department is recommended in two

EXHIBIT 1-1

EXISTING ORGANIZATION




Approximate Staff Levels:

| | | | | | | |
|---|---|---|---|---|---|---|
| 71 | 19 | 8 | 51 | 11 | 792<br>+1533 crew | 64 |

Total: 2549

phases. Phase one, illustrated on Exhibit 1-2, eliminates four bureau directors and one Deputy Commissioner. The Commissioner and one Deputy Commissioner would have overall responsibility for managing internal operations and external affairs of the Department. The positions of Commissioner and Deputy Commissioner should continue to be unclassified. Supporting the Commissioner would be four staff offices to assist in policy development, monitoring and compliance responsibilities, and to provide legal counsel. The Commissioner should also assign an employee to serve as the administrative assistant to the Commissioner. This would reduce the tendency to neglect trivial tasks to the Deputy Commissioner, who should have substantial Department-wide managerial responsibilities of his own. The administrative assistant position need not be a new one, but should be temporarily (e.g., one year) assigned from within the current ranks. Six bureau directors, each with similar levels of responsibility, would manage the major functions of the Department: Finance and Administration, Common Carrier Transportation, Planning, Project Development, Construction, and Maintenance and Operations.

The effect of this change is to elevate those individuals who now have direct responsibility for major functions of the Department (particularly the engineering functions), and to eliminate intermediate levels of top management which have primarily coordinative responsibilities.

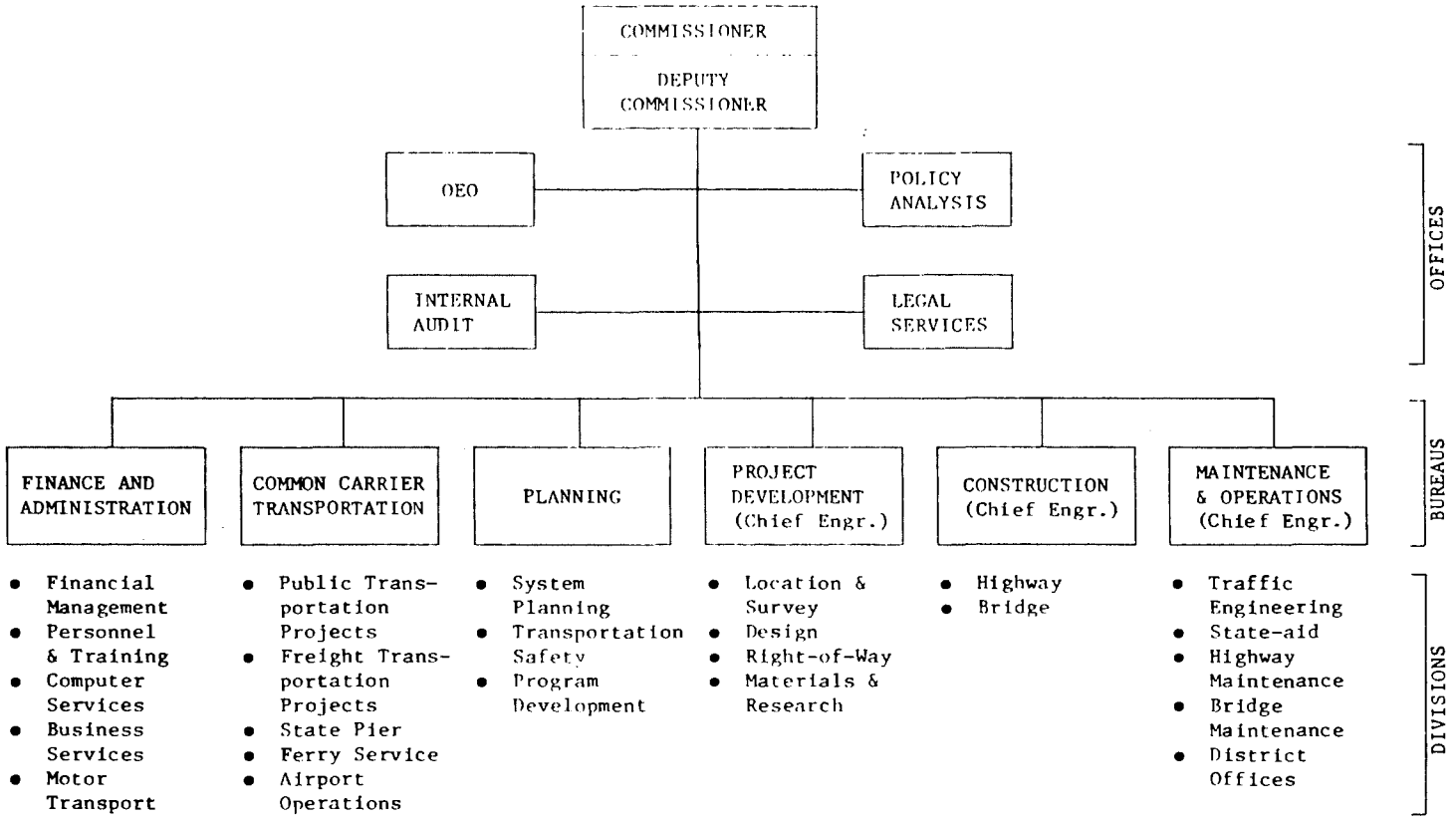
The Deputy Commissioner should be responsible for managing and coordinating implementation of improvements recommended through this management study. Each bureau director should appoint an individual to coordinate transition activities in the Bureau, and these six individuals should comprise an ad hoc Transition Task Force to work with the Commissioner and Deputy Commissioner in implementing recommended improvements.

Phase two of the recommended reorganization involves consolidation of the Bureaus of Project Development and Construction in order to institutionalize and improve upon the sharing of staff which already occurs in the current organization. The functional separation of construction staff from those in Project Development presents problems in staff utilization due to the seasonal nature of construction work. Some recommendations have been made in Chapter 6 for implementation within Construction, but detailed recommendations for integration with Project Development have not been developed. Some of the data developed through this study, plus some of the information which will be compiled through implementation of the study recommendations, will permit a detailed analysis of shared personnel use and costs and identification of opportunities for further economies.

The divisions of Project Development listed on Exhibit 1-3 represent the minimum changes which should be made in Phase two. The Materials and Research Division should be eliminated and the functions should be assigned to the divisions it now supports most directly. For example, the Soils Section works primarily in support of the Design Division; the Field Quality, Control Structural Testing, and Pavements sections work primarily in support of the Construction Division; and Research could reasonably be assigned to Planning. Further analysis should be made by DOT personnel of the areas in which staff sharing now occurs,

EXHIBIT 1-2

PHASE ONE REORGANIZATION



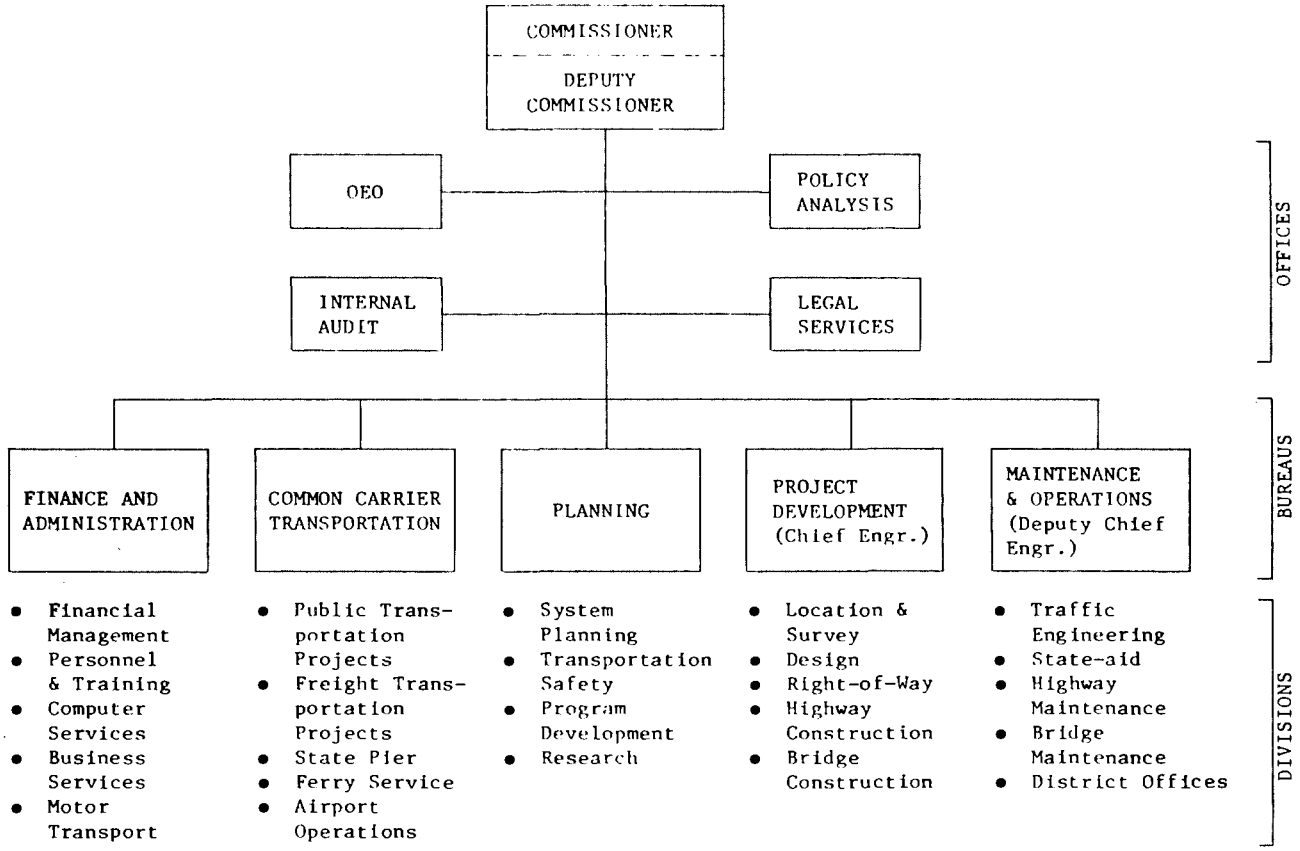

Approximate Staff Levels:

| | | | | | |
|---|---|---|---|---|---|
| 170 | 78 | 47 | 366 | 177 | 178 +1533 crew |

Total: 2549

EXHIBIT 1-3

PHASE TWO REORGANIZATION




Approximate Staff Levels:

| | | | | |
|---|---|---|---|---|
| 170 | 78 | 67 | 523 | 178 +1533 crew |

Total: 2549

the overall project development process and requirements, and functions which might be grouped together in divisions in order to provide greater breadth of experience to the engineering personnel in the Department. Some formal retraining may be required, term benefit, or at least modest reductions in the total number of professional engineers and technicians required.

* * * * * *

RECOMMENDATION: STAFF OFFICES TO THE COMMISSIONER SHOULD INCLUDE EQUAL OPPORTUNITY, INTERNAL AUDIT, POLICY ANALYSIS, AND LEGAL SERVICES.

The units reporting directly to the Commissioner should be called offices rather than divisions, to distinguish their functions as advisory and supportive of the Commissioner. Each of these offices and their responsibilities is described below.

The Office of Equal Opportunity should continue to report directly to the Commissioner. The primary duties of this office are to ensure compliance of the Department in areas of Equal Employment Opportunity and Affirmative Action, to develop programs to ensure such compliance and train managers in implementation, to develop and monitor implementation of a minority business enterprise program, and to monitor and ensure compliance of contractors in on-the-job training programs. As these programs become institutionalized in the Department, some responsibilities recommended for the Personnel Division should result in more of the data required by the OEO being available routinely (see Chapter 2). Every effort should be made to ensure that this kind of support is developed in order to minimize staff requirements in the OEO over time.

The Office of Internal Audit should report directly to the Commissioner. This function currently is fragmented, understaffed, and improperly utilized for non-audit assignments. FHWA has transferred a substantial audit responsibility to MDOT, but the Department has not responded with a viable audit organization and an effective audit program.

The primary responsibilities of the Office of Internal Audit should include review of the MDOT organizational elements, functions, activities, and programs for the purpose of determining that financial records and accounts are properly maintained in accordance with generally accepted governmental accounting practices and State Controller regulations, policies, standards, and procedures; that financial and management reports reasonably state the current status and results of operations and activities; that laws and regulations are complied with; that operations are conducted efficiently and effectively; and that the results of program and project plans are achieved satisfactorily.

Unless the audit unit operates independently of these organizational elements and programs it must review, it is subject to

pressures and biases which can influence its decisions and compromise its objectivity and independence. To ensure that independence and objectivity are maintained, the Office of Internal Audit should be transferred from the Bureau of Administrative Services to the Office of the Commissioner. MDOT should recruit and train qualified auditors, organize an effective audit plan and work programs, and assign administrative responsibility to a qualified audit supervisor.

An Office of Policy Analysis should be formed to support the Commissioner. Policy analysis functions are now performed on an as-needed basis by a variety of staff in the Department who have on-going operating responsibilities. This practice has two disadvantages: (1) it requires the Commissioner to circumvent the chain of command in order to obtain necessary assistance (the Commissioner has no staff whatsoever at present); and (2) such requests require the personnel to interrupt their day-to-day operating responsibilities to conduct the requested analysis.

A small office should be formed consisting of a director and three to four staff who may be drawn from the existing organization. Personnel should serve in this office at the pleasure of the Commissioner, and the Commissioner should be assigned some positions to staff this office at his discretion. The duties of this office would generally include activities which are not routine occurrences, but rather require a one-shot intensive analysis in order for the Commissioner to determine policy direction for the Department. Examples would include: legislative liaison and analysis of proposed legislation; benefit cost analysis of capital facility replacement and alternative rehabilitation and maintenance policies; analysis of alternative fare, tariff and subsidy policies and the implications of operating or contracting for the operations of ferry and other public transportation services; and periodic evaluation of program cost effectiveness. In these duties, staff of the Office of Policy Analysis would obtain pertinent data from planning and operating personnel and review their findings and analysis with these same personnel; however, operating personnel would not be required to set aside their routine duties in order to conduct the actual analyses.

The Legal Services Division should continue to report to the Commissioner and should be retitled the Office of Legal Services. The Office of Legal Services presently does not perform its assigned responsibilities adequately and, once properly organized, should be assigned additional responsibilities. The Office should function as a legal team and the conceded conflicts and relatively low morale should be corrected through reorganization and personnel changes as necessary.

Staff levels and the type of experience required in Legal Services should be established based on a systematic analysis of existing and anticipated workloads and the changing type of workload, including additional assigned responsibilities. The existing data base, including workload and time charges, is not adequate for such an analysis. Written descriptions of the responsibilities of this office should be developed in consultation with the Commissioner, and work categories should be developed so that time charges can be properly made in order to analyze workload and establish ratings of efficiency.

The major legal problem that the Department presently faces and is not adequately prepared to handle is tort claims. Tort claims is a relatively new area of law for public sector attorneys and presently pending and near-future cases are likely to establish precedents in case law which will largely govern cases in the future. The legal office presently has no staff experienced in tort claims cases. The Department should retain outside counsel to handle tort claims cases and should either assign or recruit at least two attorneys to work with outside counsel in order to be trained and obtain experience. This is an area of utmost importance involving potentially large claims against the State. A tort claims summary in July, 1980, included 38 claims totaling $5,235,835, seven of which involved claims from $300,000 to $1,250,000 and totaling $4,825,000.

While tort claims is the most important problem to solve in the Office of Legal Services, several other changes or modifications should be made as follows:

1. Title searches, abstracting, and the preparation of documents for eminent domain proceedings can and should be done by paralegal personnel under the supervision of a trained and experienced attorney. The Department already has authorization to hire paralegal personnel and present vacancies and future openings occurring by retirement, attrition, or personnel reassignment should be filed with paralegal personnel.

2. Determination of staff needs related to eminent domain proceedings should be made based upon the recommendations made in Chapter 5 relating to the use of minimum payment procedures which may reduce the number of right-of-way cases which go to hearing or to court.

3. Title documentation, including cases handled in the last several years should be put into record form for ready retrieval--either microfilmed or computerized. The Longley Report made such a recommendation, but it was not implemented. Currently, closed cases are stored in the State Archives and are not readily accessible, so that there are at least some cases where new 40-year title searches are made on properties which have been analyzed in relatively recent years.

4. The Office of Legal Services should be responsible for the investigations associated with both Worker's Compensation cases involving Department employees and for tort claims. Investigation of these claims, including training of departmental field personnel in documentation of accidents, is key to minimizing the liability of the Department and is very important in the preparation of cases which go to administrative hearing or trial. The State recently contracted with a private firm to perform Workers Compensation functions, excepting litigation, for all

departments on a one-year trial basis. Thus, the DOT duties in this area will be minimal during the next year.

5. Responsibility for financial accounting for claims should be transferred to the Bureau of Finance and Administration.

6. The Legal Office should routinely review contracts prior to execution and should compile and periodically update standard language for various types of contracts.

7. The Department should seriously consider obtaining at least half of its attorney positions in the unclassified service in order to attract and retain, at least for several years, attorneys who cannot be attracted to the Department under present classified service pay and conditions.

It is emphasized that the present Legal Services Office must be reorganized and significantly upgraded for the Department to be adequately represented in both its present as well as near future legal problems.

Responsibilities of the Employee Relations Division should be transferred to the Bureau of Finance and Administration. The responsibilities of this division are to investigate and attempt to resolve personnel issues before they become formal grievances, to attend disciplinary hearings and participate on the Personnel Policy Committee, to administer the union contract and train DOT managers in such administration, to compile and maintain statistical data and information, and to represent DOT at the bargaining table. These functions can be performed by a strong Personnel Division (as recommended in Chapter 2) and do not warrant a staff office reporting directly to the Commissioner.

A considerable amount of time is now spent in meetings with various Department managers to discuss potential and emerging personnel problems and in reviewing grievances in order to recommend action by the Commissioner. A carefully developed training program for managers in administering the union contract could reduce some of the time now required by Employee Relations and other DOT managers in informal meetings pertaining to grievances. Adherence to prescribed processes is a very important element of union contract management, and DOT managers should be provided with the necessary advisory information and made responsible for managing in accordance with the contract. Staff of the Personnel Division should be responsible for maintaining data on type and frequency of grievances and recommending corrective actions or training as appropriate. The Employee Relations Division currently is not staffed to handle this responsibility routinely, and such staff can be most efficiently utilized if they are part of the Personnel Division. Pertinent data should be summarized routinely for the Commissioner, particularly in anticipation of contract negotiations. Policy assistance may be provided to the Commissioner at these times from his Office of Policy Analysis.

* * * * * *

RECOMMENDATION: RESPONSIBILITIES FOR FINANCIAL AND ADMINISTRATIVE MANAGEMENT SHOULD BE CONSOLIDATED IN A BUREAU OF FINANCE AND ADMINISTRATION

All non-operational support service functions (business services) should be responsible to one administrative authority, although some staff may be physically located within operating units. Staff assigned to finance and administrative functions should be trained in business management and/or accounting. This organizational structure affords the business staff greater opportunity for advancement and should improve the overall coordination and delivery of financial and administrative services while ensuring compliance with accounting and administrative policies and regulations.

The Director of Finance and Administration should have formal training in finance and administration and experience as a business administrator. It is preferable that he have an MBA if he is selected from a background other than finance or business administration.

Authority and responsibility for budgeting, accounting, and financial management should be assigned to one division within the Bureau of Finance and Administration. Although the accounting and budgeting unit is currently assigned to the Bureau of Administrative Services, full authority and responsibility for financial matters is not vested with them. Much financial control is vested in the various operational units. To ensure the integrity of the accounting records, that expenditures are controlled within budgetary authority, assets are properly accounted for, and revenues collected expeditiously, responsibility for all fiscal matters should be vested in a financial manager responsible to the Director of Finance and Administration. Reporting to him should be sections responsible for financial planning, budgeting and cost accounting, general accounting and financial reporting and analysis.

All personnel-related functions should be consolidated in the Division of Personnel. Personnel-related functions are currently fragmented in the DOT, and the Personnel Division serves primarily a record-keeping function. Training responsibilities should be transferred to this division from the Bureau of Safety. Responsibilities of the Employee Relations Division should be transferred to Personnel, as explained in a previous section.

Responsibilities for administrative services should be consolidated in a Division of Business Services. Responsibility for the MDOT library, reproduction services, records management, building management, inventory management, and public information should be consolidated in one division. The functions now performed by the Special Services Division should be transferred to Business Services and divided between a Reproduction Services Section, Inventory Management, and a new

Public Information Section. Responsibilities for reproduction of the State Highway Map and management of the Photo Lab should be handled by Reproduction Services. A new Public Information Section should be responsible for producing the employee newsletter and development and distribution of all types of public information on behalf of the Department. In addition, the Division should be assigned a central telephone number for the Department and route incoming calls appropriately. Currently there is no general information number listed in either the State government directory or the Augusta telephone directory. Management of the DOT Library should be assigned to the Public Information Division.

The Motor Transport Division should be assigned to the Bureau of Finance and Administration. The transfer of Motor Transport Services from the Maintenance and Operations Division to the Finance and Administration Division can be justified on several grounds: greater balance to the overall organizational structure, elimination of potential conflicts of interest, and closer coordination between related organizational units.

The span of management within Maintenance and Operations is now disproportionately larger than that of any other division in terms of staff size, programs, services and activities. Of the five major program areas within the Division, Motor Transport Services is the least related and the easiest to separate. While the four maintenance-oriented programs are interrelated at the field division level with respect to personnel and functions performed, Motor Transport Services has a separate chain-of-command and has a different role in the overall maintenance program. The only level at which supervision is exercised over all five major functions is at the level of the Maintenance and Operations Director.

Transferring Motor Transport Services to Finance and Administration also eliminates potential conflicts of interest. Since Motor Transport Services is designed to operate in an almost "free enterprise" environment, one must question the wisdom of co-locating the supplier and the principal users within the same organizational unit. By separating the two, Motor Transport Services will be less susceptible to user demands and better able to make objective decisions.

Finally, assigning Motor Transport Services to Finance and Administration will allow closer coordination with other related units such as Computer Services and Financial Management. Motor Transport Services relies upon the expertise available in these units, especially Computer Services, and the recommended reorganization should facilitate these relationships.

The Computer Services Division should continue in its current form and report to the Director of Finance and Administration. The transfer of Motor Transport Services should occur in two stages. First, the financial and accounting activities should be transferred as a section to the Financial Management Division of Finance and Administration. The current financial responsibilities should be amended to include analysis of costs and development of replacement cycles as well as analysis of types of equipment used by the Department and their cost effectiveness. As this and

other recommended improvements are implemented in the Bureau, then the remainder of Motor Transport Services should be transferred as a division to Finance and Administration.

* * * * * *

RECOMMENDATION: RESPONSIBILITIES FOR PROJECT DEVELOPMENT, MAINTENANCE, AND OPERATIONS OF NON-HIGHWAY MODES SHOULD BE CONSOLIDATED IN A BUREAU OF COMMON CARRIER TRANSPORTATION.

Responsibility for planning, project development, and operations for non-highway modes is not divided among functional bureaus of the Department in a consistent manner. Aeronautics operations and project development are assigned to the Bureau of Aeronautics in Operations; maintenance and operations of the Maine State Pier and the State Ferry Service are assigned to the Bureau of Waterways in Operations; but planning and project development functions for newer areas of responsibility such as rail freight and public transit are both managed by the Bureau of Public Transportation. Highway and aeronautics planning are assigned to the Bureau of Planning, while waterways, rail freight and public transit planning are assigned to the Bureau of Public Transportation. All of these functions can be performed more effectively and efficiently if they are organized to take advantage of the existing functional structure of the Maine DOT.

As explained in the next recommendation, planning responsibilities for all modes should be assigned to the Bureau of Planning. The discussion here is focused on the benefits of consolidating non-highway project development responsibilities in one bureau of the Department.

With the functional organization of the Department, the engineering staff in Project Development provides assistance to all modes unless the work is contracted to consultants. Consequently, the project development functions which must actually be performed for the other modes primarily relate to internal contract management or grant administration. The functions involve the same basic process for all modes, but the process is modified according to the technical and procedural requirements of agencies participating in the funding: Federal Aviation Administration, Federal Railroad Administration, Urban Mass Transportation Administration.

Whether the "project" is construction of a runway, purchase of a ferry, rehabilitation of a rail line, provision of an operating subsidy, or purchase of buses, the DOT responsibility is the same: to develop a detailed scope of work, cost estimate, and schedule; to prepare and execute a contract for in-house or consultant services; to interact with funding agencies and citizen groups during development of the project; and to ensure that procedural and reporting requirements of funding agencies are followed. In order to retain modal identities, it is recommended that each of the modes be identified as a division; however, all staff handling project development and grant administration should be based in the DOT

building and should work together, as circumstances permit, in order to gain broader experience in grant administration and contract management. Since the DOT does not currently operate or maintain public transportation or freight facilities, the duties of these divisions will involve only project development and grant administration. Accordingly, they should be staffed with only one or two persons. One individual also should be assigned project development responsibilities for each of the remaining modal operations--the State Pier, State Ferry Service, and Airport Operations--and as noted above, should be based in Augusta.

The remaining responsibilities of this Bureau are for maintenance and operation of the Augusta Airport, the Maine State Pier, and the State Ferry Service. Each of these currently is assigned a manager, and each should continue as a division in the new Common Carrier Bureau in a manner comparable to highway maintenance field divisions. It should be noted that the State Pier and Ferry Service operations were not evaluated as part of this study. They are recommended for incorporation in this bureau in their current form and they would have the same approximate level and reporting relationships as at present. The investigations during this study indicate, however, that better clarification is required of the division of responsibility and reporting relationships between the State Pier and Ferry operations and DOT headquarters bureaus.

* * * * * *

RECOMMENDATION: RESPONSIBILITIES FOR SYSTEM PLANNING, TRANSPORTATION SAFETY,AND PROGRAM DEVELOPMENT SHOULD BE CONSOLIDATED IN THE BUREAU OF PLANNING.

Responsibilities for planning and project development currently are divided between the Bureau of Planning and the Bureau of Public Transportation. This inhibits coordinated development of transportation plans and objectives, interaction with local planning agencies, and efficient use of personnel--particularly in the long term.

Responsibilities for transportation safety currently are assigned to the Bureau of Safety. That bureau should be eliminated because some of the functions are more appropriately performed by other units, and the number of personnel required to perform the safety functions does not merit bureau status relative to the scope of responsibility of other bureaus in the Department. Responsibility for Worker's Compensation has been recommended for transfer to the Office of Legal Services. Responsibilities for Training and Safety financial records have been recommended for transfer to the Bureau of Finance and Administration. The Bureau of Planning should assume responsibility for maintaining accident records and administering safety programs funded through Section 402 of the Federal aid Highway Act and through NHTSA. Review of the Surface Transportation Act of 1978 and available interpretations indicate that it was the intent of Congress that the 402 programs be administered by the state highway agency. The Traffic Engineering Division is closely involved in implementing safety

programs; however, the safety functions are recommended for assignment to the Bureau of Planning for two specific reasons: (1) accident data is an important input to transportation planning and program development, and (2) the Bureau of Planning will manage the TINIS system which is to incorporate accident statistics along with other data.

The Bureau of Planning should be organized into three divisions responsible for system planning, transportation safety, and program development. The Bureau also requires a full-time director. Currently the position is filled part-time by the Deputy Commissioner for Planning and Administration. The levels of management personnel assigned to this bureau should be reviewed for consistency with other bureaus of the Department.

The functions of the Environmental Services Division should be assumed by the System Planning and Program Development Divisions of the Bureau of Planning in order to better integrate its activities into these functions. At present, the Environmental Services Division is responsible for a wide variety of tasks including: review of departmental practices, policies, and programs in terms of their relationship to the environment; identification of environmentally-sensitive projects in the annual program, and preparation of environmental planning reports on individual projects; and liaison with other State and Federal agencies, as well as special interest groups.

In order to better integrate these functions into the proposed organization, the System Planning Division should assume responsibilities for review of departmental practices, policies and programs, and liaison with external agencies and groups. The Program Development Division should assume responsibility for identification of environmentally-sensitive projects and preparation of environmental planning reports. The substance of this recommendation is discussed in more detail in Chapter 4.

The System Planning Division should also develop a capability for highway system planning as explained in Chapter 4, and should assume responsibility for airport master planning and airport system planning which are already assigned to the Bureau of Planning. In addition, this division should assume responsibility for the following system or service planning functions now assigned to the Bureau of Public Transportation: statewide rail planning, port and pier development, ferry service planning and tariff review, and public transportation service planning and fare analysis.

The Transportation Safety Division should assume responsibility for maintaining accident records, administering Section 402 safety programs, and maintaining and evaluating safety data for all transportation modes.

The Program Development Division should assume current Bureau of Planning responsibilities for preparing the preliminary project scopes, planning reports and cost estimates, and preparing the biennial program and justification for submission to the Legislature.

Existing personnel in Highway Planning and Data Resources should be divided between System Planning and Program Development. Data Resources

functions should be located primarily in Systems Planning. Some additional planning staff may be required in order to advance the recommended system planning work; however, such action should not be taken until the Bureau changes its planning emphasis, as recommended in Chapter 4. Greater reliance on evaluation of project requests should gradually reduce the staff required for program development.

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RECOMMENDATIONS: PROJECT DEVELOPMENT SHOULD BE ELEVATED TO BUREAU STATUS.

In accordance with the overall organizational recommendations, Project Development should become a bureau reporting directly to the Deputy Commissioner and Location and Survey, Design, Right-of-Way, and Materials and Research should continue as divisions. The director of this bureau should be titled Chief Engineer, Project Development.

The Environmental Study Group, which has been considered for the Location Section, should be created and staffed. Creation of this group has been delayed, at least in part, because a section chief could not be hired. This group should be created and staffed with those persons now responsible for environmental analysis in project development. Positions assigned to this group should reflect the nature of the work performed. The functions recommended for this group are enumerated in Chapter 5.

Further changes should be implemented during a second phase of reorganization. The second phase of reorganization, described previously, provides for elimination of Materials and Research as a division, transfer of its functions to the Bureau of Planning and to the Design and Construction Divisions, and incorporation of the Construction Bureau into Project Development.

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RECOMMENDATION: THE CONSTRUCTION DIVISION SHOULD BE ELEVATED TO BUREAU STATUS.

The director of this bureau should be titled Deputy Chief Engineer, Construction. The current organization of this bureau should be continued during the initial reorganization. During the second phase, the Bureau should be merged with the Bureau of Project Development. Substantive recommendations pertaining to construction may be found in Chapter 6.

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RECOMMENDATION: THE MAINTENANCE AND OPERATIONS DIVISION SHOULD BE ELEVATED TO BUREAU STATUS.

The Motor Transport Division should be transferred into two phases from Maintenance to the Bureau of Finance and Administration, as discussed in connection with that bureau. The Department should investigate further the division of responsibilities between Augusta offices and the District offices to achieve modest additional improvements. The director of this bureau should be titled deputy chief engineer, Maintenance and Operations.

The field offices of this bureau should be titled District offices. This is more compatible with national practice and it would eliminate the current confusing terminology whereby divisions supervise divisions.

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RECOMMENDATION: LEGISLATIVE PRESCRIPTIONS OF DOT ORGANIZATIONAL STRUCTURE SHOULD BE REPEALED.

In a number of instances, DOT organizational units and reporting relationships are prescribed by statute. At the very least, these would require change in order to implement the recommended organization structure. This practice, however, is an undesirable encroachment upon the prerogatives of the Commissioner, as the manager of the DOT. A more desirable practice would be for the Legislature to assign responsibilities to the DOT and the Commissioner, and to leave to the discretion of the Chief executive the manner in which those responsibilities are executed. The chief executive of any agency should be responsible for producing specific results, but should not be constrained as to the structure through which he produces these results.

# 2. FINANCE AND ADMINISTRATION

The Bureau of Finance and Administration (redesignated title) should be responsible for financial planning and management, business administration, and providing administrative support services to all operational bureaus of the Maine Department of Transportation. With the exception of financial planning and management, business and administrative services currently are being delivered effectively although some improvements are possible. These will be discussed within separate subsections to this chapter.

There are several reasons for centralizing financial, business, and administrative services, the most important of which is the cost savings from minimizing duplicative services and operating inefficiencies. Also, certain functions by their very nature should be assigned to a central authority. These include personnel, accounting and finance, and data processing. Special technical skills and professional staff which are not usually available in operating bureaus or subunits are needed to effectively deliver these services. These factors and others were considered when developing the recommended organizational structure and in evaluating the delivery of support services.

In evaluating this bureau, subordinate divisions were analyzed individually. Each provides a different type of business service, is governed by different rules, regulations, policies, and procedures, and delivers its services in differing ways. The common bond which ties them together is that they are all business and administrative services as opposed to transportation services. The divisions include the following:

- Financial management
- Personnel management and training
- Computer services
- Motor transport services
- Business services.

The main focus of this review was upon the efficient and cost effective delivery of services to the MDOT Bureau of Highways and its subordinate units. While the impact of centralized administrative services

to other operating bureaus was considered, it was not emphasized. Therefore, no comment is made concerning the delivery of services to these bureaus. However, to the extent practical, the Bureau of Finance and Administration should have direct responsibility for the delivery of these services to all bureaus, and authority for providing and controlling the delivery of similar services by contract or satellite operation when deemed necessary.

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RECOMMENDATION: THE DIRECTOR OF FINANCE AND ADMINISTRATION SHOULD DEVELOP A FORMAL MANAGEMENT SYSTEM OF PLANNING, REPORTING, AND EVALUATION TO USE AS THE BASIS FOR MANAGING THE BUREAU

At present, each division operates from year to year without a formal management plan other than a financial budget, based largely upon prior year expenditure levels. Little consideration is given to changes in MDOT operating plans, anticipated service levels, staffing requirements, or equipment needs. Informally, managers discuss issues or problems, but there is no formality to the process.

Formalized planning is important to ensure that the needs of the Bureau of Finance and Administration are satisfied, that organizational and operational programs and activities satisfy the needs of other bureaus, and that a basis for measuring performance is established.

If each division develops its own operating plan (financial, personnel, capital equipment and facilities, and programs) using standard reporting formats, management can then evaluate them individually, collectively, and in relation to overall Department programs, plans, priorities, and available funding levels. Planning decisions can be made more intelligently, based upon facts and with full knowledge of the consequences.

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RECOMMENDATION: THE FINANCIAL MANAGEMENT DIVISION SHOULD BE ASSIGNED TOTAL FINANCIAL RESPONSIBILITY AND BE REORGANIZED TO EFFECTIVELY CARRY OUT THAT RESPONSIBILITY.

In analyzing the overall efficiency and effectiveness of this division, the study team conducted extensive interviews with executives and subordinate unit supervisors; reviewed transactions processed, records maintained, and reports issued; evaluated internal controls and administrative procedures, studied management responsibilities and span of control and their effects on results achieved; reviewed FHWA audit reports; and otherwise evaluated the overall performance of the Division.

The consensus of the study team is that the financial staff and supervisors are dedicated to MDOT and are exacting in their work. They are precise in accounting and reconciling accounts and in ensuring that there is adequate support (to the extent required by management) for all expenditures. They maintain detailed records supporting allotments, obligations, and expenditures. They organize budgets according to traditional procedures and issue monthly financial reports requested by management.

However, present financial managers have limited authority and responsibility over accounting matters. Detailed accounting ledgers are maintained by other bureaus and divisions; project cost accounting is assigned to the Bureau of Project Development; accounts receivable and collection responsibilities are vested in numerous units; and assets are not all accounted for. In addition, the accounting procedures are not sufficient to ensure that detailed cost records reconcile to control accounts consistently; the state encumbrance accounting system is not used to reflect all outstanding encumbrances; contractor payments are processed with statements prepared by resident engineers; appropriation accounts are not reconciled monthly; and accounting for Federal funds is not adequate.

Strong, decisive financial leadership is needed to provide assurances to management, government leaders, and the public that the funds entrusted to MDOT are being spent for their intended purposes and protected against misuse. People generally assume that authority and responsibility are inherent in any financial unit. That authority includes custody and control of assets, financial planning and management, accounting and financial reporting, cost accounting and cash management.

It is evident that the financial unit within MDOT has very limited authority and that finance-related duties are being undertaken by non-financial interests. This structure compromises the separation of financial from operational interests which is necessary to ensure independence and objectivity in deciding financial issues and in utilizing and accounting for funds. However, in our limited review, we found no indication that funds were not being spent for their intended purpose and protected against misuse.

The Division should be organized with three sections: (1) financial planning, budgeting, and cost accounting, (2) general accounting, and (3) financial reporting and analysis.

The financial planning, budgeting, and cost accounting section should have responsibility for providing all budgeting and cost accounting services to the MDOT organization. It should set all billing rates and ensure the integrity of all cost accounting systems. It should organize the annual planning process and coordinate the development of long-range plans and annual operating plans. It should ensure that all costs are properly accounted for and that MDOT project cost accounts are reconciled monthly.

The general accounting section should be responsible for payroll, accounts receivable, accounts payable, inventory accounting, asset accounting, general ledger accounting, and financial reporting. It should

ensure that sufficient accounts are maintained to account for funds by source and for expenditures by operating section or project. All accounts and funds should be reconciled monthly.

Any accounting records maintained by others should be with the authority and supervision of the general accounting section and should be maintained according to prescribed standards and procedures. All accounting should conform to regulations prescribed by the State Controller, be in accordance with generally accepted accounting principles and procedures, and comply with various Federal regulations, in particular OMB Circular A-102 and FMC 74-4.

Financial reports should be issued monthly, by fund, including statements of revenues and expenditures, balance sheets, cash flow statements, and statements of changes in financial position.

The financial reporting and analysis section should be responsible for developing and maintaining a comprehensive management information reporting system. Monthly, a comprehensive set of program and project status reports should be compiled which measure results of plans. Narratives should be developed to explain variances and to report on the status of work. The reports should include financial status, program status, personnel staffing, capital programs, and the status of various management projects. The financial reporting and analysis section should provide copies of the reports to key operating and executive officials and summarize the data at a monthly MDOT Commissioner's planning conference. This unit should also conduct special studies as requested by management.

Continued financial management as it currently exists will adversely impact MDOT's ability to control costs and to properly manage projects. Unless stronger financial management is forthcoming, FHWA could withhold participation in highway programs, and the State could be exposed to criticism resulting from insufficient support for expenditures and inadequate accounting for assets and funds.

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RECOMMENDATION: DEVELOP A MULTI-YEAR OPERATIONS PROGRAM AND FINANCIAL PLAN AND AN ANNUAL BUDGETING SYSTEM WHICH WILL INTEGRATE PROGRAM PLANNING WITH FINANCIAL, PERSONNEL, AND CAPITAL REQUIREMENTS PLANS AND BUDGETS TO RESULT IN A COMPREHENSIVE MDOT MANAGEMENT PLAN.

The Financial Management Division provides little financial or operational information to management. Departmental budgets are developed according to State Budget Office instructions, but do not provide detailed program plans or long-range plans. The use of prior year history as the basis for developing current year budgets is not appropriate or responsive to the need for an integrated management plan based on current conditions and programs. MDOT management does not have adequate financial or operational data to evaluate the impact of or to select from among

alternative program strategies or to effectively manage its programs. Components of the MDOT management plan should include:

- Highway and bridge improvement program
- Maintenance and operations program
- State aid highway improvement program
- Other construction and improvement programs
- Motor transport utilization plan
- Departmental budgets
- Capital equipment requirements plan
- Personnel utilization and requirements plan
- Computer improvement program
- Facilities utilization plan
- Contracted services requirements.

Only through an integrated planning process can management forecast funding requirements, project cash flows, ensure the orderly development of its capabilities and resources, decide program priorities after considering alternatives, and increase the overall effectiveness and responsiveness of MDOT to the needs for transportation services.

The financial planning, budgeting, and cost accounting section should have primary responsibility for the development of both long-range and annual operating plans and budgets. The Bureau of Project Development and its divisions should have primary responsibility for developing operational requirements and program plans for both the Bureaus of Construction and Maintenance and Operations. It should work closely with the Financial Management Division in developing detailed cost, personnel, and capital equipment requirements and other data needed for the overall management plan.

The Bureaus of Construction and Maintenance and Operations should assist in the development of operational plans and should develop implementing programs, including resource requirements and staffing levels. This information should be integrated into the overall management plan.

Other MDOT operating units should develop similar program plans as directed by the Financial Management Division. Their plans should be integrated into the MDOT management plan, but should be considered separately when deciding funding levels, program priorities, and capital requirements, since their plans relate to providing a wide range of transportation services. The development of the management plan also should be closely coordinated with the activities of the Office of Policy

Analysis to ensure that the prerogatives of key MDOT executives and the latest policy implications are considered.

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RECOMMENDATION: THE ASSISTANT DIRECTOR OF FINANCE AND ADMINISTRATION WITH THE ASSISTANCE OF THE DIRECTOR OF THE COMPUTER SERVICES DIVISION SHOULD ADOPT CERTAIN ADMINISTRATIVE PRACTICES WHICH WILL ENHANCE THE EFFECTIVENESS OF THE DIVISION'S OPERATIONS AND IMPROVE ITS ACCOUNTABILITY

Overall, the Computer Services Division is providing efficient and effective services to the extent resources can permit. In comparison to similar service units operating in other states, they are considerably more productive and technologically as advanced. The Director has a comprehensive knowledge of computer technology and is very sensitive to the need for more efficient and cost-effective data processing services to replace manual and other outmoded means of data storage, retrieval, and reporting. Staff provide a high level of service and dedication, although salary levels are low in comparison to data processing professionals in other areas.

Computer Services cost accounting system should be modified to charge users for services based upon the type of service provided rather than using one overall service rate. Separate rates should be established for such services as system(s) design, programming, data entry, machine operations, data storage, etc. The cost system should be capable of capturing the costs of operations by service type and comparing actual costs to service rates. However, there is latitude in the development of a cost accounting system. It should be designed to fit the needs and operational nuances of the user and provider. Thus, the costs of some services, such as data entry, may be inappropriate to capture separately.

Data systems project control procedures will be strengthened by developing a formal system to plan, schedule, accomplish, and report on the status of various data systems projects. In this way, project priorities can be established, work schedules developed consistent with manning levels, customers kept informed of project status and work monitored more effectively. The system does not have to be elaborate; however, a project control system should be employed.

Data entry procedures should be changed to eliminate duplicated data entry. All data should be captured simultaneously for the MDOT project cost accounting system and for automatic transfer to the State's accounting computer. Interactive data entry systems should be located in business offices and used to replace current manual methods of batch processing and data entry. New efficient methods for preparing special or standard reports for computer users are available at MDOT. This capability should be publicized to users who at present are not aware of this service.

Management should consider the feasibility of replacing its IBM 1130 engineering computer when finances can be made available. It is quite old, and more efficient systems are available at reasonable prices. Also, design software packages are available which will substantially reduce engineer design effort and increase productivity. And, engineering staff should become proficient in using such engineering applications. A migration of some engineering work to the IBM 370/148 would help relieve the load on the IBM 1130 until another unit can be obtained.

Management should undertake a study to develop a computer services long-range plan. This plan should address both current and future data needs, evaluate equipment capabilities and technological advances in hardware and software design, project staffing requirements and identify more cost effective and efficient operating methods. The plan should look about five years into the future, project staffing and capital requirements and include a phased implementation program. It should be updated annually and become part of the overall MDOT long-range operating plan.

Training should be planned and scheduled with the knowledge of individual employees. It should improve their technical skills and increase their value to the Division. As a result of the computer operations planning process, employees whose positions will be eliminated or changed should be evaluated for special cross-training to prepare them for new assignments and responsibilities.

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RECOMMENDATION: ORGANIZE THE BUSINESS SERVICES DIVISION TO PROVIDE COMPREHENSIVE SUPPORT SERVICES IN AN EFFICIENT AND COST EFFECTIVE MANNER AND PROTECT MDOT ASSETS AND RECORDS AGAINST LOSS OR MISUSE.

Various supportive service sections currently report to the Director of Finance and Administration, whom we have recommended should assume a more active role in overall management of the Bureau. To provide closer coordination and supervision in the delivery of these administrative services, we recommended that they be consolidated into one division: Business Services. The following units would compose the division:

- Public information and library
- Reproduction services
- Records management
- Building management
- Inventory management
- Postal and delivery services
- Systems and procedures

Records management and inventory management are not presently assigned to the Bureau of Finance and Administration. They could be more effectively coordinated if assigned to Business Services and would relieve MDOT bureaus of these administrative responsibilities. However, bureaus should not be relieved of responsibility for accounting for or protecting assets and inventory entrusted to them.

The Systems and Procedures section presently reports directly to the Director for Finance and Administration. This function could provide equally effective service if assigned to the Business Services Division.

The support services appear to be provided efficiently. However, we noted certain activities which could be improved upon:

- Compile records of all inventories including assets acquired with Federal funds, materials left over from construction projects and inventoriable supplies. All fixed assets should be tagged for identification denoting the funding source, and a physical inventory of all assets should be conducted at least once each year. These activities should be coordinated with the General Accounting section.

- Organize a records storage system which will ensure that records are stored only as long as necessary. Develop a microfilm and microfiche system to retain records rather than keeping paper records. Replace the approximately 200 metal file cabinets used as storage contaners with cardboard boxes and return the file cabinets to the State property office for use by other State agencies.

- Evaluate the reproduction equipment to determine if newer and more efficient equipment would better serve the needs of MDOT at reduced operating costs. All new reproduction equipment should be equipped with automatic collators.

- Administrative systems and operating procedures must be documented to ensure uniform and consistent application of policies, administrative practices, and compliance with regulations.

  The effects of inadequate administrative and operating procedures are often substantial. Lack of documentation can lead to disallowed Federal participation in projects, loss of expertise when key employees leave, unclear assignment of responsibility, inadequate intra-departmental communication, difficulty in transferring employees across functional lines and reduction in opportunities for changes in job assignment. The Department has recognized these deficiencies and has developed some policy memoranda and procedures. However, many executives still resist the need to document what they are doing. This attitude is contrary to the interests of MDOT and should not be allowed to continue.

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RECOMMENDATION: MOTOR TRANSPORT SERVICES SHOULD UTILIZE ITS DATA COLLECTION AND INVENTORY CONTROL COMPUTER SYSTEM MORE EFFECTIVELY

The computerized information system installed two years ago by Motor Transport Services is a major accomplishment. It economically collects complete, accurate, and timely data in an environment which historically has been resistant to automation because of the inability to collect reliable data economically. Relatively few comparable facilities have similar data collection systems. To date, the most notable success of the system has been to reduce the stock inventory approximately 25 percent, from $4 million to $3 million. The system is also used to generate "variance" reports which identify and select for further scrutiny vehicles and equipment with high or low values for specified characteristics (e.g., cost per mile, utilization, etc.). Other uses include providing data for special studies such as cost comparisons.

Although the system has been valuable so far, it is greatly underutilized considering its capabilities and level of sophistication. Examples of useful applications which would lead to greater cost-effectiveness include:

Equipment Replacement. The system should be used to track the cost performance of specific vehicles and equipment over time to determine the optimal replacement time.

Equipment Specification. Different types of vehicles and equipment or parts and components can be monitored so as to judge their relative performance in terms of cost, maintenance, reliability, durability, etc. This information would be extremely valuable in specifying equipment needs. One example is the issue of "downsizing" automobiles. MDOT currently operates a mix of vehicles. Data are available to support a study to determine if the fuel savings of smaller cars are offset by other factors.

Labor Productivity. By instituting a standard cost system for categories of work (e.g., engine, transmission, rear end, etc.), data can be collected which could be used to set standards and evaluate performance. These data also could be used to judge the effectiveness of certain kinds of repairs, such as major overhauls and subsequent maintenance.

Utilization. By monitoring utilization, the system can be used to more effectively schedule equipment usage, maintenance, and driver availability.

The above applications are currently under consideration by Motor Transport Services in conjunction with Computer Services. It is recommended that they be implemented in order to take full advantage of the system's capabilities.

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RECOMMENDATION: THE ASSIGNMENT OF VEHICLES AND EQUIPMENT SHOULD BE THE EXPLICIT RESPONSIBILITY OF MOTOR TRANSPORT SERVICES

Cost-effective utilization of vehicles and equipment is necessary to keep capital expenses at a minimum. In analyzing utilization, the following classes of vehicles were selected for examination:

- Class 60: automobiles
- Class 70: vans, station wagons, suburbans
- Class 90: one-half to one-ton Pickups

For each class, reports were obtained from Computer Services containing the following data for each field division:

- The number of vehicles assigned
- The average annual mileage
- The lowest annual mileage
- The highest annual mileage

The above information allows a statistical determination to be made of the utilization range for 95 percent of the vehicles. (This percentage was chosen in order to discount the few vehicles which are severely under or over utilized for valid reasons.)

The results of this analysis are presented in Exhibit 2-1. As shown, the average utilization is acceptable, but the variation among divisions and within divisions appears large. There thus appears to be an opportunity to improve utilization and reduce the overall fleet size.

The best way to achieve improved utilization is through greater coordination in scheduling equipment usage, maintenance, and driver assignments and through greater control over equipment availability and rental authorizations. Because the ability to provide this coordination is concentrated in Motor Transport Services using its computerized information system, the assignment of vehicles and equipment should be the responsibility of Motor Transport Services.

At the same time, other causes of variability in utilization should be assessed. Some variation may be fully justified in certain cases. For example, the age mix of the fleet may be such that the under-utilized vehicles are fully depreciated and incur only the incremental cost of operation plus a portion of overhead. In this case, the additional capacity provided by these vehicles may justify their under-utilization as long as their unit maintenance costs are reasonable.

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EXHIBIT 2-1

UTILIZATION RANGE (ANNUAL MILEAGE)
FOR SELECTED VEHICLE CLASSES

Class 60: Automobiles

| Division | Low | Average | High | No. of Vehicles |
|---|---|---|---|---|
| 1 | 12,781 | 20,516 | 28,250 | 12 |
| 2 | 12,756 | 17,284 | 21,812 | 18 |
| 3 | 16,838 | 20,995 | 25,152 | 20 |
| 4 | 16,176 | 23,511 | 30,846 | 13 |
| 5 | 17,265 | 25,730 | 34,195 | 9 |
| 7 | 16,804 | 22,257 | 27,710 | 13 |

Class 70: Vans, Station Wagons, Suburbans

| | | | | |
|---|---|---|---|---|
| 1 | 17,586 | 25,900 | 34,214 | 6 |
| 2 | 11,818 | 18,043 | 24,268 | 4 |
| 3 | 15,022 | 19,792 | 24,562 | 6 |
| 4 | 10,711 | 18,758 | 26,805 | 5 |
| 5 | 6,584 | 21,588 | 36,592 | 4 |
| 6 | 11,254 | 15,026 | 18,798 | 9 |
| 7 | 11,565 | 19,116 | 26,667 | 7 |

Class 90: 1/2 to 1 Ton Pickups

| | | | | |
|---|---|---|---|---|
| 1 | 21,923 | 31,363 | 40,803 | 19 |
| 2 | 15,532 | 19,837 | 24,142 | 15 |
| 3 | 23,539 | 29,498 | 35,457 | 17 |
| 4 | 18,946 | 23,049 | 27,152 | 20 |
| 5 | 21,943 | 29,493 | 37,043 | 15 |
| 6 | 19,533 | 27,167 | 34,801 | 19 |
| 7 | 23,562 | 28,804 | 34,046 | 20 |

RECOMMENDATION: APPROPRIATE FUNCTIONS SHOULD BE CONSOLIDATED INTO A SINGLE PERSONNEL AND TRAINING DIVISION WITHIN THE BUREAU OF ADMINISTRATIVE SERVICES.

Personnel functions need to be consolidated and strengthened in the MDOT. Currently they are scattered throughout the Department, and no single person or office has the ability to pinpoint inadequacies in the functions or the authority to correct them. The absence of a position charged with the responsibility for the full range of personnel functions deprives MDOT of a focal point for career management, training, development of a departmental bargaining agreement, and other personnel support functions which are usually present in a fully-effective organization.

The following responsibilities should be consolidated into the Personnel and Training Division:

- Career management
- Training
- Employee relations
- Position classification
- Incentives.

Formal responsibility for career management, training, and incentives is currently absent in DOT, except as it may exist informally between the employee and supervisor. Management of career development in an organization is an important means of attracting and retaining high-quality personnel and ensuring cost-effective use of personnel in various occupations.

Top management should recognize the importance of planned and regular intake of personnel and provide the resources to meet the planned goals. The recruitment of personnel, particularly engineers, is inhibited by periodic hiring freezes and low starting salaries. In recent years the Personnel Office has projected a need to hire 13 entry level engineers annually. Actual hires, however, have ranged from three to nine per year. In order to meet the projected long-range personnel needs of the Department, the Personnel and Training Division should be given broader authority to pursue the planned goals. This should include, for example, authorization to recruit out of state when necessary.

The Personnel and Training Division should prescribe training and experience required for specific jobs and offer this training to prospective candidates. To better prepare personnel to advance to key positions in the Department, the Personnel and Training Division should conduct an

analysis of the experience and education required to fill the positions. Following this analysis, the Division should develop training opportunities which satisfy these needs. Included in the training should be the opportunity to rotate among several jobs. This would broaden the experience of employees and also provide additional stimulus and challenge.

Training for key positions should be offered to personnel in lower-level jobs who exhibit a high potential for advancement. To identify these candidates, the Personnel and Training Division should record activities and achievements of personnel which reflect their potential to advance within the career field.

The Personnel and Training Division should establish one or more specific types of recognition for professional occupations within MDOT or the state, and encourage participation in activities which result in professional recognition. Examples include membership or holding office in engineering societies, publishing articles, and receipt of honorary or other awards from MDOT, the State, or other organizations. Departmental recognition is particularly important in light of the State's policy of not compensating employees for time off or travel in connection with such activities.

The Department should establish a Training Committee to assess annual training needs for MDOT personnel. Current responsibility for training lies with the Highway Training Officer in the Bureau of Safety, and training programs are almost non-existent. A committee of key executives representing the major elements of the Department should review the training needs for MDOT, including engineering, clerical, supervisory, and managerial, and recommend an annual program to the Commissioner. A top-ranking individual in the Personnel and Training Division should be designated as the training administrator and should serve as chairman of the training committee. A high priority item for the committee should be the development of a supervisory training program to educate supervisors in such things as requirements of the bargaining agreements and methods for taking disciplinary action.

The Personnel and Training Division should emphasize program evaluation to isolate problem areas and plan for new bargaining agreements. This function should be coordinated with the training administrator and used to develop the supervisory training programs.

MDOT should seek more authority to perform job analysis and take personnel actions without recourse to the State. As an example, MDOT should work with the State Office of Personnel to increase the use of closed announcements for certain positions. When highly qualified candidates within MDOT have been trained to advance to a vacant position, the current procedure requiring all applications to be reviewed by the State office appears to be time consuming and unnecessary. The State could periodically audit the practices of MDOT in this regard.

A second example involves the classification of positions. The State currently retains the authority to classify or reclassify positions, although MDOT makes recommendations. The authority to classify positions

within MDOT should be delegated to the Personnel and Training Division and should save time both for the State Personnel Office and the Department.

The Personnel and Training Division should establish an MDOT policy on employee recognition and motivation. Such a policy should encompass recognition of personnel at all levels including clerks, crew, and professionals. The "merit increase" as it is currently used does not function as an incentive because it is awarded as a matter of routine. The early award of merit increases as well as double awards, now authorized but discouraged, should be emphasized for employees who perform exceptionally well.

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RECOMMENDATION: TO REDUCE THE NUMBER OF POSITIONS REQUIRING A CIVIL ENGINEER, THE MDOT SHOULD CAREFULLY REVIEW THOSE JOBS WHICH DO NOT REQUIRE A MAJORITY OF THE EMPLOYEE'S TIME IN ACTUAL ENGINEERING WORK.

The three classifications that require varying levels of engineering knowledge are:

Civil Engineers--registered professional engineers

Assistant Engineers--graduates of an accredited college, usually with a degree in civil engineering

Engineering Technicians--technical specialists who may have formal training in engineerings but (rarely a degree engineering) and often considerable experience in work associated with highway construction and maintenance.

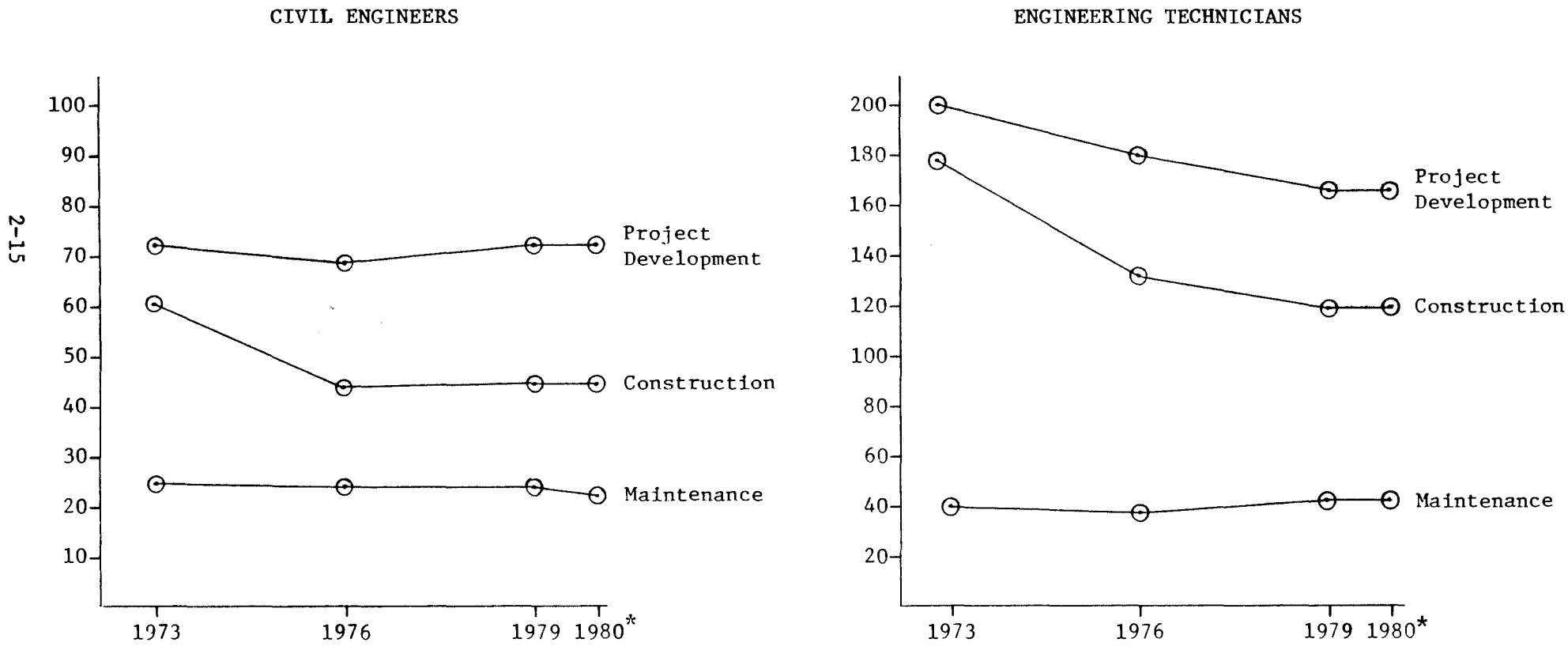
This recommendation concerns the CEs I through V (currently 127 employees) who are registered professional engineers.

Investigations in this study have indicated that there are too many engineers in the MDOT in the sense that there are too many positions which require a professional engineer. Overall staff levels have declined in the Department during the last decade. In Highway Activities, which account for about 90 percent of the MDOT employees, the decline since 1973 has occurred primarily in the engineering technician positions, due primarily to a dramatic drop in ET-I personnel. (See Exhibit 2-2.) Staff levels for civil engineers have remained fairly stable except in construction.

Interviews were conducted with a sample of civil engineers in all major segments of MDOT to discuss their programs, functions, and use of engineering knowledge. The use of engineering knowledge and skill was found to vary widely among these jobs. Moreover, at least one job reviewed at each of the CE II, III, and IV levels reflected limited need for an engineer. There is a prevalent view that an engineering background is desirable--and in some cases, required--in various jobs because it affords

EXHIBIT 2-2

CHANGES IN THE NUMBER OF
CIVIL ENGINEERS AND ENGINEERING TECHNICIANS
IN THE BUREAU OF HIGHWAYS




* As of June 1980.

a better understanding of job functions and enhances communication between a supervisor and his subordinates. This alone is not a valid basis for classifying a job as civil engineer.

The following guidelines are offered to assist in ascertaining which jobs throughout the Department do not require professional engineers:

(1) Jobs concerned with design and construction of highways, bridges, airports, or waterways generally require an engineer. Exceptions are likely to be found in jobs which are outside the mainstream of work, such as the special assistant or office engineer jobs.

(2) Most jobs involved with planning, research, safety, computer services, and environmental analysis typically involve a blending of professional disciplines. A number of these jobs currently occupied by an engineer do not require professional engineering registration.

While these guidelines should be followed, it is necessary to evaluate jobs currently held by engineers on an individual basis. The criteria used to assess the need for an engineer should be the extent to which engineering knowledge and skills are used to perform the duties of the particular job. If it is determined that little or no work requiring an engineer is performed, the engineering responsibilities can be reassigned, and the job opened to a non-engineer.

Following an identification of jobs which do not require an engineer, two actions are recommended:

(1) Jobs which require technical expertise or basic administrative skills should be reclassified for engineering technicians or administrative assistants. This would result in a cost savings to MDOT because the salaries for those employees are lower down than those for engineers.

(2) Jobs which require a highly trained professional, though not necessarily an engineer, should be reclassified to include professions with training appropriate to the job functions. While this would not result necessarily in a cost savings to the Department, it would increase the competition for these jobs. It would also enhance career possibilities for non-engineers and enable the Department to retain qualified professionals whose services are needed.

In the detailed survey and analysis of 15 engineering positions conducted during this study, five of the positions were judged to require little or no civil engineering expertise. Individuals currently filling those positions were classed as CE III or CE IV. If the positions were instead filled with planners, grant administrators, computer programming supervisors, or other appropriate non-engineer personnel and were paid in

accordance with Maine salaries1/ for such positions, the annual payroll would be reduced by about $50,000, or 13 percent of the payroll for the sample of fifteen.

This percentage savings cannot be assumed to exist across the board, however, for all civil engineers nor can it be realized immediately. Office engineers, for example, appear to have been over-represented in the sample. Furthermore, these findings should not be interpreted to suggest any need for immediate layoffs. The approach recommended is to:

1) Identify the jobs which do not require a civil engineer;

2) Encourage the incumbents to transfer to civil engineering positions which become available through attrition and retirements;

3) Reclassify those positions which do not require civil engineers, specify appropriate qualifications and attach commensurate salary ranges.

In other words, this recommendation may be implemented incrementally with no damage to individuals and with ultimate savings to the Department.

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RECOMMENDATION: THE LEVEL AT WHICH REGISTRATION AS A PROFESSIONAL ENGINEER IS REQUIRED SHOULD BE RAISED TO THE CIVIL ENGINEER II LEVEL TO PERMIT UPWARD MOBILITY FOR ASSISTANT ENGINEERS AND INTRODUCE INCENTIVES INTO THE ASSISTANT ENGINEER CATEGORY.

A significant problem in MDOT is the inability to recruit and retain assistant engineers. In the past five years, nearly 30 percent of the assistant engineers have resigned. While this statistic itself is not alarming, interviews with supervisors of these employees indicate that many were among their best engineers, and almost all left for better-paying jobs.

The current practice at MDOT is to require four years at the assistant engineer level plus registration as a professional engineer before advancing to a CE I level. However, above this level only two years in a position are generally required before an engineer is eligible to advance to the next level. The four-year requirement for assistant engineers limits the ability of the Department to offer salaries which are comparable to those outside the Department. It also limits their ability to challenge and increase the responsibilities of outstanding assistant engineers. The duties performed by a CE I do not include approval of plans

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1/ State Salary Survey, U.S. Office of Personnel Management, August 1, 1979.

or other tasks which specifically require certification as a professional engineer; thus, it does not appear that current responsibilities at the CE I level would need to be altered to accommodate this recommendation.

The anticipated benefits of permitting assistant engineers to advance to a CE I position before certification as professional engineer include:

(1) The ability to attract more candidates at the entry level because of the opportunity for more rapid advancement based on merit; and,

(2) The ability to retain competent assistant engineers by increasing their responsibilities and salaries commensurate with their competence and performance.

# 3. BUREAU OF COMMON CARRIER TRANSPORTATION

Consolidation of project development and maintenance and operating responsibilities for non-highway modes in a Bureau of Common Carrier Transportation is recommended and explained in Chapter 1. Recommendations pertaining to these functions are limited to activities related to the highway program--the primary emphasis of the management study--and to Aeronautics. Evaluation of State pier and ferry operations was not made in this study.

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RECOMMENDATION: THE BUREAU OF COMMON CARRIER TRANSPORTATION SHOULD INSTITUTE A SYSTEM OF INTERNAL CONTRACTS FOR WORK PERFORMED ON COMMON CARRIER PROJECTS BY OTHER BUREAUS IN MDOT TO ENSURE MANAGERIAL AND BUDGETARY CONTROL.

The Bureau of Common Carrier Transportation will not have engineering capability but will rely on the Bureaus of Project Development and Construction or on outside contractors. Managerial and budget accountability required by this bureau should be achieved through a system of internal contracts managed similar to consultant contracts. This procedure now exists for Aeronautics projects. The contracts should require cost reporting on a project basis so that expenditure can be monitored and reimbursement from Federal agencies can be sought as appropriate. Project accounting would be handled by the Bureau of Finance and Administration with routine reports to the appropriate modal division.

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RECOMMENDATION: CHECKPOINT MEETINGS SHOULD BE CONSOLIDATED FOR COMMON CARRIER PROJECTS AND SHOULD BE CHAIRED BY THE DIRECTOR OF COMMON CARRIER TRANSPORTATION.

At present, the Bureau of Project Development schedules and manages checkpoint meetings for all projects--highway and non-highway. Under the recommended reorganization, the Bureau of Common Carrier

Transportation will be responsible for managing project development of common carrier projects, whether developed through contracts with the Bureau of Project Development. The director of the Common Carrier Bureau should routinely convene checkpoint meetings for common carrier projects to review progress and resolve problems which arise during project development. Checkpoint meetings on common carrier projects need not be held on a bi-weekly basis, as is the case with highway projects, but should be held at least monthly.

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RECOMMENDATION: PERSONNEL RESPONSIBLE FOR AERONAUTICS PROJECT DEVELOPMENT SHOULD BE TRANSFERRED TO THE MDOT MAIN OFFICE IN AUGUSTA.

Overall management and contract administration for Aeronautics project development is now handled by the director of the Bureau of Aeronautics, located at the Augusta State Airport. These responsibilities should be assigned to a senior staff person assigned to the Airport Operations Division of the Bureau of Common Carrier Transportation located in the MDOT office building. The Airport Manager, however, would continue to be located at Augusta State Airport.

This change would reduce the need for space now occupied by Aeronautics at the Augusta Airport. Efforts should be made to lease some of that space, preferably for an aviation-related use.

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RECOMMENDATION: AERONAUTICS BUSINESS POLICIES SHOULD BE REVIEWED TO ENSURE CONSISTENCY WITH INDUSTRY PRACTICES AND TO MINIMIZE APPROPRIATIONS REQUIREMENTS.

Users of the two planes operated by MDOT are charged for aircraft usage; however, the charges are based upon normal operating costs of the aircraft and exclude overhead items such as insurance, fuel oil to heat the hangar, etc. Consequently, users are subsidized through the budget of the Aeronautics Bureau. These charges should be reevaluated to include overhead items, using the same principles applied by Motor Transport.

An opportunity also may exist to increase revenues from leases for space at the Augusta Airport. Terms of the existing leases should be reviewed to determine consistency with current industry practices and to establish business policies to be applied when these leases are renewed.

# 4. BUREAU OF PLANNING

The Bureau of Planning should be responsible for system planning, program development, and transportation safety for all modes. To this end, some functions currently performed by the Bureaus of Safety and Public Transportation should be transferred to Planning (as recommended in Chapter 1). This chapter presents recommendations for integration of these new functions as well as for improvement in the functions currently assigned to this bureau.

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RECOMMENDATION: SYSTEM PLANNING FUNCTIONS SHOULD BE ROUTINELY PERFORMED BY THE BUREAU OF PLANNING.

In the past, system planning in the Department focused on new construction. With the recent deadline in the level of new construction, due in large part to the near completion of the interstate system, this function has been deemphasized in the Bureau of Planning. (In addition, some system planning functions were assigned to the Bureau of Public Transportation when it was created. In Chapter 1 it is recommended that these be transferred to Planning.) Consequently, planning functions in MDOT are primarily project specific, and routine analyses for determining departmental priorities on a system-wide basis for all modes on a multi-year basis are not performed. System planning functions will continue to be necessary in the future; however, they will emphasize management of the existing system rather than new construction, as was the case in the past.

The current planning and program development process places considerable weight on project requests from public and private individuals outside the Department, as well as from Department staff. The extent of attention given to requests, particularly from outside the Department, is laudable in terms of responsiveness; however, the Department also has a responsibility to make a professional judgment about transportation needs and priorities in light of available funding. The recommendation here is that the emphasis in planning be reversed. Currently, the Bureau of Planning applies professional judgment to evaluate the merit of a wide variety of project requests and to establish priorities based upon funding availability. This is a reactive approach. Instead, it is recommended

that the System Planning Division first analyze available data and recommend a multi-year plan of capital improvements and maintenance needs, including an optimum program mix and establishment of priorities for individual program elements. This basic plan should be updated yearly, and it also can be modified in light of requests from others and the structure and level of transportation funding.

Upon completion of the program, the Program Planning Division would have responsibility for refinement of the yearly elements of the program, defining and selecting individual projects based on the priorities contained in the plan, and identifying and securing funding for each project. Along these lines, it is recommended that MDOT take advantage of funding flexibility available with Federal aid highway programs to tailor funding needs to the program needs identified by the Department.

MDOT traditionally has allocated funds among its highway programs based on Federal Highway Administration allocations to the interstate, primary, secondary, and urban system programs. Individual projects are then chosen within the limits of the funding allocation to each program. Recent amendments to the Federal Aid Highway Act allow considerable flexibility in expending individual program monies and provide MDOT with an opportunity to advance highway improvement programs that are custom-tailored to the State's needs. For instance, interstate projects in urbanized areas may be traded in and an equivalent amount of money spent on other highway (or transit) projects eligible for Federal aid funds; primary and secondary funds may be interchanged; and primary and secondary funds may be interchanged; and primary and urban systems funds may be interchanged. This flexibility may be used to advantage in Maine by shifting program emphasis to reflect the particular needs of the State rather than being bound by the mix of Federal aid program funding nationwide. In fact, in the current biennium, there have been some shifts along these lines. While some of this flexibility may not be available to MDOT for a number of reasons (such as interstate transfer), MDOT should continue to explore the possibilities thoroughly to ensure that Maine, and not national, prerogatives are being met.

Reemphasis of system planning and analysis will benefit the Department in other ways as well. For instance, the Bureau will be in a better position to recommend changes in goals, objectives, or strategies for consideration by the Commissioner, and to provide guidance in discretionary functions such as maintenance and operations. The Department will be able to systematically assess the trade offs among options for coping with different levels of funding and the Commissioner will be in a better position to advise the Legislature of the effects on maintenance or construction of potential budget reductions. As such, the system planning function can support policy analysis activities conducted by the proposed small Office of Policy Analysis reporting directly to the Commissioner.

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RECOMMENDATION: THE SENIOR ENVIRONMENTAL POSITION IN THE DEPARTMENT SHOULD BE LOCATED IN THE SYSTEM PLANNING DIVISION WITH RESPONSIBILITIES FOR OVERALL ENVIRONMENTAL POLICY AND PLANNING FOR THE DEPARTMENT AND LEADERSHIP OF A DEPARTMENT-WIDE ENVIRONMENTAL POLICY COMMITTEE.

This position should be occupied by the principal environmental professional in the Department. Its principal functions would include review of the Department's policies, practices, and programs as they affect natural and cultural resources; recommendation of new departmental matters to other bureaus and divisions; review of Federal and State legislation relating to the environment; and coordination with Federal and State agencies and special interest groups. The position should be filled by a person with broad experience in environmental matters, knowledge of the transportation field and its interrelationships with the environment, and the capability of serving as the Department's principal spokesman on environmental affairs.

Environmental activities in the Department cut across the functional lines of the organization with the result that lines of authority and responsibility are confused. Some examples of environmental functions performed by various units of the Department include:

Planning

- General oversight of the environment
- Scenic highways program
- Review of program proposals
- Monitoring of environmentally-sensitive construction
- Coordination with EDP on State Implementation Plan
- Identification of projects for non-attainment areas

Location and Survey

- Preparation of environmental assessments and impact statements
- Technical assistance on permits

Design

- Permit acquisition
- Construction specifications for environmentally-sensitive projects

Landscape Unit

- Administers herbicide program
- Soils erosion and sedimentation control
- Landscape design

Right-of-Way

- Well claims arising from salt leaching or sedimentation

Materials and Research

- Research projects relating to the environment
- Department soils unit

Construction

- Control of erosion and sedimentation during construction
- Implementation of specific construction specifications

Maintenance and Operations

- Herbicide program
- Salting operations
- Soil erosion and sedimentation control on existing system
- Control of environmental impacts during State aid construction and maintenance projects.

The ubiquitous nature of environmental activities and the need for coordination and monitoring suggests the need for an Environmental Policy Committee. The membership of this committee should be comprised of staff level personnel with responsibilities for environmental activities and environmentally-sensitive operations. Each bureau should have at least one representative on the committee. It should be chaired by the senior environmental specialist in the Department.

The committee's first responsibility should be to identify all of the Department's functions relating to the environment and develop clear lines of authority and responsibility for each of the functions. In the future, the committee's responsibilities could include:

- Coordination of environmental functions in the Department
- Development and recommendation of departmental policies
- Identification and resolution of specific environmental problems associated with departmental activities

- Creation of training programs in conjunction with the Personnel Division

- Functioning as a professional peer group to encourage communication and information-sharing across functional lines in the Department.

Consideration was given to the creation of a separate group within the organization which would provide environmental services to the entire Department. This organizational approach was not pursued for two reasons. First, environmental activities are scattered throughout the Department and it would be impractical to assemble them in one section of the organization.

Second, there is an increasing awareness of, and concern for, the environment on the part of the public and government agencies. If the Department is to successfully respond to this concern, environmental functions must be integrated into each of the bureaus and considered on a day-to-day basis. The various functions can be managed effectively by clearly distinguishing the type and nature of responsibilities assigned to each unit of the Department.

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RECOMMENDATION: AN ADDITIONAL ENVIRONMENTAL POSITION SHOULD BE CREATED WITHIN THE PROGRAM DEVELOPMENT DIVISION.

At present, environmental functions in the Bureau of Planning are handled by the one-person Environmental Services Division. The lack of personnel assigned to this division has greatly limited performance of these functions. For instance, environmental project reports, critical to the early identification of potential issues and concerns which affect project development, have not been prepared for all projects. Creation of an additional position to supplement the Bureau's staffing on environmental matters is important.

The functions of this position--which should be identified as an environmental specialist or analyst and should be part of the Department's career ladder for environmental professionals (recommended in Chapter 5)--would include field review of proposed projects for all modes, identification of environmentally-sensitive projects, preparation of environmental planning reports, review of maintenance and State-aid projects on request, and participation in project development checkpoint reviews. The person holding this position could also have responsibility for maintenance of the Department's environmental data base.

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RECOMMENDATION: STATE-SUBSIDIZED COMMON CARRIERS SHOULD BE REMOVED FROM REGULATION BY THE PUBLIC UTILITIES COMMISSION

The purpose of common carrier regulation by a Public Utilities Commission is basically threefold: to preserve competition at reasonable prices; to maintain essential services; and to provide for the safety of the traveling public. However, when a common carrier becomes subsidized by a governmental agency, there is usually no competition, and the express purpose of the subsidy is to maintain an essential service.

When the State subsidizes a carrier, and particularly when MDOT administers Federal assistance programs, it assumes responsibility for ensuring conformance with a variety of requirements pertaining to the levels of service and fare structures. This, in effect, duplicates the regulation by a PUC. Removal of subsidized carriers from regulation by PUCs has worked successfully in the states of New York and New Jersey, and it is recommended for the State of Maine.

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RECOMMENDATION: THE DEPARTMENT SHOULD PURSUE THE USE OF URBAN MASS TRANSPORTATION ADMINISTRATION SECTION 3 MONIES TO ASSIST IN FINANCING THE MAINE STATE FERRY IMPROVEMENT PROGRAM.

MDOT has embarked on a $13 million ferry improvement program to acquire one new vessel and upgrade the remainder of the fleet. Financing of this program through a State bond issue will incur interest charges over and above the capital cost of the program. On the other hand, the Urban Mass Transportation Administration has expressed willingness to consider an application for Section 3 capital monies (80% Federal, 20% State) for this program if MDOT includes the program in its Statewide Surface Transportation Plan. Maine's chances of success for this application seem to be good since Maine has received only a small amount of funding from this program in the past. This opportunity should be vigorously pursued.

# 5. PROJECT DEVELOPMENT

The recommendations in this chapter pertain to the functions of the (redesignated) Bureau of Project Development.1/ The Bureau of Project Development is involved in a wide range of activities, including preliminary and final engineering and right-of-way acquisition for contract construction projects, surveying and field testing for proposed projects and projects under construction, and independent research. Bureau activities are critical to the expeditious and cost-effective production of highway and bridge projects.

Exhibit 5-1 compares changes in staff levels engaged in the project development activities to contract construction dollar volume over the past ten years. As can be seen graphically in Exhibit 5-2, total contract value in constant dollars has been decreasing along with staff levels. The average size of construction projects, measured by the contract award value in constant dollars, has also declined in the last ten years. This has been partially due to a trend away from new construction to more rehabilitation and resurfacing projects.

As noted in Chapter 1, no substantial modifications in the Bureau are necessary from an overall organization and management sense in the Phase one reorganization, except the formalization of an environmental assessment unit within the Location and Survey Division. This change should facilitate a Department-wide understanding of the lines of authority and accountability for specific environmental functions.

Additional recommendations presented in this chapter are concerned with five areas: management information systems, materials and research function, right-of-way acquisition, survey activities, and delegation of duties. No substantial indicators of mismanagement or lack of innovation in resolving problems were found in the analysis. Instead, the recommendations point to areas where small efficiencies may be realized in the short run and where improvements in systems and procedures may lead to long-run savings and benefits.

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1/ Although construction activities would become a division of the Bureau of Project Development under Phase two of the reorganization plan (Chapter 1), they are covered separately in Chapter 6.

EXHIBIT 5-1

PROJECT DEVELOPMENT ACTIVITIES:
TEN-YEAR MDOT CONTRACT AWARD HISTORY

| Calendar Year | Number of Projects | Contract $ Value | Average Contract Value Per Project | Average Contract Value Per Project (1967 $)[4] | No. of Proj. Dev. Persons[5] | Number of Projects Per Person | Total Contract Award Value (1967 $) Per Person |
|---|---|---|---|---|---|---|---|
| 1971 | 96 | 27,838,000 | 285,200 | 216,100 | 445 | .22 | $ 46,618 |
| 1972 | 93 | 33,092,000 | 355,800 | 257,800 | 425 | .22 | 56,424 |
| 1973 | 87 | 33,619,000 | 386,400 | 254,200 | 415 | .21 | 53,296 |
| 1974[1] | 65 | 21,989,000 | 338,300 | 167,500 | 383 | .17 | 28,423 |
| 1975[2] | 88 | 33,800,000 | 384,100 | 188,300 | 360 | .24 | 46,025 |
| 1976[3] | 65 | 23,333,000 | 359,000 | 180,400 | 355 | .18 | 33,028 |
| 1977 | 105 | 33,626,000 | 320,200 | 148,200 | 359 | .29 | 43,365 |
| 1978 | 118 | 43,385,000 | 367,700 | 138,800 | 362 | .33 | 45,227 |
| 1979 | 106 | 46,007,000 | 434,000 | 140,900 | 374 | .28 | 39,939 |
| 1980 (thru 6/30) | 27 | 12,728,000 | 471,400 | 153,100 | 367 | - | - |

1 Slow down due to original energy crisis. (Federal dollars frozen).

2 A single interstate project had a contract value of over $5.0 million.

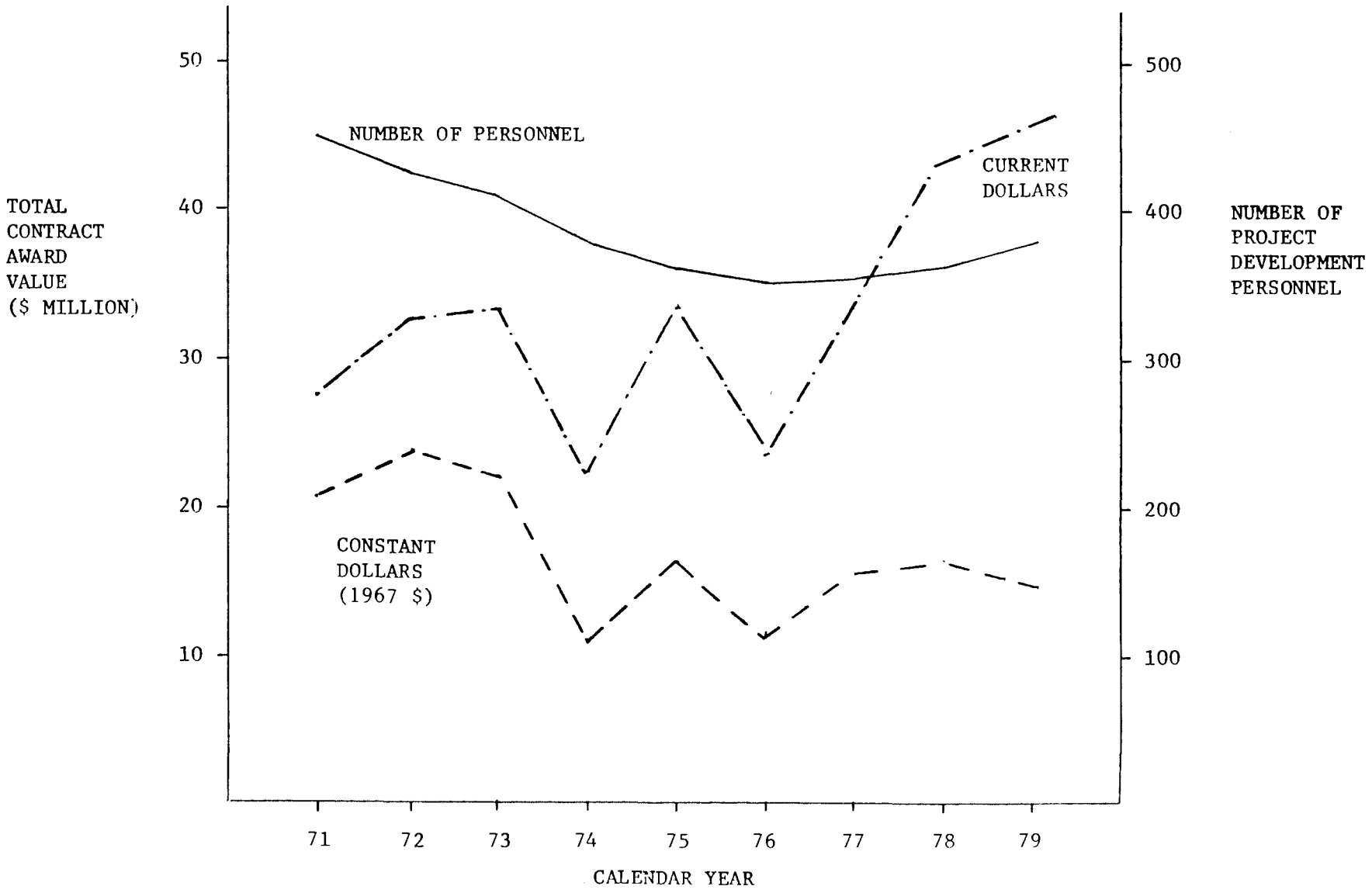
3 There was a 4-month moratorium on advertising projects during calendar 1976.

4 Based on Price Trend Index for Federal Aid Highway Construction, Highway Statistics, 1978.

5 Figures from 1977 to present include project scheduling activities.

EXHIBIT 5-2

CONTRACT AWARD VALUE VS STAFFING LEVEL
IN PROJECT DEVELOPMENT



One may also note that the Phase two reorganization plan covered in Chapter 1 would dissolve the Materials and Research Division, reassigning its testing and inspection functions to other divisions of the Bureau of Project Development and its research functions to the Bureau of Planning.

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RECOMMENDATION: MDOT SHOULD CONTINUE EFFORTS TO DEVELOP MEANINGFUL AND EFFICIENT MANAGEMENT INFORMATION SYSTEMS.

The analysis revealed a number of areas where better information is needed for management and performance evaluation. The proposed PROMIS system, if fully implemented, would accomplish many of these needs. There are, however, improvements which may be developed independently on a less costly and less sophisticated scale which will greatly enhance management capabilities.

The Department should continue development of the Project Identification Number (PIN) System. Efforts in this regard have slowed considerably. Currently, there are at least three separate ways of identifying projects:

- Item number--used in the Highway and Bridge Improvement Program
- State project number--based on funding sources and project location
- Project accounting number--used in the accounting system.

The PIN System will provide a single, unique number for each project at MDOT. The development of this system will improve project management since it will allow information from various subsystems (such as the advertising schedule, project funding system, project accounting system, and TINIS) to be more readily combined for analysis and improved managerial control. The PIN number also will provide the capability of grouping projects by project type, such as interstate construction, primary system rehabilitation etc. This will greatly facilitate project management, project scheduling, and future manpower planning activities.

The Bureau of Project Development should immediately implement a manual system of periodic reporting of major activities by division, and if appropriate, by section. Currently, only a few sections prepare reports summarizing activities and accomplishments over time. For example, the Bridge Design section produces an annual summary of activities showing the number and type of projects awarded, staff size and make-up, and a summary of staff time by activity. The Survey section produces a monthly summary report showing the staff makeup and the number of surveys completed and in process.

Due to the complexity of project development activities and large seasonal staff fluctuations, it is important that managers have sufficient information to properly manage staff resources. Periodic reports summarizing staffing fluctuations, relevant output statistics, activities performed and any other relevant information should be required from each division, and where appropriate, each section. Although some of this information may be generated by existing or anticipated computer systems, most of it will have to be manually prepared at first. As the automated reporting system is improved, the need for the manually prepared reports should disappear. In the meantime, managers will have the necessary information for properly monitoring and managing personnel and project development activities.

MDOT should develop improved automated management reporting. Currently, managers receive little routine information from Computer Services that helps them manage staff resources or projects. (The exception is the Bridge Design section, which has its own system.) No reports are generated that summarize manpower levels or major activities performed in each section or division. The budget run is distributed among some managers, on request, but not all elect to receive it. Also, it does not provide enough detail to manage projects on a day-to-day basis, since it summarizes project expenditures only by function code and not by activity. At present, very little detailed information is provided for individual projects. In fact, the only information provided to managers showing project expenses by activity is generated for samples of projects on a non-routine basis.

Improvements to the management reporting system will allow section and division managers to routinely monitor staffing levels and project activities. This system should include the following:

- Reports routinely generated (at least monthly)
- Reports of all costs over which a manager has control, including time and costs charged by temporary and seasonal employees, computer usage, and purchased services (consultants, contract survey crews, fee appraisers, etc.)
- Summaries of staff time and costs by major activity, i.e., administrative, sick or leave time, special projects, unassigned, etc.
- Reports of project costs and time incurred by activity for each section.

The Department should revise function and activity codes. As currently designed, function and activity codes are not useful for managing projects, since they do not provide sufficient detail by activity, and they do not distinguish between activities performed by separate sections. For example, most activities in the Highway, Bridge, and Location sections are charged to 25-038, Plans and Computations. Design managers cannot

distinguish between preliminary or final design work, and thus they cannot monitor those activities occurring in their particular section. Inadequacies in the current function and activity coding scheme have led to the development of a more detailed, but separate, activity reporting system in the Bridge section, with a similar system under development in the Highway section.

A revision to the codes should provide for a separation of activities by section and more relevant detail for activities performed within each section. This would allow, for example, a manager in the Bridge section to monitor the amount of time his staff spent performing a particular task, such as writing specifications for a bridge project.

Efforts to improve the project advertising schedule should continue. The project advertising schedule is one of the primary management tools used in the Bureau of Project Development. Although it has been continually enhanced since its initial development, additional improvements would increase value as a management tool. These include:

- Standardize procedures for obtaining information for the advertising schedule to ensure that the schedule is accurate and complete.
- Include both the actual dates (for historical purposes) and planned dates, and a means of quickly differentiating between them.
- Develop the schedule so that lists can be generated of projects nearing milestone target dates and so that exception reports can be generated of projects behind schedule.
- Develop the capability of developing and summarizing the estimated and actual time intervals between milestones.

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RECOMMENDATION: THE PROCESS FOR DEVELOPING THE RESEARCH PROGRAM IN THE MATERIALS AND RESEARCH DIVISION SHOULD BE REVISED.

The Materials and Research Division (M&R) of the Bureau of Project Development conducts ongoing research for MDOT. Last year the effort included projects funded with Highway Planning and Research money ($120,000) and several ongoing contracts with the Federal Highway Administration (FHWA). New contracts signed with FHWA last year amounted to $345,000, all of which is Federally funded.

MDOT does not perform periodic evaluation of the benefits of M&R research, although certain research projects may have improved the cost-effectiveness of MDOT operations (e.g., a study of salt usage and a study of the usage of white versus yellow paint in pavement striping). In

most cases, however, the actual benefits of such projects are unknown. Further, the fact that there is not generally an awareness of the nature, extent, or worth of these research efforts among MDOT managers is a strong indication that the research effort needs improvement.

The process by which research projects are selected also raises a question regarding responsiveness of the research effort. Every three to five years, the Materials and Research director solicits statements of research needs from the various MDOT bureaus and divisions. Selection of the research projects to be performed, however, are made independently by the division director and his staff. Since some projects are funded with Highway Planning and Research funds administered by the Bureau of Planning, the Bureau is advised of, but does not approve, selections. The isolation and autonomy of the Materials and Research Division in identifying, setting priorities for, and selecting the research projects conducted for MDOT limits the relevance and practical application of the research efforts. The physical separation of the research group (located in Bangor) from the central MDOT office exacerbates the problem.

To improve the relevance, practical application, and accountability of the research effort, involvement of top MDOT management is required. Because M&R is part of the Bureau of Project Development, it is recommended that an annual research program be developed by the director of the Bureau. He or she should consult with the director of the Bureau of Planning, because the latter is responsible for allocation of Highway Planning and Research funds that may be used to finance M&R research projects. The program should be submitted to and approved by the Commissioner as part of the annual MDOT budgeting process.

Although the location of the research group may inhibit potential usefulness of the research effort, it is not recommended that this group be moved to Augusta at present. Implementation of the above recommendation should resolve the current problem without entailing a major relocation. However, as Phase two of the reorganization plan is implemented per Chapter 1, and the functions of M&R are relocated to other units of the Department, consideration should again be given to the relocation question.

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RECOMMENDATION: INCREASE UNIVERSITY OF MAINE (ORONO) INVOLVEMENT IN MATERIALS AND RESEARCH DIVISION RESEARCH EFFORTS.

Research and testing efforts conducted by departments of transportation throughout the nation capitalize on university resources. The use of university professors bolsters in-house staff capability, and the use of students reduces personnel costs while financially supporting students and advancing their education. Pre-graduate employment also enhances a DOT's ability to attract qualified students after graduation. Equipment sharing provides operating efficienies as well.

The MDOT Materials and Research Division (M&R) uses University of Maine resources to a limited extent. During the past decade, University involvement has ranged from $11,000 to $30,000 per year, although MDOT has contracted with UMO for approximately $72,000 this past year. With M&R research funding currently at about $465,000, the figures reveal that University involvement represents a small portion of the M&R effort.

Overall, opportunities to increase University involvement in M&R research and testing activities, which benefit the school, the students, and MDOT have not been pursued. University resources are primarily used when specialized expertise or equipment is required. Also, M&R purchases laboratory supplies through the University to take advantage of discounts. However, the school's Civil Engineering Department has not been involved with M&R on a formal contractual basis for the past ten years. Further, M&R has not taken advantage of potential assistance the Department could offer without remuneration. For example, some M&R soil tests could be performed by students since soil testing is part of the curriculum. An evaluation of University capabilities applicable to MDOT research and testing should be performed and, when cost-effective, the use of University resources should be expanded.

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RECOMMENDATION: THE RIGHT-OF-WAY DIVISION SHOULD CONSIDER ADOPTING FHWA-APPROVED MINIMUM PAYMENT PROCEDURES AND VALUE FINDING APPRAISAL TECHNIQUES AS APPLICABLE.

Due to the changing nature of the MDOT program, the Right-of-Way Division has increasingly acquired more right-of-way parcels of low individual value (i.e., strip taking). FHWA allows states to utilize time saving, value finding appraisal techniques (instead of market analysis techniques) to set the estimate of just compensation. FHWA also allows states to adopt a minimum payment procedure whereby a minimum payment of $150 is made to property owners when very minor takings are involved--even though the parcel value may be less than that amount.

Of the 3,700 properties acquired by MDOT for fiscal years 1977-1980, 97 percent were valued at less than $2,000. Many of these properties may have been eligible for value finding appraisals. For the same period, 52 percent of the parcels were valued at less than $100. Each of these properties would be eligible under minimum payment procedures.

Adoption of value finding appraisal techniques would allow existing manpower to handle the increased workload in this area-acquisitions increased from 605 in FY 1977 to 1,321 in 1980. And while the minimum payment procedure would marginally increase the cost of acquisition, the higher payment to property owners might reduce the number of instances where property owners resort to the State Claims Board--a process which is expensive to the Department in terms of Right-of-Way and Legal staff time.

Additional evaluation of this concept should involve contact with other states who are using it. Issues to be explored include the likelihood of inflated opinions of damage from persons actually damaged and the willingness of the State's taxpayers to understand and support a program which may be cost-effective but counter-intuitive.

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RECOMMENDATION: MDOT SHOULD IMPROVE THE UTILIZATION AND EFFICIENCY OF SURVEY CREWS.

The management of survey crews is one of the most challenging responsibilities assigned to the Bureau of Project Development. It is extremely important that surveying activities not impede progress on construction jobs nor hold up preliminary engineering early in the project development process.

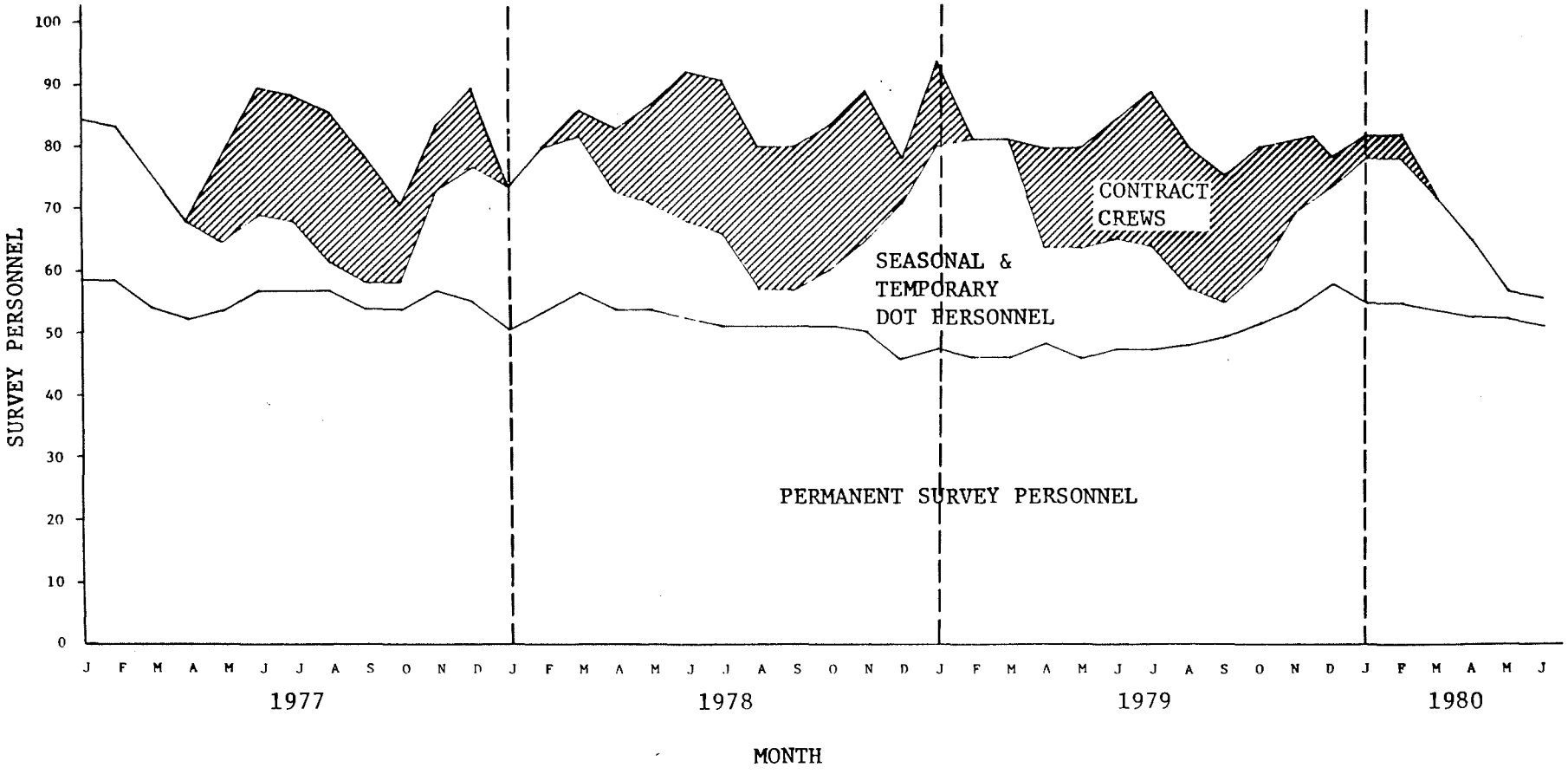
There are a number of elements contributing to the difficulty of an efficient and effective surveying operation. Because of the nature of the work, the survey crews are geographically disbursed around the State. With an average staff size of about 70, plus 7 crews reporting to the Bureau of Maintenance and Operations in the districts, MDOT is thus expending over $6,000 per day (salaries and fringes) on surveying activities. These activities are difficult to control efficiently because of their inherently decentralized operation. Also, projects are extremely variable in terms of their nature and scope. Some may last only a few days; others may take months and have highly precise requirements. Weather is of continual concern to surveying operations. Adjustments have to be made for winter weather, such as concentrating on preliminary location surveys and working in coastal areas where snowfall is less of a problem. Also, the mix of the survey staff fluctuates substantially due to the use of seasonal hires, temporary in-house assignments, and contract crews, contributing to the management challenge.

The following exhibit (Exhibit 5-3) shows Survey section personnel involved directly in survey work over the last 3 1/2 years. Prior years involve about the same level of personnel, with the exception that no contract crews were used between 1973 and 1977, nor have any been employed in the 1980 construction season. As can be seen, the total number of MDOT survey personnel are augmented each winter when individuals from other units (principally Construction and Materials and Research) are temporarily assigned to the Survey section. Although some temporary summer help is obtained, the number of MDOT employees dips during the summer when the demand for construction surveys is greatest. In the last few years, contract crews have been hired to fill this gap in staffing.

Given the reduced MDOT construction program level and the likelihood of its continuance at a low level in the short run, there appears to be little need for contract crews until the construction program picks up substantially. As long as construction projects are not delayed,

EXHIBIT 5-3

SURVEY PERSONNEL LEVELS BY MONTH




NOTE: Contract personnel assume 4 persons per crew. L&S persons include control crews.

savings can be substantial. Contract crew payments for the last several fiscal years were as follows:

| FY 1978 | FY 1979 | FY 1980 |
|---|---|---|
| $193,705 | $275,621 | $219,389 |

Handling construction surveys entirely in-house over the next few years can thus save approximately $250,000 annually, based on recent prior expenditures, assuming the program level remains in its present state of decline and no contract crews are needed.

The efficiency of contract crews, as with MDOT survey crews, is affected by winter conditions. The exhibit shows that contract survey personnel are used over relatively long periods of the year, although their activities are reduced during the most severe winter months of December through April. However, during the 1978 and 1979 seasons, contract crews were used for 11 months each season. This fact raises the issue of whether MDOT was paying for relatively inefficient contract crew operations due to weather conditions at least for a portion of the two seasons. Obviously, MDOT managers would prefer to set an optimum staff level where there is a balance between the costs incurred by hiring contract crews and the opportunity costs of having MDOT personnel unassigned. The desirability of limiting contract crew activities to highly productive non-winter months places substantial burdens on managers to schedule staffing levels to match survey needs.

There are potential efficiencies to be gained through better coordination and utilization of survey personnel from the Location and Survey Division and survey crews located at the district level. Each of the seven maintenance and operations districts has a permanently assigned survey crew. One district crew in particular spends approximately 30 percent of their time working with the Location and Survey Division in performing survey work, especially in the winter season. This fact raises the question of survey crew utilization in the other six districts, and whether efficiencies can be gained by combining these operations. It should be possible to reassign district survey crews to the Location and Survey Division so that survey responsibilities for preliminary engineering and construction on all highway systems and for all MDOT programs can profit from centralized and coordinated scheduling. As noted, this practice is essentially in effect in one district already, and it appears to be working well.

Policy should be developed to monitor the activities and improve the utilization of survey crews on "rain days." Ensuring the conscientious productivity of survey crews when inclement weather prevents field work is a universal problem of the engineering and construction communities. At a minimum, however, survey crews should not be paid a full day's wages for sitting for significant portions of the day waiting for the weather to clear. Current MDOT management intent is that district offices maintain a backlog of appropriate work, crew chiefs or others conduct training programs to upgrade the competence of crew members, or other such useful

diversions be developed in order to reduce the actual survey crew downtime. It is poor management practice to simply charge three to four mandays of unproductive survey time for each day of rain on an assigned project. If all the downtime due to inclement weather were lost to field surveying activities (and not compensated by other constructive activities), and if an average of five days per month per four-man crew were lost (MDOT estimate), the approximately 17 crews from the Location and Survey Division would lose 4,000 mandays per year. This would cost about $250,000 annually in unproductive survey time. To the extent that this potential downtime can be utilized for useful activities (i.e., complete paperwork, assist resident engineers in field offices, maintain equipment, etc.) the estimated loss is reduced accordingly. MDOT should develop a simple performance evaluation system to better understand and control this situation and to aid in manpower planning and utilization generally.

The informal policy requiring preliminary survey work substantially in advance of project design should be modified. Recent MDOT policy (apparently unwritten) has been to complete all location and survey work within the first sixteen months of a four-year program. In fact, according to MDOT personnel, survey is almost complete as of August, 1980, on the first (FY 1980-83) four-year plan. This was done to ensure that location and survey work would produce a continual backlog feeding the design process. The concept is a good one; the level of the backlog is subject to question, however. Survey activities, as with all other activities of the project development process, should be planned so that the effect of timing on subsequent activities is minimal. At a time when the number of construction projects is shrinking and is likely to remain down for several more years, a survey backlog of about two years is not needed. In fact, too great a lead time between preliminary engineering and the design process can lead to the need to resurvey--obviously a costly activity to be avoided. According to MDOT personnel, however, this has not been a problem, with design action taking place about two months on the average after surveying is complete. However, the precaution is to carefully control surveying activities according to anticipated program levels. This is because surveying initiates the preliminary engineering process and thus impacts the expenditure of design and other PE resources down the line.

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RECOMMENDATION: MANAGEMENT RESPONSIBILITIES SHOULD BE DELEGATED WITHIN THE BUREAU OF PROJECT DEVELOPMENT TO FREE THE DIRECTOR FOR OTHER MANAGERIAL DUTIES AND TO DEVELOP MANAGEMENT EXPERTISE AT LOWER LEVELS.

At present, the Director of the Bureau of Project Development functions as the project manager for all projects, and chairs all checkpoint meetings. This level of involvement of the Director of the second largest bureau in the Department is inappropriate and limits the development of managerial expertise among the middle level managers who constitute the future executives of the Department. It also limits the time available to the Director for critical managerial functions such as

improvement of the operations of the Bureau, manpower planning, budget monitoring, and staff development. Based on the recommendations presented earlier in this report, the Director would also acquire some increased responsibilities as the Department's Chief Engineer in the Phase two reorganization plan.

Delegation of authority does not mean that the Director would relinquish control over the affairs of the Bureau; it may, in fact, mean that more control is gained over other aspects of the Bureau's operation. Delegation of managerial authority for individual projects would also limit the Director's involvement to those instances when his expertise is most needed. Delegation of managerial responsibilities may be accomplished in several ways. For instance, one individual may be given responsibility for managing a set of tasks (i.e., right-of-way) for several projects, or project teams may be created to handle unique projects. However the delegation is structured, it accomplishes several functions which are important to the long-term management of the organization:

- Provides for training and testing of lower-level employees in management skills;
- Provides opportunities for professional challenges to employees whose advancement is temporarily blocked;
- Allows employees to broaden the scope of their knowledge across functional lines (i.e., project management opportunities should be open to personnel from each of the Bureau's divisions: Location and Survey, Design, Right-of-Way, Materials and Research, and ultimately, Construction).

Many of the activities carried out in Project Development are already set out in the Maine Action Plan or FHWA regulations. These materials provide the basic information required for middle managers and may be supplemented with additional procedural descriptions and with informal training seminars organized in conjunction with the Personnel Division.

* * * * * *

RECOMMENDATION: AN ENVIRONMENTAL STUDY GROUP SHOULD BE CREATED WITHIN THE LOCATION SECTION.

At present, there is no organizational distinction between personnel in the Location Section assigned to environmental functions associated with major projects which require extensive environmental analysis, and those assigned to preparation of design and location documentation for non-major actions requiring little or no environmental analysis. The Location Section has considered revising its organizational chart to distinguish between these two functions by creating an Environmental Study Group and a Location Study Group under the Location Engineer.

Reorganization of the Location Section should be implemented. In addition to recognizing the difference in the nature of the functions of the two groups with the Location Section, the reorganization would also visibly reflect the consideration that MDOT gives to environmental issues in Project Development.

The functions of the new Environmental Study Group would include preparation of environmental assessments and impact statements for major projects, provision of assistance on environmental matters to the Location Study Group as necessary, coordination with environmental agencies and interest groups during the project development process, and acquisition of permits for individual projects (this function should be transferred from the Design Division).

The primary responsibility of the Location Study Group would be to prepare the documentation necessary to secure Location and Design approval for those projects which are non-major actions and which constitute the bulk of the projects implemented by the Department.

Both the Environmental and Location Study Groups should have Directors who report to the Location Engineer. The Director of the Environmental Study Group should have knowledge of environmental rules and regulations, familiarity with environmental analysis techniques and preparation of environmental documents, experience in dealing with outside environmental agencies and interest groups, and an understanding of highway project development procedures. The position should be open to non-engineers.

Job titles within the Environmental Study Group should reflect the functions of the positions. At present, environmental specialists within the Location Section are classified as Engineering Technicians. Alternate titles such as Environmental Analyst or Environmental Specialist should be developed for these positions (perhaps using classifications comparable to those in the Department of Environmental Protection). This would have the advantages of providing professional recognition for these specialists, aiding in identification of a non-engineering career ladder within the Department for persons who might qualify for these positions, and communicating to external agencies MDOT's concern and competence in environmental matters.

* * * * * *

RECOMMENDATION: RESPONSIBILITY FOR ACQUISITION OF STATE AND FEDERAL PERMITS SHOULD BE TRANSFERRED FROM THE DESIGN DIVISION TO THE ENVIRONMENTAL STUDY GROUP IN THE LOCATION AND SURVEY DIVISION.

Prior to construction, a project may require one or more of the following permits:

| | |
|---|---|
| Department of Environmental Protection | Indirect Source Review<br>Water Quality Certification<br>Wetlands Permit<br>Great Ponds Permit<br>Discharge Permit |
| Department of Inland Fisheries and Wildlife | Stream Alteration Permit |
| Maine Land Use Regulation | Permit for projects in unorganized townships |
| Corps of Engineers | Dredge and Fill Permit |
| Coast Guard | Navigability determination<br>Bridge Permit |
| Federal Energy Regulation Commission | Permits for projects involving utilities (utility takes lead role). |

In 1978, the Department acquired 50 permits. In 1979, 79 permits were required. For the first half of 1980, 40 permits have been required.

At present, the Design Division coordinates the permit application process. This activity requires approximately one to two person years of effort. Additional time is spent responding to questions and comments from permitting agencies.

This function should be transferred to the Environmental Study Group for several reasons. First, that group includes most of the environmental professionals in Project Development and has as one of its functions the responsibility for interacting with external agencies during preliminary engineering. Continuing this interaction through the permitting process is a logical extension of this function.

Second, most of the material included in the initial permit applications, as well as most of the responses to comments or questions, is actually prepared by the Environmental Study Group, because the Design Division can address only those issues directly related to the design of a project.

Third, relocation of this activity may provide the opportunity for earlier identification and resolution of conflicts with permitting agencies, thus reducing delays during design.

Finally, assignment of this function to the Environmental Study Group would eliminate the appearance of a conflict between the Design Division's mission to complete design as quickly as possible with the Department's objective of paying conscientious attention to environmental concerns. (Note: While this problem may be exacerbated in the Design Division, it should be noted that any division assigned this function may find itself with competing objectives, unless the advertising schedule takes sufficient account of environmentally-sensitive elements at the outset of project development.)

The Design Division would continue to have responsibility for all design issues relating to permit acquisition and the Environmental Study Group would utilize its expertise as necessary. In addition, the Design Division should be responsible for incorporating permit conditions into the contract specifications to ensure that they are adhered to. Because of these ongoing responsibilities, only those personnel directly involved with the preparation and coordination of permit applications should be transferred from the Design Division to the Environmental Study Group.

# 6. CONSTRUCTION

The Bureau of Construction is primarily responsible for overseeing contract construction activities. Although involved in the planning and development of projects, the construction staff's duties largely begin following the award of the contract. These duties include pre-construction conferences with contractors and surety companies, coordination with utilities and railroads, project inspection, preparation of invoices for contractor payments, and review of project expenditures.

Staffing levels in the Bureau of Construction have declined from 261 in 1971 to 158 in 1980, a decrease of almost 40 percent. One of the basic issues that has been raised is whether changes in staff size have been consistent with changes in the size and types of construction projects. Other issues of concern include the productivity of the staff and their utilization during the winter months.

A summary of construction activities for the last five years as measured by the number and value of contracts awarded is shown in Exhibits 6-1 and 6-2. These exhibits demonstrate that, although the total contract award value has increased in current dollars, the total construction activity (appropriately measured by the constant dollar award value) has remained relatively stable.

Changes over time in the mix of construction projects are depicted in Exhibits 6-3, 6-4, and 6-5, respectively, for three major categories of projects: highway, bridge, and "other." Each exhibit shows the contract award value in constant dollars by project type. Although there are fluctuations from year to year, several trends can be observed. As shown in Exhibit 6-3 for highway projects, the trend has been away from new construction in favor of more resurfacing. No significant trends can be discerned for reconstruction and rehabilitation projects, however. Exhibit 6-4 shows the change in mix of bridge projects over the last five years. In this case, the trend has been away from new bridge construction projects toward replacement projects. No clear trend can be observed for deck rehabilitation projects. Finally, Exhibit 6-5 shows the change in mix of miscellaneous projects such as intersection improvements, sign, safety, rest area, grade crossing, and other projects. Most appear to be generally increasing over the five-year time period shown. In general, therefore, there has been a shift from new construction projects (the traditional activity associated with a construction division) to projects involving resurfacing, rehabilitation, and/or improvements of existing facilities.

EXHIBIT 6-1

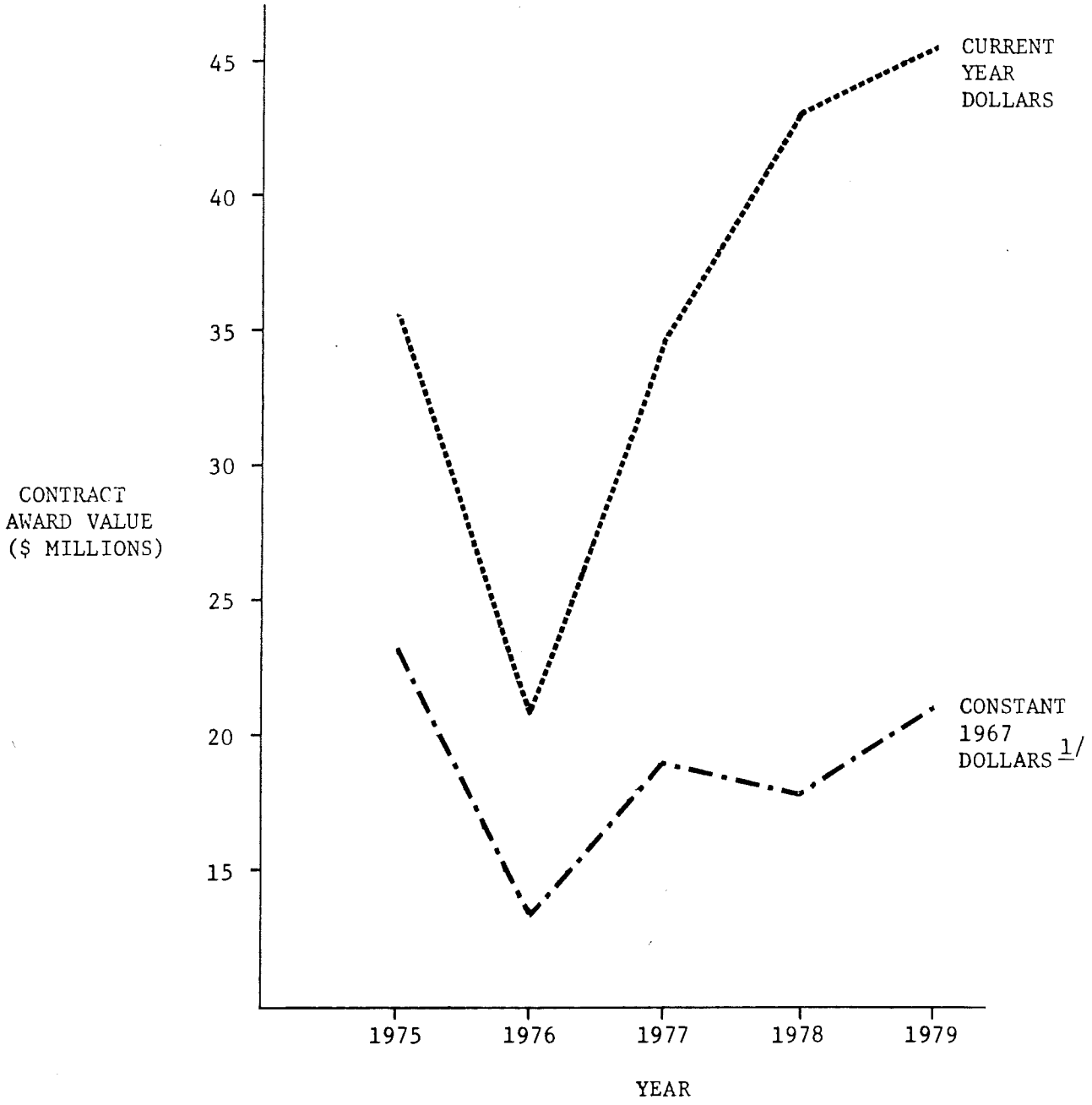
CONTRACTS AWARDED

| CALENDAR YEAR | NUMBER OF CONTRACTS | CONTRACT AWARD VALUE (MILLIONS) | CONTRACT AWARD VALUE (1967 DOLLARS)* |
|---|---|---|---|
| 1979 | 93 | $45.5 | $21.2 |
| 1978 | 112 | 43.0 | 17.9 |
| 1977 | 86 | 34.4 | 19.0 |
| 1976 | 68 | 21.0 | 13.3 |
| 1975 | 92 | 35.6 | 23.3 |
| Average | 90 | 35.9 | 18.9 |

*Calculated using the FHWA Highway Construction Cost Index for Maine.

EXHIBIT 6-2

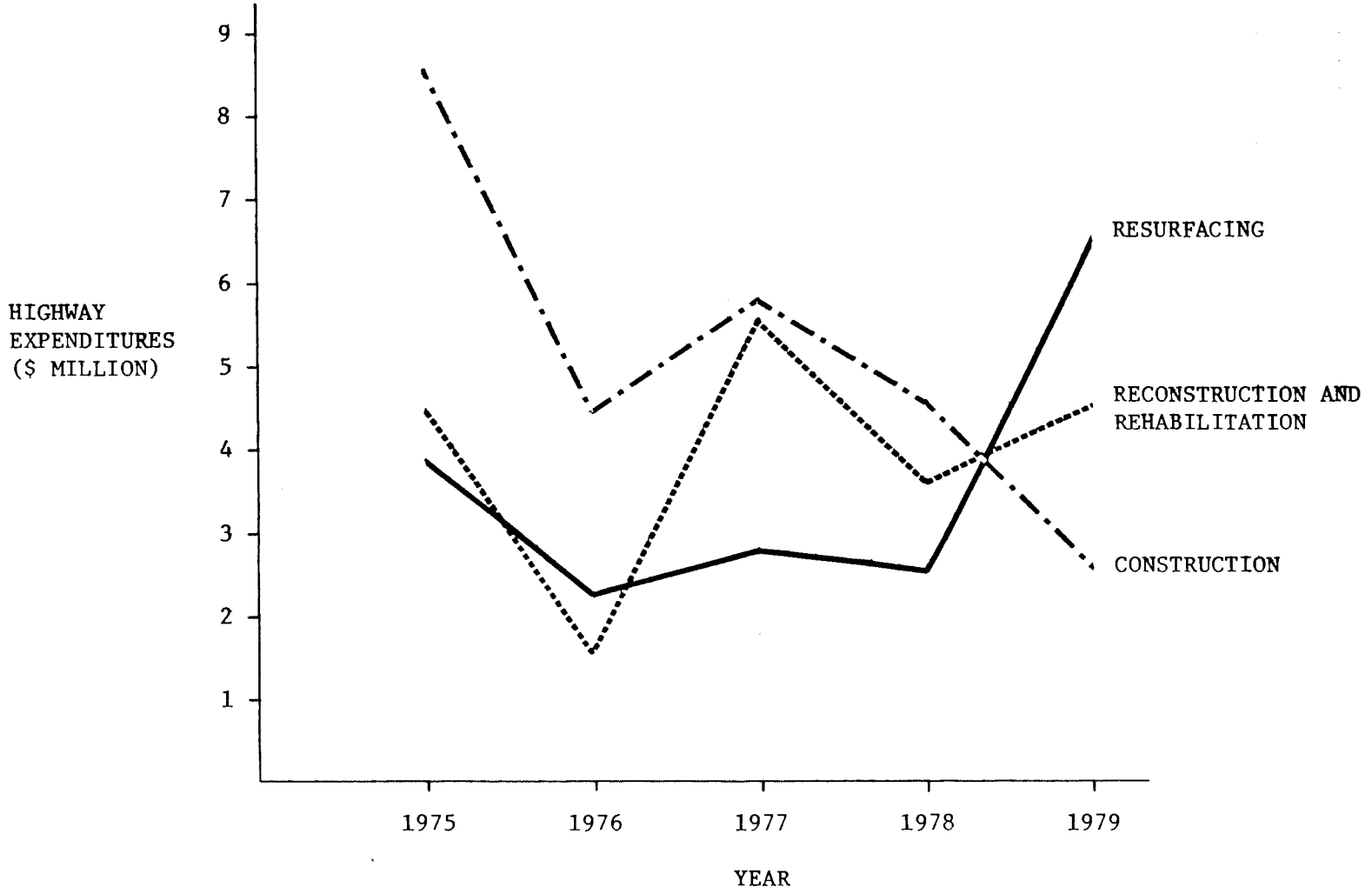
CONTRACT AWARD VALUE




1/ Using FHWA Highway Construction Cost Index for Maine.

EXHIBIT 6-3

TOTAL HIGHWAY EXPENDITURES FOR 1975-1979
(CONSTANT 1967 DOLLARS) 1/




1/ Using the FHWA Construction Cost Index for Maine.

EXHIBIT 6-4

TOTAL BRIDGE EXPENDITURES FOR 1975-1979
(CONSTANT 1967 DOLLARS)

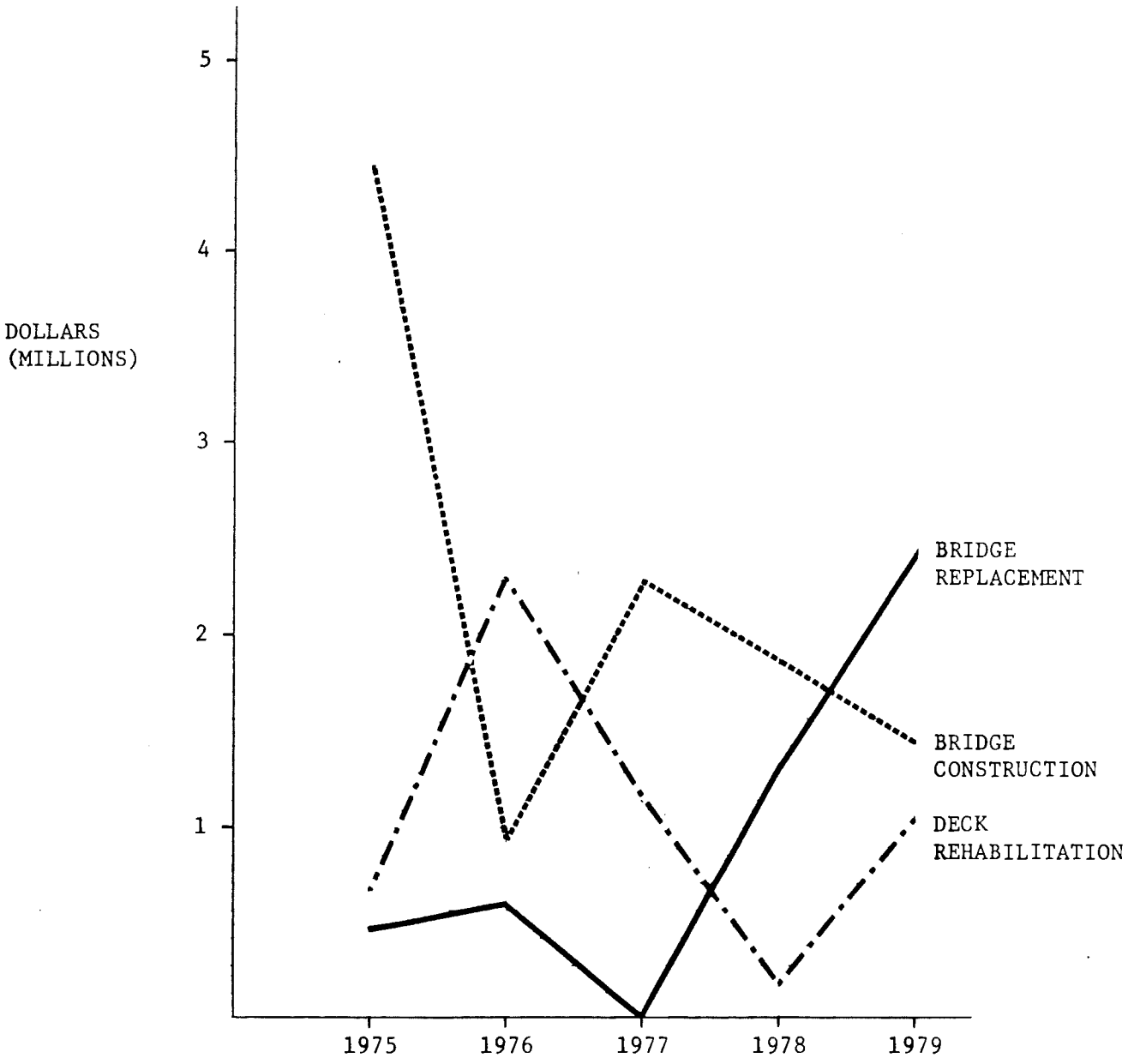
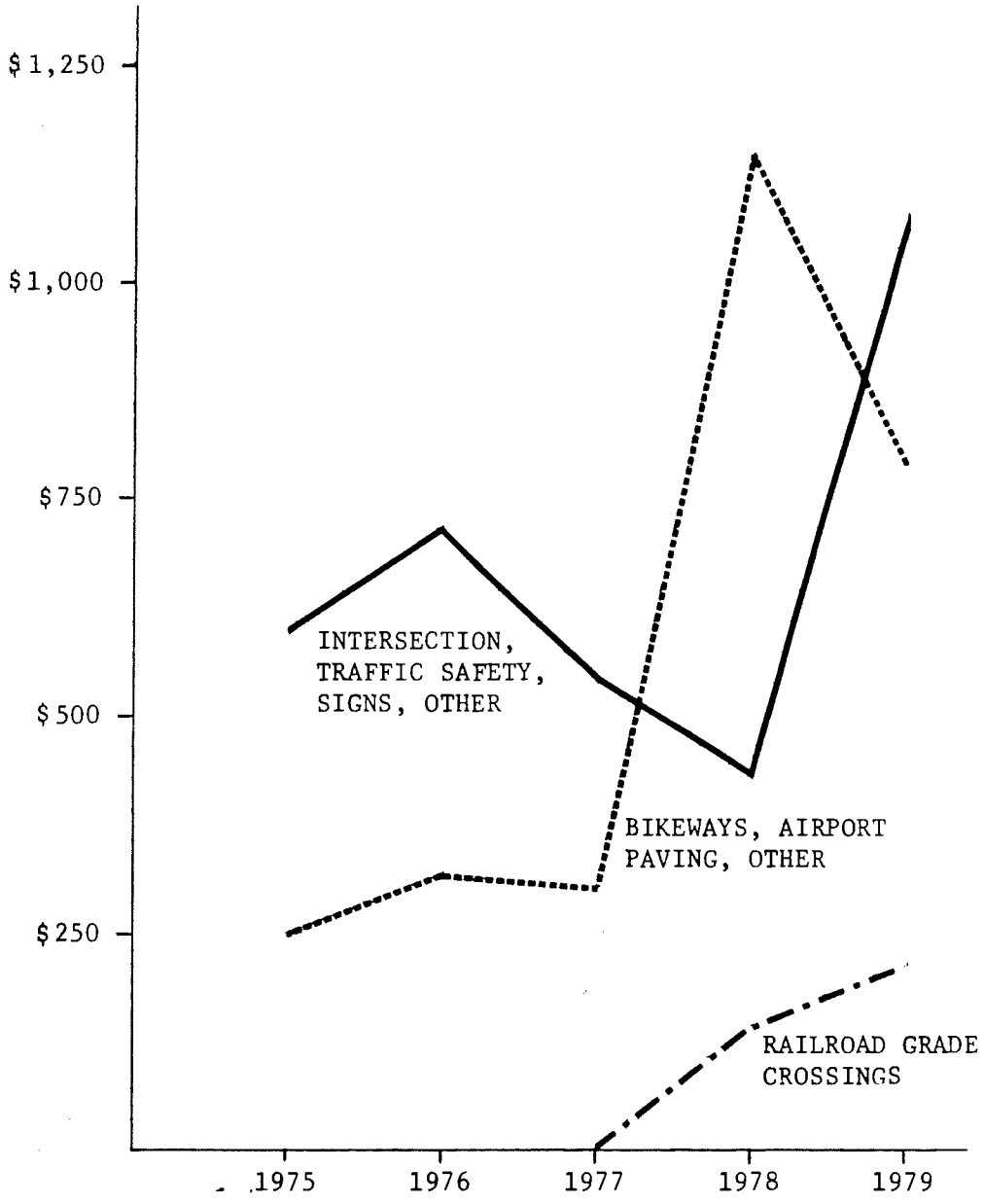


EXHIBIT 6-5

TOTAL OTHER EXPENDITURES FOR 1975-1979
(CONSTANT 1967 DOLLARS)



An analysis was conducted to determine if changes in staff size have been consistent with this shift in project type. First, the ratio of construction engineering costs to contract award value was examined for a sample of 174 projects completed between 1975 and 1980. A statistical summary of the ratios of construction engineering cost to contract award for different project types is presented in Exhibit 6-6. As shown, there is a great deal of variability within most of the ratios. In addition, the ratios are generally higher for bridge projects, reflecting the generally higher complexity of bridge construction.

A statistical analysis shows that, for the sample of 174 projects, the ratio of construction engineering costs to contract award tends to be more a function of project type than project size. An informal survey of FHWA officials and of several state DOTs (New Hampshire, Vermont, New York, Pennsylvania, Maryland, and South Dakota) confirmed this fact and also indicated that the ratios in Exhibit 6-6 appear to be within a reasonable range, although they lie toward the high end of the range in most cases. In fact, the average for several project categories is higher than the FHWA national standard of 15 percent. However, an FHWA official stated that some states, including Vermont, which experiences construction conditions similar to Maine, typically experience higher-than-average construction engineering costs.

Exhibit 6-7 compares the trend in staff levels in the Bureau of Construction to estimated construction engineering costs for the past five years. These costs, estimated using the ratios in Exhibit 6-6 and the change in the mix of projects, are expressed in constant dollars, using both the FHWA national construction cost index and the comparable FHWA construction cost index for Maine. As shown in Exhibit 6-7, changes in staff levels appear to be consistent with changes in the amount of construction engineering activity, represented by constant dollar construction engineering costs.

Combining the information in Exhibit 6-7 into one ratio--construction engineering costs in constant dollars to the number of persons involved construction engineering activities--gives the following:

| Year | Dollars Per Person Ratio Using National Index | Dollars Per Person Ratio Using Maine Index |
|---|---|---|
| 1979 | 10,620 | 15,251 |
| 1978 | 10,835 | 11,964 |
| 1977 | 11,031 | 13,174 |
| 1976 | 7,557 | 9,520 |
| 1975 | 11,341 | 15,146 |

This information is plotted in Exhibit 6-8. Except for the deviation in 1976 due to a four-month moratorium on project advertising, the plots show a relatively constant relationship between construction engineering

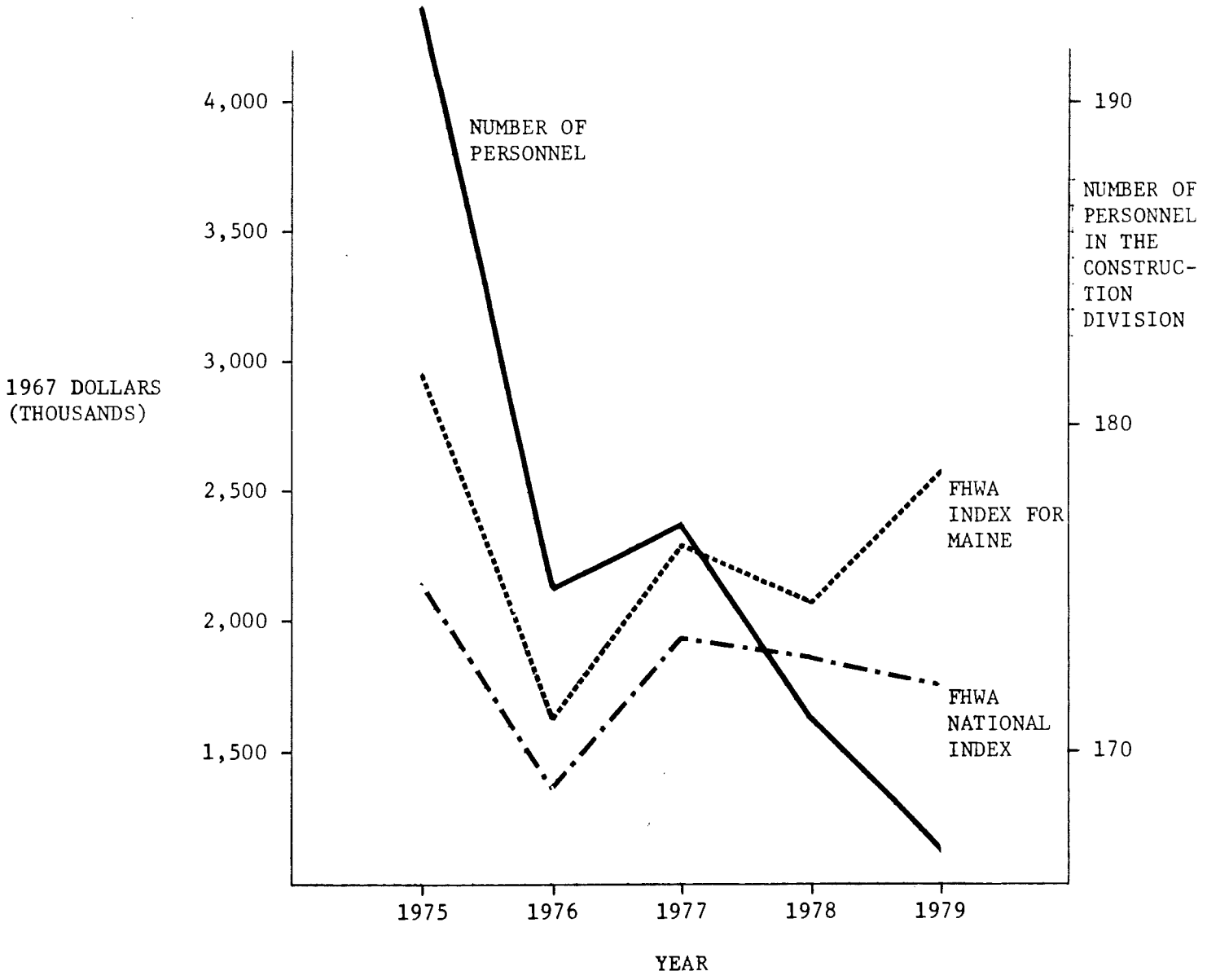
EXHIBIT 6-6

CONSTRUCTION ENGINEERING COSTS AS A PERCENT OF CONTRACT AWARD VALUE FOR 174 SAMPLE PROJECTS

| | SAMPLE SIZE | AVERAGE RATIO OF CE COSTS TO CONTRACT AWARD | SAMPLE HIGH | SAMPLE LOW | STANDARD DEVIATION |
|---|---|---|---|---|---|
| ALL PROJECTS | 174 | 12.81 | 35.99 | 1.72 | 6.09 |
| ALL HIGHWAY | 71 | 10.81 | 28.59 | 4.79 | 4.82 |
| Highway Resurfacing | 35 | 8.22 | 13.14 | 4.79 | 2.46 |
| Highway Construction | 13 | 11.97 | 22.41 | 6.59 | 5.05 |
| Highway Reconstruction | 23 | 14.10 | 28.59 | 7.49 | 5.28 |
| ALL BRIDGE | 42 | 15.62 | 28.39 | 6.23 | 4.70 |
| Bridge Construction | 14 | 14.54 | 22.28 | 6.23 | 3.73 |
| Bridge Deck Rehabilitation | 4 | 14.50 | 18.51 | 9.46 | 3.98 |
| Bridge Replacement | 24 | 16.43 | 28.39 | 7.81 | 1.25 |
| ALL OTHER | 61 | 13.22 | 35.99 | 1.72 | 7.36 |
| Intersection, Traffic Safety, Signs | 42 | 13.41 | 35.99 | 2.81 | 7.13 |
| Miscellaneous (Bikes, Piers, Airports, other) | 13 | 16.83 | 28.47 | 6.23 | 6.36 |
| Railroad Crossings | 6 | 4.12 | 7.89 | 1.72 | 2.24 |

EXHIBIT 6-7

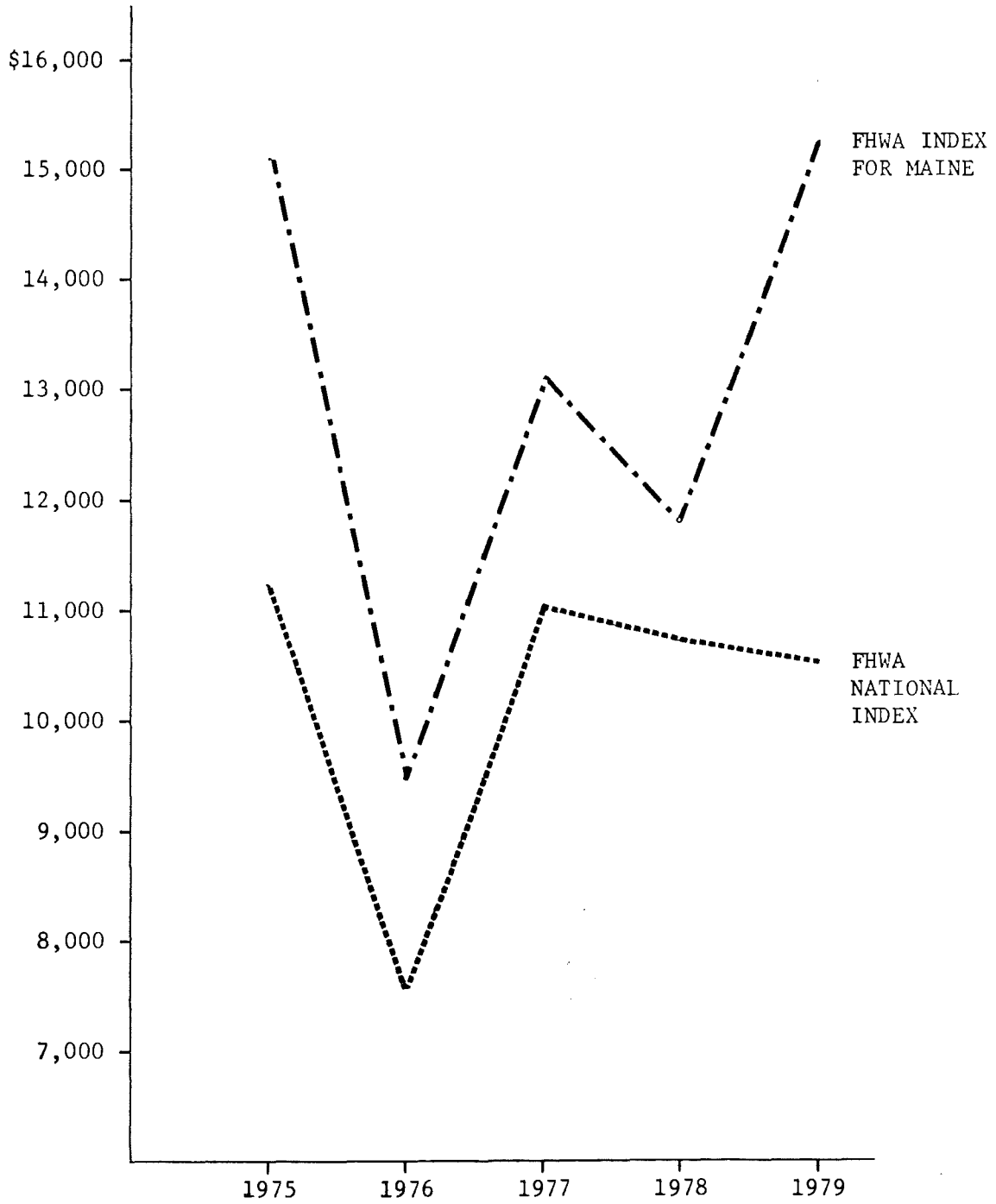
ESTIMATED CONSTRUCTION ENGINEERING COSTS
FOR 1975-1979
(CONSTANT 1967 DOLLARS)




NOTE: 1976 had a 4-month advertising moratorium on projects.

EXHIBIT 6-8

CONSTRUCTION ENGINEERING COSTS
PER CONSTRUCTION ENGINEERING PERSON
(CONSTANT 1967 DOLLARS)



activity and staff size. Based on these measures, then, the cost-effectiveness of the Bureau of Construction has remained relatively constant as the size of the construction program and the mix of projects has changed.

In addition to the analysis of project-related construction engineering activities, the overall utilization of the construction engineering staff was also examined. Payroll data for selected periods were collected for approximately one-third of the employees in each staff level to determine how staff time was spent. Exhibit 6-9 shows the activities charged for the entire year and for the construction season (labeled summer) and the non-construction season (labeled winter). Clearly, construction engineering activities take up a great portion of time for all staff levels in the summer. In the winter, however, construction staff time shifts toward project development activities, miscellaneous activities, and vacation, sick leave, etc.

A shift from construction engineering to project development during the winter appears to be a reasonable way of more effectively utilizing staff resources, provided several conditions are met. First, there must be a need for additional personnel in project development in order to effectively absorb the people. This is questionable in some cases, such as the survey section, where preliminary survey work is now substantially ahead of schedule. In the design division, on the other hand, the use of outside consulting firms has increased, implying that sufficient work may be available. Second, the skills of the construction personnel must match those needed by the Bureau of Project Development. Apparently, however, the Design sections (Highway and Bridge) hesitate to use construction personnel on complicated projects or activities because they perceive that construction engineers have lost or never adequately developed the necessary design skills. If this is indeed the case, the potential benefits of employee retraining or rotation programs, in terms of improved staff utilization and effectiveness, appear promising.

As shown in Exhibit 6-9, the amount of time spent on vacation, leave, training, and miscellaneous activities (which include administration and working on special projects such as TINIS) increases in the winter, but the amount of increase seems smaller than would be expected. Although employees are encouraged to take vacations in the winter months, it appears that this policy is not as effective as it should be in helping to smooth out the peaks and valleys of the construction season workload. For example, during the summer construction season, the amount of time charged to activities other than contract projects exceeded 10 percent for the entire sample.

In Exhibit 6-10, the utilization of construction personnel in bridge and highway activities is compared. Interestingly, the utilization of highway personnel in construction engineering increases with higher employee classifications, while the utilization of bridge personnel in construction decreases with higher employee classifications. Also, there are relatively wide discrepancies in utilization for construction engineering activities between bridge and highway CE activities among individual staff classifications. For example, EA, ET1, and ET2 personnel in highway construction spend 65.3 percent of their time on construction engineering activities, while those in bridge construction spend 78.0 percent of their

EXHIBIT 6-9

UTILIZATION OF CONSTRUCTION PERSONNEL BY SEASON:
PERCENT OF SAMPLE GROUP'S TIME BY ACTIVITY

| Activity / Group | SEASON | PROJECT DEVELOPMENT | | CONSTRUCTION ENGINEERING | | OTHER | |
|---|---|---|---|---|---|---|---|
| | | Preliminary Survey and Engineering | Preliminary Plans and Computations | Construction Survey and Engineering | Construction Engineering and Inspection | Sick Leave, Vacation, Misc. Leave & Training | Miscellaneous |
| | | 27-037 | 25-038 | 27-037 & 930 | 27-040 | 99-88X/99-980 | All Other |
| EA, ET1, ET2 | YR | 3.1 | 8.0 | 7.3 | 63.3 | 10.7 | 7.7 |
| (Sample Size=17) | W | 6.2 | 14.3 | 6.5 | 45.7 | 13.5 | 13.7 |
| | S | -0- | 1.6 | 8.0 | 80.8 | 8.1 | 1.6 |
| ET3 - ET5 | YR | .9 | 8.4 | 3.9 | 72.9 | 11.0 | 2.8 |
| (Sample Size=23) | W | 1.8 | 15.7 | 4.8 | 63.4 | 11.0 | 3.3 |
| | S | --- | 1.3 | 3.2 | 82.3 | 11.0 | 2.3 |
| AE1, CE1, CE2 | YR | --- | 9.5 | 2.2 | 75.0 | 8.0 | 5.4 |
| (Sample Size = 13 | W | --- | 16.2 | 2.3 | 63.7 | 8.4 | 9.4 |
| | S | --- | 2.7 | 2.0 | 86.4 | 7.6 | 1.3 |
| TOTAL | YR | 1.5 | 8.6 | 4.5 | 70.3 | 10.2 | 4.9 |
| (Sample Size=53) | W | 3.0 | 15.3 | 4.7 | 57.8 | 11.2 | 8.0 |
| | S | --- | 1.9 | 4.3 | 82.8 | 9.2 | 1.8 |

YR - Year Round W - Winter (December, February, April) S - Summer (June, August, October)

EA - Engineering Aide
ET - Engineering Technician
AE - Assistant Engineer
CE - Civil Engineer

EXHIBIT 6-10

UTILIZATION OF HIGHWAY AND BRIDGE CONSTRUCTION PERSONNEL:
PERCENT OF SAMPLE GROUP'S TIME BY ACTIVITY

| Activity / Group | SAMPLE SIZE | BORROWED HOURS | PROJECT DEVELOPMENT | | CONSTRUCTION ENGINEERING | | OTHER | |
|---|---|---|---|---|---|---|---|---|
| | | | Preliminary Survey and Engineering | Preliminary Plans and Computations | Construction Survey and Engineering | Construction Engineering and Inspection | Sick Leave, Vacation Misc. Leave & Training | Miscellaneous |
| | | | 25-037 | 25-038 | 27-037 & 930 | 27-040 | 99-88X/99-980 | All Other |
| EA, ET1, ET2 | 9 | H | 5.6 | 2.9 | 13.4 | 51.9 | 12.8 | 13.3 |
| | 8 | B | --- | 13.5 | 2.1 | 75.9 | 8.6 | --- |
| ET3-5 | 19 | H | 1.1 | 9.7 | 4.8 | 71.1 | 9.9 | 3.3 |
| | 4 | B | --- | 2.4 | 0.5 | 81.2 | 16.0 | --- |
| AE1, CE1, CE2 | 7 | H | --- | 2.3 | 0.4 | 88.7 | 3.9 | 4.7 |
| | 6 | B | --- | 18.0 | --- | 62.9 | 12.8 | 6.3 |
| TOTAL | 35 | H | 2.0 | 6.5 | 6.1 | 69.7 | 9.4 | 6.1 |
| | 18 | B | --- | 12.4 | 1.0 | 72.8 | 11.7 | 2.0 |

time on these activities. Thus the relatively low-level personnel in highway construction appear to be substantially underutilized. These figures suggest that staffing changes between the Bridge and Highway sections may be warranted.

* * * * * *

RECOMMENDATION: MDOT SHOULD STRENGTHEN THE POLICY OF LIMITING STAFF LEAVE DURING THE CONSTRUCTION SEASON.

As pointed out earlier, a review of activities for the construction engineering staff showed that a considerable amount of time (9.2 percent for sample employees) is spent on leave and vacation during the construction season. This means that the average construction employee is spending almost three weeks each construction season in such a manner. Although MDOT encourages employees to take leave in the winter months, the extreme peaks and valleys in the work load and the ensuing problems of underutilization of the staff in winter require more positive actions by MDOT officials. With only moderate action, e.g., cutting summer vacation/leave allowed by one-half, a 5 percent productivity increase is possible, other things remaining equal. It is recommended that MDOT officials evaluate, with employee input, alternative ways to handle leave time. Some alternatives might include:

- Forbidding vacation during the extreme construction peaks for all employees in construction,
- Requiring that discretionary time off be approved by the director of construction,
- Allowing some time off during heavy construction months based on seniority, or rotating summer vacation on a three- or four-year cycle,
- Providing additional compensatory time off in lieu of vacation not taken during the construction season,
- Changing to four-day work weeks and staggering days off.

* * * * * * *

RECOMMENDATION: IMPLEMENT AN EMPLOYEE ROTATION PROGRAM TO IMPROVE THE DESIGN SKILLS OF THE CONSTRUCTION ENGINEERING STAFF.

The utilization of the construction staff in the winter months is a major problem at MDOT. Although the construction staff is utilized to some degree in project development during the off season, their involvement could be increased. This is especially true in light of the relatively large amounts of time charged to leave and miscellaneous activities in the winter (between 14.3 percent and 27.2 percent of total time, depending on the staff classification). In addition, the design sections have both increased the use of consultants in the last few years, indicating partly that they have more work than their staffs can handle.

The caliber of design work given to the construction staff has also been questioned. Although the design sections try to use lower-level technicians for the less complex tasks such as drafting, analysis indicated that upper-level construction personnel are utilized as much as lower-level personnel. However, when higher-level engineers are used for design work, they are often given simple jobs, such as designing railroad grade crossings.

The reasons for these problems are likely due to a number of interrelated factors, including:

- Misconceptions by the project development staff of the skills of the construction engineering staff,
- Geographic dispersion of much of the construction staff, and
- Real limitations in the skills of the construction staff due to limited opportunities for involvement in areas other than construction inspection.

To overcome these problems, it is recommended that MDOT take a two-step approach to improving the utilization of the construction engineering staff in the winter months. The first is to begin a program of voluntary employee rotation, in which construction personnel transfer to Augusta for two- or three-year tours in the design division. The primary benefit of this program would be the enhancement of the skills of construction personnel so they could be better utilized on design projects in the winter months after returning to their remote location. This program would also give the staff a broader perspective and exposure that might enhance their opportunities for advancement within MDOT. MDOT may wish to limit such a program to civil engineer grades at first, since they are more likely to have the basic skills needed for design work and the aptitude for moving into higher level DOT positions.

Since the quality of life is an important factor to consider when implementing such a program, MDOT officials may also wish to determine

which employees would like to participate in the program, and to choose employees from those interested. If employee responses are not positive, however, MDOT should consider possible incentives to attract employees to the program. In the private sector, such moves often mean greater long-term benefits and promotions, and they are often involuntary.

The second part of the recommended approach is to implement a short-term rotation program for a greater number of employees. This program should be mandatory for employees at appropriate staff levels, and should include shorter tours (perhaps three or four weeks) in Augusta on an annual or bi-annual basis. These tours should focus on orienting staff to the specific projects they will be assigned and could also include training sessions in specific areas as needed.

Both recommended approaches would greatly enhance communications among the construction and project development staffs, which should lead to greater cooperation, motivation, and utilization of construction personnel.

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RECOMMENDATION: MDOT SHOULD IMPLEMENT SYSTEMS AND PROCEDURES TO IMPROVE MANAGEMENT AND CONTROL OF CONSTRUCTION ACTIVITIES.

Systems and procedures are needed at MDOT to control and manage both overall staff resources and construction engineering activities for individual projects. Monitoring and managing staff utilization is especially critical because of the large seasonal variations in construction activities in Maine. The need for greater control of construction engineering costs for individual projects was apparent from examining the ratios of construction engineering costs to contract award value for several types of projects. The ratios were high in relation to those experienced in some other states, and they varied greatly within particular project categories.

The Department should improve manual and automated information systems for monitoring staff activities and project costs. Recommendations in this area parallel those presented in Chapter 5 and will not be presented here in detail. Simply put, automated management reporting should include reports on all costs over which a manager has control, summaries of staff time and costs by major activities, and reports of project costs.

The construction engineering staff size and mix should be adjusted as needs change. Over the last five years the overall size of the construction engineering staff has decreased consistently with the decreased need for construction engineering services. However, variations in the utilization of personnel in the Bridge and Highway units indicate

that some shifts in personnel may be needed. Construction engineering Managers should continually monitor staffing requirements and make adjustments as needed. Improvements in management information supplied to the Construction Division will greatly enhance management's ability to monitor staffing needs and to make appropriate adjustments.

Construction engineering costs should be more carefully monitored and controlled. Cost control must begin by setting up standards against which performance can be evaluated. Reasonable percentage standards should be developed--preferably by project type and size--that can be used to estimate the total construction engineering budget for a particular project before construction begins. Actual costs should be monitored as often as monthly for each project and compared to the budget, as well as to construction progress, to identify potential overruns as soon as possible so that corrective action can be taken.

More emphasis should be placed on manpower planning in the Bureau of Construction, particularly for planning winter activities. Monitoring and controlling construction engineering costs as described in the previous paragraph should help to monitor manpower usage during the construction season. However, when construction activities are down, planning is needed to ensure that the staff is used as effectively as possible. Bureau of Construction managers should meet with Bureau of Project Development managers in the early fall to begin development of an effective plan for utilizing construction personnel. At this time, staff assignments can be sketched out, and specific projects that the construction staff will work on can be identified tentatively. This lead time will also give Project Development managers a better estimate of whether their staff levels are inadequate and whether consultants will be needed. The planning process should continue throughout the winter season to ensure that staff utilization is kept to a maximum. Improvements to the information systems that were mentioned earlier will greatly enhance this process by providing continuous information on staff utilization.

Finally, though personnel utilization is more of a management issue than an organizational one, the recommended Phase two organizational changes (Chapter 1) in which all construction activities become a division of the Bureau of Project Development will tend to facilitate improved winter manpower planning.

# 7. MAINTENANCE AND OPERATIONS

The primary focus of this chapter is on the cost-effectiveness of the programs, activities, and services provided by the Bureau of Maintenance and Operations. A brief summary of the analyses undertaken and the results obtained are presented, followed by a set of recommendations aimed at improving the overall cost-effectiveness of the Bureau. Other issues relevant to the Bureau such as organization, management, and appropriate program levels are treated elsewhere in this report.

The issue of cost-effectiveness is not new within the Bureau. In 1976, Roy Jorgensen Associates, Inc., conducted a comprehensive examination of the Bureau encompassing four of the five major program areas:

- Highway maintenance
- Bridge maintenance
- State aid construction
- Traffic services.

(The fifth major unit, Motor Transport Services, is discussed in Chapter 2: Finance and Administration.) The purpose of the Jorgensen study was to document maintenance work methods; to demonstrate opportunities for improvement; to determine distribution of manpower and equipment; to recommend procedures for planning and control; and to recommend necessary management changes. Within the context of this chapter, the Jorgensen report provided two important results: (1) an assessment that the Division is generally operating efficiently, and (2) a recommended system for planning and control that, if properly implemented, would ensure a continued cost-effective operation.

Rather than duplicating the Jorgensen study at the same level of detail, the efforts of the study team were directed towards an evaluation of current operations and a determination of the extent to which the recommendations of the Jorgensen report have been implemented. The former was considered necessary in order to determine whether changes in the operating environment, such as declining staffing levels and budgetary constraints, have adversely affected productivity to the point that the operation of the Bureau is no longer cost-effective. In regard to the latter, it should be noted that the study team carefully reviewed the findings of the Jorgensen report and concurred with its recommendations.

The approach consisted of interviews with key management and staff personnel at the headquarters and field division levels and statistical analyses of available data and information. During the course of the investigation, several issues surfaced which were specifically addressed. These were:

- Are productivity levels consistent with established performance standards?
- Does productivity vary significantly by field division?
- Have declining manpower levels affected productivity adversely?
- Are cost savings possible through greater use of contractors for snow plowing?

To answer these and other questions, the study team collected and analyzed data from several sources. The first consisted of time sheet records for FY 1980 which provide weekly summaries of the amount of work accomplished by a crew assigned to different maintenance activities. Over 14,000 observations were obtained for 36 specific activities in the general areas of surface and shoulder maintenance, roadside and drainage maintenance, traffic services, and snow and ice control. According to a fiscal year 1979 cost summary, the activities studied represented over 70 percent of the costs incurred in the above general areas.

The data described above were processed and summarized by Computer Services personnel. The summary described, by activity and by field division, the average amount of work accomplished per man-hour, the number of observations, and the variance associated with each average. This information allowed statistical tests to be conducted to determine the significance, if any, of discrepancies between actual productivities and established performance standards. These performance standards, developed as part of the Jorgensen study, specify the amount of work that should be accomplished by a crew of a given size during an eight-hour day and were developed in conjunction with MDOT personnel at the time.

The statistical analysis showed that on a statewide basis, the actual productivity of 17 of the 36 activities are higher than the performance standard, 10 are equal, and 9 are lower. Those activities which have low productivities account for approximately 20 percent of the cost represented by the sample. However, 80 percent of those costs are due to only three activities: stockpiling salt, snow fencing, and snow plowing. Therefore, with the exception of the three latter activities, maintenance activities are generally being performed efficiently, and in those cases where inefficiencies are identified, the significance is relatively minor.

A second issue examined using the same data is whether productivity levels vary significantly by field division. It was found that discrepancies do exist in the productivities among field divisions for certain specific activities. However, the real issue is whether there is a consistent pattern to these discrepancies; that is, whether some divisions

have consistently higher or lower productivity levels than others. Using analysis of variance techniques, it was found that, compared to the normal random variation inherent in the data, there are no significant differences among divisions.

(A word of caution should be noted concerning the data used to derive these results. As mentioned previously, these data were retrieved from computer files containing time sheet information. Although the data were reviewed before being entered into the computer, it is possible that errors such as keypunching mistakes or incorrect reporting from the field are present within the data. However, although a review of the results indicates some inconsistencies, it is felt that the presence of error is insufficient to contradict the overall findings.)

A second source of data used were the work records kept by foremen of maintenance crews which describe on a daily basis the activities performed, the number of personnel assigned to the activity, and the number of hours worked. These data were used to determine if declining maintenance force levels have prevented the use of standard crew sizes and, if so, if this has adversely affected productivity. In all, a sample of over 3,600 observations was obtained for the work crews and periods of observations shown in Exhibit 7-1.

The results of this analysis indicate that the use of less-than-standard crew sizes does not appear to be a major factor contributing to lack of productivity. In general, other factors including the use of larger-than-standard sized crews seem to be the primary causes of poor productivity for those activities in which productivity problems exist.

The basic conclusion to be derived from these analyses is that with the exception of previously-noted activities related to snow and ice control, the Bureau of Maintenance and Operations is generally performing efficiently. In fact, in many cases, the productivity is substantially greater than would normally be expected according to the established performance standards. This is exemplary considering the many problems facing the Bureau and the Department as a whole: reduced staff levels, budget restrictions, morale, etc. At the same time, however, there is room for improvement. The following are recommendations as to how to achieve these improvements.

* * * * * *

RECOMMENDATION: THE MAINTENANCE AND OPERATIONS BUREAU SHOULD USE THE PLANNING AND CONTROL SYSTEM RECOMMENDED IN THE JORGENSEN REPORT AS IT WAS ORIGINALLY DESIGNED.

From discussions with personnel at the headquarters and field division levels and from reviews of available management information reports, it was found that the recommendations of the Jorgensen report have not been fully implemented. The basic structure is in place in terms of the information collected and the reports generated, but a commitment to utilizing it to a greater extent is lacking. This refers primarily to the system of planning and control, where an incremental phasing in of the

EXHIBIT 7-1

SAMPLE FOR DETERMINING EFFECT OF CREW SIZE ON PRODUCTIVITY

| Work Crew Number | Period of Observation |
|---|---|
| 2521 | 12/1/78 - 9/14/79 |
| 2523 | 6/3/77 - 12/29/78 |
| 2742 | 12/1/78 - 5/30/80 |
| 3321 | 7/29/77 - 2/9/79 |
| 3322 | 6/15/79 - 4/25/80 |
| 3351 | 10/15/76 - 7/21/78 |
| 4322 | 9/29/78 - 7/20/79 |
| 4523 | 1/11/80 - 5/9/80 |
| 4540 | 6/22/79 - 5/16/80 |
| 5524 | 2/9/79 - 5/30/80 |
| 6321 | 4/13/79 - 2/29/80 |
| 6323 | 9/14/79 - 6/27/80 |
| 6432 | 10/27/78 - 5/25/79 |

Jorgensen recommendations would not be costly. It is felt that these management tools are critically needed if the Bureau is to maintain its level of productivity, especially if budgetary constraints become more severe.

The recommended planning process can be used to plan programmed maintenance work based on existing inventories and service levels per inventory unit and to plan non-programmed maintenance work (e.g., emergency repairs) based on extrapolations of historical trends. Using these projections of work to be accomplished and manpower and equipment assignments contained in the Jorgensen report, a cost estimate can be developed. If a funding shortfall results, service levels, priorities, and objectives must be re-examined in order to reconcile the difference. Thus, by using the planning process, the Bureau can help ensure that its resources are employed in the most effective manner.

Two types of control are needed to gain the full benefits of the planning process. The first refers to the monthly monitoring of actual work accomplishment versus planned work accomplishment. At the present time, these reports are issued, but are incomplete due to the absence of planning for many activities and the failure to report work accomplishments. A conscientious effort should be made to provide all needed information and to disseminate these reports in a timely fashion. Also, a concerted effort should be made to resolve discrepancies between actual and planned amounts and to revise the plan as needed.

The second type of control deals with the level of productivity. To complete the planned amount of work within budget, it is necessary that actual productivity be consistent with the expected productivity used to estimate costs. To ensure this consistency, productivity should be closely monitored and action should be taken to correct problems as they are identified. Currently, reports are generated monthly which describe productivity by activity for each crew, but these reports are voluminous and incomplete. Necessary information such as work accomplishments, man-hours, etc., should be obtained from all work crews and checked for accuracy. Reports describing productivity should be appropriately summarized for each level of supervision in order that such reports may be an effective management tool.

* * * * * *

RECOMMENDATION: PERFORMANCE STANDARDS SHOULD BE REVIEWED PERIODICALLY AND UPDATED AS NECESSARY.

The purpose of updating standards should be to set attainable goals that continually provide incentives for improved performance. As noted earlier, the actual productivities associated with some activities appear to be consistently greater than the current performance standards. In these cases, a higher level of productivity should become the standard.

The same does not necessarily hold in the reverse situation. That is, performance standards should not be automatically decreased for those activities for which the actual productivities are consistently lower than the standards. Instead, this signals a potential problem area which should be reviewed to determine the cause. If it is found that there are no problems inhibiting productivity, then the standard should be set at a more realistic level which still provides for efficient operation.

Finally, the case of significant productivity differences among field divisions must be addressed. Although the Jorgensen report specified uniform performance standards, there may be factors contributing to productivity differences that are beyond the control of the field divisions. For example, the primary function of division personnel in the hot maintenance mulch program is to transport the hot mulch from the plant to the site. The performance standard is currently set at 1,200 tons per day for a seven-man crew, but the actual productivity appears to be affected by the distance travelled which, of course, varies by division. In this and other similar cases, either the unit of measurement should be changed (e.g., ton-miles instead of tons in the example cited) or different performance standards should be set for each field division.

* * * * * *

RECOMMENDATION: DEVELOP MORE USEFUL MEASURES OF WORK ACCOMPLISHMENT.

The benefits of a comprehensive system of planning and control are discussed in another recommendation. However, to be effective, the measures of work accomplishment used for planning purposes and for defining performance standards should be in terms of meaningful units. However, many activities (e.g., all bridge maintenance activities) currently measure work in man-hours, which does not provide a meaningful description of either accomplishment or productivity (i.e., number of man-hours per man-day is meaningless).

Field division and first-line supervisors should collectively develop alternative measures which are meaningful and easily understood. If possible, the same measures as used for accounting and stock handling purposes should be selected in order to standardize units of measures and to help streamline reporting procedures. Once implemented, these measures should be monitored to discern performance patterns and to set appropriate standards.

* * * * * *

RECOMMENDATION: THE BUREAU OF MAINTENANCE AND OPERATIONS SHOULD REVIEW SNOW AND ICE CONTROL ACTIVITIES TO IMPROVE PRODUCTIVITY AND TO EXAMINE THE FEASIBILITY OF GREATER USE OF CONTRACTED SERVICES.

As previously described, inefficiencies in using maintenance crews for snow plowing and other snow and ice control activities were identified. This deserves special attention since these activities comprise a significant portion of the Bureau's budget. Also, because labor cost includes a substantial amount of overtime pay, any improvement in productivity directly translates into a cost savings.

To improve productivity, a comprehensive examination of the current snow and ice control operation should be conducted to identify problems and their solutions. One possible problem identified as a result of the analysis is the apparent use of larger-than-necessary crews for some activities such as snow plowing. Although the total work accomplishment increases with the crew size, the productivity per crew member diminishes. Consequently, there appears to exist an opportunity for cost reduction through better crew assignments. However, factors such as equipment availability, break-downs, etc., should be thoroughly examined to determine if there are other underlying causes.

An additional result of the above analysis would be a better understanding of the cost of providing these services. This information can then be used to determine the feasibility of purchasing services from towns or private contractors. A preliminary cost comparison between MDOT maintenance crews and contractors is presented in Exhibit 7-2. As shown, the MDOT cost per mile is generally less than contractor cost, although not always. Many variables come into play, however, and there is insufficient experience in recent years with contracted winter maintenance to develop a substantive MDOT policy. For example, MDOT currently contracts private services for only four road segments. Consequently, there may be differences which are unaccounted for in the type and use of roadways involved in the comparison. Also, whereas MDOT costs vary with the amount of snowfall and the need for related activities, the cost for contractors is fixed in advance. The present system for letting contracts requires bids to be submitted before the snow season and the contractor receives the agreed-upon amount regardless of the amount of snowfall. This explains the cost differences between fiscal years 1979 and 1980. Since there was appreciably less snow in FY 80 than in FY 79, the MDOT costs decreased while the contractor cost either remained constant or increased.

It is felt that with greater use of contractors and a different method of payment, contractor costs could be more competitive with MDOT costs. For example, the City of Portland relies heavily on private contractors for snow removal and pays an hourly rate. Based on its own analysis, the City has concluded that this arrangement is cost-effective for several reasons. First, the contractor receives a set hourly rate while City personnel would receive overtime. Second, the contractor is able to supply superior equipment (although this would not be true for

EXHIBIT 7-2

COMPARISON OF MDOT AND CONTRACTOR COSTS

SNOW PLOWING ONLY

| MDOT | FY 79 | FY 80 |
|---|---|---|
| Total Cost | $2,464,752.37 | $1,702,513.10 |
| Total lane mileage | 7,641.54 | 7,746.90 |
| Cost/lane mile | $ 322.55 | $ 219.77 |
| **CONTRACT** | | |
| Total Cost | $ 25,974.97 | $ 50,034.00 |
| Total lane mileage | 130.86 | 130.86 |
| Cost/lane mile | $ 198.49 | $ 382.35 |

SNOW PLOWING & SANDING

| MDOT | FY 79 | FY 80 |
|---|---|---|
| Total Cost 1/ | $7,922,772.78 | $6,489,635.46 |
| Total lane mileage | 7,641.54 | 7,746.90 |
| Cost/lane mile | $ 1,036.80 | $ 850.62 |
| **CONTRACT** | | |
| Total Cost | $ 79,798.20 | $ 79,798.20 |
| Total lane mileage | 65.76 | 65.76 |
| Cost/lane mile | $ 1,213.48 | $ 1,213.48 |

1/ Includes cost of plowing snow, sanding, salting, producing sand, stockpiling salt.

every contractor). Another factor is fuel availability and cost. If fuel supplies are limited, the City can preserve its own supplies for other uses by using contractors who provide their own fuel. Also, fuel price increases are not passed on to the City as quickly. Finally, use of private equipment reduces the stress on MDOT-owned equipment which should then break down less frequently and last longer.

The above arguments in favor of greater use of private contractors are promising. The Bureau of Maintenance and Operations should therefore capitalize on the potential cost savings through an analysis and evaluation of the possibilities. Opportunities for improving in-house productivity in winter maintenance activities, such as the institution of shift work, should also be investigated.

# 8. MDOT PROGRAM LEVELS

This chapter contains recommendations relating to the efficiency and adequacy of various MDOT programs. In developing these recommendations, we made a critical examination of the appropriateness and worth of various programs, the level of effort that is required of each to continue to maintain an efficient and safe highway system, and ways in which the programs could be enhanced to achieve their objectives in a more cost effective way. As a result of this examination, we have recommended increases or decreases in the activity levels and funding of programs, revision of program delivery procedures, transferring of programs to other State agencies or towns, termination of some programs, and performance of research that will enhance the cost effectiveness of MDOT's operations.

The consequences of our recommendations on MDOT funding requirements are summarized in Exhibit 8-1. The exhibit shows that to implement our recommendations, MDOT will have to increase total highway program expenditures by less than one percent or about $1.2 million in the next biennium relative to the current biennium budget. The change in program costs is stated in terms of FY 1980 and 1981 buying power, i.e., no adjustment for inflation has been made. As per the study's scope of services, we also have not projected revenues for the next biennium to determine whether they will be sufficient to provide for the program levels we are recommending.

It is nonetheless clear that the existing revenue structure will not be able to provide for program requirements over the long run. The gallonage gasoline tax, eroded by energy conservation measures, will not be able to keep pace with increases in revenue requirements resulting from inflation. As a consequence, we recommend that MDOT begin now to lay the foundation for the development of a new revenue structure for the transportation program.

In the interim, should MDOT find that revenues are not sufficient to provide for desired program levels, we recommend adoption of a policy that protects the existing highway system to the extent possible until adequate revenues are forthcoming. This can be accomplished through a selective maintenance and capital improvement effort aimed at preventing the loss of highway base and bridge structures. The policy should include provision for capital improvements at least to the extent that Federal funds would not be lapsed. The capital improvements also would emphasize protection of the existing system. Implementation of resurfacing and rehabilitation projects as opposed to new construction and reconstruction projects would predominate.

EXHIBIT 8-1

SUMMARY OF PROGRAM LEVEL RECOMMENDATIONS

| PROGRAM | RECOMMENDED CHANGE FROM THE CURRENT BIENNIUM PROGRAM | |
|---|---|---|
| | Recommended Change | Cost of Change [1] |
| Radio Operations | No change | -0- |
| State Aid Construction | Changes in program delivery/ administration [2] | -0- |
| Special State Aid | Terminate program | ($500,000) |
| Access Roads | No change | -0- |
| Island Town Refunds | No change | -0- |
| Bridge Maintenance | o Increase staff<br>o Transfer responsibility of town way bridges, covered bridges<br>o Eliminate redundant bridges | $100,000 [3] |
| Picnic Areas | Transfer financial and perhaps total responsibility to another State agency and/or towns [1] | ($800,000) [4] |
| Traffic Services | Retain pavement striping reduction already implemented by MDOT for biennial cost savings of $900,000 | -0- [5] |
| Summer Maintenance | Increase paving cycle to 8 years until more accurate cycle can be determined | $4,000,000 [6] |
| Town Way Bridge Improvements | Lobby for more flexible Federal standards | -0- |
| Town Road Improvements | Terminate program | ($1,600,000) |
| Winter Maintenance | No change | -0- |
| Highway Safety | Reevaluate cost effectiveness of program components | -0- |

EXHIBIT 8-1 (Continued)

| PROGRAM | RECOMMENDED CHANGE FROM THE CURRENT BIENNIUM PROGRAM | |
|---|---|---|
| | Recommended Change | Cost of Change |
| Compensation | No change | -0- |
| Grade Crossing Protection | No change | -0- |
| Abolish, Alter/Reconstruct Railroad Crossings | No change | -0- |
| Bridge Construction and Bridge Projects Under the Highway & Bridge Improvement Program | No change; current funding level is adequate to meet needs | -0- |
| Highway Improvements Under the Highway & Bridge Improvement Program | No change; current funding level is adequate to meet needs | -0- |
| Total - All Programs | | $1,200,000 |

1/ "Cost of change" is the difference between our recommended program levels and the levels for the current biennium. The cost change is stated in terms of current--FY 80 and FY 81--dollars; no account has been made for inflation.

2/ Changes will result in the ability to improve a significantly larger number of miles with no additional funding.

3/ An increase in staff level could reduce bridge deterioration rates and thus lead to long-run bridge improvement cost savings. Cost to increase staff ($400,000) is largely offset by other recommended reductions in bridge maintenance responsibility.

4/ Cost change includes a reduction in picnic area policing activities which are part of the Traffic Services budget.

5/ Because this action has already been implemented by MDOT, no change in program level would result from our recommendation.

6/ Ultimate program level to be determined upon completion of recommended study which would establish the optimal highway condition MDOT should maintain.

The basis of this policy is that capital improvements--new construction, reconstruction, and replacement of highways and bridges--can be deferred at lesser eventual cost than would be incurred by substantial reductions in maintenance-oriented efforts. New construction obviously must be a low priority; new highway and bridge construction would further strain already limited resources. Reconstruction also must be a low priority, particularly insofar as reconstruction involves expanding or upgrading the system. Reconstruction is sometimes necessary to restore badly-deteriorated highways and bridges. However, unless these highways and bridges are critical links in the system, their reconstruction can be deferred without incurring substantial long-run additional costs (except the costs of inflation, which adversely affect all deferred projects), until such time as revenues become available.

Thus, this policy recognizes that insufficient revenues and the consequent deferral of highway activities will impose costs on the State. The objective of the policy is to minimize these costs through selective maintenance and capital improvements. For example, the cost per mile of maintenance paving is about $9,000; the cost of one mile of reconstruction on the State Highway System ranges from $400,000 to $1,000,000 or more. This means: (1) if maintenance is deferred to where reconstruction is required, the eventual cost is substantial; (2) despite Federal aid, maintenance dollars can be stretched much further than capital improvement dollars. Thus, a higher level of overall condition and performance can be retained by emphasizing maintenance-oriented efforts.

What are the costs associated with this policy? First, the highway system would deteriorate in terms of condition and performance. If no capital improvements were implemented during the next biennium about 250 miles of State and State aid highways could deteriorate to a condition requiring reconstruction. This represents about 2 percent of the mileage on these systems. The number of bridges for which rehabilitation or reconstruction would have to be deferred would be about 50, according to remaining life statistics, or about 2 percent of the State highway and State aid highway bridges in the State. In most cases, the deteriorated highways and bridges could remain open, but would require use limitations.

The repercussions of poorer highway conditions would include increased user costs. (It has been determined that fuel consumption increases in direct relation to decreases in pavement condition.) Poor pavement increases vehicle wear as well. User costs also would increase due to required restrictions on highway and bridge use. (The latter are considered less significant than the costs of reduced highway conditions. Posting of many bridges in the State, for example, can be tolerated with little inconvenience or cost to motorists or truckers.)

Another cost of deferred improvements will be that incurred by the State to restore highways and bridges neglected during the period of revenue insufficiency. This will result because the additional deterioration of the highways and bridges will mean eventually higher reconstruction costs.

Another cost that will be incurred will result from deferred use of available Federal funding. The State has four years in which to obligate most Federal funds apportioned to it. Consequently, to ensure that Federal funds are not lapsed will require MDOT to provide the match only for Federal funds that would expire in each year; obligation of other Federal funds available to the State can be deferred. The costs associated with this process are (1) inflation, which will reduce the buying power of the Federal funds so that the real cost to the State to implement a given set of highway and bridge improvements will be increased, and (2) deferred and/or reduced economic activity generated by the injection of Federal funds into the State's economy.

In summary, it is clear that revenues insufficient to meet program requirements will impose specific costs on the State in terms of higher eventual costs to provide for deferred projects, user costs incurred as a result of reduced highway system condition and performance, and economic costs associated with reduced economic activity in the highway improvement sector. Obviously, these costs will be experienced unequally among the people and industries of the State. Most directly affected will be those more highly dependent on the highway construction industry--MDOT employers and private construction firms--and on highway-dependent industries.

Exhibit 8-2 illustrates the policy direction we are recommending for coping with a short-term revenue problem. It suggests, by program, the type of action that may be required. It also indicates the consequences that could result from implementation of such actions. The consequences are stated largely in qualitative terms. A more accurate determination of actions and consequences would require an accurate estimate of expected revenues in the next biennium and a detailed analysis of individual projects that may have to be deferred. Neither of these requirements was part of our management study directive. Consequently, we cannot present specific program actions or an estimate of the magnitudes of costs associated with them. To Maine's advantage the highway system is in relatively good condition, as noted in the next section. This will mitigate the costs that may be associated with short-term program reductions.

## MAINE COMPARED WITH OTHER STATES

As further context for the recommendations which follow, the following paragraphs compare MDOT's level of activity in recent years with that of similar states and MDOT's accomplishments relative to these states in terms of highway condition and performance improvements. The states selected for comparison are Montana, New Hampshire, North Carolina, North Dakota, South Dakota, Vermont, Virginia, and West Virginia. These states were selected because they are similar to Maine in many respects, including population density, rural/urban population distribution, per capita income and percentage of persons with incomes below the poverty level, climate, geography, and highway mileage density and use.

## EXHIBIT 8-2 ILLUSTRATION OF PROGRAM POLICY DESIGNED TO COPE WITH SHORT-TERM REVENUE INSUFFICIENCY

| PROGRAM | RECOMMENDED ACTION IF REVENUES ARE INSUFFICIENT TO PROVIDE FOR RECOMMENDED PROGRAMS | COMMENTS ON REDUCED PROGRAM LEVEL |
|---|---|---|
| Radio Operations | No change. | ---- |
| State Aid Construction | Defer changes in program delivery and restrict projects to those needed to avoid loss of base. | Changes in program delivery will increase the use of the joint fund account. Postponement of the changes will reduce the demand on State revenues. Restricting projects could eliminate some requests for funding. For example, a 20 percent reduction could mean a $2,600,000 reduction in program funding requirements. The cost associated with this reduction is a potentially higher ultimate improvement cost as the highways continue to deteriorate. |
| Special State Aid | Terminate program. | Action is recommended regardless of revenue situation. |
| Access Roads | No change. | ---- |
| Island Town Refunds | No change. | ---- |
| Bridge Maintenance | Delay increase in staff. | This would reduce program requirements by about $400,000. Slower bridge deterioration rates that would result from increasing staff would be delayed. Given that it will take several years for the reduced deterioration rates to be achieved, the short-term effect of delaying staff increases will be small. |
| Picnic Areas | Transfer financial and perhaps total responsibility to another State agency and/or towns. | Action recommended regardless of revenue situation. |
| Traffic Services | Further reduce pavement striping. | MDOT Currently stripes only numbered highways and highways with ADT >600. If highways with ADT <1,000 were temporarily not striped, annual striping requirements would be reduced by about 1,500 centerline miles and $650,000. Given results of MDOT and national studies on pavement striping, the effect on safety should be small. |
| Summer Maintenance | Reduce maintenance paving to minimum required to avoid loss of base. | Based on available data, it appears that the recommended eight-year paving cycle is needed to avoid loss of base. Thus, no cutback is recommended insofar as revenues permit. If a cutback is necessitated, substantial additional costs may be incurred in the long run. For example, a paving cycle of nine years would require deferment of 100 miles of highway annually. If this deferment leads to loss of base, reconstruction rather than paving may be required to restore the highway at a cost at least ten times greater. |
| Town Way Bridge Improvements | Defer all bridge improvements that are not needed to eliminate an immediate danger to users and that are not needed to avoid a major disruption to traffic<br><br>Avoid lapsing Federal aid. | Replacement or rehabilitation of many of these bridges may be deferred without additional cost to MDOT other than that caused by inflation. Posting use limitations and periodic inspection could ensure safe use of bridges scheduled for improvements. In some cases, closing of bridges may be feasible and appropriate if a reasonable alternate route is available. This approach could, for example, reduce short-term program needs by 50 percent or $1,500,000. |

EXHIBIT 8-2 (Continued)

| PROGRAM | RECOMMENDED ACTION IF REVENUES ARE INSUFFICIENT TO PROVIDE FOR RECOMMENDED PROGRAMS | CONSEQUENCES OF REDUCED PROGRAM LEVEL |
|---|---|---|
| Town Road Improvements | Terminate program. | Action is recommended regardless of revenue situation. |
| Winter Maintenance | No change | ---- |
| Highway Safety | Fund at minimum level needed to ensure Federal funds are not lapsed. | A short-term reduction in delivery of safety efforts under this program would have, in our opinion, only a minor effect on highway safety. Some loss of stimulus to the State economy would be experienced by deferring the use of Federal aid. |
| Compensation | No change | ---- |
| Grade Crossing Protection and Abolish, Alter/ Reconstruct Railroad Crossings | Fund at minimum level needed to ensure Federal funds are not lapsed. Fund projects that contribute to the objective of avoiding loss of highway base. | To avoid lapsing Federal aid for these two programs will require additional matching funds of about $150,000. The possible reduction in the program levels with this policy is about $500,000. Also, to the extent possible, available funds should be used to contribute to avoiding the loss of highway base--resurfacing or reconstruction of crossing approaches may be eligible for crossing protection funding. The reduction in crossing improvements that these policies may cause will have a negligible adverse effect on crossing accidents in Maine (10 to 12 per year) and the nature of the improvements being made. Of the projects scheduled to be implemented under this crossing protection program in FY 80 and FY 81, over 70 percent were not the scene scene of any accident between 1974 and 1978, the years for which data were provided. Also, despite the 90 percent Federal funding, deferred use of the Federal funds whould have less economic impact on the State than deferment of other Federal aid. This is because the projects are capital rather than labor intensive. |
| Bridge Construction and Bridge Projects Under the Highway and Bridge Improvement Program | Fund to level that would avoid loss of structure (i.e., where deferred improvement would mean replacement rather than rehabilitation).<br><br>Fund replacement projects that are necessary (a) to eliminate an immediate safety hazard and (b) to avoid significant traffic disruption if the bridges were closed.<br><br>Avoid lapse of federal funds. | To avoid lapsing of Federal aid will require about $1,200,000 in matching funds during FY 82 and FY 83. This could reduce total program expenditures in the next biennium by 75 percent of the current biennium level, or around $22,000,000. Implementation of the recommendations regarding ensuring loss of base and avoiding immediate safety hazard and major traffic disruption will mean deferment of bridge projects. Deferment would necessitate increased inspection frequency and posting of bridges for which deferment of improvements is feasible. Some bridges may have to be closed and traffic diverted if this is possible without major traffic disruption. |

EXHIBIT 8-2 (Continued)

| PROGRAM | RECOMMENDED ACTION IF REVENUES ARE INSUFFICIENT TO PROVIDE FOR RECOMMENDED PROGRAMS | CONSEQUENCES OF REDUCED PROGRAM LEVEL |
|---|---|---|
| Highway Improvements Under the Highway and Bridge Improvement Program | Fund resurfacing projects required to avoid loss of base.<br><br>Avoid lapsing of Federal aid.<br><br>Defer safety improvements associated with resurfacing projects insofar as this does not jeopardize federal aid eligibility.<br><br>Defer rehabilitation and reconstruction projects unless they are needed to eliminate an immediate safety hazard that cannot be addressed with posting and/or detours. Substitute rehabilitation for reconstruction wherever possible.<br><br>Generally, do not fund projects that improve as opposed to maintain/preserve the existing highway system, i.e., new construction, widening, eliminating poor horizontal and vertical alignment, etc.<br><br>Defer bikeway projects and traffic operation improvements that are not meant to remedy a high accident location situation. | Funding (match) required to avoid lapsing Federal aid is about $3,000,000. Limiting new funding to this level would result in about a 75% reduction in the improvement program as budgeted in FY 80 and FY 81, or about $35,000,000.<br><br>The long-term costs associated with a major program reduction would be (a) deferment of some safety improvements (e.g., guard rail installation, shoulder paving), (b) loss of Federal aid purchasing power due to inflation, (c) deferment of State economy stimulation from Federal aid, (d) increased costs of ultimate improvements to be made insofar as additional deterioration occurs and stopgap measures employed. Also, deferred use of Federal aid will require a substantial State revenues lump sum subsequent to the FY 82/83 biennium to avoid lapsing the Federal aid. |



1/ Estimates of program funding reductions represent total costs and thus include federal and local shares as well as the State share. Also, much of the State share of capital improvement programs is funded with bond issues as opposed to current (gas tax) revenues. Consequently, estimated program level reductions do not represent estimated reductions in current State revenue requirements.

Overall, MDOT's performance in recent years compares very favorably with that of the other states. MDOT's overall expenditure rate has been lower than most states, yet the condition and performance of the Maine highway system exceeds that of most of the states.1/

The most recent comparative data regarding highway expenditures made by the states are for 1977 and 1978. During these years, Maine disbursed an annual average of $122 million to develop and maintain state-administered highways (reported as 11,300 State highway and State aid highway miles). On a per mile basis, Maine disbursed $10,800; on the basis of million vehicle miles traveled (MVM), $15,400 were disbursed. These disbursement rates place Maine in the lower, or favorable, end of the range established by the eight comparison states. The range and average level of disbursements for the states and Maine's rank among them are as follows:

Disbursements/MVM 2/

- Average--$16,000
- Range--$14,000 - $19,100
- Maine's rank--5th 3/ ($15,400)

Disbursements/System Miles

- Average--$14,800
- Range--$7,800 - $26,300
- Maine's rank--7th ($10,800)

A comparison also was made of the distribution of expenditures made by the states. The data are presented below. The states, including Maine, are quite comparable in administrative, law enforcement, and bond-related expenditures. The states differ considerably in expenditures for capital improvements and maintenance. Maine ranks low in terms of the percentage of funds expended on capital improvements and high in relative percentage of maintenance expenditures, which is in keeping with the revenue shortfall policy proposed earlier.

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1/ The comparative statistics presented in this section must be viewed in relative rather than absolute terms. The data are reported by states to the Federal Highway Administration. In calculating the statistics and in reporting the data, equivalent procedures and definitions may not have been used. Also, some data are based on professional opinion rather than hard facts.

2/ Figures exclude one state that made disbursements/million vehicle miles (MVM) significantly in excess of the other states.

3/ In descending order of disbursement.

DISTRIBUTION OF HIGHWAY EXPENDITURE

| | Capital Outlay | Maintenance and Traffic Services | Administration | Law Enforcement | Bond Interest & Retirement | Total |
|---|---|---|---|---|---|---|
| Maine | 44% | 36% | 7% | 7% | 6% | 100% |
| All States Average | 55 | 25 | 8 | 6 | 6 | 100 |
| All States Range | 41-70 | 13-36 | 5-11 | 2-10 | 0-19 | -- |

In terms of highway condition and performance, Maine's highway system compares very favorably with those of the other states. Maine's system ranks above most of the others in terms of all performance and condition indicators examined.

| Indicator 1/ | Maine's Rank |
|---|---|
| Highway System Condition: | |
| Pavement condition (7) 2/ | 1 |
| Horizontal alignment adequacy (7) | 1 |
| Vertical alignment adequacy (7) | 2 |
| Volume/capacity ratio (7) | 3 |
| Average design speed (7) | 2 |
| Deteriorated structures (9) | 2 |
| Highway System Performance: | |
| Average highway speed (8) | 7 |
| Motor vehicle accidents fatality rate (9) | 2 |

The findings presented above--that Maine's highway system compares very favorably with similar states despite a relatively low level of expenditures--speaks well for the relative effectiveness of the MDOT program.

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1/ Data for Maine represents the arterial and collector components of the State highway and State aid highway systems. These components comprise about 65 percent of State highway and State aid highway mileage in the State. The data represent conditions prevailing in 1978.

2/ The number in parenthesis is the number of states for which data were obtained.

RECOMMENDATION: MDOT SHOULD MAINTAIN ITS CURRENT LEVEL OF BRIDGE IMPROVEMENT PROJECTS UNDER THE HIGHWAY AND BRIDGE IMPROVEMENT PROGRAM.

Bridges eligible for improvement under this program are those located on the Federal aid and State highway systems. There are 1,860 of these bridges. MDOT is responsible for improvements to and maintenance of essentially all of them.

MDOT has been able to keep pace with the demand for bridge improvements on these highway systems over the past several years. Since 1976, an annual average of four bridges have been posted for use limitations due to structural deficiencies. The total number of posted bridges has remained at about 25; new bridge postings have been offset by removal of postings from other bridges after remedial actions were taken.

Given current estimates of bridge improvement requirements and the current capability of the bridge improvement program, MDOT will be able to continue to satisfy bridge needs for the next several years. Towards the end of the decade, the level of effort may have to be increased substantially. According to estimates of remaining bridge life prepared by MDOT, 350 bridges will require rehabilitation or replacement within the next ten years; 220 of these have an estimated remaining life of 10 years. These statistics indicate that for the next several years, an annual average of 14 bridges will require major rehabilitation or replacement, i.e., [(350 - 220) ÷ 9]. Obviously, as the end of the decade approaches, improvement requirements will increase substantially.

The number of bridge improvement projects implemented under the Highway and Bridge Improvement Program has averaged about 18 bridges per year since FY 1976. The current program--for FY 1980 and FY 1981--contains 25 bridge projects, or 12 to 13 per year. The bridge maintenance unit also may be able to make a substantial step to fulfilling bridge requirements. While the division does not do capital improvement projects, it implements about 20 major bridge maintenance projects each year. Such projects can prolong bridge life, e.g., deferring major rehabilitation or replacement, by 10 to 20 years. The contribution of bridge maintenance forces will, of course, depend on the specific work that will be required on the bridges identified above.

In the near term, then, the program appears to be adequate to meet improvement requirements, assuming that actual bridge improvement costs do not vary appreciably from average cost per bridge improvement in recent years in constant dollars. After several years, however, the program level must be reassessed because the estimated increase in bridge improvement requirements toward the end of the decade will probably necessitate a considerable increase in the funding level.

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RECOMMENDATION: MDOT SHOULD CONTINUE THE CURRENT LEVEL OF EFFORT OF THE BRIDGE CONSTRUCTION PROGRAM.

The Bridge Construction program provides primarily for construction and reconstruction of bridges under the Bridge Act. To be eligible for Bridge Act funds, a bridge must be on the State Aid highway system. This involves approximately 1,270 bridges, excluding those on the federal aid system that are eligible for funding under the Highway and Bridge Improvement Program (380 bridges).

Bridges are improved under this program primarily in response to town petitions submitted to MDOT. The decision to implement a project is decided by a majority vote of the three parties involved financially in the proposed project--the town, county, and MDOT. Very few petitions have been rejected. Typically, petitions are not prepared until a bridge is in urgent need of repair or replacement. Given the nature and stability of petitions received by MDOT over the past 10 years, the rate of petitions provides an indicator of future program requirements, as long as one recognizes the potential for a project backlog to build up. During the past decade, an annual average of 14 petitions have been presented to MDOT.

Examination of remaining bridge life estimates suggest that the need for Bridge Act projects may begin to increase above the rate of the last decade. The statistics show 220 bridges in need of rehabilitation or replacement over the next 10 years. About 120 of these bridges are estimated to have a remaining life of 10 years. This means that requirements for bridge rehabilitation or bridge reconstruction may average 10 bridges per year for several years and then increase considerably.

Over the past decade, the Bridge Act has funded an annual average of 11 bridge projects. Given the estimated demand for bridge projects--10 to 14 per year in the near term, 22 per year over the decade--the level of funding may be adequate in the near term but will have to be increased towards the end of the decade. (As with the Highway and Bridge Improvement Program analysis, this conclusion assumes that average cost per bridge improvement in constant dollars will not differ significantly from recent experience.)

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RECOMMENDATION: MDOT SHOULD WORK TO RELAX THE MORE STRINGENT FEDERAL STANDARDS THAT GOVERN THE USE OF FEDERAL AID FOR TOWN BRIDGE IMPROVEMENTS.

Federal design standards for the rehabilitation or construction of off-system bridges have severely limited the planned capability of the Town Bridge Improvement Program. Even with the program operating at maximum potential, it may not be able to satisfy demands for Town Bridge improvements. Consequently, relaxation of the Federal standards would be of substantial benefit to the town bridge assistance efforts.

There are approximately 970 bridges on the Town Way System. In response to the creation of a new Federal program of assistance for off-system bridge improvements and in response to a growing concern for town

bridge improvement requirements, the Town Bridge Improvement Program was established in 1977. The program provides for cost sharing among the State and counties or towns for implementing bridge rehabilitation and replacement projects.

MDOT has just completed an inspection of all bridges on the Town Road System. Preliminary results of the survey suggest that the number of deficient town bridges far exceeds the number of deficient bridges on the other highway systems. One-quarter to one-half of the bridges may require rehabilitation or replacement during the next decade. A more accurate estimate of improvement requirements will be possible after MDOT has thoroughly studied the results of the inspections.

As initially planned, the Town Road Improvement Program was expected to finance about 25 bridge improvement projects per year. However, stringent design standards imposed with the use of Federal funds (to finance 60 percent of the projects' costs) have severely constrained program accomplishments to date. The Federal requirements increase costs beyond what most towns and the State are able or willing to pay. Consequently, only two or three bridge projects have been implemented to date.

Even if the problem with Federal requirements can be overcome, the program may not be adequate to fulfill bridge improvement needs. If the previously-stated estimates of deficient bridges holds after more detailed analysis, 25 to 50 bridge projects per year may be required over the next decade.

At this time, however, we recommend that the only bridges in critical need of repair or replacement be funded. There are two reasons for this recommendation: (1) a more accurate estimate of improvement requirements is needed and will soon be available and (2) the possibility of securing less stringent Federal requirements means that overbuilding of bridges may be avoided, saving both the towns and the State considerable unnecessary expenditure.

* * * * * *

RECOMMENDATION: THE HIGHWAY IMPROVEMENT EFFORT UNDER THE HIGHWAY AND BRIDGE IMPROVEMENT PROGRAM SHOULD BE MAINTAINED.

The Highway and Bridge Improvement Program provides for restoring and improving the condition of the Federal Aid and State highway systems through new construction, reconstruction, rehabilitation, and resurfacing. The capability of MDOT to implement improvement projects has declined steadily due to falling revenues and inflation. The program for the current biennium includes plans for about 145 miles of improvements, excluding the interstate system.

Estimated current highway improvement requirements, excluding the interstate System, are on the order of 90 miles. Requirements are expected to grow at an annual rate of 75 to 90 miles. Most of these miles will

require resurfacing; the remainder will require rehabilitation or reconstruction. (The estimate of improvement requirements includes only what is needed to preserve and restore the existing highway system. It does not include consideration for changes in the system such as improving horizontal and vertical alignment, widening lanes, or implementing safety improvement. The latter may improve the highway system, but they are not necessary to preserve the existing system. These estimates of current requirements are based on the pavement condition rating of the highway system as reported by MDOT to the Federal Highway Administration in 1978 for the Highway Performance Monitoring System. Adjustments based on highway pavement deterioration rates and improvements made since 1978 were made to estimate current pavement condition. Deterioration rates also were used to determine the growth in improvement requirements that will occur over time. It should be noted that MDOT criteria for assessing pavement condition are more stringent than those applied by FHWA and most states. Use of MDOT criteria would consequently result in a higher estimate of improvement requirements. We have elected to use the lower criteria in this analysis in light of (a) our recommendation that MDOT reassess the optimal pavement condition in which the highway system should be maintained and (b) the constrained revenue situation confronting the Department.)

Comparison of the current improvement program (145 miles) with estimated improvement requirements (75 to 90 miles per year) indicates that continuation of the current program may be inadequate. Program ability, however, could be bolstered by redistributing funds among project types. In particular, a shift of some construction and reconstruction funds to rehabilitation and resurfacing projects, and a decrease in safety improvements implemented with resurfacing projects insofar as Federal aid eligibility is not jeopardized would increase the number of miles MDOT could improve such that improvement requirements could be met in the existing budget. Given this possibility and our reccommendations elsewhere discussed that MDOT determine the optimal highway condition to maintain, it is recommended that the current level of highway improvement funding be retained.

* * * * * *

RECOMMENDATION: MDOT SHOULD MAINTAIN ITS POLICY OF NOT LAPSING AVAILABLE FEDERAL AID. MAXIMUM ADVANTAGE SHOULD BE TAKEN OF FEDERAL AID TRANSFER PROVISIONS IN ORDER TO MOLD FEDERAL AID TO MAINE'S HIGHWAY REQUIREMENTS.

A variety of Federal programs offer financial assistance to states for highway and bridge improvements. Funds are allocated among the states using various formulas. To use Federal funding, the states must provide matching funds (ranging from 10 to 25 percent of project costs), must spend the funding in specified categorical areas, and must implement projects according to Federal standards. The long-standing policy in Maine is not to lapse available Federal dollars.

Several issues were examined relative to the efficacy of Maine's policy:

1. Does the policy require MDOT to implement low-priority or unwarranted highway or bridge projects?

2. Does the policy require MDOT to overdesign highway and bridge improvements?

3. Does the policy provide benefits to the State that override the distortion in MDOT activities it may create?

Federal funds that match State funds must be dedicated to specified projects within a limited range of highway and bridge improvement categories. Among the categorical program areas eligible for matching Federal funds are interstate, primary, secondary, and urban highway system improvements; highway bridge replacement and rehabilitation; and various safety programs. Inevitably, restrictions on program eligibility inhibit the State's ability to set its own priorities. But, in reviewing the use of Federal funds in Maine, projects funded with Federal funds are generally warranted. An exception may be railroad/highway grade crossing improvements and perhaps some safety projects, but this represents only a small portion of Federal aid used by the State--less than one percent in FY 1980.

At the same time, it was found that MDOT has not taken full advantage of transfer provisions in the Federal aid highway legislation. The legislation allows transfer of certain amounts of Federal aid among program categories. Traditionally, MDOT has allocated funds to various programs in accordance with the Federal allocation formula; individual projects are then selected within the limits of these allocations. This process inhibits allocation of funds according to MDOT priorities. In a break from tradition, MDOT has shifted Federal allocations among programs in the current improvement programs. (Continuation of this practice is strongly encouraged along with lobbying for increased Federal aid flexibility, to maximize the benefit of Federal aid in Maine.

MDOT officials contend that satisfaction of Federal highway and bridge improvement standards--a requirement of Federal aid--forces MDOT to overdesign or overbuild facilities. The added cost of overbuilding has not been calculated. However, the following example reveals that even if the added cost to satisfy Federal standards is two to three times that which would be incurred if lesser standards were employed, it would cost Maine more to forego than to use Federal aid.

COST OF ONE MILE OF HIGHWAY RECONSTRUCTION

| | Built to Federal Aid Standards | Built to Lesser Standards |
|---|---|---|
| Total | $700,000 1/ | $250,000 |
| Federal Share | 525,000 | $ 0 |
| State Share | 175,000 | $250,000 |

1/ Average cost of one mile of reconstruction under the Highway and Bridge Improvement Program.

Finally, the positive effect of Federal funds on the State economy is not an insignificant consideration. The inflow of Federal dollars has a direct, multiple effect on the State economy. For every dollar of Federal aid used in Maine, about $1.50 of personal income may be generated, based on studies of economic multiplier effects in other states. This means that FY 1980 expenditure of Federal funds in Maine may have created $70 million in personal income. (Total personal income in Maine is currently about $6.0 billion.)

In conclusion, it is in Maine's interest to continue the policy of not lapsing available Federal aid. At the same time, Maine should use existing flexibility in the use of Federal aid to its full advantage as well as lobby for increased flexibility. Reducing transfer restrictions, gaining eligibility of the hot mulch overlays as well as the heavy resurfacing, and reducing construction standards are areas of increased Federal fund flexibility that would significantly balance Maine's highway program ability to address Maine highway and bridge improvement requirements.

* * * * * *

RECOMMENDATION: THE STATE SHOULD CONDUCT A THOROUGH EVALUATION OF ITS HIGHWAY SAFETY ACTIVITIES TO DETERMINE THEIR COST-EFFECTIVENESS AND TO IDENTIFY WAYS TO REVERSE THE STEADILY INCREASING ACCIDENT RATE.

The State is involved in a variety of highway safety programs including alcohol countermeasures, enforcement of the statewide 55 mph speed limit, elimination of high accident locations, railroad/highway crossing improvements, as well as others.

While the motor vehicle fatality rate in Maine has been steadily decreasing, the accident rate continues to increase. Since 1969, the fatality rate has declined from 4.55/HMVM (hundred million vehicle-miles of travel) to around 3.00/HMVM in 1978. This rate compares very favorably with other states; the national fatality rate in 1978 was about 3.30/HMVM. At the same time, the personal injury rate in Maine has not changed since 1971, and accident rates have steadily increased. The most recent personal injury rate is 182/HMVM. The accident rate is over 400/HMVM. These rates are also at or below national rates. Thus, while some significant improvements have been made, additional reductions are attainable.

It is difficult to specify what actions should be taken to improve safety conditions because insufficient information is available on the effectiveness of past efforts. Documentation of efforts to reduce accidents at high accident locations, for example, is incomplete. This makes it impossible to assess the results of actions already implemented and to identify areas for potential improvements. To establish realistic safety program objectives, to identify cost-effective ways to accomplish these objectives, and to determine the level of funding the safety program warrants, the State must establish a better system for documenting and evaluating the results and status of the program.

* * * * * *

RECOMMENDATION: MDOT SHOULD DEVELOP A POLICY REGARDING THE OPTIMAL LEVEL OF STATE HIGHWAY MAINTENANCE. THE POLICY OBJECTIVE SHOULD BE TO MINIMIZE OVERALL PUBLIC COSTS, I.E., HIGHWAY-USER COSTS AS WELL AS MDOT COSTS.

MDOT decisions regarding the need for maintenance paving and resurfacing are based on the professional opinion of MDOT staff and strategies for minimizing MDOT costs. These criteria ignore the costs incurred by highway users, which are directly affected by highway condition. Thus, while the decision-making process may result in an optimal allocation of resources from MDOT's perspective, they may not result in an optimal resource allocation from an overall public investment perspective. Consequently, it is recommended that MDOT investigate its current policies--principally the pavement condition it strives to maintain--to determine how they would change if they were based on minimizing the combination of user as well as MDOT costs. Based on this investigation, MDOT should revise its policies and programs, as appropriate.

A primary indicator of highway condition is the Present Serviceability Rating or Index (PSR or PSI). This is a scale used to rate pavement condition and is illustrated in Exhibit 8-3. (The exhibits, as well as the basis of this presentation, are taken from two documents: (1) NCHRP Report 111, Highway Research Board, 1971, and (2) Goods Roads Cost Less, Utah Department of Transportation, 1977.) The rating of a pavement is based on informed professional judgement or measurement of certain physical features, including roughness, cracking, rutting, and patching of the the pavement surface. A newly-constructed pavement will have a rating between 4.0 and 5.0. Pavement condition will deteriorate over time, primarily due to repeated vehicle load applications and environmental factors. A typical performance curve, which shows the deterioration rate of pavement condition, is also shown in Exhibit 8-3.

Typically, a pavement is considered to have reached its design life when the PSR decreases to 2.5 for high volume highways and 2.0 for low volume roads. At this point, the terminal PSR, a pavement overlay--resurfacing or maintenance paving--is considered warranted. A proper overlay on a good base will restore the pavement to a very good PSR at which time the cycle represented by the performance curve is repeated.

The use of PSRs of 2.5 and 2.0 to determine the need for a pavement overlay is based primarily on highway maintenance cost considerations. That is, if the pavement is allowed to deteriorate much beyond a PSR of 2.5 or 2.0, considerable base damage may result and reconstruction may be required to restore the failed pavement to its desired design standard.

Determination of the terminal PSR, however, should be based on user costs as well as highway maintenance costs. Studies have shown that vehicle operating costs--vehicle wear and fuel consumption--increase as pavement condition deteriorates. The effect on fuel consumption is illustrated in Exhibit 8-4. Given the increasing cost of motor fuel and motor fuel's increasing scarcity, the fuel consumption effect should be

EXHIBIT 8-3

THE PRESENT SERVICEABILITY RATING SCALE AND
A TYPICAL PAVEMENT PERFORMANCE CURVE

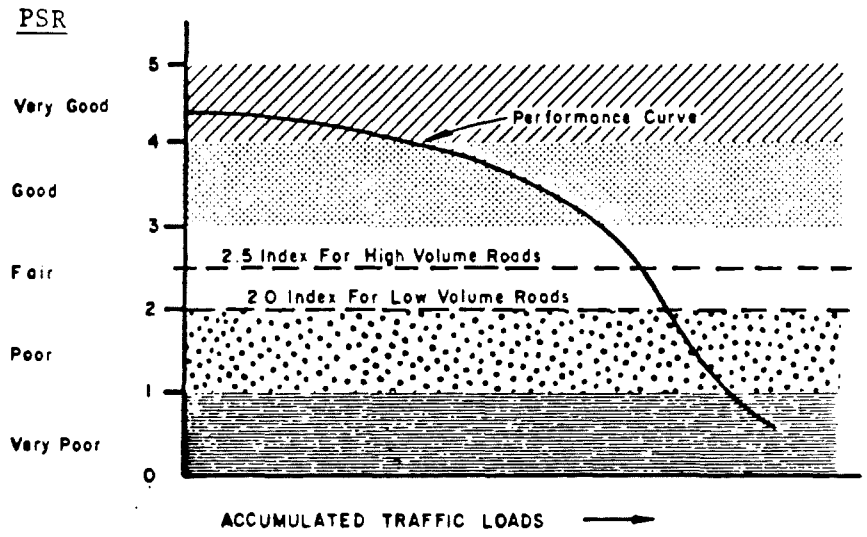
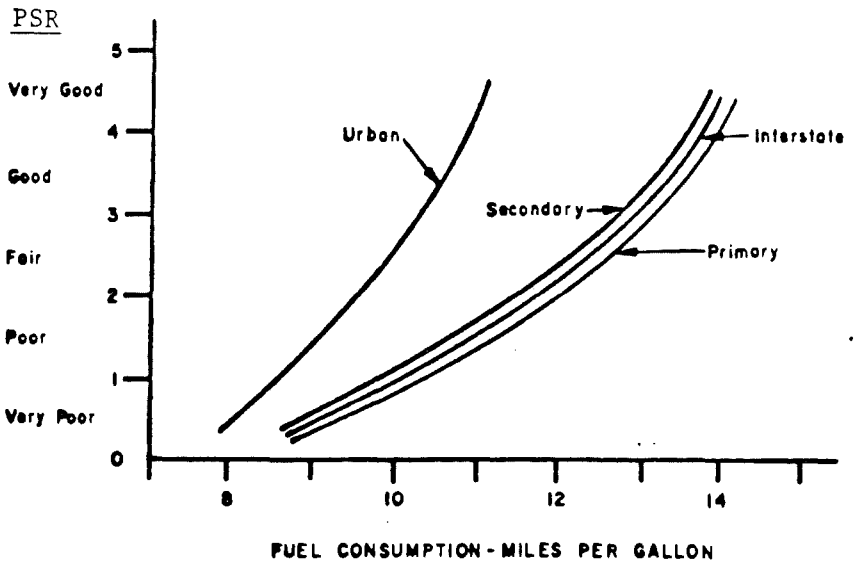



EXHIBIT 8-4

PAVEMENT CONDITION VS FUEL CONSUMPTION BY HIGHWAY SYSTEM




Source: "Good Roads Cost Less." Utah Department of Transportation, 1977.

taken into account in establishing the terminal PSR. With a decision rule to minimize user and highway maintenance costs, various terminal PSRs can be evaluated.

Such an evaluation is illustrated in Exhibit 8-5 by an example based on Maine highway statistics. The illustration shows that considering overlay costs alone, the optimal terminal PSR should be 2.0. However, when incorporating user fuel costs into the comparative analysis, the optimal PSR is clearly 3.0.

* * * * * *

RECOMMENDATION: MDOT SHOULD REVIEW THE PAVING CYCLE STANDARDS FOR THE MAINTENANCE PAVING PROGRAM. IN THE INTERIM, FUNDING OF THE PROGRAM SHOULD BE INCREASED TO PROVIDE FOR A PAVING CYCLE OF SEVEN TO EIGHT YEARS.

The hot maintenance mulch or maintenance paving program conducted by MDOT has proven to be quite popular and effective as a means of restoring pavement condition. The program accounts for 30 to 35 percent of the annual expenditures under the summer maintenance program.

In developing the paving program, MDOT estimated that the life expectancy of the hot mulch treatment is five years. On the average, hot maintenance mulch should be placed on highways once every five years. Given the number of miles for which hot mulch is the appropriate maintenance treatment (about 7,300 miles according to the Bureau of Maintenance and Operations), 1,460 miles of hot mulch paving should be accomplished each year under the original MDOT program concept.

This mileage objective has not been achieved in any of the past nine years. The average number of miles paved with hot mulch between FY 1973 and FY 1979 is about 1,000. The revenue shortfall has further reduced the program's capability. About 670 miles, or less than one-half the MDOT objective, will be paved each year of the current biennium.

In assessing the implications of the failure to meet the paving objective, it was found that the paving cycle established by MDOT may be too low. A cycle of seven to eight years--or, paving of 900 to 1,000 miles per year--appears to be adequate to maintain highways in reasonable condition. This estimate is based on fairly gross data and consequently should not be used to establish MDOT long-term maintenance paving objectives. (An explanation of the derivation of the paving cycle estimate is presented below.) The estimates, however, do lead to the following conclusions:

- The appropriate paving cycle for the hot mulch effort is not certain.
- While the MDOT objective of paving 1,460 miles per year is probably higher than necessary, the current level of effort is inadequate.

EXHIBIT 8-5

ILLUSTRATION OF ALTERNATIVE TERMINAL
PAVEMENT CONDITION ANALYSIS

A. Comparison of Costs of Alternative Terminal PSRs ($ millions)

| Cost Item | Terminal PSR | |
|---|---|---|
| | 3.0 | 2.0 |
| Annual Overlay Cost[1/] | $ 16.9 | $ 15.0 |
| Annual Fuel Cost[2/] | 125.0 | 135.0 |
| Total Cost | 141.9 | 150.0 |

B. Base Data Used to Calculate Costs

| | PSR | |
|---|---|---|
| | 3.0 | 2.0 |
| Overlay Cost/Mile[3/] | $180,000 | $250,000 |
| Overlay Frequency[4/] | 1/16 yrs | 1/20 yrs |
| Miles Per Gallon[5/] | 13 | 12 |

| | | |
|---|---|---|
| System mileage[6/] | = | 1,500 |
| Vehicle miles traveled per Year [7/] | = | 1,250,000,000 |
| Fuel cost [8/] | = | $1.30 |

EXHIBIT 8-5 (Continued)

C. Notes

1/ Overlay Cost Per Year = $\frac{\text{(System Miles)}}{\text{(Overlay Frequency)}}$ (Overlay Cost)

2/ Fuel Consumption Per Year = $\frac{\text{(Vehicle Miles Traveled)}}{\text{(Miles Per Gallon)}}$ (Cost Per Gallon)

3/ Average cost of a sample of MDOT resurfacing projects is $180,000. This figure is used for overlay cost at a PSR of 3.0 since MDOT has indicated this is the terminal PSR it uses (see MDOT response to AASHTO survey). The cost at a PSR of 2.0 is somewhat higher in recognition of thicker overlay required to restore pavement to this rating.

4/ Estimated from discussion with MDOT officials and other data.

5/ Source: Utah study cited in the text.

6/ MDOT highway mileage requiring resurfacing treatment according to the Bureau of Maintenance and Operations.

7/ Estimated miles traveled per year on the 1,500 miles of state highway requiring resurfacing = (MVMT in Maine 1978)(1,500/ 11,620 total state highway and state aid highway mileage in Maine).

8/ Approximate per gallon gasoline cost in Maine, 1980.

Based on these conclusions, we are recommending that MDOT thoroughly review the results of the hot mulch paving program in order to establish a well-founded paving cycle. Now that the program has a history, excellent data are available to determine the performance of hot mulch paving. Field examination of a sample of highways paved throughout the past nine years can be used to establish an accurate relationship between the age of hot mulch treatment and pavement condition. This data can then be used, as discussed in our recommendation for developing a maintenance paving policy, to firmly establish an appropriate paving cycle and annual paving program.

While this policy is being developed, the funding level for maintenance paving should be increased to provide for a seven- to eight-year paving cycle. If highways are not paved in a timely fashion, they will deteriorate to the point at which reconstruction rather than maintenance paving is required to restore them. Given that the cost of reconstruction is upwards of 10 times that of maintenance paving on the State aid system (more on the State highway system), maintaining the current inadequate paving program level could result in substantial additional highway costs over time.

## Derivation of the Paving Cycle Estimates

The paving cycle estimates presented above are based on changes in highway pavement condition between 1975 and 1978 and the level of maintenance paving effort MDOT expended to achieve this change. According to pavement condition estimates provided to the Federal Highway Administration by MDOT for the Highway Performance Monitoring System, between 1975 and 1978 the percentage of miles maintained by the State that were in deteriorated condition (i.e., requiring maintenance paving, rehabilitation or reconstruction) declined from 10 percent to 1 percent. (This excludes interstate mileage.) Given this reduction in deteriorated pavement and the level of effort MDOT expended to achieve it, an estimate of the number of miles requiring maintenance paving per year in order to eliminate deteriorated mileage from the system was developed. This analysis also revealed that highways requiring resurfacing rather than a hot mulch overlay have a paving cycle of about 16 years. This figure is consistent with data MDOT sent to AASHTO in response to a recent survey. For roads for which a liquid surface treatment is used, the estimated cycle is five years; MDOT's estimated cycle is three years.

Because the manner in which the percentage of deteriorated miles as calculated by MDOT differed in 1975 and 1978, the two estimates of deteriorated mileage are not exactly comparable. Also, MDOT management maintains that the change between 1975 and 1978 was less significant than the published data indicates. Given the absence of better data, however, we maintain our recommendation of a seven- to eight-year paving cycle.

* * * * * *

RECOMMENDATION: MDOT SHOULD INCREASE THE OVERALL BRIDGE MAINTENANCE STAFF AND EQUALIZE STAFF LEVELS AMONG DISTRICTS.

The Bridge Maintenance Division is responsible for the maintenance of about 2,800 of the 4,200 bridges in the State. Bridge maintenance responsibilities are increasing because bridges replaced under the Bridge Act (an average of 11 bridges per year since 1971) become the Division's responsibility.

While the number of bridges for which the Division has maintenance responsibilities is increasing, staff levels in the Division are declining. Current staff levels are about 60 percent of early 1970s levels and 90 percent of the FY 79--80 level, according to Bridge Maintenance Division estimates.

Specific productivity or performance statistics have not been developed for the Division. However, a comparison of staffing levels and bridge deficiencies among MDOT districts is instructive. The comparison shows a definite inverse relationship between the percentage of bridges that are deficient and the staff level in the districts. The function describing the relationship is $y = 8.80 - 0.32x$, where y is the percentage of deficient bridges in a district and x is the number of maintenance personnel per bridge in the district. This means, for example, that a 25 percent increase in deficient bridges is associated with a 20 percent reduction in staffing. One specific district has a substantially different staffing level from the others and, thus, is dissimilar to them. If this district is eliminated from the analysis, the function becomes $y = 14.00 - 0.72x$, revealing an even stronger relationship between staffing levels and the number of deficient bridges.

(Deficient bridges are defined as those with a sufficiency rating of less than 50.) The sufficiency rating is a mathematical representation of the condition of a bridge based on structural adequacy and safety, service ability and functional obsolescence, and essentiality for public use. FHWA has established a sufficiency rating of 50 to 80 for a bridge to qualify for Federal rehabilitation funding and a rating of 50 or less for replacement funding. However, discussion with the Bridges Maintenance staff revealed that due to procedures used to calculate sufficiency ratings, most bridges in the 50 to 80 range are not deficient on close examination; in fact, some bridges with a rating under 50 need not be rehabilitated or replaced. The threshold of 50 was selected in consultation with Bridge Maintenance Division staff as the most accurate level for identifying bridges needing rehabilitation or replacement. Staff levels are defined as the average number of person-years for the past decade.

While this result is not conclusive, given the data limitations, it does indicate that reductions in maintenance staff may result in significant increases in bridge deterioration rates and rehabilitation and replacement requirements. Given the relative cost of increasing maintenance staff (maintenance expenditures per staff member were about $22,000 in FY 1980) versus bridge replacement or rehabilitation ($220,000)

per bridge project advertised for bid in the last five years under the Bridge Act and the Bridge Improvement projects), the following actions are recommended:

(a) Personnel should be increased by 10 to 20 percent, or by 7 to 14 person-years.

(b) The Bridge Maintenance Division should continue its efforts to equalize the distribution of personnel among districts in terms of persons per bridge.

The results of these changes should be carefully monitored to determine the cost-effectiveness of this action.

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RECOMMENDATION: MDOT SHOULD ELIMINATE ALL REDUNDANT BRIDGES FOR WHICH IT IS RESPONSIBLE.

A redundant bridge is one that, if eliminated from the highway system, would not adversely affect motorists because an alternative route or bridge is readily available. In the opinion of the bridge maintenance staff, MDOT is maintaining 20 to 50 redundant bridges.

MDOT routinely identifies possibly redundant bridges when they require substantial maintenance work. These bridges are reported to the Commissioner, who decides whether to continue maintenance on them.

A more expedient and cost-effective approach would be to identify all redundant bridges through a statewide survey. Closing redundant bridges (or transferring maintenance of them to towns if the towns decide they merit retention), would relieve MDOT of considerable maintenance expense. In one case, for example, a pair of redundant bridges may require $50,000 to $100,000 in improvements during the next few years. The average annual maintenance cost per bridge is about $1,000, based on FY 1980 expenditures.

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RECOMMENDATION: MAINTENANCE OF TOWN WAY BRIDGES SHOULD BE THE RESPONSIBILITY OF THE TOWNS.

MDOT maintenance of town way bridges is inappropriate for three reasons:

- It is inconsistent with State maintenance policy.
- It is inconsistent with legislative intent.
- It results in inequitable distribution of State assistance among towns.

The Bridge Maintenance Division is responsible for maintaining about 170 bridges on the town road system, or 18 percent of all town bridges. These statistics were derived from TINIS data on town ways bridges.

State law governing summer maintenance establishes shared responsibility between MDOT and the towns for maintaining the State highway and State aid highway systems. Summer maintenance of town roads is a town responsibility. Ordinarily, this policy applies to bridges on the town road system as well; towns are responsible for maintaining their bridges. Exceptions to this policy are the bridges built under the Bridge Act that MDOT is required by law to maintain.

To qualify for Bridge Act funds, a bridge must be on the State aid system. MDOT responsibility for maintaining some town way bridges has resulted from construction or reconstruction of bridges under the Bridge Act (while on the State aid system) that were subsequently transferred to the town way system. It has also been suggested that some bridges in the past may have been temporarily transferred from the town way to the State aid system in order to qualify for Bridge Act funds. For these reasons, it is recommended that towns should be responsible for maintaining all town way bridges. It is also recommended that the temporary transfer of bridges from the town way to the State aid system in order to qualify for Budget Act funding be disallowed in the future.

The assumption of town way bridge maintenance by towns could result in a $100,000 annual reduction in MDOT bridge maintenance cost. (This assumes that town way bridges, because of their relatively small size and low use, are less costly to maintain than bridges on the State highway and State aid systems. MDOT maintenance cost for the average bridge is $1,000 per year.) The shift in responsibility for maintaining bridges should be made gradually to permit towns to prepare financially. Towns not capable of maintaining bridges could contract with MDOT to perform the work.

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RECOMMENDATION: CONSTRUCTION, MANAGEMENT, AND MAINTENANCE OF HIGHWAY SAFETY REST AREAS SHOULD BECOME THE RESPONSIBILITY OF THE BUREAU OF PARKS AND RECREATION, DEPARTMENT OF CONSERVATION AND/OR INDIVIDUAL TOWNS.

Safety rest areas for which MDOT is currently responsible primarily serve a recreation purpose. They also provide some traveler services which contribute to Maine's attractiveness as a tourist area. The primary reason for MDOT responsibility for rest areas, however, is their purported highway safety functions. We believe that the rest areas contribute little to highway safety and, therefore, we recommend that responsibility for the rest areas be transferred to a more appropriate State agency such as the Bureau of Parks and Recreation, an economic development agency or, to individual towns. This transfer would place responsibility for deciding (and financing) the number, location, and types of facilities with officials responsible for providing public recreation opportunities and for investing State resources to generate economic

activity. MDOT should be willing to construct, manage, and maintain specific rest areas under contract to other agencies should they request this arrangement.

There are 113 safety rest areas developed, managed, and maintained by MDOT, excluding 43 rest areas recently closed as a cost-saving action. The cost of the rest areas, exclusive of periodic Federal aid for capital improvements, is about $450,000 annually, according to FY 1980 expenditures. This estimate includes MDOT responsibilities for 114 turnouts.

The contribution of rest areas to highway safety is a questionable rationale for MDOT responsibility over rest areas. The extent to which rest areas contribute to accident reductions has not been documented at the State or the national level. The fact that rest areas are not fundable under Federal highway safety programs suggests that the accident reduction attributable to rest areas is marginal.

Response to the recent closing of 43 rest areas highlights the local recreation value of many rest areas. The complaints emanated almost entirely from towns whose residents frequently use the rest areas for recreation. The fact that about one-third of the areas originally scheduled for closing have been retained under town management and financing further attests to the predominant local, recreational-oriented importance of many of them.

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RECOMMENDATION: THE TRAFFIC SERVICES DIVISION SHOULD MAINTAIN THE CURRENT LEVEL OF PAVEMENT STRIPING.

MDOT faces two issues in pavement striping: (1) which roads should be striped; and (2) how frequently should they be striped.

Until recently, MDOT was striping all State-maintained highways, i.e., 10,560 centerline miles. The frequency of striping ranged from six months to two years, depending on highway use and condition. High-volume highways were striped every six months, medium-volume highways every year, and low-volume roads every two years. With these parameters, MDOT established that 6,000 to 6,500 miles of striping are required each year.

Because of both the revenue shortfall and substantial inflation in paint prices, MDOT decided to stop striping lower volume highways. Numbered highways with less than 600 vehicles per day and unnumbered State aid highways have not been striped recently. This cutback reduced annual striping to 4,000 from 4,500 miles annually. Even before the revenue shortfall, MDOT had decided to eliminate edgeline striping.

Based on highway safety analyses conducted by MDOT (for the striping demonstration program) and the National Highway Traffic Safety Administration (NHTSA), striping of low-volume roads is ineffective in reducing motor vehicle accidents. According to the State's analysis, the striping of low-volume roads in Maine has not reduced accidents. NHTSA analyses confirm this result.

Other national studies show that pavement striping and markings reduced fatalities by 237 and injury accidents by 9,200 during the period studied. (The analyses do not distinguish low-volume roads from other roads.) This translates into 0.00015 accidents and 0.00549 fatalities per year per hundred million vehicle miles traveled. Applying these results to MDOT's striping activity indicates that elimination of striping on low-volume roads (as MDOT has done) may increase statewide fatality and injury accidents by 0.2 and 6.0 per year, respectively. Thus, if MDOT continued not to stripe low-volume highways, the annual number of highway accidents might increase by 0.01 percent and fatalities by 0.09 percent over current levels. The reduction in cost obtained by the MDOT striping cutback is about $450,000 in the current fiscal year. Given these data, it is recommended that MDOT continue to stripe only the higher-volume roads.

As previously noted, MDOT has established pavement striping frequency requirements. These requirements are consistent with national rules of thumb for maintaining striping visibility and, thus, effectiveness. Discussions with NHTSA led to the following guidelines for striping frequency: (a) twice per year for highways with ADTs of 10,000, (b) once a year for highways with 2,000 - 10,000 ADTs, and (c) once per two years for highways with ADTs less than 2,000. Based on these frequency requirements and the elimination of low-volume roads, MDOT should be striping 4,000 to 4,500 centerline miles per year, as has recently been done.

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RECOMMENDATION: MDOT SHOULD REEXAMINE ITS CURRENT TRUCK WEIGHT LIMITATIONS AND ITS TRUCK PERMIT FEES TO DETERMINE IF THE ECONOMIC BENEFITS TO THE STATE OUTWEIGH THE ADDED COST OF HIGHWAY CONSTRUCTION AND MAINTENANCE RESULTING FROM THE LIMITATIONS.

The number and weight per axle of trucks that travel on a highway are the principal determinants (along with environmental conditions) of highway construction and maintenance requirements. Given a specific volume of truck traffic on a highway, an increase in the truck weight per axle requires an increase in pavement and base thickness to construct a highway to a selected design standard. Similarly, an increase in truck weight per axle will accelerate the deterioration of an existing highway.

Truck weight limitations in Maine are among the highest in the nation. In fact, only five states have higher tandem axle weight limitations and only nine have higher single axle limitations than Maine. Both of the Maine weight limits exceed the AASHTO (American Association of State Highway and Transportation Officials) policy levels. (AASHTO is the recognized source of highway construction and maintenance standards and practices.)

| | WEIGHT LIMITS (LBS.) | |
|---|---|---|
| | Single Axle | Tandem Axle |
| Maine | 22,000 | 38,000 |
| AASHTO | 20,000 | 34,000 |
| National Median | 20,000 | 34,000 |
| New England States | 22,400 | 36,000 |

The issue then is how much additional highway cost is incurred by Maine by having relatively high limitations. And, is the added cost compensated by the benefits generated by allowing higher truck weights.

A comparison of highway maintenance and capital improvement costs for MDOT's current weight limitations and for the AASHTO policy limits was made. It was found that highway improvement costs (for construction, reconstruction, rehabilitation, and resurfacing) with MDOT's weight limitations are about 15 percent higher than those required if the AASHTO limits were used. Maintenance paving costs are about 25 percent higher. (These estimates are based on the difference between AASHTO road test equivalence factors associated with the weight limitations. Equivalence factors are used to compute axle loads that will be experienced on a highway, given truck volume. Axle loads in turn are used to determine structural requirements for highways. Thus, a comparison of the factors associated with the MDOT and the AASHTO weight limits provides an indication of the relative structural requirements for highway improvements for the two weight limits. It can also be used along with a structural nomograph to determine the relative difference in life expectancy of an existing roadway and consequently the relative frequency of maintenance paving or resurfacing associated with each weight limitation.) These estimates suggest that Maine incurs additional highway costs on the order of $7--10 million annually, excluding bridge costs, to maintain the State's existing weight limitations rather than the lower AASHTO standards. (This is a gross figure for all State highway and State aid highway miles. In cases of specific highway segments, the relative cost differences may be significantly higher.)

Offsetting these costs are probable public economic benefits. No attempt was made to quantify these benefits using Maine data. Studies conducted by or under the auspices of the Office of Research, Federal Highway Administration, reveal that under certain conditions, a positive benefit cost ratio can be attained with truck weights limitation increases. A benefit/cost ratio of 3:1 to 12:1 was calculated in the studies assuming increases in truck weight limits from 18,000 lbs. (single axle) and 30,000 lbs. (tandem axle) to 22,000 and 36,000 lbs., respectively. This benefit cost result cannot be directly applied to Maine's situation since the weight limits examined are lower than Maine's and a national data base was used. Whether Maine's weight limits are appropriate from a public benefit cost perspective depends on the kinds of trucks that in fact use Maine's highways and the kinds of industries they serve. A thorough analysis is required to make this determination.

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RECOMMENDATION: MDOT AND TOWNS SHOULD JOINTLY REVISE THE STATE AID PROGRAM TO ENHANCE ITS EFFECTIVENESS IN FULFILLING HIGHWAY IMPROVEMENT REQUIREMENTS.

The State Aid Program is a unique approach for implementing improvements to highways serving both State and local functions. Through a coordinated State/town effort that pools resources and expertise, the program has proven to be a popular and effective way to implement mutually beneficial highway improvements.

Based on our examination of the program, we have developed the following recommended improvements:

(1) Highways and roads in the State should be reexamined to ensure that they are properly classified as State highways, State aid highways and town ways.

(2) The State Aid Program should be limited predominantly to reconstruction as opposed to construction projects.

(3) The procedure for allocating State aid among towns should be revised to better reflect relative highway needs and relative fiscal capabilities among towns.

(4) The policy for expenditure of State aid funds--the joint fund--should be revised to eliminate the substantial build-up of an unexpended balance and provide for more expeditious application of funds.

(5) A better-coordinated approach to the design of State aid projects should be established.

(6) There should be increased flexibility in the use of State aid to increase responsiveness to local and State priorities.

Implementing these improvements must be done gradually to avoid severe disruptions in program delivery. For example, changes in the allocation procedures could result in significant gains for some towns and losses for others. Staged implementation of the new formula is needed to provide an orderly transition for the towns and the State. The following summaries clarify and present the basis for our recommendations.

(1) Reexamine highway system. The intent of the State Aid Program is to provide a vehicle for the construction and reconstruction of highways that serve joint State and local functions, as opposed to predominantly State or local transportation purposes. Construction and reconstruction of the latter types of highways and roads are appropriately the responsibilities of the jurisdictions that derive the benefits.

should be noted that MDOT criteria for assessing pavement condition are more stringent than those applied by FHWA and most states. Use of MDOT criteria would consequently result in a higher estimate of improvement requirements.)

The current joint fund balance could support reconstruction of approximately 190 miles. This estimate assumes availability of the entire joint fund, including the $8 million that MDOT has drawn down and allocated temporarily to other programs. The estimate also assumes an average reconstruction cost of $100,000 per mile. This cost estimate, which was derived from a sample of State aid projects, is for full reconstruction as opposed to resurfacing. Since improvement requirements include resurfacing as well as reconstruction, the estimate probably understates the program's current capability.

Despite the apparent adequacy of the funding level, State aid highway needs are not being fully met. The problem is that the joint fund cannot be readily applied to improvement requirements. This problem is the result of (1) the procedure for determining the amount of State aid funds available to towns and (2) the policy governing expenditure of State aid funds. (The latter issue is discussed in the next section.)

The distribution of State aid funds under the current funding procedure is not consistent with relative highway needs among towns. The consequence is that State aid is not available to the towns that may need it most. Our analysis of the allocation procedure, based on a random sample of 30 towns, indicates that towns with equal State aid highway mileage can obtain substantially different shares of available state aid dollars. For example, one town with 0.22 percent of total State aid improved highways could obtain $33,800 in FY 79; another town with the same mileage could obtain only $18,600. We also found that towns with a small percentage of State aid miles can receive a disproportionately large share of State aid dollars. Conversely, those with a large share of miles can obtain a disproportionately small share of State aid dollars. These discrepancies arise because the value of units raised by towns and the State matching ratio vary with the town's assessed valuation, rather than with highway mileages.

Our findings indicate that the funding procedure does not reflect relative fiscal capability among towns. Towns with the same valuation receive significantly different levels of State dollars per mile of State highway. For example, the potential amount of State money per mile available to towns in the sample with an assessed valuation under $5 million ranged from $1,600 to $10,200. Similarly, towns with significantly different valuations may receive equivalent levels of State dollars per mile. From the sample, towns that could obtain about $1,200 of State monies per mile varied in valuation from $9 million to $38 million. Again, these discrepancies arise from the reliance on town valuation as the basis for establishing funding levels.

The consequence of the funding procedure is that State aid is not distributed in accordance with the distribution of need for highway improvements or need for assistance in financing improvements. Thus, while the total amount of money in the joint fund could fulfill current requirements, the funding procedure essentially precludes this.

To remedy this the reliance on town valuation for determining the level of funding available to towns must be modified. Because valuation may reflect a town's relative fiscal capability to raise money for highway projects, it should remain a component of the funding procedure. At the same time, indicators of highway improvement requirements should be introduced into the procedure. Over time, the number of State aid highway miles, the use of State aid highways (i.e., daily traffic, particularly truck traffic), and/or the cost of highway construction (insofar as there are significant differences among towns) should provide reasonable indicators of improvement requirements. Parameters such as these should be identified and used to determine the maximum level of funding each town can raise under the program, as well as the State match.

Revision of the funding procedure also would overcome the long-run tendency to shift financial responsibility for State aid highway improvements to the towns. A sample of 30 towns participating in the State aid construction program revealed that the funding procedure results in an increased financial burden on the towns over time. In the last five fiscal years, the State share of the potential joint fund declined from 70 percent to 67 percent. This trend will continue as long as the valuation-based funding procedure is used and unit values and State matching ratios remain unchanged. This change does not represent a sizeable redistribution of responsibility in dollar terms, but this type of change has led to periodic legislative revision of the parameters used in the funding procedure. A revised procedure based on need rather than on valuation will eliminate the need for periodic adjustment to rebalance State/local shares.

(4) Revise State aid expenditure policy. The expenditure policy for the State Aid Program results in a large, unexpended joint fund balance. This unexpended balance contributes to the program's inability to fulfill its potential because (1) improvement requirements are left unmet and (2) inflation erodes the buying power of the account balance.

Towns are restricted to the expenditure of the current amount of money in their joint fund account plus up to a two-year joint fund advance. The problem is that it takes several years for a town to raise a sufficient amount of money to afford a reasonably-sized improvement project. Indicative of this situation is the response from towns to an MDOT inquiry asking why the towns had not spent joint fund monies they have held since FY 1976. The towns responded that they were accumulating these funds for specific improvement projects.

The result of this expenditure policy is a large, unexpended joint fund balance. Since FY 1970 the average balance in the fund has been almost $8.0 million. Throughout the past decade, only 45 percent of the joint fund has been used each year to implement State aid projects.

The inability to expend State aid obviously reduces the capability of the program to fulfill improvement requirements. Since only 45 percent of the fund is used each year, under current expenditure policy a joint fund equal to twice the cost of improvement requirements is needed to fulfill those requirements. Unspent funding means that improvements cost considerably more to implement because inflation erodes the buying

power of the unexpended balance. The maintenance of an average unexpended balance of $8.0 million over the past decade has cost the program about $5.0 million in highway improvements (based on the cost change to reconstruct one mile of State aid highway during the decade).

To eliminate this problem, MDOT and towns should develop an expenditure policy that allows towns to borrow more than is currently allowed from each other's joint fund accounts. If such a system could be established, it would make the program more efficient and more responsive to State aid improvement requirements.

(5) Coordinate approach to project design. Towns have suggested that MDOT allow more flexibility in the design standards used for State aid projects. The towns contend that MDOT's standards lead to over-design in some cases and have pointed to examples where they believe roads were over built as a result. The towns argue that more flexible standards would further stretch available funds. In evaluating this suggestion, we found that MDOT is willing to reduce design standards on horizontal and vertical alignment components, provided towns accept the restrictions on highway use that lesser standards require for safe travel (e.g., posting of slower speed limits). MDOT is unwilling to compromise on structural design standards--depth of base, pavement quality, and drainage--on the premise that lesser structural standards will result in increased maintenance costs, for which MDOT is responsible.

This policy seems reasonable. Indeed, after the policy was clarified, a representative set of towns basically agreed to its reasonableness. However, the policy's effectiveness depends on State/town cooperation in developing improvement objectives and design alternatives. Currently, this cooperative effort falls short when MDOT presents towns with completed designs. Towns can reject the design, but are reluctant to do so because of the resulting delay in implementation.

Consequently, the joint State aid effort would be more effective and responsive to local priorities if a more coordinated approach to project design was adopted. For example, general alternative designs and their costs and performance characteristics could be discussed prior to development of a detailed project design.

(6) Flexibility in the use of State aid. It has been suggested that increased flexibility in the use of State aid and town improvement funds would allow towns to better address their priorities. For example, establishment of a block grant program to replace existing "categorical" programs has been suggested. Some flexibility in the use of these funds already exists. The State Aid Program does include provisions for the transfer of State aid funds to other programs at the request of a town and with the concurrence of MDOT. As many as three State aid units, without bonus, can be used to pay the town's share of the cost to reconstruct town way bridges, reconstruct bridges under the Bridge Act, or reconstruct railroad/highway grade separations. State aid funds also may be used to construct or reconstruct town roads, provided the town's State aid roads are in good condition.

Towns have exercised all of these possibilities to a limited extent. Less than 5 percent of the towns request a transfer of State aid funds to their TRI fund each year. Moreover, MDOT denies few transfer requests. In fact, only one request has been denied in the past three and one half years. On the other hand, the restrictions imposed on transfers--some of which are noted above--tend to discourage and limit the transfer of funds among programs. Without these disincentives, a larger transfer might occur.

We recommend that the restrictions and disincentives on the transfer of State aid funds to State aid bridge improvement projects be relaxed or eliminated. Bridges are an integral part of the State aid system. The State and towns should be able to set priorities among bridge improvements and highway improvements and be able to allocate resources accordingly. Increased flexibility would provide the capability to address the highest priority improvements in the State Aid Program.

The recommended increases in flexibility will be more to the towns' than to the State's advantage. The State is responsible for summer maintenance of State aid highways and bridges built under the Bridge Act. (The Bridge Act basically provides for construction or reconstruction of bridges for the State aid highway system.) Consequently, a transfer of funds from State aid highway to bridge improvements may increase MDOT's highway maintenance costs to the extent that highway improvements are deferred. This transfer also could increase MDOT's bridge maintenance responsibilities if bridge improvements are new Bridge Act projects. Policies and procedures to minimize the potential shift of maintenance responsibility (e.g., not transferring bridge maintenance responsibilities to MDOT after bridge improvements are financed with State aid funds) will be needed.

Finally, the increased flexibility called for excludes transfers to projects involving the town way system. This exclusion is based on two considerations. First, the appropriateness of State involvement in the improvement of roads that serve a strictly local function is questionable. Second, diversion of funds to town roads may mean deferral of State highway improvements and may, therefore, increase short-term maintenance costs.

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RECOMMENDATION: THE SPECIAL STATE AID PROGRAM SHOULD BE TERMINATED.

Our recommendation to terminate this program is based on the conclusion that (1) the program is a relatively insignificant component of the State Aid Program and (2) the same objective can be accomplished by other, more appropriate methods.

This program was set up to enable the State to fund completely or to supplement regular State aid funds for high priority State aid highway projects. Generally, three types of projects are funded by this program:

- Construction of an unimproved gap between sections of improved State aid system highways

- o Elimination of a safety hazard which is beyond the financial capacity of the community to remedy

- o Elimination of a high maintenance location.

Special State Aid funds are normally used as seed money to provide an incentive to a town to implement a project deemed by MDOT as particularly important. The Commissioner decides which projects warrant Special State Aid funding.

Several things point to the relative insignificance of this program. The Special State Aid appropriation represents only a small fraction of available State aid funds. It is about 3 percent of the potential Joint Fund for fiscal years 1980 and 1981. The appropriation level has been declining in recent years, and expenditure of program funds has been held in abeyance for the current fiscal year in light of the revenue difficulties confronting MDOT.

The capability to provide seed money exists within other MDOT programs. Summer maintenance funds have been used for this purpose and highway and bridge improvement program funds might be similarly employed. Having to compete for maintenance or highway improvement monies with other projects for which MDOT is responsible would ensure that proper priority is placed on these kinds of State aid projects.

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RECOMMENDATION: THE TOWN ROAD IMPROVEMENT PROGRAM SHOULD BE TERMINATED.

Every year the State provides grants to towns to construct all-weather roads in rural areas. The amount of funding is set each biennium by the Legislature.

When the program began there were 10,000 miles of unimproved town roads. According to data provided by the Bureau of Maintenance and Operations, a total of 3,200 to 4,600 miles have been improved as a result of the program.

Current program funding is $600,000 (fiscal year 1981). This amount provides for improvement of about 30 miles of town roads at current estimated improvement costs. However, the capability of this program is substantially reduced by the disbursement of funds among towns. On the average, each town will receive less than $1,000 this fiscal year which will allow an average improvement of 0.05 of a mile (about half a block) in each town. At this level of funding, the program cannot be effective. Based on our conclusion about program effectiveness and the questionable appropriateness of State involvement in the maintenance and improvement of local roads, we recommend elimination of the Town Road Improvement Program. Funds made available by this section could be reallocated to a more cost-effective use.