REPORT OF THE

JOINT LEGISLATIVE AUDIT AND REVIEW COMMISSION ON

STAFFING AND MANPOWER PLANNING IN THE

DEPARTMENT OF HIGHWAYS AND TRANSPORTATION

TO

THE GOVERNOR

AND

THE GENERAL ASSEMBLY OF VIRGINIA

HOUSE DOCUMENT NO. 18

COMMONWEALTH OF VIRGINIA
RICHMOND
1983

MEMBERS OF THE JOINT LEGISLATIVE AUDIT AND REVIEW COMMISSION

Chairman
Senator Hunter B. Andrews

Vice Chairman
Delegate L. Cleaves Manning

Delegate Richard M. Bagley
Delegate Robert B. Ball, Sr.
Senator Herbert H. Bateman
Senator John C. Buchanan
Delegate Vincent F. Callahan, Jr.
Delegate Theodore V. Morrison, Jr.
Delegate Lacey E. Putney
Delegate Ford C. Quillen
Senator Edward E. Willey
Mr. Charles K. Trible, Auditor of Public Accounts

Director
Ray D. Pethtel

JLARC STAFF FOR THIS REPORT

Walter L. Smiley, Jr., Project Director
Robert B. Rotz
E. Kim Snead

R. Kirk Jonas, Division Chief

PREFACE

Item 649.2 of the 1982-84 Appropriations Act was adopted by the General Assembly as a mechanism to assess the minimum number of personnel required by the Department of Highways and Transportation to staff programs and activities funded by the Act. The Item had two interrelated parts. First, the department was directed to prepare a manpower plan specifically aimed at establishing a minimum staffing number. Second, JLARC was directed to monitor the planning process, the plan prepared by the department, and subsequent staffing actions. This report includes the findings and recommendations related to that monitoring exercise.

An integral part of the workplan developed by JLARC was an assessment of the staffing environment of the department as it existed during the summer and fall of 1982. The assessment was intended to be used in part to understand the manpower plan and to validate to the extent possible the staff numbers generated by the department. JLARC focused on eight staff activities covering both field and central office organizational levels as well as construction, maintenance, preconstruction, and administrative activities. The staffing analysis, however, now serves other purposes because the department did not produce a manpower plan by the reporting date assigned to JLARC -- December 1, 1982.

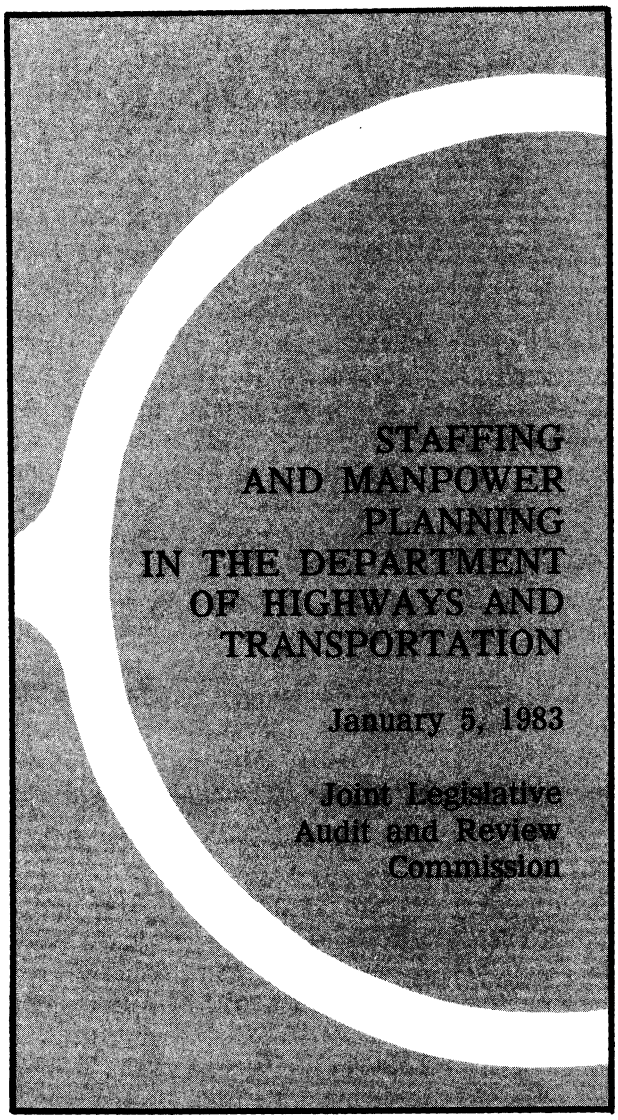
The findings regarding the staff efficiencies and economies that may be achieved and the conclusions that may be reached about reserve staff capacity have been reported as an independent analysis in free-standing chapters. We believe the staff environment analysis should be useful to the Department of Highways and Transportation as it brings its manpower planning process to completion and the first usable staff plan is reported. We also feel the analysis will serve as a useful point of reference for the House Appropriations and Senate Finance Committees as they consider staff authorization requests contained in the 1984-86 Appropriations bill.

Because the department's manpower planning system will not be implemented until mid-summer of 1983, a principal recommendation of this report is for a follow-up report by JLARC after the system is implemented. That recommendation has been adopted by the Commission.

On behalf of the Commission staff, I wish to acknowledge the very valuable help and assistance of the administrative and field personnel of the Department of Highways and Transportation.

Ray D. Pethtel
Director

February 2, 1983



Item 649.2 of the 1982-84 Appropriations Act requires the Commissioner of the Department of Highways and Transportation (DHT) to prepare a manpower plan. This plan is to identify both the minimum number of employees necessary to staff the programs and activities funded by the Act, and the methods to expedite staff reduction to meet that minimum staffing level. The plan is to specifically consider and report on the feasibility of reducing central office staff to 900 employees.

The same item also requires the Joint Legislative Audit and Review Commission (JLARC) to review (1) the planning process, (2) the plan required by law, and (3) the resulting staffing actions. This report contains the findings and conclusions of that three-part evaluation.

Throughout 1982, DHT staff who were assigned to prepare the manpower plan met periodically with JLARC staff to review progress and to expedite feedback about the planning process on an interactive basis. On the basis of its monitoring activity, JLARC can report that DHT initiated an active manpower planning process, which the department asserts will be capable of producing comprehensive staffing requirements based on reliable and validated workload standards. However, the DHT manpower planning documents do not yet sufficiently address the Appropriations Act requirements.

A JLARC REPORT SUMMARY

The *Short-Range Approach to Manpower* stated that it was intended to "document the steps and methodologies utilized by DHT to comply with the letter and intent of the Appropriations Act." In fact, however, the document was principally a compilation of requests from divisions and districts for 600 additional staff in the current biennium. This outcome apparently resulted from an earlier management strategy intended to amend the department's maximum employment level. Consequently, the document was of little use in helping determine the minimum staffing level for the department. DHT acknowledged that the *Short-Range Approach to Manpower* was incomplete, and in effect set the document aside, focusing its compliance effort on a long-term process.

The department's effort to establish a long-term manpower plan is described in the *Human Resource Planning System (HRPS).* This major manpower project is an ambitious effort to develop a total human resource planning system. The system is intended to be a comprehensive method for linking staffing with workload and for responding to alternative funding levels. However, the report currently lacks the documentation and precision needed for compliance. The document fails to fully address the requirements set by the Appro-

priations Act. In addition, how staffing efficiencies will be assessed in the department's effort to establish a minimum staffing level is not spelled out. Finally, the means of determining service levels from predicted revenue, a vital step in forecasting staffing needs under the system, remains unclear.

While the department may fully intend to address such concerns as a part of its manpower planning efforts, these intentions are not yet explicitly discussed in *HRPS*. For the department's manpower process to fully comply with Appropriations Act intent and be effectively operationalized, the plan must explicitly address the Act's requirements.

In order for JLARC to assess the manpower projections prepared by the department, a study was made of the current DHT staffing environment. That review—an exercise that tested existing workload standards and staffing patterns—concluded that the maximum employment ceiling specified in the 1982-84 Appropriations Act (10,177) is reasonable and can be achieved without inordinate staff disruptions or personal hardships. In fact, minimum staffing levels that can be inferred from the productivity enhancements identified in this analysis could result in staff economies equal to between 635 and 793 staff-years of effort (see table). If these improvements are achieved, DHT maximum staffing levels can be reduced to between 9,767 and 9,925 FTE employees, assuming as a base the actual July 1982 staff level of 10,560. Some of these economies would apply even assuming a lower base, such as the maximum level of 10,177 required for July 1, 1983. Annual savings of between $8.4 million and $14.0 million could be achieved if such economies were implemented.

All of the productivity improvements are independent of construction funding increases, and many economies can be achieved even if the department receives additional State or federal revenues. For example, although the department is likely to receive $263 million in new funds during the 1982-84 biennium, these revenues do not signal the beginning of an increased construction program, but the continuation of an existing maintenance and construction program that is already adequately staffed. Had the department not received additional funds, its staff requirement was expected to drop to 7,686 by the 1986 biennium, according to DHT's 1982-84 budget program proposal. The additional revenues, therefore, preclude the necessity for a severe staff cutback but do not justify additional staff.

There is also increasing speculation that the State may benefit from a new infusion of federal funds for construction and maintenance. In the event those funds create opportunities for new or accelerated programs, additional staff may be necessary for a few select areas examined in this report. In that event, it is especially important for the department to have a manpower planning system in place and workload standards validated.

POTENTIAL DHT STAFFING REDUCTIONS

	Potential Reductions	Potential Savings
Reduce Area Headquarters	23-64	$400,000-1,500,000
Centralize Timekeepers Within Residencies	87-114	$990,000-1,700,000
Improve Productivity for Routine Maintenance	158-248	$1,600,000-3,500,000
Improve Inspector Productivity	228	$3,400,000-4,600,000
Eliminate Plant Technicians	65	$810,000-1,100,000
Implement Computer-Assisted Design	60	$980,000-1,300,000
Improve Right of Way Productivity	12	$190,000-270,000
Consolidate Programming Divisions	2	$70,000-90,000
Total	635-793	$8.4-14.0 million

Staffing of DHT's Field Organization (pp. 9-50)

Much of the business of DHT is supervised and carried out by an extensive field organization. Of all DHT permanent salaried employees, 8,877, or 86.4 percent, are located in the eight districts, 44 residencies, four toll facilities, and one field division.

The basic structure of the field operation was validated by a management consultant retained by DHT in 1980. In a 1981 report, JLARC also supported the concept of decentralized authority and responsibility for highway programs. An understanding of the staffing environment in the DHT field organization is critical to an understanding of the DHT manpower planning process.

JLARC assessed the two basic functions that are carried out by DHT's field organization: the construction and maintenance of highways. These activities are performed by approximately 6,000 employees, or two-thirds of all field staff.

Staffing appears to be above minimum levels in the basic field functions. Productivity of construction staff has fallen in the last few years, and excessive variation in productivity among residencies was found in routine maintenance activities. If productivity levels attained by construction staff were increased to levels achieved a few years ago, as many as 228 positions would not be needed. Similarly, if maintenance employees in all residencies attained the levels achieved by the most productive locations for three major activities, between 158 and 248 positions would not be needed for those activities.

Productivity gains by field staff can be expected for several reasons. First, maintenance staff work out of 240 area headquarters, which appears to be an excessive number. Using a measure which accounts for workload differences between highway systems, it appears that at least 23 headquarters should be considered for closing and 21 more considered for downgrading to subareas. Second, maintenance operations do not take full advantage of current technology. Better distribution of the most productive types of equipment would improve maintenance productivity.

A third major reason for declining field productivity has been the practice of assigning more construction inspectors to projects than construction division guidelines suggest. Increasing the consistency of methods used to inspect construction should also lead to improved productivity and decrease the need for inspectors. Thus, DHT can take several steps to reduce the staffing of field operations.

Recommendation (1). The number of area headquarters should be evaluated on the basis of a guideline which considers a number of workload indicators. Areas should be evaluated for compliance with this guideline. This systematic assessment should reduce the number of area heaquarters by either consolidating areas or downgrading them to subarea status. In high growth areas, headquarters should be considered for closing or downgrading and the property retained for future expansion. DHT should expand the practice of allowing area headquarters to maintain roads in more than one county. In addition, areas should be reviewed for possible consolidation with other areas in adjoining counties.

Recommendation (2). The number of timekeepers should be adjusted by centralizing them within residencies. Reductions should be patterned after residencies which have already implemented such centralization.

Recommendation (3). DHT should ensure that residencies have access to the most productive types of equipment for ordinary maintenance. Large capacity distributors, tailgate spreaders, pavers, and rotary ditchers should be made accessible when needed. The feasibility of using self-propelled scrapers to a greater extent statewide should be evaluated.

Recommendation (4). DHT should implement a maintenance methods improvement program. The maintenance division should devise a computer program which will identify high and low productivity performances at area, county, and residency levels. Reasons for particularly low and high performances should be investigated. The division should also evaluate what the best achievable productivity levels are for field units. Productivity standards should be set at high levels to call attention to performances which need to be improved. The division should assess field techniques and promote

the transfer of technologies and methods which seem most productive. Specific consideration should be given to work planning and scheduling methods, parts availability, and other factors which appear related to productivity, including complaint-handling techniques, inter-residency exchanges of crew members, and the availability of foremen.

Recommendation (5). A productivity standard should be established for construction inspectors. The standard should be used in assessing inspector needs, and should be set so as to encourage high productivity.

Recommendation (6). The construction division should develop written guidelines for phase inspection of projects, identifying the project phases which are "critical." A staffing plan should be prepared for each project, based on the phase inspection guidelines. The plan should link the need for inspectors to the project phase, ensuring that an adequate number of inspectors will be available during each phase and showing how inspectors will be assigned during non-critical phases.

Recommendation (7). The construction division should establish a method of forcasting inspection needs based on project characteristics for use in the *Human Resource Planning System.*

Central Office Staffing (pp. 51-71)

While it did not question the overall structure of the department, the 1982 General Assembly expressed interest in reducing central office employment over the biennium. The Appropriations Act limited to 1,312 the number of positions available to the central office for both years of the biennium. The Act also required the department to report on the feasibility of further reducing central office positions to 900 full-time equivalent positions over the 1982-84 biennium.

Due to the Act's specific focus on staffing of the DHT central office, an assessment was undertaken by JLARC in order to evaluate compliance with the Appropriations Act mandates and short-term staffing needs. Although the mandated central office staffing level of 1,312 was reached in September 1982 as a result of a layoff, DHT has not assessed the feasibility of further lowering central office staffing to 900 by 1984. Such an assessment should include a variety of productivity indicators, and should consider improved technology in determining the feasibility of further reductions. A variety of opportunities are available to achieve economies in central office staff below the mandated July 1982 level of 1,312 positions. DHT should examine such opportunities as part of its mandated assessment of the feasibility of reducing central office staff to 900.

Recommendation (8). The department should consider proposing an alternative definition of "central office" to the 1983 General Assembly. The alternative definition should be based on administrative functions as well as location. If an amended definition is used, however, information about central office staffing should be presented for both definitions—that used by DHT and that used during the 1982 General Assembly.

Recommendation (9). DHT should assess the feasibility of reducing central office staffing to 900 by July 1984. The assessment should identify efficiencies which can lead to staffing reductions. All central office units should be included in the review.

Recommendation (10). DHT should assess the costs involved in implementing computer assisted design (CAD), and identify offsetting savings available through staffing economies and productivity improvements. The department should prepare a written report on the feasibility of implementing CAD in the bridge division and the location and design division.

Recommendation (11). DHT needs to specify all the projects which will require preliminary engineering and assess the need for staff in such activities over the six-year program.

Recommendation (12). The department should set productivity standards, such as those used by the right-of-way division, at levels above a long-term average. Targets should be linked to high levels of productivity that have actually been achieved by the sections. Steps for moving toward that level should be identified and taken. In addition, guidelines for individual employee performance should be tied to the targets.

Recommendation (13). DHT should develop a method for recording hours worked by all employees. This method

should provide for recording effort spent on major functions and any overtime worked, even if it is not compensated. The method should be a feature of the human resource planning system being developed by DHT.

Recommendation (14). DHT should audit positions classified as technician supervisor to determine whether the job content matches the job description. If there is need for separate promotional opportunities in technical and technical management tracks, separate job titles and descriptions should be established.

Recommendation (15). DHT should review spans of control assigned to all central office supervisory personnel. Positions which vary significantly from generally accepted standards should be considered for merger into other supervisory positions. Positions titled as supervisory but which actually spend a majority of the time performing work similar to that assigned to subordinates should be reclassified as subordinate positions and the supervisory responsibilities merged. Excess supervisory positions should be eliminated.

Recommendation (16). The merger of the programming and scheduling, secondary roads, and urban divisions as separate sections in one division should be under continuous study by DHT. Reductions from the current level of staffing should be considered. Cross-training of staff who currently develop and coordinate the programming and scheduling of projects on the primary, secondary, and urban systems may prove to facilitate staff reductions. Additional consolidation opportunities within the central office should be identified by the department.

Recommendation (17). JLARC may wish to direct the Comptroller to designate the central garage as a working capital fund.

DHT's Short Range Approach to Manpower (pp. 74-82)

The *Short Range Approach to Manpower* states that it is intended to "document the steps and methodologies utilized by DHT to comply with the letter and intent of the Appropriations Act." The *Short Range Approach* is acknowledged by the department to be incomplete, however, and the department deferred some of its objectives to the long-term effort.

The JLARC assessment of the DHT staffing environment demonstrated that minimum staffing levels can and should be linked to productive and efficient operations. The analysis indicated that not all divisions and staff are uniformly operating at the productivity levels achieved in recent years. While DHT management appears to be aware that efficiencies in planning and work methods are available, the *Short Range Approach* does not specify how or whether these efficiencies will be achieved. Due to these shortcomings, the *Short Range Approach* may comply with but does not satisfy the Appropriations Act mandates.

The Human Resource Planning System (pp. 83-90)

The DHT Commissioner assembled a task force in April 1982 and charged it with developing the manpower plan. The task force, designated the Manpower Advisory Group (MAG), quickly began to develop methods and identify resources within the agency. The overall approach of the group was to develop a manpower forecasting tool incorporating work measures for most DHT employees. The Department's effort to establish a long-term manpower plan is described in the *Human Resource Planning System* . This system is intended to be a comprehensive method for linking staffing with workload and for responding to alternate funding levels.

An interactive review process was used to assess the MAG effort. JLARC staff met with the Manpower Advisory Group on five occasions to receive progress reports on the group's work. MAG also provided JLARC staff with six written status reports over the course of the year. In response, JLARC identified 11 concerns about the MAG effort in a letter report submitted to the department on August 12, 1982. At subsequent meetings and in correspondence, MAG assured JLARC that the concerns would be addressed in the manpower plan.

At this time, however, the *Human Resource Planning System (HRPS)* lacks the documentation and precision needed for compliance with the Appropriations Act mandates. How the proposed system will determine the minimum levels of staffing

needed by the department remains unclear. Consideration of alternatives to an across-the-board hiring freeze and further layoffs is incomplete. An assessment of further central office reductions to the 900 level is not contained in the document, although the assessment will apparently be conducted in 1983.

Several additional problems are evident in the *HRPS* document. First, the determination of service levels, or the types and quantities of work to be performed, may reflect current staffing rather than essential or minimum service levels. A second problem is that a means of adjusting service levels to available or forecasted revenue is not articulated in the document. Third, adjusting or validating work standards on the basis of current productivity levels may build in productivity that is at historically low levels, as shown in the field staffing analyses in this report. Finally, specific opportunities for staffing economies should be included in the *HRPS*.

Recommendation (18). The *Human Resources Planning System* should specifically include:

a) A clear and consistent definition of minimum staffing, which incorporates a high level of productivity, should be consistently used in developing the system.

b) A clearly articulated method for linking available and forecasted revenues with service levels and staffing levels. The method should address the two levels of maintenance under development by the department, and provisions for contracting to the private sector for ordinary maintenance.

c) Specific performance targets for all work standards. For example, productivity at the 75th percentile of the past highest performance could be required. Steps for achieving this higher level should be identified.

d) An assessment of the feasibility of reducing central office staffing to 900. The assessment should specify analytical methods used to determine feasibility, and be completed prior to the 1984 session of the General Assembly.

e) An identification of the relationship of productivity improvements to staffing levels. Productivity improvements should be clearly distinguished from production increases.

Recommendation (19). DHT should develop alternative methods of adjusting workforce size. Methods should include:

a) A department-wide plan for selectively implementing a hiring freeze as part of the *Human Resource Planning System*. The plan should specify the conditions under which the freeze would be invoked, and the job classifications which would be affected. The freeze should be tailored to meet maximum employment levels specified in legislation. Targeted position levels should be specified for the affected classifications. Plans should be developed for maintaining the specified levels.

b) An expansion of department policy on temporary transfers to include transfers between classifications. Classifications suitable for such transfers should be identified. Suitable training should be provided. Guidelines should be developed for district and resident engineers to follow in effecting such transfers.

Recommendation (20). DHT, with the cooperation of the Department of Personnel and Training, should review the State layoff policy as it applies to DHT, specifically considering whether individual employee productivity may be a factor in the determination of eligibility for layoff. Positions covered by work standards which incorporate productivity goals should be the focus of this review.

Recommendation (21). The implementation of DHT's long-term manpower planning system should be reviewed. A report on implementation should be made by JLARC to the appropriate legislative committees as part of the routine follow-up report to be submitted to the General Assembly by January 1, 1984.

TABLE OF CONTENTS

I. INTRODUCTION

Item 649.2 of the 1982-84 Appropriations Act requires the Commissioner of the Department of Highways and Transportation (DHT) to prepare a manpower plan. This plan is to identify both the minimum number of employees necessary to staff the programs and activities funded by the Act and the methods by which staff reductions can be expedited to meet that minimum staffing level. The plan is to specifically consider and report on the feasibility of reducing central office staff to 900 employees.

The same item also requires the Joint Legislative Audit and Review Commission (JLARC) to review (1) the planning process, (2) the plan required by law, and (3) the resulting staffing actions. This report contains the findings and conclusions of that three-part evaluation.

Monitoring the Planning Process

Throughout 1982, DHT staff assigned to prepare the manpower plan met periodically with JLARC to review progress and to expedite feedback about the planning process on an interactive basis. Six status reports were received. Two formal commentaries on the process were prepared by JLARC and sent to the department in the form of letter reports. A summary report about the planning process was made to the Commission on October 11, 1982.

On the basis of its monitoring activity, JLARC can report that DHT did initiate an active manpower planning process, which the department asserts will be capable of producing comprehensive staffing requirements based on reliable and validated workload standards. DHT's efforts to comply with the Appropriations Act are reflected in its preparation of two documents: (1) the Short Range Approach to Manpower, an interim assessment of staffing needs which DHT subsequently set aside, and (2) the Human Resource Planning System, which documents a comprehensive manpower system that the department has scheduled for implementation in July, 1983.

The report entitled Short Range Approach to Manpower was intended to comply with the legislative mandate to identify the minimum staff required to carry out 1982-84 programs and activities, but fell short of satisfying the legislature's request for an assessment of minimum staffing. Specifically, it did not address the question of reducing central office staff; nor did the staff level projected by the department for FY 1983 (10,963 FTE employees) reflect considerations of

efficiencies in planning, scheduling, or work methods. Furthermore, the department had not sufficiently examined areas of potential staff reductions. The Short Range Approach to Manpower was largely a compilation of the staffing requests from individual DHT divisions and field operations calling for 600 additional staff. Subsequent to its release, DHT acknowledged numerous inadequacies in the Short Range Approach to Manpower and set it aside as a manpower planning tool.

The department's effort to establish a long-term manpower plan and to comply with Appropriations Act requirements is described in the Human Resource Planning System (HRPS). The document describes an ambitious effort at establishing a comprehensive manpower planning system. It is not yet complete, however, and lacks the documentation and precision necessary for full compliance. For example, the document does not adequately describe how the system will aid in identifying minimum staffing or in setting minimum service levels. While the success of the HRPS will ultimately depend on how well it works in practice, its implementation would be aided by improved clarity and precision in the written plan.

Minimum Staff Levels

To enable JLARC to assess the department's manpower projections, a study was made of the current DHT staffing environment. That study -- an exercise that tested existing workload standards and staffing patterns -- concluded that the maximum employment ceiling specified in the 1982-84 Appropriations Act (10,177) is reasonable and can be achieved without inordinate staff disruptions or personal hardships. In fact, the minimum staffing levels that can be derived from productivity enhancements identified in this analysis could result in staff economies equal to between 635 and 793 staff years of effort. If these improvements are achieved, DHT maximum staffing levels can be further reduced to between 9,767 and 9,925 FTE employees, assuming as a base the actual July 1, 1982 staff level of 10,560.

All of the staff productivity improvements are independent of construction funding increases, and many staff economies can be achieved even if the department receives additional State or federal revenues. For example, although the department may receive as much as $263 million in new State funds during the 1982-84 biennium, these revenues do not signal the beginning of an increased construction program but the continuation of an existing maintenance and construction program that is already adequately staffed. If the department had not received additional funds, its staff requirement was expected to drop to 7,686 by the 1986 biennium, according to DHT's 1982-84 budget program proposal. The additional revenues, therefore, preclude the necessity for a severe staff cutback, but do not justify additional staff.

There is also increasing speculation that the State may benefit from a new infusion of federal funds for construction and maintenance. In the event these funds materialize and create opportunities for new or accelerated programs, additional staff may be necessary in certain areas examined in this report. Should this occur, it will be especially important for the department to have its manpower planning system in place and its workload standards validated.

THE DHT STAFFING ENVIRONMENT

DHT has long been one of the State's largest agencies. As other agencies and programs have been established, however, DHT's workforce has declined in a proportion to total State employment. In 1970, DHT employees represented 23 percent of all State salaried employees; by 1982, the proportion had declined to 15 percent.

Since 1978, DHT has reduced total staffing by more than 2,300 positions, or 18 percent of its workforce (Table 1). Hourly employees, typically hired as summer help, have almost been eliminated, and the number of permanent salaried employees has dropped by more than 1,300.

Table 1

DHT EMPLOYMENT TRENDS
1978-82

Year*	Hourly Employees (FTEs)**	Permanent Salaried Employees	Total
1978	1,242	11,623	12,865
1979	871	11,650	12,521
1980	432	11,620	12,052
1981	279	10,956	11,235
1982	291	10,269	10,560

*As of July.

**A full-time equivalent (FTE) equals 1,992 man-hours per year, for purposes of converting hourly employees into FTEs.

Source: DHT personnel records.

Staff reductions have occurred by means of a hiring freeze and three layoffs. Most staff reductions are the result of a freeze on filling vacancies, which was in effect until June 30, 1982. This freeze was first implemented by the DHT Commissioner in January 1980. A

statewide hiring freeze was subsequently imposed by Governor Dalton and extended by Governor Robb. To supplement the freeze, a State layoff procedure was developed. To date, 287 DHT positions have been vacated in three layoffs. The most recent occurred in June, 1982, when DHT identified 35 surplus positions and laid off 13 employees to comply with the central office staffing limit.

Most positions are located in DHT's field operations. Of the total 10,560 positions filled as of July 1, 1982, 8,293, or 78.5 percent, were in the districts and residencies. An additional 584 slots were located at toll facilities. The 1,392 central office positions filled as of July 1, 1982 represented 13.2 percent of total department staffing. Figure 1 provides an organizational chart of DHT, and indicates field and central office units.

JLARC REVIEW

The JLARC review encompassed the department's manpower plan and planning process, and assessed the DHT staffing environment in terms of existing staffing levels and above-average productivity standards. A variety of quantitative indicators of staffing efficiency were developed and used to assess DHT's manpower plans in the context of the current staffing environment. Each of the statistical standards was tested to the extent possible by examining actual field conditions.

Purpose and Scope of the Review

The JLARC review had three major objectives:

1. To determine DHT compliance with Appropriations Act staffing mandates.

2. To assess the DHT staffing environment in order to provide a basis for evaluating its manpower plans.

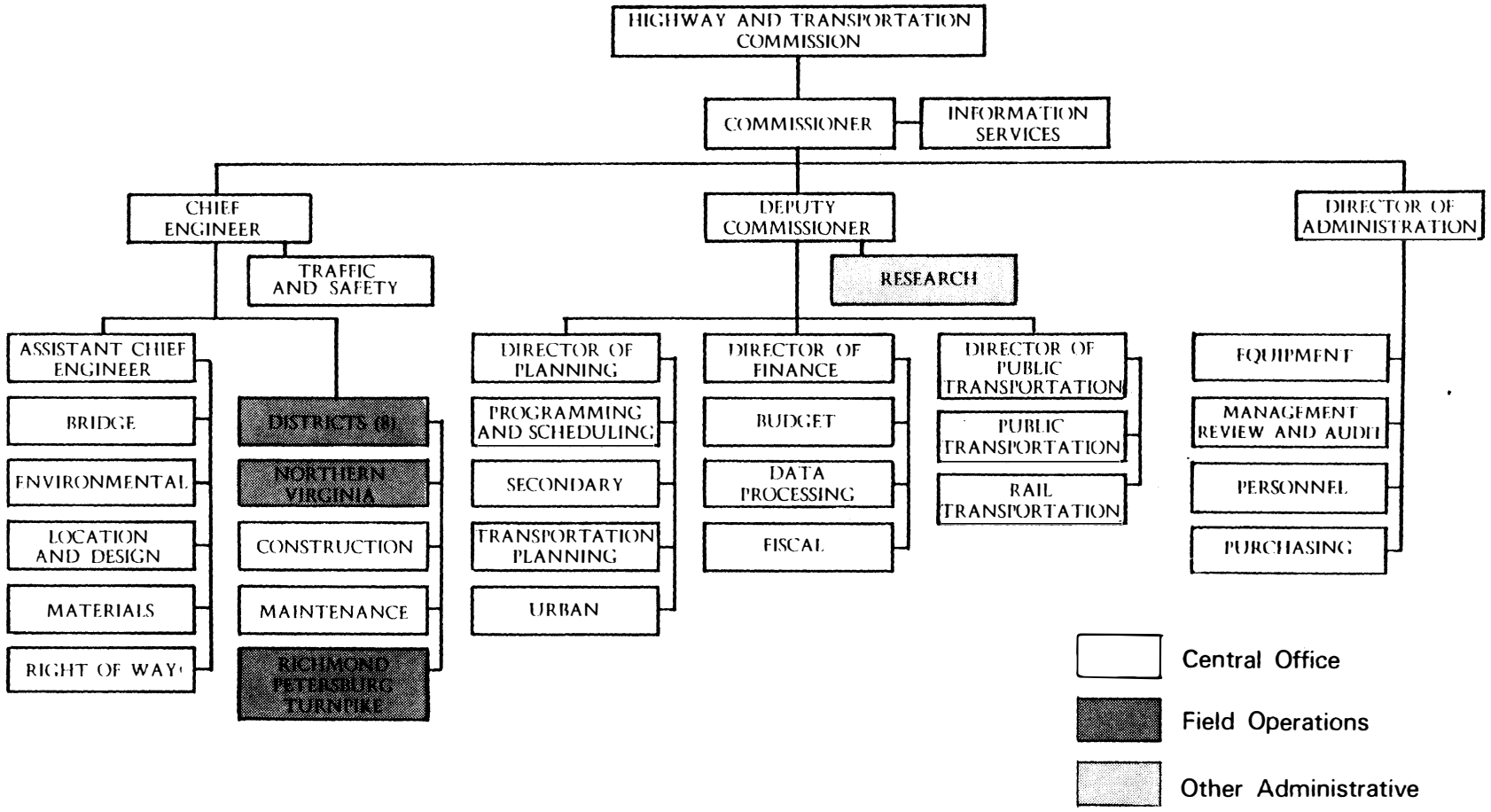
3. To evaluate the department's manpower planning process and the plans resulting from that process.

In consideration of the Appropriations Act language, this report concentrates on two areas: the minimum staffing levels and the manpower planning process.

Minimum Staffing Levels. The Act calls for the department's manpower plan to identify (a) the minimum number of employees necessary to staff funded programs, and (b) methods to expedite reductions in staff to meet minimum levels. JLARC undertook a determination of whether the department is operating at minimum staffing levels by

Figure 1

DEPARTMENT OF HIGHWAYS AND TRANSPORTATION
ORGANIZATION CHART (July 1, 1982)



reviewing the staffing environment with a series of indicators of staffing efficiency. The review also assessed the methods the department has used to effect reductions, such as attrition and layoffs.

Manpower Planning. The Act calls for JLARC to examine the department's manpower planning process, including the plan itself and the staffing actions that result.

JLARC assessed the department's long-term process and short-term plan within the context of the current DHT staffing and funding environment. The JLARC review covered approximately 5,400 construction, maintenance, and central office positions. Altogether, the review addressed 53 percent of the total DHT workforce. The analysis did encompass the new construction funds provided by HB 532, which was passed by the 1982 General Assembly.

Methodology

A variety of methods was used to assess department staffing levels and manpower planning processes.

JLARC staff established an interactive process with DHT to review the development of the manpower plan and to monitor staffing actions. The purpose of this process was to provide DHT with interim feedback on the planning process prior to the completion of the plan, and to allow adequate time for the department to respond to any concerns identified by JLARC. Six meetings were held for this purpose between May and October of 1982.

In addition, DHT provided six written status reports on the plan's development. In return, JLARC provided DHT with written comments on the planning process on August 23 and September 28, 1982. Copies of these letters are contained in the Appendix.

To carry out the staffing review, JLARC collected and analyzed data from a number of sources. The principal data collection effort aimed at assessing maintenance productivity and involved in-depth interviews with area superintendents and residency maintenance supervisors located in 13 residencies. This effort was supplemented with workload and staffing data collected from all 240 areas, 44 residencies, eight districts, and the one field division. Additional information was compiled from various functional analyses, staffing projections, annual reports, and other information prepared by the DHT divisions; from reports of departmental committees and task forces; and from staffing standards and manpower systems developed in other states.

A synopsis of methods used for evaluation follows. A more detailed discussion of methods used may be found in the text or in the Technical Appendix.

Central Office Review. The assessment of central office staffing was based on several major approaches. First, compliance with mandated staffing levels was checked against DHT payroll and personnel records. Second, several productivity and workload indicators were reviewed for applicability to DHT. Third, the feasibility of transferring activities out of DHT was assessed. Finally, workload information from numerous sources in the central office was compared with staffing levels.

Area Headquarters Assessment. JLARC's assessment of the number of area headquarters was based on an analysis of mileage figures supplied by DHT district offices and staffing figures supplied by DHT's personnel division. DHT's recent Study of Maintenance Areas was also reviewed.

Maintenance Productivity Review. JLARC's review of maintenance productivity built on findings reported in JLARC's 1981 report, Highway Construction, Maintenance, and Transit Needs in Virginia. Residency accomplishments for six routine maintenance activities were reviewed, using data from DHT's maintenance management system. Field visits and interviews were conducted in four high, four medium, and four low productivity residencies in an attempt to explain the productivity variations. Maintenance management system data and equipment data were then examined as a means of assessing problems reported by maintenance field personnel.

Inspector Staffing. To assess the appropriateness of inspector staffing, JLARC reviewed construction project summaries; interviewed several inspectors, project engineers, and other supervisory personnel; and reviewed a report of an internal task force which assessed paperwork performed by inspectors.

Preconstruction Staffing. Although preconstruction personnel are located both in the central office and in the districts, for purposes of this review the activities are discussed in the chapter on the central office. The distinction between field and central office staff positions is made where appropriate. Workload, staffing, and productivity data were reviewed for three major preconstruction divisions. Correspondence from the divisions was also reviewed to determine division staffing projections and other information.

Report Organization

This report is organized into four chapters. This first chapter has described the legislative mandate, the DHT staffing environment, staffing trends, and the study approach. Chapter II reviews the staffing environment in the DHT field organization. Chapter III assesses the staffing environment within the central office and in preconstruction units, and focuses on compliance with the staffing requirements set for the central office. Understanding the DHT staffing environment provides a framework for reviewing the department's short-term and long-term manpower plans, which are discussed in Chapter IV.

II. STAFFING OF DHT'S FIELD ORGANIZATION

Much of the business of DHT is supervised and carried out by an extensive field organization. Of all DHT permanent salaried employees, 8,877 or 86.4 percent are located in the eight districts, 44 residencies, four toll facilities, and the Northern Virginia division. An understanding of the staffing environment in the DHT field organization is critical to an understanding of the DHT manpower process and plans.

The basic structure of the field operation was validated by a management consultant retained by DHT in 1980. In a 1981 report, JLARC also supported the concept of decentralized authority and responsibility for highway programs.

Although the overall structure of the field organization has been found to be sound, the 1982 General Assembly was concerned about whether minimum staffing levels had been achieved department-wide. While the Appropriations Act did not explicitly set a staffing level for the field, a level can be derived from the Act (Table 2). If the central office were staffed at the prescribed 1,312 level, total field staffing for FY 1983 could be limited to 9,359 permanent positions. The FY 1984 limit would be 8,865 positions, if the central office remained at the 1,312 level.

Table 2

DHT EMPLOYMENT CEILINGS IN THE 1982 APPROPRIATIONS ACT

	Maximum Employment Level	Explicit Central Office Ceiling	Implicit Balance
FY 1983	10,671	1,312	9,359
FY 1984	10,177	1,312	8,865

Source: 1982 Appropriations Act.

JLARC assessed the two basic functions carried out by DHT's field organization: highway construction and maintenance. These principal activities are performed by approximately 6,000 employees, or two-thirds of all field staff.

Staffing appears to be above minimum levels in the basic field functions. Productivity of construction staff has fallen in the last few years, and an excessive variation in productivity for basic routine maintenance activities was found between residencies. If productivity levels attained by construction staff were increased to levels achieved a few years ago, as many as 228 positions would not be needed. Similarly, if maintenance employees in all residencies attained the levels achieved by the most productive locations for three major activities, between 158 and 248 positions would not be needed for those activities.

Improved productivity could result in several important benefits for DHT. The principal benefit would be reduced costs per unit of service. These cost reductions could be achieved through reduction of staffing or through the use of more efficient equipment. Productivity improvements could also lead to the provision of more or better service, and could offset future costs by reducing the cost of providing service.

Productivity gains by field staff can be expected for several reasons. First, maintenance staff work out of 240 area headquarters, which appears to be an excessive number. Second, maintenance operations do not take full advantage of current technology. Better distribution of the most efficient types of equipment would improve maintenance productivity.

Another major reason productivity gains can be expected is that increased adherence to construction division guidelines for inspector assignments and increased consistency in inspection methods should lead to improved productivity and decrease the need for inspectors.

Thus, DHT can take several steps to achieve more efficient staffing of field operations.

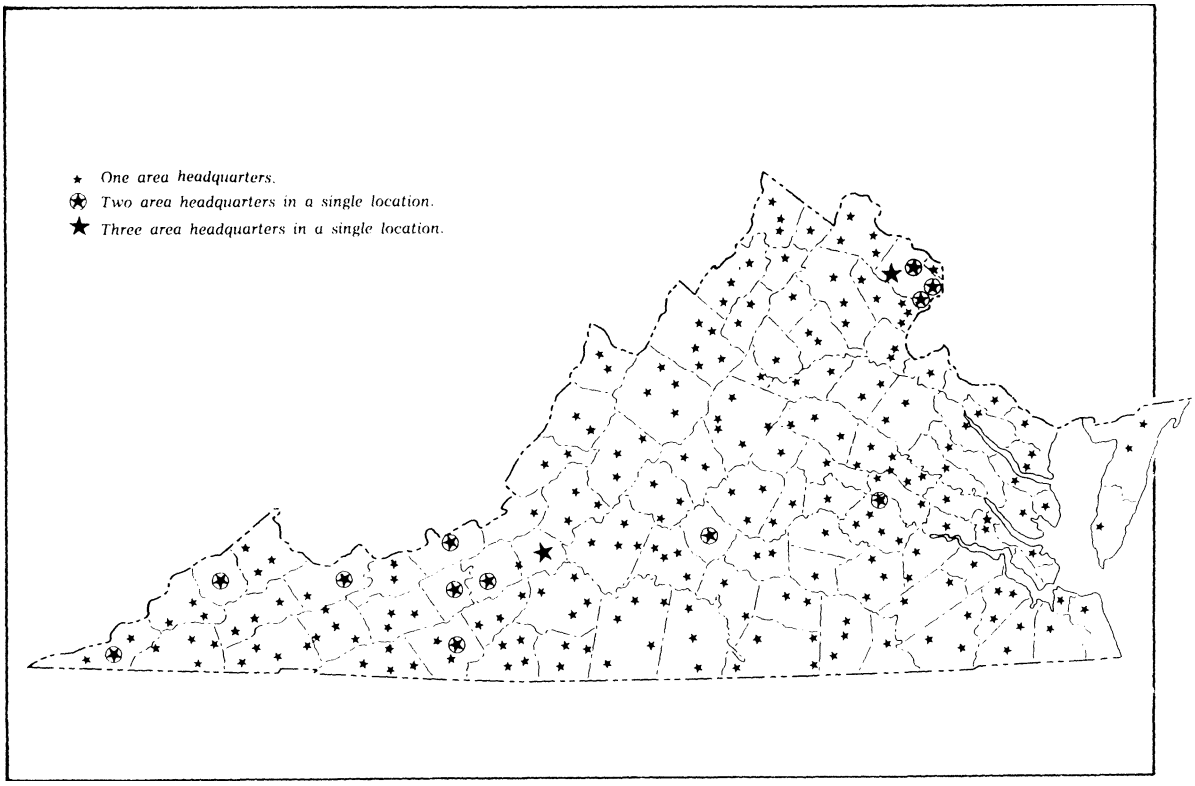
EVALUATING THE NUMBER OF AREA HEADQUARTERS

Most routine highway maintenance is the responsibility of DHT field staff assigned to 240 area headquarters in 224 different locations (Figure 2). Area headquarters typically have facilities for housing maintenance crews and equipment and for storing materials and other supplies. There is at least one area headquarters in each of Virginia's 95 counties.

The locations of area headquarters result from historical factors as well as proximity to the workload. Prior to inclusion of secondary roads in the State highway system in 1932, counties were responsible for maintaining their roads, and constructed various facilities to house the crews. Many of these sites were brought into the State system and are still in use today, although newer facilities

Figure 2

LOCATION OF AREA HEADQUARTERS



may have been constructed on the locations. After the interstate highway system was initiated in 1956, the department began locating new headquarters near interchanges to provide quick access.

Previous JLARC reports noted the fact that DHT might be able to reduce the number of area headquarters. The reports found that at least half of all area headquarters were within 10 miles of another area headquarters, and that a wide variation existed in the number of miles each area headquarters maintained. Recommendation 23 of JLARC's Highway and Transportation Programs in Virginia: A Summary Report states:

> DHT should consider increasing the mileage served by an area headquarters and corresponding reductions in the number of area headquarters and related timekeeper and area supervisor positions. The elimination of each area headquarters will reduce overhead costs by about $50,000 and should prove to have little, if any, negative effect on the responsiveness of maintenance crews.

In response to this recommendation, DHT reviewed the location of area headquarters. Eleven areas were identified for possible elimination. To date one area has been eliminated.

Reasons for not closing headquarters frequently cited by DHT staff include the age of the superintendent, travel time, capital outlay, and the need to have at least one headquarters per county. However, DHT has also developed two workload indicators for purposes of evaluating headquarters. Although DHT recently completed a study of headquarters, all areas apparently have never been systematically assessed using such indicators.

JLARC assessed all 240 areas using four criteria. First, the service area mileage guidelines from the DHT study were applied to all areas. Second, the superintendent's span of control in all areas was compared to the standard identified by DHT. A third measure, miles per worker, was developed and applied to all areas. Finally, reduction possibilities were identified on a county-wide basis, using a mileage standard which accounted for differences in maintenance effort between road systems. The JLARC analysis found that systematic application of this measure identified 23 headquarters which could be eliminated and 20 more which could be reduced to subarea status. Additional adjustments to the mileage served by headquarters were indicated in eight counties.

DHT's Area Headquarters Study

Of Virginia's 95 counties, DHT examined 17 (Figure 3) which were "believed to be the only ones in the State where areas could be reduced in number or other adjustments made." DHT's analysis concluded that reductions in only 11 counties could be made. The maintenance engineer later stated that DHT plans to make the proposed reductions in six of these counties as the superintendents retire within the next year. Reductions in the other five counties have apparently been ruled out.

DHT's study examined the following factors in determining whether reductions could be made:

1. The number of miles an area headquarters would be required to maintain. The area guideline was set at 10 miles of interstate, 38 miles of primary, and 210 miles of secondary roads.

2. The number of employees the superintendent would be required to supervise. The optimal number was set at 25.

3. The costs of travel time from a combined or new headquarters location compared to the costs of travel time from the current headquarters location.

4. The capital outlay that would be required to combine headquarters.

Figure 3

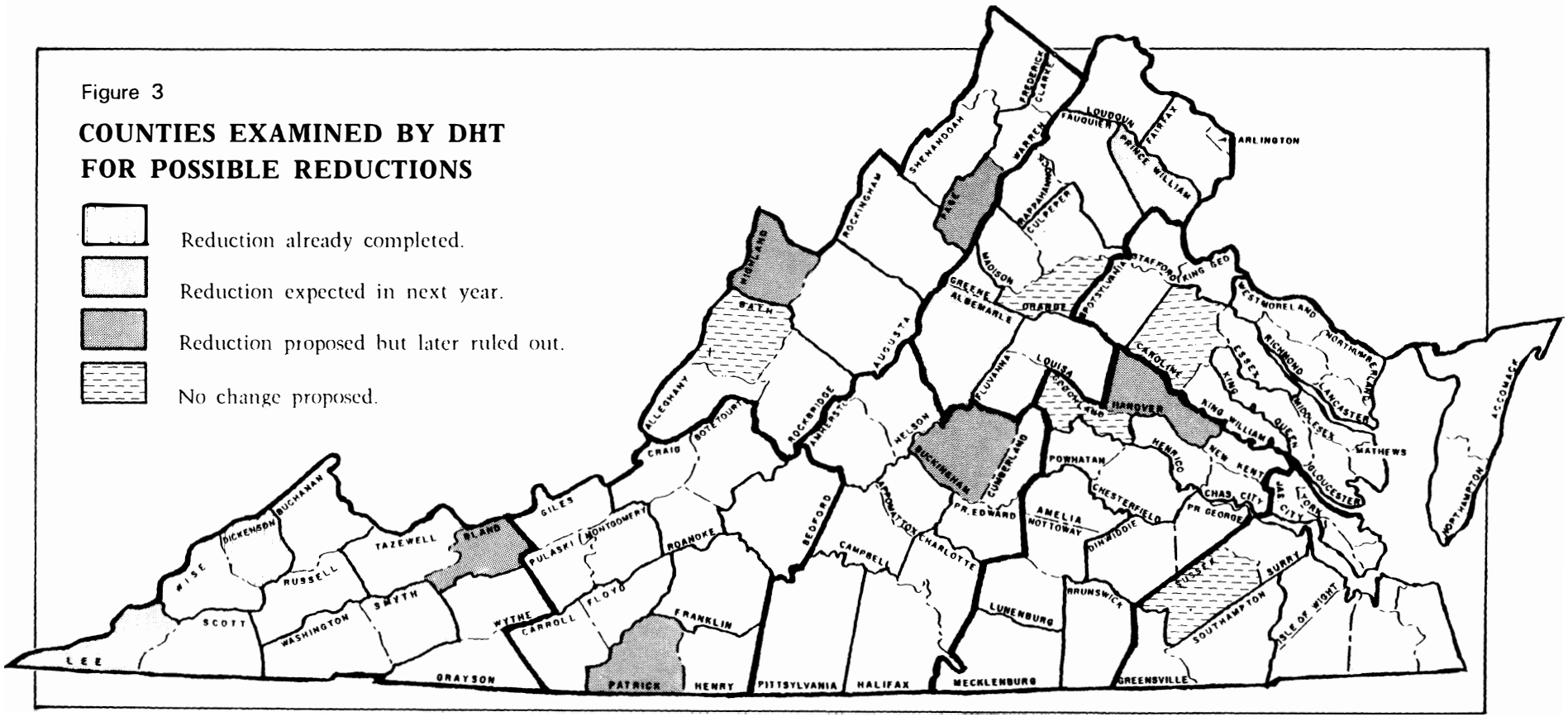
COUNTIES EXAMINED BY DHT FOR POSSIBLE REDUCTIONS

Reduction already completed.

Reduction expected in next year.

Reduction proposed but later ruled out.

No change proposed.



The DHT study was faulty for several reasons. First, DHT did not evaluate all areas. Of the 240 total headquarters, only 51 were considered for possible reductions. Second, it is not clear that options and criteria were consistently applied when assessing areas. For example:

> *The only option DHT discussed for Patrick County was whether to close Vesta headquarters or reduce it to a subarea. Closing Vesta was rejected as "it is not readily accessible from any other headquarters." The Vesta area superintendent explained that Vesta is located on top of a mountain. Although the workload is light in the summer, snow removal is so demanding that other areas have to assist. The superintendent would not, however, expect any particular problems in maintaining part of the Fairy Stone area, for example, assuming that additional workers were assigned. While closing Vesta may, in fact, be inappropriate, DHT did not explain why no other headquarters in the county were considered for closing.*

Need for Subareas. A third problem is that DHT recommended reducing area headquarters to subareas in several counties, but did not systematically consider this possibility. As a result, potential reductions were missed in at least three counties. A subarea differs from an area headquarters in that a maximum of 100 miles is maintained by a foreman and a smaller number of workers. No superintendent or timekeeper is assigned to a subarea. The subarea foreman reports to the superintendent of a nearby area.

> *In evaluating Bath, Goochland, and Lee counties, DHT did not discuss the alternative of reducing an area headquarters to a subarea. DHT simply discussed whether one or two headquarters should be located in Bath and Goochland and whether two or three should be in Lee. In each case, DHT concluded that the smaller number would be inadequate. If subareas are considered, however, reductions could be made. In Lee County, a reduction of two areas would result in an average of 275 miles for two areas, plus a 100 mile subarea. In Goochland, a 281 mile area and a 100 mile subarea could result. In Bath, one area would have 216 miles and a subarea would have 100 miles.*

DHT should give additional consideration to the downgrading of area headquarters to subarea status and consolidating staff with other area headquarters. Staffing efficiencies would result; larger crews would be available for large projects, and the property would remain available to the department for storage purposes and future expansion, if needed.

Travel Time. An additional problem with DHT's study is that it overestimates the additional travel time costs resulting from the consolidation of areas. DHT provided for only one atypical county the specific calculations of how travel time would make area consolidation inefficient. In this case DHT determined the additional expense by figuring that a 15-man crew would travel an extra 25 miles (or 40 minutes) every working day (225 days a year). DHT's calculations of the annual cost of the additional travel time are shown in Exhibit 1.

Exhibit 1

DHT'S CALCULATION OF THE ANNUAL COST OF ADDITIONAL TRAVEL TIME

$$10 \text{ manhours, or } \frac{40 \text{ minutes} \times 15 \text{ workers}}{60 \text{ minutes}} \times 225 \text{ days} \times \$8.50 \text{ salary} = \$19{,}125$$

DHT assumed in its calculations that the 15 workers, transferred from one area headquarters to the other, would be dispatched to the previous headquarters every day to perform maintenance activities. Assignments would not need to be made in this way, however. As one resident engineer explained, his area superintendents plan their maintenance activities to minimize unproductive time. Work will therefore be scheduled on the roads the crews must travel in reaching the more distant parts of the area. In some cases, workers can also report directly to the maintenance site or the previous headquarters rather than the new area headquarters.

Travel time is simply an unavoidable component of maintenance work, and does not necessarily depend on the number of miles an area must maintain. In a survey of 15 area superintendents, travel time was identified as a unique problem in only two of the 15 areas. One area headquarters was located within a city, and the other was separated from the rest of the county by a mountain range.

Capital Outlay. The DHT study considered construction costs a major deterrent to relocating area headquarters. These costs, however, are incurred only once, while the savings of closing an area would be realized each year. Expanding or constructing a new facility is therefore typically more economical, in the long run, than keeping an area headquarters open simply because it already exists.

> *According to the DHT study, the cost of expanding an existing headquarters is approximately $100,000, and the cost of constructing a new headquarters is approximately $300,000. However, savings which would offset these outlays would*

result from the elimination of the need for a superintendent, timekeeper, truck, and utilities associated with operating the headquarters facility. These savings total $44,260 annually.

Using these estimates, it would take 2.3 years to recover the cost of expanding a facility and 6.8 years to recover construction costs for a new facility. Discounting to account for the present value of these expenditures yields a recovery period of 2.4 years for expansion and 10.1 years for construction. The expected life of an area headquarters is therefore far beyond any reasonably calculated repayment period. Additional revenue could be generated by leasing or selling any land made available by closing headquarters.

In one case DHT rejected consolidation although the cost-effectiveness seemed clear:

DHT proposed reducing one of Bland County's two area headquarters to a subarea. DHT had also considered having only one headquarters for the entire county. This consolidation was rejected because of the expense of expanding Rocky Gap headquarters, estimated at $100,000. DHT calculated a $75,000 net loss the first year and $25,000 savings in each subsequent year. The expansion would therefore pay for itself in savings in four years.

County Lines. DHT has stated that assigning an area headquarters lane miles in more than one county "would complicate unreasonably the budgeting, allocation, and control of funds." However, there are currently several examples where these complications apparently have been overcome. The Oilville headquarters is located in Hanover County but maintains roads solely in Goochland County. The Zion Crossroads area headquarters maintains roads in both Fluvanna and Louisa counties. In the Zion Crossroads case, the maintenance supervisor and area superintendent both maintain that the only problem caused by this arrangement is some increased paperwork. Both agreed that the advantages in terms of more uniform mileage assignments and accessibility to roads easily compensate for the increased paperwork.

DHT could more closely adhere to its mileage standards for area headquarters if county lines were not considered absolute boundaries. Provisions for budgeting by county could be retained, as illustrated in the existing cases of cross-county areas. Provision could also be made to retain an area headquarters in each county, but with the service area expanded beyond the county lines. Because DHT's county line rule contributes substantially to the variation in mileage maintained by a single area headquarters, consideration should be given to expanding the use of cross-county areas.

JLARC Review of Area Headquarters

JLARC undertook an assessment of all 240 area headquarters. System mileage and staffing data were collected and reviewed using DHT's mileage and span of control standards, and a composite measure which addressed both of these components of a superintendent's workload.

Service Area Mileage. The first area headquarters workload indicator evaluated by JLARC uses DHT's own service area mileage guideline of 10 interstate, 28 primary and 210 secondary miles. Taking a statewide average, an area headquarters currently maintains 5 interstate, 35 primary and 183 secondary miles. It is clear that these numbers are somewhat misleading when the mix of system mileage maintained is considered. Only 73 of the 240 area headquarters maintain interstate mileage, while two headquarters have no primary and seven have no secondary mileage to maintain.

Totalling these system mileages so all area headquarters could be compared would equate a mile of interstate with a mile of secondary. This would not account for the differences in the maintenance workload between systems. A comparison between the 10 lowest-mileage area headquarters and the 10 highest-mileage headquarters illustrates the system discrepancy (Table 3). Nine of the 10 highest-mileage headquarters maintain no interstate miles; while eight of the headquarters having no primary or no secondary mileage are listed among the 10 lowest mileage headquarters. JLARC staff concluded that the DHT mileage guideline could not be accurately applied to 176 of the 240 area headquarters.

Although the DHT study used mileage as a measure of the superintendent's workload, the study did not systematically apply such measures to all counties. Consequently, some workload improvements were missed. This is illustrated by the contrast between Hanover and Caroline counties:

> *DHT asserts that area headquarters in Hanover County cannot be reduced from four headquarters and one subarea due to "the workload on the interstate mileage and the urban nature of parts of Hanover County." Hanover contains 31 miles of interstate, 90 miles of primary, and 635 miles of secondary road. JLARC's proposal involves reducing the number of area headquarters in Hanover County to three. The headquarters would then average 10.3 miles of interstate, 30 miles of primary, and 212 miles of secondary road, for on average area mileage of 252 miles. These figures are practically equal to the mileage guidelines set by DHT.*

* * *

Table 3

TEN LOWEST AND HIGHEST CASES OF MILES PER AREA HEADQUARTERS

Area Headquarters	Residency	Interstate Miles	Primary Miles	Secondary Miles	Total Miles
Ten Lowest					
Wards Corner	Norfolk	19	0	0	19
Bowers Hill	Norfolk	20	3	0	23
Va. Beach Toll Plaza	Norfolk	5	20	0	25
Columbia Pike	Fairfax	11	42	0	53
Van Dorn	Fairfax	56	0	0	56
Elko	Sandston	17	50	0	67
Dale City	Manassas	13	0	67	80
Short Pump	Sandston	28	55	0	83
Vesta	Martinsville	0	15	85	100
Ladysmith	Bowling Green	16	12	77	105
Ten Highest					
Emporia	Franklin	25	25	293	343
Accomac	Accomac	0	62	282	344
King and Queen	Saluda	0	52	294	346
Northumberland	Warsaw	0	44	303	347
Brosville	Chatham	0	39	316	355
Nottoway	Amelia	0	82	305	387
Amelia	Amelia	0	39	353	392
Westmoreland	Warsaw	0	68	327	395
Madison	Culpeper	0	159	303	462
Farmers	Bowling Green	0	84	382	466

Source: JLARC Analysis of DHT Data.

Caroline County encompasses 571 miles of State-maintained roads. This mileage is unequally divided between the Ladysmith area, which maintains 105 miles, and the Farmers area, which maintains 466 miles. The Ladysmith area superintendent told JLARC staff he could handle more mileage with his current workforce. Ladysmith already mows grass and removes snow within the Farmers area.

A review of area staffing also revealed substantial disparity. Ladysmith employs 11 workers for an average of 14 miles per worker, while Farmers has 25 workers for an average of 19 miles per worker. The mileage and workers assigned to these two area headquarters could be adjusted to more evenly distribute the work.

Span of Control. The second area headquarters workload indicator JLARC evaluated was DHT's own span of control criterion. DHT's study stated that "the ideal area would require approximately 25 employees" for one superintendent. Analysis of the filled positions in April 1982 indicated that only six of the 240 areas met or exceeded the goal of one superintendent per 25 workers. On the average, an area superintendent supervised 14 workers. The actual number of workers per superintendent ranged from five in the Vesta area of the Martinsville residency to 27 in the Eastville area of the Accomac residency. Workers included all foremen, equipment operators, and maintenance helpers. Superintendents and workers with special crews such as bridge repair and convicts were excluded. Table 4 lists the nine lowest and eleven highest areas in terms of the superintendent's span of control.

Table 4

LOWEST AND HIGHEST CASES OF WORKERS PER AREA SUPERINTENDENT

Area Headquarters	Residency	No. Workers Per Superintendent	Miles Maintained
Lowest			
Vesta	Martinsville	5	100
Bartlett	Suffolk	6	122
Columbia Pike	Northern Virginia	7	53
Glade Hill	Rocky Mount	7	271
Lake Ridge	Prince William	8	117
Pennington Gap	Jonesville	8	139
Chase City	South Hill	8	178
Patrick Springs	Martinsville	8	219
Annandale	Fairfax	8	246
Highest			
Zion Crossroads	Louisa	23	233
Emporia	Franklin	23	343
King and Queen	Saluda	23	346
Fancy Gap	Hillsville	24	289
Madison	Culpeper	24	462
Temperanceville	Accomac	25	331
Amelia	Amelia	25	392
Westmoreland	Warsaw	25	395
Farmers	Bowling Green	25	466
Accomac	Accomac	26	344
Eastville	Accomac	27	297

Source: JLARC analysis of DHT staffing data, August 1982.

Adopting a different span of control norm would suggest changing the number of areas. Because six areas achieved it, the 25-to-1 norm is not completely unrealistic. However, a preferable approach might be to set the span of control norm at the level actually achieved by the headquarters at the 75th percentile of all headquarters. Using the 75th percentile sets the norm above average performance, but not beyond what present experience indicates is attainable. This would establish a norm of 16 workers per superintendent. Given the 3,451 workers statewide, a 16-to-1 span of control would require 216 area superintendents.

Miles Per Worker. The third workload measure, miles per worker, was developed by JLARC and applied to all areas. The miles per worker measure encompasses both key factors determining an area superintendent's workload--miles to maintain as well as workers to supervise. DHT has not established a standard for the number of miles one worker should be able to maintain. Such a guide could be helpful in determining the total number of maintenance workers needed as well as the number to assign to a particular headquarters.

Using the headquarters at the 75th percentile as the norm (19 miles per worker and 16 workers per headquarters, or 304 miles per headquarters), 176 area headquarters appear to be necessary.

In determining the need for areas DHT should establish a miles per worker standard. The standard should be used as a factor in redistributing workload between areas.

Potential Headquarters Reductions

JLARC staff developed conversion factors, based on system workload differences for five major maintenance activities, as an example of how DHT could standardize area headquarters mileages. To account for workload differences between interstate, primary, and secondary roads, JLARC converted all mileage into standard or adjusted mileage. Using conversion factors tied to the labor used for five major maintenance activities over a four-year period, the mileage of the DHT standard and of all counties was adjusted. The procedures for making this adjustment are described in Exhibit 2. The DHT system mileage ideal of 10-38-210, adjusted for differences in workload, is 18-65-210, or 293 miles per area.

System mileage within all 95 counties was then converted on the basis of these factors. A range of ±15 percent of the 293 adjusted mileage ideal, or 250 to 338 adjusted miles, was set as acceptable for an area headquarters. Setting an acceptable range is preferable to setting a specific mileage target, as it provides flexibility to accommodate differences in terrain and other factors. Counties were then reviewed to identify possible headquarters reductions.

Exhibit 2

ADJUSTED AREA MILEAGE

The DHT area mileage standard includes ten miles of interstate, 38 miles of primary, and 210 miles of secondary road. JLARC adjusted these numbers to develop a mileage standard that reflects actual differences in maintenance effort required for the three road systems.

To develop a mileage standard, the actual number of manhours worked per mile for five major maintenance activities was determined for the four-year period FY 1979 through FY 1982. The total manhours per mile of interstate and primary were then divided by the total manhours per mile of secondary. This yielded factors for converting a mile of interstate and primary into "standardized" or equivalent-to-secondary units.

Activity	Manhours Per Mile of Interstate	Manhours Per Mile of Primary	Manhours Per Mile of Secondary
Skin patching	2.89	9.63	8.95
Premix patching	8.09	11.53	6.07
Tractor mowing	33.25	16.15	4.32
Machine ditching and hauling spoil	.76	5.33	5.11
Machine ditching and leaving spoil	.05	.24	.82
TOTAL	45.04	42.88	25.27

$$\text{Interstate Miles Conversion} = \frac{45.04}{25.27} = 1.78 \text{ or } 1.8 \text{ miles}$$

$$\text{Primary Miles Conversion} = \frac{42.88}{25.27} = 1.69 \text{ or } 1.7 \text{ miles}$$

System mileage in each county was "standardized" on the basis of these conversion factors. Applying these conversion factors to DHT's mileage standard yields an ideal of 293 adjusted miles.

Road System	DHT Standard	Conversion Factor	Adjusted Miles
Interstate	10	1.8	18
Primary	38	1.7	65
Secondary	210	1.0	210
	258		293

Area headquarters currently maintain an average of 251 adjusted miles. There are 47 counties and cities in which the average adjusted mileage per area is below the ideal range. These localities appear to be the most likely places where area headquarters can be eliminated or downgraded to subareas, thus eliminating the need for superintendents, timekeepers, and trucks. Table 5 lists the current and proposed distribution of headquarters within these localities.

This analysis indicated that there are 39 localities in which 23 headquarters should be closed and 21 in which headquarters should be reduced to subarea status. In four of these localities, the elimination of area headquarters would result in service areas that are slightly above the mileage standard. This may be possible, inasmuch as 13 localities already have service mileages greater than the top of the range. In eight localities, consideration should be given to consolidating the area with an adjoining area. Although this analysis does not specifically pinpoint which headquarters should be eliminated, it does identify which localities should be considered for reduction possibilities. Additional factors should be considered in determining the specific headquarters for elimination or consolidation.

Table 6 lists the area workload measures and the reductions that could occur from applying the measures. DHT should develop conversion factors which account for the workload variation between the interstate, primary, and secondary road systems. These factors should be consistently applied to the service mileage of all area headquarters to determine reduction potential. DHT should also consider closing at least 23 area headquarters, and assess closing as many as 64 headquarters. This would result in staffing reductions of 23 to 64 superintendents. In high-growth areas, headquarters identified for closing should be closed and the land retained to provide for possible future expansion. If 23-64 superintendent positions were eliminated, the savings in salaries would range from $408,000 to $1.5 million annually, including fringe benefits.

Reducing The Need For Timekeepers

Most timekeepers work within one area headquarters and are responsible for recording labor, equipment, materials used, and work performed on sections of road. They also receive road information and public complaints by telephone. DHT employed 189 timekeepers within area headquarters in April 1982.

Previous JLARC reports have recommended substantially reducing the number of timekeepers statewide. The final report on the Organization and Administration of DHT stated:

> If [the] practice of using one timekeeper in each county were used throughout the State, the complement of timekeepers could be reduced from approximately 233 to about 100.

Table 5

POTENTIAL HEADQUARTERS REDUCTIONS

County	CURRENT Areas	CURRENT Average Adjusted Mileage	PROPOSED Areas/Subareas*	PROPOSED Average Adjusted Mileage
Albemarle	5	202	4	253
Alleghany	2	232	1/1	364/100**
Amherst	3	242	2/1	314/100
Bath	2	184	1/1	269/100
Bland	2	188	1/1	276/100
Botetourt	3	244	2/1	316/100
Buchanan	3	191	2	287
Buckingham	3	241	2/1	312/100
Campbell	4	204	3	271
Charles City	1	203	Consolidation potential***	
Chesapeake****	1	41	Consolidation potential***	
Chesterfield	5	226	4	282
Cumberland	2	189	1/1	278/100
Dinwiddie	3	238	2/1	308/100
Fairfax	10	229	8	286
Floyd	3	237	2/1	306/100
Frederick	3	239	2/1	309/100
Giles	2	227	1/1	354/100**
Goochland	2	227	1/1	354/100**
Grayson	4	209	3	279
Greene	1	218	Consolidation potential***	
Hanover	5	169	3	281
Henrico	2	130	1	260
Highland	2	168	1/1	236/100
Isle of Wight	3	208	2	312
James City	2	208	1/1	317/100
Lee	4	181	3	241
Loudoun	4	226	3	301
Mathews	1	194	Consolidation potential***	
Middlesex	1	226	Consolidation potential***	
Montgomery	3	200	2	300
Norfolk****	1	35	Consolidation potential***	
Page	2	196	1/1	291/100
Patrick	4	199	3	265
Prince George	2	205	1/1	310/100
Prince William	5	163	3	271
Roanoke	3	226	2/1	289/100
Rockbridge	4	226	3	302
Russell	3	248	2/1	322/100
Scott	4	215	3	286
Smyth	4	162	2/1	274/100
Stafford	2	233	1/1	366/100**
Tazewell	3	226	2/1	289/100
Va. Beach****	1	43	Consolidation potential***	
Wise	3	183	2	274
Wythe	3	219	2	328
York	1	204	Consolidation potential***	
TOTALS	136		93 areas, 21 subareas	

*Subareas are assigned 100 adjusted miles in this analysis.
**Consideration should be given to exceeding the 293 mile standard in this county.
***Consideration should be given to consolidating one or more areas in this locality with areas in adjoining localities.
****A city wherein an area headquarters is located.

Table 6

POTENTIAL HEADQUARTERS REDUCTIONS
BASED ON WORKLOAD MEASURES

	Potential Headquarters Elimination
Span of Control	24
Miles per Worker	64
Standardized or Adjusted Mileage	23 + 21 downgraded to subareas
Range:	23 - 64

Source: JLARC

Timekeepers' Duties. Timekeepers assigned to single area headquarters now frequently perform tasks outside of their job description to keep busy. During field visits to area headquarters, JLARC staff learned that timekeepers actually perform a wide variety of tasks across the State. These tasks include mowing the headquarters lawn, repairing equipment, loading trucks and assisting crew with road work.

> *One resident engineer stated that the timekeeper's assigned duties requires a maximum of two hours of work a day.*
>
> * * *
>
> *An area superintendent asserted that collecting all the information necessary for reporting to the residency and central office took no more than 15 minutes each day.*

The number of timekeepers could be reduced further through consolidation at residency headquarters.

It appears that the timekeepers' function as currently assigned is not always a full-time job. JLARC staff surveyed 15 area superintendents and 12 resident maintenance supervisors concerning the duties performed by their timekeepers. When the areas which have moved their timekeepers into the residency office are excluded, nine of 12 area superintendents and seven of ten resident maintenance supervisors stated that their timekeepers perform duties other than "keeping records, filling out reports, answering the telephone and taking road information and requests." The additional duties performed included a variety of tasks such as issuing gasoline, substituting for the mechanic, cleaning around the lot, mowing grass, assisting crews with road work and snow removal, operating loaders, getting deer out of the road, counting traffic, and running errands.

None of these tasks are listed in the timekeeper's job description from The Timekeeper's Handbook revised by DHT in January 1980:

> The timekeeper's job is one of the most important jobs in the Residency. He/she is responsible for preparing various cost documents for his/her superintendent and keeping records which will enable the superintendent to know his financial status. The timekeeper is responsible for keeping time for the employees on the A-7's (timesheets); time worked by equipment on the ED-7's (equipment rentals); maintaining fuel records; and for charging out materials and accomplishments on the A-19's (Stock Materials Issue and Accomplishment Report.) In some instances he/she will report time worked by convicts on the Form A-8 (Report of Convicts). In most cases he/she will have to report time worked for hired equipment on the Form A-7.
>
> The timekeeper is also responsible for keeping a record of current balances for various budget items for his/her area. He/she will sometimes be asked to keep a record of various other expenditures (such as current balance for Ordinary Maintenance on Primary, Secondary, and Interstate; Accounts Receivable; a special record on cost of snow removal which would include cost of labor, indicating whether it is salaried, hourly, hired equipment, overtime, cost of equipment, and cost of materials, showing types of materials used).
>
> He/she prepares leave application for employees and keeps a record of their sick leave and vacation, both earned and taken.
>
> Finally, and not the least important, he/she answers the telephone and takes road information and requests.

The cost-effectiveness of having timekeepers perform tasks that could be periodically performed by equipment operator A's and maintenance helpers is questionable when the salaries of these workers are compared. Timekeeper is a grade 4 position ($9,749 - $13,309) while equipment operator A is a grade 3 ($8,911 - $12,175) and maintenance helper is a grade 1 position ($7,460 - $10,192).

Centralization of Timekeepers. Five of the six residencies within the Salem District have moved timekeepers into the residency office, thereby reducing the total number of timekeepers needed. Christiansburg, for example, has three timekeepers in the residency office who serve seven areas. Superintendents phone in the necessary information to the timekeepers daily. In Bedford, two timekeepers serve four areas. No loss of service to the public has been reported with this arrangement. In both residencies, the public calls the

residency to make comments or complaints. Based on the Bedford experience, where there are half as many timekeepers as there are areas, between 87 and 114 timekeepers could be eliminated statewide. This would generate annual savings of $990,582 to $1.7 million in salaries and fringe benefits.

DHT should reduce the current number of timekeepers by housing them in residency headquarters and by increasing the number of employees, materials, and equipment that each timekeeper must account for. Considering that a timekeeper's assigned duties should be consistent throughout the State, there is reason to believe that centralization would result in a reduction in the number of timekeepers needed throughout the State.

MAINTENANCE PRODUCTIVITY

Highway maintenance accounts for $263.4 million, or 28 percent, of the FY 1983 DHT appropriation. Approximately 5,200, or 50 percent, of all DHT employees are in maintenance-related classifications. As new roads are constructed in the State, and as other roads in the highway system age, the maintenance program may grow substantially. Because maintenance represents a major component of DHT's overall mission, and because maintenance workloads may grow in the future, JLARC undertook a review of maintenance productivity and efficiency. Productivity improvement was viewed as a method DHT could use to identify staffing efficiencies for the present, and to reduce the need for new staff in years to come.

A review of six major maintenance activities found that although productivity could be improved for all six, targeting three activities (skin patching, premix patching, and machine ditching) for a productivity improvement program would provide an adequate basis for projecting possible economies. The remaining three activities were excluded from position economy estimates, because convict crews provide most of the labor for brush cutting and hand cleaning ditches, and time constraints precluded a thorough review of tractor mowing.

Productivity Analysis

The JLARC report Highway Construction, Maintenance, and Public Transit Needs in Virginia identified a wide variation between residency productivity rates for several ordinary maintenance activities. According to a JLARC regression model, the amount of work accomplished in the residencies was largely explained by the resources which were used to perform the activities. Therefore, the extent of productivity variation suggested that many residencies were not using efficient practices to perform their work.

JLARC reviewed productivity for six activities: spot sealing and skin patching, premix patching, machine ditching, tractor mowing, hand cleaning ditches, and brush cutting. These maintenance activities

were chosen because more money and more man-hours are spent on them than on other routine maintenance activities (Table 7). While these six activities represent a significant portion of the routine workload of area headquarters, they accounted for only 27 percent of all ordinary maintenance expenditures not devoted to snow and ice control during the 1978-80 biennium. Therefore, significant additional economies may be identified if more activities are reviewed.

Maintenance data for FY 1979 and FY 1980 was used to evaluate the productivity of DHT residencies for each of the six selected activities. Three measures of productivity were used: expenditures, man-hours, and equipment-hours per unit of quantity produced. High, medium, and low productivity performance by the residencies were identified for each activity. A residency was rated either high or low in productivity for any activity if the quantity of work accomplished was two standard errors above or below the mean on all three productivity measures for at least three of the six activities.

All 45 residencies were then stratified into three groups: high, medium, and low productivity. Residencies stratified as high or low in productivity were high or low on all three productivity measures for at least three of the six activities reviewed. All other residencies were stratified as medium in productivity. Further description of the stratification procedures is contained in the technical appendix.

According to the analysis, there were four high productivity residencies, 34 medium productivity residencies and seven low productivity residencies in the State. The residencies and their productivity levels are shown in Figure 4.

JLARC staff selected 12 residencies for site visitation and review. All four high productivity residencies were selected. The four medium productivity residencies were chosen by a random sampling procedure as were four of the seven low productivity residencies.

Table 7

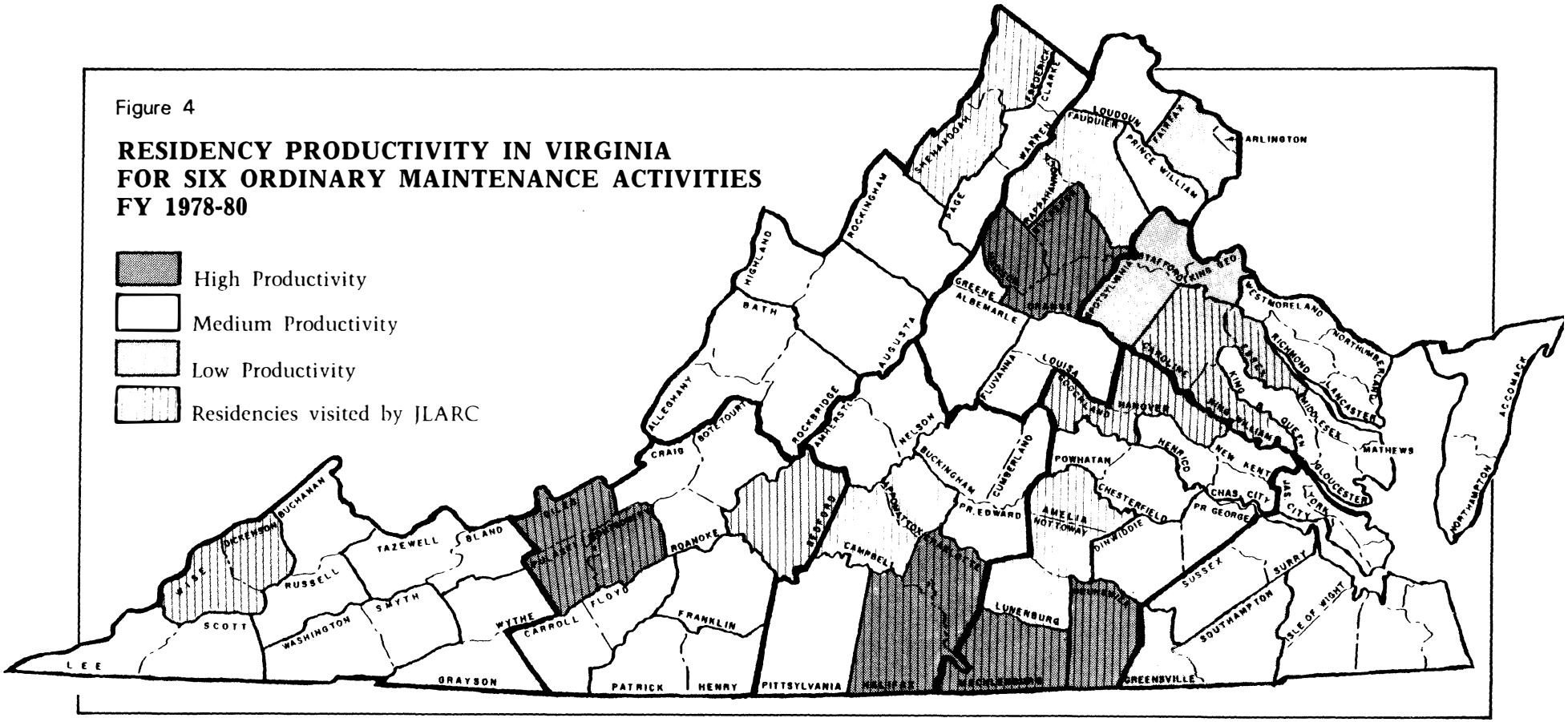
MAN-HOURS AND COSTS OF ACTIVITIES SELECTED FOR REVIEW
(1978-80 biennium)

Activity	Total Man-Hours	Total Cost
Spot sealing and skin patching	880,957	$13,613,149
Premix patching	734,876	10,786,105
Tractor mowing	711,975	6,963,712
Hand cleaning ditches	691,103	2,350,565
Brush cutting	690,164	3,098,737
Machine ditching and hauling spoil	543,997	5,680,315
	4,253,072	$42,492,583

Source: Maintenance Division performance reports, 1979 and 1980.

Figure 4

RESIDENCY PRODUCTIVITY IN VIRGINIA FOR SIX ORDINARY MAINTENANCE ACTIVITIES FY 1978-80



JLARC staff then visited these twelve residencies in order to identify factors which might cause variations in performance on the selected activities. The maintenance supervisor and the area superintendents in the residencies were interviewed and maintenance crews were observed.

Skin Patching. Skin patching involves placing a light application of emulsified asphalt on a road surface and covering it with stone. The purpose of this activity is to seal cracks in order to prevent moisture from weakening the pavement. A JLARC staff review indicated that the key factors in explaining residency productivity for this activity appear to be the size of the crews and the type of equipment used to apply the material.

For skin patching, productivity economies of between 70 and 88 FTE positions could be realized if medium and low productivity residencies achieved the level of performance of residencies representative of high productivity levels in the 1978-80 biennium, assuming that quantities achieved remained constant. At the level of the upper bound of the high productivity residencies (in this case the second highest productivity residency), for example, the low productivity residencies would need 82,900 fewer man-hours per year (45 FTE's) over the biennium to achieve the same quantity, and the medium productivity residencies would need 79,300 fewer man-hours per year (43 FTE's). The DHT Manpower Advisory Group has determined that the average department employee works 1,832 man-hours a year. Using this figure, the low and medium productivity residencies could achieve staffing economies of up to 88 positions. At the bottom bound of the highest productivity residencies (the ninth highest residency in productivity for this activity), the low and medium productivity residencies could achieve staffing economies of up to 70 positions. A reduction of 70 to 88 equipment operator positions could save $728,000 to $1.2 million annually in salaries and fringe benefits.

The equipment used for skin patching has a significant bearing on productivity. Equipment inventories for June 30, 1982 showed that DHT had 256 tar kettles with capacities of 500 gallons or less, 101 pull-type distributors with 600-gallon capacities, and 40 truck-mounted units with 800- to 1,000-gallon capacities. Maintenance areas are not charged rental fees when they use the older, lower-capacity tar kettles. For this reason, many superintendents visited in the field stated that the smaller tar kettles were cost-effective.

However, greater productivity could be obtained if residencies used large-capacity distributors with spray bars instead of small tar kettles. Tailgate spreaders could also aid productivity for skin patching. Examples of how these two types of equipment could improve the productivity of skin patching follow:

> *Culpeper superintendents use the distributor for virtually all the patching they do. The residency's performance was high on all three productivity measures. On labor productivity, the residency's rate for FY 1979 and 1980 averaged .80*

man-hours per quantity unit, the highest in the JLARC sample and second-highest in the State. The residency's labor productivity rate in FY 1982 was also outstanding, at .77 man-hours per quantity unit.

* * *

Superintendents in Wise stated that they moved from hand spraying to spray bars about three years ago. For FY 1979, Wise's labor productivity rate was 2.67 man-hours per quantity unit; by FY 1982, it was 2.25 man-hours per quantity unit.

* * *

Bedford had one of the lowest labor productivity rates in the State for skin patching from 1978 to 1980, 4.08 man-hours per quantity unit. The Bedford maintenance supervisor said that within the last three years, the residency acquired a distributor and a tailgate spreader. The labor productivity rate improved to 2.89 man-hours per quantity unit in fiscal year 1982.

Lack of proper equipment can hurt patching productivity, as shown in this case:

In Bowling Green, the only distributor in the residency was taken away in FY 1982. The residency had not been doing particularly well in skin patching during FY 1979 and FY 1980, with an average labor productivity rate of 3.74, and the fact that the distributor was not used to the utilization standards may be part of the explanation. However, once the distributor was taken away, labor productivity predictably declined to 5.05 in 1982.

The size of skin patching crews also appears to affect productivity. All of the residencies JLARC surveyed indicated that large crews with distributors tend to be most efficient. The range that supervisors and superintendents stated was most efficient was from six to 13 workers. Maintenance personnel in two low productivity residencies visited, however, stated their areas did not have the manpower to staff most efficiently for patching operations with distributors. This did not seem to be a problem in the high productivity residencies visited. In Culpeper, for example, the areas of the residency shared workers so that large 13-member patching crews could be put together. Culpeper residency personnel argued that crews of this size using distributors were very productive.

In the 1978-80 biennium, the residency with the highest productivity on the man-hour measure achieved more than 10 times the skin patching production rate of the residency with the lowest productivity. The range in productivity for this activity across the State was from 0.52 to 5.68 man-hours per ton. In that biennium, 880,957 man-hours were used statewide to put down 403,921 tons of material, or an average of 2.2 man-hours per quantity unit.

For skin patching, nine residencies were high in productivity, 26 residencies were medium in productivity, and ten residencies were low in productivity by the expenditure, labor, and equipment use measures. The residencies high on all three measures achieved 35% of statewide patching production with 23% of the total man-hours devoted to the activity, while the residencies low on all three measures achieved only 16% of production with 29% of the man-hours.

Premix Patching. This activity involves patching the road surface with commercial or shop-prepared mixes, which may be cold or hot. The purpose of this activity is to correct road defects such as potholes and depressions that are greater than one inch in depth. JLARC field investigation found that several factors could affect patching productivity, including the distance which the premix has to be hauled to the job site, the number of operators assigned, and the availability of rollers and pavers for the job.

For premix patching, staffing economies of between 69 and 118 FTE positions could be realized if medium and low productivity residencies achieved the level of performance of the second and sixth highest productivity residencies (the next-to-the-highest and the lowest of the high productivity residencies, respectively) in FY 1978-80, assuming that quantities achieved remained constant. At these higher productivity levels, the low and medium productivity residencies would need between 126,700 and 217,400 fewer man-hours per year over the biennium to achieve the same quantity. Salary and fringe benefit savings could total in $718,000 to $1.7 million annually.

Greater productivity could be achieved, for example, if areas sent out their trucks to get premix material from asphalt plants early enough to make it available for the patching crews shortly after they arrived on the job site. The two following examples illustrate the problem:

> *In one residency with low productivity for premix patching, the maintenance personnel noted that they faced a problem because trucks are loaded at the asphalt plant on a first-come, first-serve basis. Truck drivers in the residency did not leave for the asphalt plant until after the work day began, at 8:00. JLARC staff observed a premix patching operation in one of the areas of the*

residency. Four crew members waited until 9:30 for the truck with the premix to arrive. Maintenance personnel said that it would not be unusual for their trucks to return as late as 10:30.

* * *

The crews of another low productivity residency on premix patching travel a long distance to pick up premix. The maintenance supervisor said that his truck drivers would leave at seven in the morning to pick up the material, and would not get back to an area until ten. The supervisor stated that this situation reduced the productivity of his crews.

In both of these cases, productivity could be improved if the truck operators picked up the premix material earlier in the day.

It appears that the size of the crews assigned to premix patching also affects productivity. While small crews may be efficient for minor patching repairs, the experience of the high productivity Culpeper residency indicates that large crews are efficient for most work. Culpeper accomplishes its premix patching work with only 59% of the statewide average number of man-hours per quantity unit. The superintendents typically assign nine to twelve operators for the work. The residency also runs a large hot mix specialty crew in each area for one entire week. Other residencies visited by JLARC staff did not typically assign crews of this size.

Finally, in many of the residencies surveyed, the areas had trouble getting rollers or pavers when needed for premix patching. The operators therefore had to use motorgraders. The evidence suggests that residencies obtain higher productivity with rollers than with motorgraders, and produce at even higher levels with pavers rather than with rollers. Two low productivity residencies used motorgraders frequently for premix patching:

In one low productivity residency, area superintendents expressed dissatisfaction because there was only one roller in the residency. They said that time was wasted when motorgraders had to be used.

* * *

In another low productivity residency, residency personnel favored the use of motorgraders over pavers for premix patching.

Higher productivity residencies used rollers and pavers whenever possible:

> *In a medium productivity residency, the maintenance supervisor said that the residency had improved productivity after starting a program in which they rent a paver from a private construction firm. The supervisor stated that the paver was cost-effective and increased productivity. He also said there was little problem with broken-down time because it was easy for the private concern to get parts. The superintendents in the residency originally did not like renting the paver because its use "required more planning." However, the supervisor said that when the superintendents saw the results (improved work quality and quantity), they all agreed the program should be continued.*
>
> * * *
>
> *Superintendents in the high productivity Culpeper residency said they try to use a district-wide paver as much as possible. They claimed that the paver is "quicker," produces "a better end product," and requires fewer people to perform the activity.*

In the 1978-80 biennium, the residency with the highest productivity on the man-hour measure for premix patching achieved more than 16 times the production per hour of labor of the residency with the lowest productivity. The range in productivity across the State for premix patching was from 0.7 to 11.5 man-hours per ton. In that biennium, 734,876 man-hours were used statewide to put down 299,331 tons of material, or an average of 2.5 man-hours per quantity unit.

For premix patching, six residencies were high in productivity and eight residencies were low in productivity on the expenditure, labor, and equipment use measures. The residencies which were high on all three measures produced 27% of statewide premix patching production with 17% of the man-hours, while the residencies low on all three measures achieved only 16% of production with 26% of the man-hours.

Machine Ditching. JLARC staff assessed productivity levels for machine ditching and hauling spoil. This activity involves the cleaning and reshaping of roadside ditches. Debris or spoil is loaded onto trucks and hauled away from the job site. The purpose of this activity is to maintain ditches which are adequate to handle flows of water during rainy periods.

For machine ditching and hauling spoil, staffing economies of between 19 and 42 positions could be achieved if medium and low productivity residencies improved upon the productivity levels achieved in

the 1978-80 biennium, assuming that quantities remained constant. The resulting position reductions could result in $198,000 to $597,000 annual savings in salaries and fringe benefits. The residency with the highest productivity on this activity achieved almost five times the production of the residency lowest in productivity. The range in productivity across the state for machine ditching was from 10.9 to 51.3 man-hours per ton. In the 1978-80 biennium, 543,977 man-hours were used statewide to clean and reshape 26,471 miles of ditches, or an average of 20.6 man-hours per quantity unit.

For this activity, thirteen residencies in the State were high in productivity, 15 residencies were medium in productivity, and 17 residencies were low in productivity on all three resource measures. The residencies rated high on all three measures achieved 43% of the statewide machine ditching production with 33% of the total man-hours devoted to the activity, while the residencies rated low on all three measures achieved only 24% of production with 33% of the man-hours. Field investigation indicated that productivity could be increased statewide for machine ditching and hauling spoil if large crews, county- or residency-wide specialized ditching crews, and paddle pans were used more.

In three of the residencies visited, maintenance supervisors and superintendents stated that they had very efficient machine ditching programs.

> *Superintendents in Culpeper stated that their ditching program was successful because they assigned large crews to ditching jobs. A typical ditching crew in the residency would be composed of 12 workers plus two individuals to clean out pipe. The reason that such a large operation works well, the superintendents indicated, is because they use a large number of trucks to pick up the spoil from an Athey loader. The Athey loader scoops spoil off the road on to a conveyor belt, which elevates the spoil so it can be dumped onto the back of trucks. Usually the Culpeper superintendents have five trucks to pick up the spoil so the Athey loader can be kept running.*
>
> *The residency could staff and equip such a large operation because they had assembled a residency-wide ditching crew to perform the ditching in prime ditching months. All superintendents cooperated in providing staff and equipment for the operation when needed.*
>
> * * *
>
> *In Edinburg, the maintenance supervisor said that they had a "good ditching program," and an important part of the reason in his opinion was*

that they had specialized county ditching crews, with an Athey loader specialist floating throughout the residency. As the operators performed ditching routinely, they became more efficient.

* * *

In South Hill, a paddle pan is used instead of an Athey loader with dump trucks. A paddle pan has buckets with which it loads the spoil. When the pan is full, the unit is driven to a spot where the spoil can be dumped. The paddle pan is limited in its application because it is not efficient when the spoil has to be hauled long distances, and because it is too heavy to drive over some roads. However, the maintenance supervisor in South Hill said that where it can properly be used, a paddle pan is extremely efficient because it eliminates the need for several dump trucks and their drivers.

Maintenance data tended to support the belief of these maintenance personnel that they had efficient ditching programs. All three residencies were high in productivity for machine ditching and hauling spoil for all three measures. While the statewide average during the 1978-80 biennium was 20.5 man-hours expended per mile ditched, Culpeper used 14.9 man-hours, Edinburg 17.4, and South Hill 15.1.

While Culpeper superintendents suggested that very large ditching operations were most productive, all maintenance personnel surveyed also felt that, in theory, sizable ditching crews were most efficient. In the twelve residencies which JLARC staff visited, eight workers were the fewest that any maintenance supervisor or superintendent stated would be most efficient for machine ditching and hauling spoil. However, not all of these residencies used eight workers. The fact that the use of small crews can hurt ditching productivity is illustrated in two residencies:

In Bowling Green, the area superintendents said that sometimes ditching in their residency is performed inefficiently because they only have five or six men and three trucks at their disposal. Workers apparently are not shared between areas in the residency, and unexpected worker absences particularly disrupt ditching operations.

* * *

In Warrenton, JLARC staff observed a ditching crew which included just five operators and two trucks. A foreman on the job said that only two trucks were being used because the place to dump the spoil was close. However, the Athey loader

operator had to stop and wait for the trucks to return between hauls. It appeared that the use of three or even four trucks would have been more efficient.

Bowling Green and Warrenton were both low in ditching productivity for all three productivity measures. The two residencies expended 28.3 and 31.3 man-hours, respectively, per mile ditched.

Although productivity for machine ditching and hauling spoil could be improved statewide with the increased use of larger crews, county- or residency-wide operations, and paddle pans, the greatest maintenance productivity improvement in machine ditching overall may be achieved by hauling less spoil. Sixty-six percent of all machine-ditched spoil in Virginia was hauled during the 1978-80 biennium, and there was a fairly wide variation in the proportion of spoil that was hauled in residencies of similar terrain and population densities. Increased efficiency and staffing reductions could be attained if less spoil were hauled, since maintenance data indicates that a mile of machine ditching typically takes about 20 man-hours when the spoil is hauled and fewer than five man-hours when it is not.

The JLARC Needs report stated that the cost of machine ditching could be reduced in many cases through the use of rotary ditchers. A rotary ditcher eliminates the need for hauling the spoil. Instead, material is thrown back onto banks, or into woods and fields. Although rotary ditchers cannot be used in areas which are densely populated or where the soil is rocky, they have more application than at present:

The Bowling Green maintenance supervisor, for example, said that he was trying to negotiate a trade with the DHT Equipment Division -- one of his two Athey loaders for a rotary ditcher. The supervisor stated that 50% of the spoil in his residency would not have to be hauled if the residency had a rotary ditcher. To get a rotary ditcher, the supervisor was willing to give up an Athey loader, even though that loss may place his residency in a bind if the remaining loader breaks down. The increased efficiency of a rotary ditcher is, in the supervisor's opinion, a benefit that outweighs the risk.

Methods Improvement Program

The JLARC Needs report noted that increased maintenance productivity could be promoted through a statewide methods improvement program. Field visits for this report indicated that residencies differ in their management techniques and in the practices they use to perform maintenance activities. This variation provides an opportunity

for the maintenance division to design experiments to test the productivity of various techniques, and to make recommendations to the field based on the findings.

The DHT maintenance division has a management system which generates the data upon which a methods improvement program could be based. Information from the field on quantities of work accomplished and man-hours and dollars expended are printed out monthly. However, several factors seem to prevent an effective review of productivity by the division. First, the computer program on maintenance performance is designed to merely report the data -- it does not sort out high or low performances, or compare the productivity of areas, counties, and residencies. Second, maintenance division personnel devote limited time to assessing reasons for productivity variations.

A third factor is that division personnel have limited motivation to review productivity, both because their primary concern is with the total maintenance budget and because they believe that uncontrollable problems such as weather or traffic conditions are the principal cause of productivity differences. A fourth factor is that division personnel use labor rate and cost performance standards (man-hours and dollar per quantity) to determine if district and county productivity levels are satisfactory or unsatisfactory, but they do not attempt to evaluate what the best achievable productivity levels would be for field units. Finally, productivity standards are in many cases not set high enough to call attention to performance which needs to be improved. For example, the labor productivity standard for premix patching is 6.0 man-hours per ton on interstate roads, 4.0 man-hours per ton on primary roads, and from 3.5 to 5.0 man-hours per ton on secondary roads. However, the statewide average for premix patching on all roads over the 1978-80 biennium was only 2.5 man-hours per ton.

A review of productivity by the DHT maintenance division could include an assessment of a number of factors which appear associated with improved productivity. As discussed previously, the type of equipment used for patching and ditching is a key factor in productivity. By considering the productivity of various crew sizes, and by ensuring a better distribution of the most productive types of equipment, the methods improvement program could improve productivity. In addition, several other factors were identified by JLARC staff and should be assessed in the methods improvement program.

Planning and Scheduling. To ensure greatest productivity, superintendents must plan for full utilization of the crews and anticipate contingencies that may require plans for alternate work. The JLARC report on Highway Construction, Maintenance, and Transit Needs in Virginia concluded from interviews with maintenance division personnel and resident engineers that much improvement was "needed in the ability of area superintendents to plan and schedule activities for their crews."

Fieldwork for this report reaffirmed the need for detailed written planning by superintendents and the need for communicating these plans to foremen if productivity is to be improved.

One barrier to the implementation of county or residency-wide specialty crews like the ditching operation in Culpeper is the desire of area superintendents to avoid extensive interarea planning.

* * *

In one low productivity residency, the foreman out with a patching crew was uncertain which areas the superintendent wanted patched. Areas needing patching had not been identified.

On the other hand, in the high productivity residencies JLARC visited, the superintendents' planning was fairly well developed. These residencies generally spent less crew time responding to complaints which could disrupt planned work. For example, in one high productivity residency, the maintenance supervisor required that his superintendents submit their weekly work plans and notify him of any changes. The supervisor kept this information on file. He stated that this process aided work performance in the residency. The supervisor also kept all public complaints which were received in the area to help him monitor the disruption of work plans. The methods improvement program should foster the use of detailed planning by superintendents.

A key work planning factor which should be addressed by the methods improvement program is the present method of budgeting for snow removal. Snow removal is budgeted on the basis of a three-year average, although this average has not always provided a reliable guide to snow removal costs. Because it is difficult to know how much snow removal will be required, it is difficult for maintenance personnel to judge for many months of the fiscal year how much should be spent on other activities.

In an effort to cope with this uncertainty, and out of a concern with keeping budgets balanced, residencies plan to spend by December 1 of each year 10% less than a straight-dollar trend of their budget would indicate. This practice, however, does not solve the problem that budgeting snow removal as ordinary maintenance poses for making rational workload or manpower utilization decisions. Two examples follow.

In Bowling Green, the maintenance supervisor said that July, August, and September were ideal months to do machine ditching. However, machine ditching is an expensive activity. The residency therefore does less ditching than would be maximally productive in order to keep costs down in case of a bad winter.

* * *

Despite its practice of entering the winter with a 10% budgetary cushion, the Chesterfield residency was over its budget after a harsh winter. In order to achieve a balanced budget, the resident engineer and maintenance supervisor were encouraging areas to perform less costly, labor-intensive, complaint-oriented jobs such as removing debris from drainage structures and pruning trees in the spring and early summer. The result was that crews were performing relatively minor tasks while their superiors were aware of structural problems in the roads that needed maintenance attention.

The methods improvement program should consider whether snow removal budgeting ought to be handled as an extraordinary maintenance item instead of as ordinary maintenance. This change could result in better manpower utilization.

Availability of Spare Parts and Tires. Equipment breakdowns and flat tires reduce productivity because they are responsible for a large amount of downtime in maintenance activities. Wasted time and dollars due to flat tires are especially magnified for large operations such as machine ditching. Ten to twelve workers may be completely idled for an hour or more by a flat tire on a motorgrader during ditching work. In one residency, two superintendents said that they had covertly taken tires from broken-down motorgraders not assigned to their areas. They stated that this was the only way that they could have regular access to spare tires, and that having the spares increased productivity because it took far less time to change tires than it did to repair them. The methods improvement program should ensure that adequate spare tires and parts are available to residencies, and assess the need for two-way radios in foremen's trucks to cut down idle time spent waiting on parts delivery.

Other Factors. Several other factors that appear to affect productivity were identified during this study. An assessment of complaint handling, sharing of crew members between residencies, and foreman availability should be included in the methods improvement program.

Over the course of a week, an area superintendent may get a number of requests or complaints from the public, asking that maintenance crews perform some particular task. A high degree of responsiveness by area superintendents to all complaints may be good for public relations, but it can decrease productivity. For example, productivity can be increased if area superintendents fit complaints into their work schedules rather than handling them immediately. Responding to complaints can disrupt scheduled work and increase travel time. JLARC staff found that the more productive residencies studied generally spent less crew time handling complaints.

Frequent sharing of workers between areas appears to improve productivity by reducing the impact of unexpected absences and by facilitating operations which require large crews. In one high produc-

tivity residency, a superintendent stated that unexpected worker absences were not a disruption in the residency. The reason, he said, was that it was easy to arrange to borrow men to make up for absent workers or to staff large crews. The superintendent stated that he was borrowing or lending workers "just about every day." By contrast, superintendents in the four low productivity residencies stated that unexpected worker absences were either the first or second greatest disruption of their work plans. However, these superintendents said that they rarely shared workers with other areas. The methods improvement program should promote increased exchange of workers between areas where productivity can be improved.

Concerning availability of foremen, there is considerable variation across the State in the number of foremen in area headquarters. Some areas lack a full-time foreman. DHT should review its foremen staffing statewide in order to ensure that foremen are available to supervise more complicated operations and activities where supervision is critical to obtaining high productivity. DHT should also review whether crews are, as many superintendents argued, less productive when they are supervised by "working" foremen.

A methods improvement program for maintenance should be established. The maintenance division should devise a computer program which will sort out high and low productivity performances at area, county, and residency levels. Reasons for particularly low and high performances should be investigated. The division should assess field techniques and promote the transfer of technologies and methods which seem most productive. Finally, the division should evaluate what the best achievable productivity levels are for field units. Productivity standards should be set at high levels to call attention to performances which need to be improved.

CONSTRUCTION INSPECTOR STAFFING

Construction inspectors perform a quality control function, inspecting and testing contractor-supplied work and materials on highway construction and major maintenance projects. Inspectors and project engineers, who supervise several inspectors and often several projects, are assigned to specific residencies, although they are subject to temporary assignments in other locations.

The number of construction inspectors has decreased by 36 percent, or 333 positions, since 1979. This staffing decline has accompanied a 46 percent decrease in the current value of construction projects under way. In the second quarter of 1982, the number of inspectors averaged 603 while the value of construction projects under way averaged $384,600,000.

Staffing and Workload

In 1980 the department's consultant found that "the level of inspection was based more on the number of inspectors available than on a planned phase inspection." The number of inspectors assigned per project has almost doubled since 1979, with a corresponding decrease in inspector productivity. If productivity levels equal to the average levels achieved by DHT inspectors during 1976, 1977, and 1978 could be reestablished, staffing economies of 228-257 inspectors could be achieved in the current year. A review of the construction program for FY 1983 through FY 1986 indicates that DHT will continue to be substantially overstaffed if the number of inspectors remains at the present level. Improved phase inspection might also help the department reduce staff and improve productivity.

Project Staffing. DHT has consistently assigned more inspectors to projects than are called for in construction division guidelines. The construction engineer has stated that a rule-of-thumb used for manpower planning since 1980 is $1 million of construction under way per inspector. Previously the guideline was $750,000 per inspector. DHT failed to meet these guidelines in all but three years since 1972. The value of construction per inspector (in current dollars) ranged from a low of $500,000 to a peak of $791,000, and most recently stood at $639,000.

Although $1 million per inspector is viewed as a useful guideline, it is not viewed by construction division personnel as particularly useful for determining staffing on individual projects. The department's management consultant found a related problem in 1980:

> *A review of staffing against contractor's operations under way revealed a wide variation in staffing between projects as well as from month-to-month on individual projects. It appeared that the level of inspection was based more on the number of inspectors available than on a planned phase inspection.*

This finding suggests that projects may be assigned more inspectors than necessary.

A review of the average number of inspectors per project indicates that more inspectors have been assigned per project since 1980 than in previous years. The average has risen from about 2.5 inspectors per project in 1978, the peak construction year, to more than four inspectors per project in 1980, 1981, and 1982. Increased project staffing has been reflected by increased construction engineering costs.

Inspector Workload. Individual inspectors may be responsible for inspecting, on the average, less actual construction work now than in recent years. When either of the two workload indicators, project

value or balance underway, is adjusted for inflation, the amount of construction per inspector (excluding permit and utility inspectors) has actually decreased substantially over the last ten years. Table 8 illustrates that inflation-adjusted project value per inspector has decreased since 1975, as has inflation-adjusted balance underway per inspector. At that time, each inspector was assigned to inspect $662,300 of project value in constant 1972 dollars. In 1981, however, each inspector was assigned construction valued at $284,100 in 1972 dollars. Balance underway per inspector dropped from $584,500 to $340,200 over the same period.

Table 8

INFLATION-ADJUSTED PROJECT VALUE PER INSPECTOR

Year	Number of Inspectors	Adjusted Project Value Per Inspector* (Thousands)	Adjusted Balance Underway Per Inspector** (Thousands)
1972	1,030	$500.0	$522.0
1973	1,062	478.8	517.8
1974	1,052	443.3	585.6
1975	864	662.3	584.5
1976	772	615.8	578.0
1977	869	425.9	490.4
1978	897	395.3	511.5
1979	936	357.5	470.4
1980	846	336.6	399.6
1981	696	284.1	340.2

*Adjustment was based on DHT Construction Cost Index, 1972 base year.
**DHT-supplied balance underway and inspector staffing figures for June of each year were used.

Source: JLARC calculations based on Construction and Personnel Division data.

Fewer inspectors would have been needed in the third quarter of 1982 if individual inspectors had been assigned the same amount of construction as inspectors averaged in 1976 through 1978, measured in constant 1972 dollars. Using these three years excludes the peak productivity years of 1974 and 1975 and includes inspectors assigned to traffic and erosion control. Exhibit 3 shows that as many as 257 fewer inspectors would have been needed in 1982.

A partial explanation for the decreasing productivity of inspectors is an increased emphasis on inspection of traffic and erosion controls. The Federal Highway Administration (FHWA) expanded regulation on traffic control and safety requirements in 1976, which affected all federal-aid highway construction. These regulations

Exhibit 3

The adjusted total value of projects underway in the third quarter of 1982 was $166,900,000. Dividing $166,900,000 by the average ratio of project value (also in 1972 dollars) assigned in 1976-1978 yields a need for 348 inspectors.

Year	Adjusted Value Per Inspector
1976	$615,800
1977	425,900
1978	395,300
TOTAL	$1,437,000

Three Year Average: $\frac{\$1,437,000}{3} = \$479,000$

$$\frac{\$166,900,000 \text{ total project value for 1982}}{\$479,000 \text{ value per inspector average}} = 348 \text{ inspectors}$$

DHT actually assigned an average of 605 inspectors to construction projects in the third quarter of 1982. Thus 605 minus the 348 needed equals 257 excess inspectors. If a reduction of 257 inspector positions could be achieved, between $3.8 and $5.2 million could be saved annually in salaries and fringe benefits.

require a traffic control plan and a designated safety officer for each project. On larger projects the safety officer's duties can be a full-time job for one inspector. JLARC staffing projections are based on years (1976, 1977, 1978) which include these added requirements.

Erosion control requirements were implemented in 1974 by the FHWA. Inspectors determine contractor compliance with the erosion control plan on each project. Typically, this requires inspecting siltation fences and the placement and condition of straw bales used to control erosion. According to FWHA personnel, a typical project may require eight man-hours per month for erosion control duties.

Using data on the balance of construction underway, which has been suggested by the department as a more realistic measure of inspector workload than project value, also indicates a surplus of construction inspectors (Table 9). The balance of construction underway is based on a 20-month period which is the average time from the day a contract is awarded to the date of final acceptance. Although a 20-month period may be typical of the duration of a construction project, many projects do not continuously require a full complement of inspectors. Fewer inspectors are typically assigned to a project at its beginning and end.

Table 9

BALANCE UNDERWAY AND INSPECTOR STAFFING

Year	Balance Underway in Millions (Adjusted to 1972)	Inspectors	Balance Underway Per Inspector	Inspectors* Needed
June 1972	$548.05	1,050	$521,952	
Dec. 1972	528.30	978	540,184	
June 1973	549.90	1,063	517,310	
Dec. 1973	537.85	1,033	520,668	
June 1974	616.10	1,074	573,650	
Dec. 1974	540.40	1,029	525,170	
June 1975	505.05	876	576,541	
Dec. 1975	460.20	834	551,799	
June 1976	446.20	776	575,000	
Dec. 1976	430.45	775	555,419	
June 1977	426.15	873	488,144	
Dec. 1977	404.50	883	458,097	
June 1978	458.85	899	510,400	
Dec. 1978	432.15	909	475,413	
June 1979	440.35	943	466,967	
Dec. 1979	368.35	928	396,929	
June 1980	338.10	860	393,140	
Dec. 1980	280.35	815	343,988	
June 1981	236.75	733	322,988	
Dec. 1981	202.90	666	304,655	
June 1982	194.20	598	324,749	370
Dec. 1982	220.85**	697-800***		421**
June 1983	234.95**	697-800***		448**
Dec. 1983	300.10**	697-800***		572**
June 1984	325.70**	--		621**
Dec. 1984	355.85**	--		678**
June 1985	364.20**	--		694**
Dec. 1985	329.20**	--		628**
June 1986	311.75**	--		594**
Dec. 1986	316.70**	--		604**
June 1987	320.10**	--		610**

*Based on June 1976, June 1977, and June 1978 ratio of balance underway per inspector average.
**Estimated.
***Estimated by DHT in its Short-Range Approach to Manpower.

Source: DHT, JLARC.

If inspectors in June 1982 could have achieved the average productivity level achieved in June of 1976, 1977, and 1978, only 370 inspectors would have been needed instead of the actual 598. Based on the balance underway data, therefore, DHT in June 1982 had as many as 228 surplus inspectors. Elimination of 228 inspector positions could achieve a savings of $3.4 - $4.6 million in salaries and fringe benefits annually.

Improving Inspector Utilization

Inspectors perform a variety of duties intended to ensure that contractors perform up to State standards. Some recent actions have been taken to improve inspector productivity. A panel of DHT staff recently reviewed some of these duties and recommended efficiencies, primarily in the form of reduced record-keeping. The department also has implemented a quality assurance program for manufacturers of materials used on highway construction that will reduce the need for materials technicians.

Several actions that would improve productivity remain to be taken. The phase inspection process should be formalized. A manpower system to link project characteristics with staffing should be developed.

Phase Inspection. Construction projects are inspected using the phase inspection process. According to the department's 1980 management consultant:

> The objective of phase inspection is to maintain a level of inspection in keeping with the significance of the items being inspected and the risk of failure. Under phase inspection, the contractor's work is inspected intermittently at key points in the work rather than on a full-time basis.

The consultant also noted that:

> There are no written instructions or guidelines available for phase inspection....The lack of standard instructions or guidelines results in variations among districts and residencies in its application. The potential for even greater savings exists if it were used more uniformly in all districts.

DHT's construction division administrator told JLARC staff that phase inspection is "a philosophy rather than a set of rules." However, until guidelines for phase inspection are formalized and written down, there is a clear possibility that the practice of phase inspection will not be fully understood or consistently implemented. For example, JLARC staff received the following replies when project inspectors and construction administrators were asked to discuss phase inspection:

Concerning one construction project, an assistant district engineer indicated that the inspectors were receiving outstanding cooperation from a "respected" contractor on the project. Nonetheless, the engineer explained that the chief inspector felt he needed a large crew of inspectors because he was a "very cautious" inspector who liked to have as much of the construction observed as possible. For this chief inspector, phase inspection meant to prioritize points of inspection when necessary, but to observe everything if possible.

* * *

A department engineer noted that he knew that "many times" inspectors were assigned to inspect bridge construction without any training or experience in bridge work. He questioned how they would be able to identify critical phases of construction.

* * *

According to another DHT engineer, construction inspectors are as rigorous and thorough as inspectors of nuclear power plants.

The construction division should develop written guidelines for phase inspection of projects. The guidelines should identify which project phases are "critical" and which are not. Training in the guidelines should be provided to inspectors. A staffing plan should be prepared for each project on the basis of the phase inspection guidelines. The plan should link the need for inspectors to project phases, ensuring that an adequate number of inspectors will be available during each critical project phase and showing how inspectors will be assigned during non-critical phases.

Record-Keeping. An internal DHT task force reviewed policies and procedures involving documentation on construction projects. The task force made twelve recommendations that would reduce documentation requirements, and thus reduce the time inspectors spend keeping records. For example:

Specifications currently provide for topsoil to be paid for by the acre, seeding (regular and overseeding) by the pound, fertilizer and lime by the ton, and mulch to be included in the cost of seeding. According to the findings of the task group, it appears that the major objection of the field personnel involves the measurement and record-keeping with respect to topsoiling. On larger projects, the measuring of topsoiled areas takes as much as two weeks and the computations and sketch book work another one to two weeks.

> *The task group recommended that topsoil inspection be set up on a plan quantity basis. This would eliminate the need for measuring the areas, computing, and showing the data in the sketch books. Under the plan quantity concept, there would still be a unit price bid so that additions or deletions could be handled.*

This recommendation will soon be implemented, and should reduce the workload of inspectors.

Quality Assurance Program. The work performed by as many as 65 materials technicians could be eliminated, and an annual savings of $809,000 to $1.1 million in salaries and benefits could be achieved, if the department's new quality assurance program for materials were expanded. This program would eliminate the practice of assigning technicians to inspect construction materials, such as bituminous concretes and aggregates, at the point of manufacture. Under the program, manufacturers may certify to the department that their materials meet DHT specifications. Participation in this program is voluntary for manufacturers. To date, 46 of 150, or 31%, of all bituminous concrete and aggregate plants have agreed to certify their materials. As more plants come under this program, DHT staffing efficiencies should be achieved. The materials will continue to be inspected when delivered to the project, thus ensuring that materials meet specifications.

Improving Inspector Planning. Implementing these recommendations will reduce the time required of inspectors on projects. However, there is currently no systematic means of adjusting project staffing to accommodate such workload reductions.

The 1980 report of DHT's management consultant concluded that, for inspectors:

> Staffing estimates or the level of staffing cannot be effectively reviewed by anyone not thoroughly familiar with the projects to be built. Staffing standards related to the project characteristics would correct these deficiencies.

The Florida Department of Transportation has developed staffing standards for inspectors which link inspector time to the items specified in the project contract. An example is shown in Exhibit 4. Such standards could be readily adjusted to reflect such workload reductions as recommended by the record-keeping task force, or reductions that result from the quality assurance program. This would improve DHT's ability to adjust the size of the inspector workforce.

The construction division should establish a method of forecasting inspection needs based on project characteristics.

Exhibit 4

Florida's Construction Inspector Standards

For Inspection of
Earthwork Excavation or Embankments

To inspect 10,000 cubic yards requires 20 inspector hours
If under traffic add 5 inspector hours
If urban project add 20 inspector hours

Source: Florida DOT Construction Management System, Users Manual.

CONCLUSIONS AND RECOMMENDATIONS

Productivity has slipped in several of DHT's field operations. A number of steps should be taken to improve productivity, ranging from a reduction in the number of area headquarters to improved standards for construction inspectors. Staffing efficiencies should result. Potential staff economies identified in this chapter are shown in Table 10.

Recommendation (1). The number of area headquarters should be evaluated on the basis of a guideline which considers a number of workload indicators. Areas should be evaluated for compliance with this guideline. This systematic assessment should reduce the number of area headquarters by either consolidating areas or downgrading them to sub-area status. In high-growth areas, headquarters should be considered for closing or downgrading and the property retained for future expansion. DHT should expand the practice of allowing area headquarters to maintain roads in more than one county. In addition, areas should be reviewed for possible consolidation with other areas in adjoining counties.

Recommendation (2). The number of timekeepers should be adjusted by centralizing them within residencies. Reductions should be patterned after residencies which have already implemented such centralization.

Recommendation (3). DHT should ensure that residencies have access to the most productive types of equipment for ordinary maintenance. Large capacity distributors, tailgate spreaders, pavers, and rotary ditchers should be accessible when needed. The feasibility of using self-propelled scrapers to a greater extent statewide should be evaluated.

Recommendation (4). DHT should implement a maintenance methods improvement program. The maintenance division should devise a computer program for their management system which will sort out high

Table 10

POTENTIAL ECONOMIES IN THE DHT FIELD ORGANIZATION

	Potential Economies
Timekeepers	87-114
Area Superintendents	23-64
Maintenance Workers	158-248
Construction Inspectors	228-257
Materials Technicians	65
	561-748

Source: JLARC analysis.

and low productivity performances at area, county, and residency levels. Reasons for particularly low and high performances should be investigated. The division should also evaluate what the best achievable productivity levels are for field units. Productivity standards should be set at high levels to call attention to performances which need to be improved. The division should assess field techniques and promote the transfer of technologies and methods which seem most productive. Specific consideration should be given to work planning and scheduling methods, parts availability, and other factors which appear related to productivity, including complaint-handling techniques, inter-residency exchanges of crew members, and the availability of foremen.

Recommendation (5). A productivity standard should be established for construction inspectors. The standard should be used in assessing inspector needs, and should encourage high productivity.

Recommendation (6). The construction division should develop written guidelines for phase inspection of projects, identifying the project phases which are "critical." A staffing plan should be prepared for each project, based on the phase inspection guidelines. The plan should link the need for inspectors to the project phase, ensuring that an adequate number of inspectors will be available during each phase and showing how inspectors will be assigned during non-critical phases.

Recommendation (7). The construction division should establish a method of forecasting inspector needs based on project characteristics for use in the Human Resource Planning System.

III. CENTRAL OFFICE STAFFING

Assessing the staffing environment of the central office is an important element in understanding the department's manpower process and plans.

Two recent studies have found that the basic decentralized structure of DHT is fundamentally sound and reflects the principal functions of highway maintenance and construction. A management consultant retained by DHT in 1980 found that the central office provided overall direction, control, and coordination for the department. A 1981 JLARC study of DHT's organization also concluded that, although changes were needed, the structure was fundamentally sound.

While it did not question the overall structure of the department, the 1982 General Assembly expressed interest in reducing central office employment over the biennium. The Appropriations Act limited to 1,312 the number of positions available to the central office for both years of the biennium. The Act also required the department to report on the feasibility of further reducing central office staffing to 900 full-time equivalent positions over the 1982-84 biennium.

Due to the Act's specific focus on staffing of the DHT central office, an assessment was undertaken by JLARC in order to evaluate compliance with Appropriations Act mandates and short-term staffing needs. Although the mandated central office staffing level of 1,312 was reached in September 1982 as a result of a layoff, DHT has not yet assessed the feasibility of further lowering central office staffing to 900 by 1984. Such an assessment should use a variety of productivity indicators and consider improved technology in determining the feasibility of further reductions.

COMPLIANCE WITH CENTRAL OFFICE STAFFING MANDATE

While the term "central office" may be informally understood as an agency's central administrative apparatus, the General Assembly used a specific definition in setting DHT's central office employment ceiling. Although the definition used by the legislature was based on information provided by the department, it differed from DHT's central office payroll and excluded some units that perform central administrative functions but are located outside the central facility in Richmond. Although the attrition anticipated to bring down central office employment did not occur, DHT took action to achieve a central office staffing level of 1,312 through layoffs. That level was actually reached in late September.

Definition of Central Office

The General Assembly was quite specific in defining the central office. Documentation attached to the floor amendment which inserted the central office employment levels into the 1982-84 Appropriations Act included a table (Table 11) which identified 1,396 positions in 23 divisions. This table was based on figures provided by the department, and excluded three organizational units carried on DHT's central office payroll: the research council, which is located in Charlottesville; the central garage, which was then located on South 15th Street in Richmond; and the Richmond-Petersburg Turnpike, headquartered ten miles south of Richmond. Attorneys assigned to DHT were also excluded from the central office definition, as the Attorney General announced in early 1982 that attorneys assigned to agencies would be removed from agency payrolls and consolidated in one location. Agencies would then be billed for legal services.

DHT personnel reported some initial confusion about the definition of central office. Confusion arose because some central administrative functions and 250 associated positions were located outside the central office facility at 1221 East Broad Street in Richmond. In July 1982, 1,142 positions were housed at the central facility. Twenty-six positions were assigned to the central garage. Another 92 positions were located at the equipment division's facility in Fulton, east of Richmond, and 72 positions were situated in the materials division lab in Elko, east of Sandston. An additional 60 positions were assigned to the research council in Charlottesville.

The legislative definition of central office included the equipment and materials division, and excluded the central garage and research council. Except for the central garage these divisions may be considered to perform central administrative functions. Consequently, DHT may wish to propose an alternative definition of central office that would be clearly tied to a distinction between central administration and field operations. For the purpose of this report the legislative definition has been adopted.

Staffing Actions

It was initially expected that attrition alone would reduce central office staffing to 1,312. As explained in the floor amendment documentation:

> The amendment fixes maximum employment in the DHT central office at 84 positions less than current levels. This figure is based on projected reductions through attrition through July 1, 1982.

However, the attrition that was expected to bring down the central office staffing level did not occur. Despite the Governor's moratorium on filling vacant positions, it was clear by May 1982

Table 11

VIRGINIA DEPARTMENT OF HIGHWAYS & TRANSPORTATION

CENTRAL OFFICE PERSONNEL, POSITIONS, AND DIVISIONS (February 1982)

Divisions	Officials and Administrators	Professionals	Technicians and Skill Craft Workers	Office and Clerical	Service - Maintenance	TOTALS
Bridge	4	42	39	9		94
Budget	1	4	1	2		8
Commission	7	4	0	7	1	19
Construction	5	7	11	18		41
Data Processing	3	16	35	29		83
Environmental	2	36	12	11		61
Equipment	2	10	49	16	24	101
Fiscal	2	21		41		64
Location & Design	5	59	162	25		251
Maintenance	3	4	4	20		31
Management Services	2	10		3		15
Materials	4	20	37	15	1	77
Personnel	2	13		18		33
Programming & Scheduling	2	9	11	2		24
Public Information	2	5	17	7		31
Public Transportation	3	7	1	2		13
Purchasing	3	14	12	75	4	108
Rail Transportation	2	6		1		9
Right of Way	6	17	32	15		70
Secondary Roads	3	2		2		7
Traffic & Safety	3	31	148	11		193
Transportation Planning	4	27	18	6		55
Urban	2	3	1	2		8
TOTALS	72	367	590	337	30	1,396

Note: This table has been used by DHT and the General Assembly to define central office personnel, positions, and divisions.

Source: Documentation submitted with an amendment to the 1982 Appropriations Act.

that attrition alone would not sufficiently bring down central office employment. A layoff was subsequently imposed to achieve the specified level of 1,312.

The layoff was imposed in a hurried fashion, with some incongruous results. On June 2, 1982, the Commissioner met with the division administrators and asked them to identify, by the next day, positions eligible for layoff. On June 3, thirty-five positions were identified from 12 divisions. Among them were three positions which had been filled on April 16, May 16, and June 1, 1982. These positions had been justified as exceptions to Governor Robb's hiring moratorium, yet were laid off within weeks of being filled. Of the 35 surplus positions identified, 13 employees were subsequently laid off.

Due to the bumping provision of the State layoff procedure, an actual workforce reduction may take several months to achieve. Consequently, the delayed implementation of the central office layoff meant that DHT would be likely to exceed the mandated level during the early part of the biennium.

On July 1, 1982, DHT's central office staffing stood at 1,396 positions. This level included 1,306 employees on the central office payroll plus as many as 90 employees who were in the "pipeline" -- employees who, for example, had submitted resignations giving a month's notice.

Because the mandated 1,312 level was not achieved until late September, 1982, DHT was technically out of compliance with the Appropriations Act for three months of the biennium. However, action had been taken to achieve the required level and JLARC concludes that legislative intent was honored.

Feasibility of 900 FTEs by FY 1984

Although the Appropriations Act sets a specific 1982 staffing level for the central office, the Act clearly indicates further reductions by requiring the department to assess the feasibility of 900 central office positions by July 1984. Although DHT plans to conduct this assessment as part of the Human Resource Planning System, the department has not yet conducted the required assessment.

This assessment must be conducted to comply with the Appropriations Act mandate. Until such an assessment is completed, the potential for further central office reductions will not be known.

Several methods could be incorporated in the analysis. Some relevant methods are discussed in this chapter. For example, a careful review of productivity trends in central office divisions may identify opportunities for staffing reductions. Technological improvements currently in use in other states, such as computer-assisted design, may also provide the means for reducing central office staff. A careful review of these opportunities could result in significant productivity improvements and subsequently more efficient central office staffing.

THE CENTRAL OFFICE STAFFING ENVIRONMENT

To adequately address minimum staffing and the feasibility of reductions to 900 central office positions, a comprehensive assessment is needed of the appropriateness of existing staffing levels and productivity standards. Such an assessment is also important to understanding the department's manpower process and plans. Because DHT has not completed such an assessment, JLARC reviewed a series of staffing efficiency indicators for several divisions. This review suggested that productivity can be improved and staffing levels reduced in several central office divisions. A thorough assessment of several additional factors could lead to further efficiencies. Table 12 summarizes the efficiencies discussed in this chapter.

Preconstruction Staffing

Preconstruction comprises a variety of activities which occur prior to the actual construction of a highway project. Included are such functions as determining the exact nature and location of the

Table 12

EXAMPLES OF POTENTIAL STAFFING ECONOMIES

	Central Office	Field
Implement Computer-Assisted Design	27	33
Improve Right-of-Way Productivity		12
Consolidate Program Management Activities	2	—
TOTAL	29	45

Source: JLARC analysis.

needed improvement; acquiring the needed land; designing the roadway, bridges, and other structures; and planning for compliance with all regulatory requirements, such as environmental and traffic controls.

The preconstruction function contains both a central office and a field component. Key management functions and the more complex design work are located in the central office. Some design work and various other activities are carried out by district personnel. Because the General Assembly specifically included portions of each preconstruction division in its definition of central office, the general topic of preconstruction is addressed in this chapter. However, the distinction between positions located in the field and positions located in the central office is made when necessary.

Several economies should be considered by DHT. Implementation of computer-assisted design could lead to staffing reductions of as many as 13 positions in the bridge division and 47 positions in the location and design divisions. An assessment of the accumulated balance of plans may also be needed in the location and design division. For effective preconstruction staffing, a stable schedule of projects that covers a period longer than the current six-year schedule is necessary, as preconstruction activities often commence seven or eight years ahead of construction. Finally, if past levels of productivity in the right-of-way division could be re-established, as many as 12 positions could be eliminated.

Computer-Assisted Design. A major opportunity for staff reductions and improved productivity is afforded by computer-assisted design (CAD). An important benefit of CAD is in reducing the need for draftsmen in road and bridge design.

Under a CAD system implemented by the Michigan Department of Transportation, about half of all plans are drafted by using automated processes. According to Michigan's deputy director for highways, the system has resulted in:

> . . . an estimated 20% to 25% increase in productivity. We [the Michigan Department of Transportation] also estimated an efficiency factor of 3 to 1 between the automated system and manual drafting methods. Our most recent estimates suggest a factor of 4 to 1. We realize our maximum efficiency on projects that contain repetitive details, e.g., joint repair, bridge deck resurfacing, bridge railing replacement, etc. Projects of this nature may drive the efficiency factor as high as 10 to 1.

In explaining that the number of engineers and technicians engaged in plan production had declined 13 percent, from 376 to 329 positions, the deputy director stated that:

> . . . the system is the major factor in the decline of personnel, [although] falling revenues have also contributed to these reductions. On the other hand, the high productivity of the system makes the cutback of design personnel more tolerable and makes it possible to maintain our production schedule.

In July 1982, DHT had a total of 459 draftsmen and engineers who developed and reviewed plans; 103 were in the bridge division (40 in the districts and 63 in the central office), and 356 were in the location and design division (211 in the districts and 145 in the central office). If DHT could achieve as much as a 13 percent personnel reduction, as did Michigan, through automating the drafting process, up to 60 engineers and technicians could be eliminated (as

many as 33 in the districts and 27 positions in the central office). This reduction would save $981,000 to $1.3 million in salaries and benefits annually.

An additional outlay for terminals, graphics printers, and related equipment will be necessary to realize the enhanced productivity available through CAD. For example, the system implemented in Michigan required a total outlay of $1.6 million. DHT should assess the costs involved in implementing CAD and identify offsetting savings available through staffing reductions. The department should report on the feasibility and economy of implementing CAD in the bridge division and the location and design division.

Location and Design Division. The primary activity of the location and design division is to develop detailed plans for highway construction. Central office employees prepare most interstate and urban plans, and review plans prepared by the districts. Primary and secondary road plans are handled mainly by district designers. In July, 1982, a total of 251 central office and 404 district personnel were performing location and design activities. These figures include support staff and survey parties in addition to to the draftsmen and engineers discussed earlier.

Staffing of the location and design function is projected to decrease. The division's projections are based on the projects appearing on the six-year improvement program, using staffing guidelines developed within the division. For FY 1984 the projection is for 216 total central office staff, dropping to 195 in FY 1985 and 168 in FY 1986.

The amount of plans already prepared and awaiting construction has been increasing since 1978. Table 13 shows that the accumulated balance of plans increased 76 percent from 204 plan-miles to 360 plan-miles between FY 1978 and FY 1982.

Table 13

PLAN PRODUCTION COMPARED TO CONSTRUCTION PROGRAM
FY 1978-1982

Year	Plan Miles Completed	Miles Put Under Construction*	Accumulated Balance
1978	273	350	204
1979	272	215	261
1980	270	211	320
1981	342	321	341
1982	195	176	360

*Includes state-force construction.

Source: Location and Design Division records.

Despite an increasing backlog of completed construction plans, designers may be preparing plans of questionable value. In at least three instances, projects slated for construction after 1990 are being prepared by location and design personnel. These projects are not funded under the six-year program. A large number of additional projects are assigned to staff, but are not funded under the six-year program. Indications are that little effort is currently being expended on these projects. However, their presence on the work assignment schedule raises a question about how they were derived from the six-year program.

The location and design engineer recently addressed the gap between the six-year construction program and the five- to seven-year lead time needed by the preconstruction divisions. This gap has occurred because the department has recently adopted a six-year improvement program that requires very little preconstruction activity in FY 1987 and FY 1988. In a memorandum to the director of administration, the location and design engineer stated that the six-year improvement program:

> . . . may be realistic as a guide to construction during the period evaluated but it is not a realistic program as far as preliminary engineering is concerned. I base this on the fact that the preliminary engineering to be initiated during the last two years of the program is almost nothing--only three projects on the entire Interstate, Primary and Urban systems. If this is a true picture, and I suspect it isn't, then no appreciable construction will occur after the end of the current Six-Year-Program.
>
> To be realistic and to assure that trained, qualified personnel are available to carry out the program, a six-year program based on the first six years of a ten-year program should be developed and extended each year. Since an interval of from five to seven years is needed from conception to construction, a sufficient amount of preliminary engineering should be initiated in the fourth year of the program to satisfy the fiscal capabilities for construction in the tenth year of the program.

Although the division's own staffing projections show a significant decrease over the next four years, the excessive accumulated balance of plans and the fact that staff may be beginning work on projects not on the current schedule suggest a need for a re-examination of division staffing and assignments. The department should specify the projects which will require preliminary engineering and assess the need for staff in such activities over the six-year program.

Right-of-Way Division. The right-of-way division appraises and acquires the real property needed for highway construction. The

division also assists in the relocation of families and businesses displaced by highway construction. As of July 1982, there were 307 right-of-way employees statewide, 64 in the central office and 243 in the eight districts. These levels were down from earlier years, as shown in Table 14. Projections made by the division show a statewide increase to 390 positions for FY 1984, followed by a drop to 312 in FY 1985 and 1986. However, if improved productivity could be achieved, as many as 12 fewer district positions would be needed in the current year.

Table 14

RIGHT-OF-WAY EMPLOYEES
1975-1982
(March)

Year	Central Office	Districts	Total
1975	101	390	491
1976	94	348	442
1977	88	341	429
1978	100	347	447
1979	97	337	434
1980	96	327	423
1981	96	327	423
1982 (July)	64	243	307

Source: DHT Personnel Records.

The division reviewed work accomplishments of its staff over the ten-year period 1971-80, and compared these accomplishments to the number of right-of-way employees performing these duties. However, no provision was made for improving productivity. The division used average accomplishments from 1971-80 to project staffing needs over the next four years, based on a review of construction projects listed in the six-year plan. Table 15 shows the number of parcels and appraisals required over the next four years.

A key problem in developing staffing forecasts from past productivity patterns is the assumption that productivity levels in the 1980s will remain at the same level as average accomplishments between 1971 and 1980. Several districts were able to achieve consistently higher than average productivity in the 1970s, however, and it would seem reasonable that such performance will continue.

Staffing economies could be realized if the other districts could achieve productivity approaching the level achieved by the most productive districts. For example, a review of three major activities--relocations, appraisals, and parcel negotiations--indicated

Table 15

ANTICIPATED WORKLOAD
(FY 1983 through FY 1986)

Year	Parcels	Relocations
1983	2,241	174
1984	3,060	258
1985	2,222	222
1986	2,442	182

Source: Right-of-Way Division

that, if all districts could achieve 75% of the rate achieved by the district with the highest productivity for each activity, as many as 12 staff positions could be dropped in the current year. Salary and benefit savings would amount to between $195,108 and $266,448 annually.

When asked about low productivity in some districts, an assistant division administrator and a program coordinator agreed there was "dead wood" in some districts. They further indicated that recent layoffs had removed some of the most productive, but junior, staff.

The department should set productivity standards for divisions such as right-of-way at levels above a long-term average. Targets should be linked more closely to the highest level of productivity actually achieved by a section. Steps for moving toward that level should be identified and taken, and staff positions eliminated as improvements are made. Guidelines for individual employee performance should be tied to the targets. For example, special training should be offered to help improve individual employee productivity.

Central Office Staffing Efficiency

A variety of administrative and support functions are located in the DHT central office. Consequently, assessing whether the central office is staffed at minimum levels requires a review of multiple indicators and a thorough knowledge of the functions carried out in the central office. This section describes several indicators of staffing efficiency and suggests their application. Indicators include paid overtime, span of control, consolidation potential, and attrition.

Attrition could open as many as 820 positions department-wide this year. However, due to the complexity of central administrative functions and the lack of clear productivity indicators for these functions, a thorough review based on such indicators should be conducted by the department to determine the need for retaining and filling positions which come open in the central office.

Paid Overtime. One general indicator of how well staffing matches workload is the amount of overtime worked. While the data must be interpreted carefully because not all employees who work overtime are paid for overtime, it appears that the central office has not been understaffed to the point of requiring extensive paid overtime. This may raise a question as to whether such divisions could perform their work with fewer staff. For central office staff, paid overtime has declined since 1979, primarily because of a 1980 DHT policy intended to eliminate overtime.

As Table 16 shows, paid overtime worked by central office staff declined from a peak of 41,305 hours in 1977 to 12,164 hours in 1981. Twelve of the 22 central office units paid overtime in calendar 1981, ranging from ten hours overtime in the maintenance division to 7,960 hours in the equipment division. The other ten central office units paid no overtime in 1981. Units that paid overtime perform functions closely tied to field construction and maintenance operations; equipment division mechanics, for example, service vehicles used by field personnel.

Table 16

CENTRAL OFFICE PAID OVERTIME
1977-1981
(calendar years)

Year	Number of Employees	Total Hours Worked	Total Paid
1977	516	41,304.5	$312,494
1978	472	33,706.8	275,014
1979	307	33,701.4	276,417
1980	296	25,648.8	229,596
1981	162	12,163.8	122,425

Source: DHT fiscal division records.

Most central office staff may have had a workload which could be handled during normal work hours. However, DHT currently lacks comprehensive information on the amount of overtime worked by employees. Such information is necessary in order to accurately assess overtime. DHT should develop a method for recording hours worked by all employees. The method should include all overtime worked, even if it is not compensated. This could be a feature of the human resource planning system currently being developed by the department.

Other Approaches to Assessing Central Office Staff

In addition to its assessment of productivity indicators and potential improvements in technology, JLARC reviewed a number of other

methods which could be of value in assessing central office staff. The department should give consideration to these methods in any effort to accurately gauge minimum staffing requirements for the central office.

Span of Control. Management effectiveness is constrained by the number of people who report to one manager or supervisor. Historically DHT has had problems with excessive numbers of subordinates reporting to top management. For example, the Stone Commission in 1963 and a JLARC report on DHT's organization and administration in 1981 both noted that an increasing number of organizational units were reporting directly to the commissioner. Both reports recommended structural changes to reduce the commissioner's span of control.

Although DHT top management has often had too many subordinates to supervise directly, middle levels of management may have too few subordinates per supervisor. Divisions within the central office exhibit wide variation in the number of employees reporting to supervisory personnel. Because increases in the control span would provide opportunities to reduce staffing and increase productivity, DHT should undertake a thorough assessment of spans of control within the organization.

Guidelines have been established for assessing the ratio of subordinates to supervisors. The American Management Association, for example, has developed the broad guidelines shown in Table 17 from the experience of private industry. While these guidelines are not intended to be rigidly applied, they provide an indication of the minimum and maximum number of subordinates that could be expected for various types of work.

A review of the ratio of technicians to technician supervisors in DHT raises a question about the appropriateness of existing control spans. Within one section of the traffic and safety division, for example, two supervisors (one titled technician supervisor and one titled engineering supervisor) recently supervised only one subordinate each. In the same section another technician supervisor recently

Table 17

SPAN OF CONTROL GUIDELINES

Type of Work Supervised	Span of Control Range
Manual routine tasks (without a lead worker)	12-25
Clerical routine tasks	10-20
Administrative jobs	6-10
Semi-analytical, non-technical jobs	4-8
Technical and analytical jobs	3-7

Source: American Management Association.

supervised as many as 11 subordinates. The AMA span of control standard for technical and analytical jobs is three to seven subordinates per supervisor.

The ratio of technicians to technician supervisors ranges from 1.1-to-1 in planning to 9.2-to-1 in right of way, as shown in Table 18. Although JLARC did not conduct a functional review of each position, an average ratio of 1.1 planning technicians per supervisor appears very low under any circumstances, and is well below the AMA recommended minimum for technical jobs. Traffic technicians are also below the guideline.

Table 18

RATIO OF TECHNICIANS TO TECHNICIAN SUPERVISORS
(August 31, 1982)

Discipline	Number of Technicians	Number of Supervisors	Average Ratio
Planning	10	9	1.1
Traffic	114	46	2.5
Engineering	275	84	3.3
Materials	176	45	3.9
Right of Way	55	6	9.2
Total	630	190	3.3

Source: DHT personnel records.

The potential benefit of this type of analysis is illustrated by noting that if these two disciplines were brought up only to the AMA minimum, 13 fewer supervisory positions would be required. If all disciplines except right of way were brought up to AMA's maximum span (right of way already exceeds the maximum guideline), as many as 101 fewer supervisory positions would be required. However, additional research would be required to validate specific surplus supervisory positions. Consequently no figures based on the span of control analysis have been included in JLARC tables on potential staffing economies.

DHT should review the spans of control assigned to all central office supervisory personnel. The review should be based on functions actually performed as well as on job titles. Positions which vary significantly from generally accepted standards should be considered for merger into other supervisory positions. Positions titled as supervisory but in which a majority of the time is actually spent performing work similar to that assigned to subordinates should be considered for reclassification and any supervisory responsibilities merged with other supervisory positions.

Position Misclassification. Some positions have a supervisory title but supervise no subordinates. These positions may be misclassified. Such misclassification hampers a span of control review. Job audits and reclassification of these employees appear to be needed.

In some cases, misclassification has resulted because subordinate positions were declared surplus and subordinate employees were laid off. In other cases, however, employees were promoted to supervisory classifications so that the division could retain their technical services, although they were not functioning in supervisory roles. During the course of this review, JLARC staff were told of several technician supervisor positions in the materials division which were typical of the misclassification problem. Technicians had been promoted to the technician supervisor title because they had become specialists in a specific area, and the division wanted to acknowledge and retain their expertise. While retaining skilled employees is vital to the organization, promoting them to a supervisory title without assigning supervisory responsibilities may be inappropriate.

The department should audit positions classified as technician supervisor to determine whether their job content matches the job descriptions. If there is need for separate promotional opportunities in technical and a technical management tracks, separate job titles and descriptions should be considered.

Consolidation and Cross-Training. Some opportunities for staff reductions are available through consolidating organizational units and through training employees to perform similar work in other divisions or units. For example, staff reductions could result from consolidating the three programming divisions into one program management division. Programming translates legislative policies and long-range plans into work programs which link available funds with specific construction projects. Consolidation was initially recommended in the final JLARC Organization and Administration of DHT report.

The programming and scheduling division links specific primary and interstate projects with available funds and schedules project construction. The secondary roads division programs projects for that system, and the urban division works with projects within city and town boundaries. The responsibilities of these divisions were originally assigned during a period of rapid construction and abundant funds. Now, however, the construction program is receiving much less funding and the divisions' workloads have decreased. According to the previous JLARC report, the urban engineer stated in July 1981 that his division was overstaffed and that by August most of his staff would have little to do during the remainder of the year.

Because each division provides visibility for and has special knowledge of its programs, the functions of these divisions should be retained. However, the functions should be consolidated within a program management division comprised of the three existing programming divisions, which could be downgraded to sections. Separate sections within the division could continue to provide visibility and access.

Staff should be cross-trained to assist in the other sections when their own section is less active. This change would allow the combined divisions to operate with fewer than the 38 clerical, technical, and administrative positions in the present three divisions. Only one division administrator would be required, for example, instead of the current three. Salary and benefit savings would range from $66,334 to $90,592 annually. DHT should implement this consolidation and determine whether additional consolidation opportunities exist.

Attrition

A key method of reducing DHT employment has been through a freeze on filling vacancies. Although this has been an effective technique, it has led to imbalances in the workforce. Past attrition patterns suggest, for example, that of the 820 employees who may leave DHT in the current year, more than two-thirds of the vacancies will occur in only a handful of job classifications. A planned or selective hiring freeze may be preferable to unplanned attrition as a means of reducing the overall department workforce.

Most DHT staffing reductions since 1980 have occurred because of an across-the-board prohibition or freeze on filling vacancies, which was in effect until June 30, 1982. A hiring freeze was first implemented by the Commissioner in January 1980. A statewide hiring freeze was subsequently imposed by Governor Dalton and extended by Governor Robb. Since the initial hiring freeze, DHT employment dropped 11.6 percent, from 11,620 permanent positions in July 1980 to 10,269 in July 1982.

A hiring freeze reduces staffing as vacancies or attrition occur. A rigid hiring freeze could reduce DHT employment to an estimated 9,450 by the end of the current fiscal year. This figure is based on an assumption that the attrition rate for FY 1983 will decline by the average of the annual change in the attrition rate since FY 1979. If this assumption is correct, an attrition amounting to eight percent of the July 1982 workforce, or about 820 employees, could be expected in FY 1983 (Table 19).

One major problem with attrition as a method of reducing staffing levels is that it affects some job classifications disproportionately. Table 20 shows that nearly 69 percent of all attrition during the last four fiscal years occurred in only ten of the more than 200 job classifications in DHT. Three job classifications --equipment operators, construction inspectors, and maintenance helpers --accounted for 50.4 percent of all attrition, yet represented only 41.9 percent of all employees. Under a rigid hiring freeze that provided no exceptions, the ten classifications shown in Table 20 would sustain the greatest losses.

Table 19

ATTRITION FROM DHT

Fiscal Year	Attrition	July 1 Payroll*	Attrition Rate %
1979	1,424	11,623	12.25
1980	1,297	11,650	11.13
1981	1,156	11,620	9.95
1982	990	10,956	9.04
1983	820 (est.)	10,269	8.00 (est.)

*Excludes hourly workers.

Source: DHT Personnel Records; estimates by JLARC staff.

Table 20

ATTRITION BY JOB CLASSIFICATION
July 1978 - June 1982

Classification	Attrition	Percentage of Total 4-Year Attrition
1. Equipment Operators	1,874	38.5
2. Construction Inspectors	361	7.4
3. Maintenance Helpers	219	4.5
4. Clerk Stenos	192	3.9
5. Engineering Technicians	164	3.4
6. Foremen	149	3.1
7. Toll Collectors	142	2.9
8. Equipment Mechanics	117	2.4
9. Materials Technicians	95	2.0
10. Clerk Typists	88	1.8
Sub-Total	3,352	68.9
Total, 1978-82	4,868	100%

Source: DHT Personnel Records

Attrition as a staffing-reduction strategy is often termed "painless" because positions are eliminated as they become vacant. However, attrition can be quite "painful" to the program managers most affected by the disproportionate nature of attrition. For example, half of all equipment operators left employment during the four-year period, requiring a significant re-hiring effort in the residencies.

A second major problem with attrition is that the department has little control over the number or location of the vacancies created. Attrition results primarily from resignations and retirements. These two methods of separating from employment accounted for 84 percent of all attrition from DHT between 1978 and 1982. Although resignations are distributed fairly evenly across job classifications, retirements have come, and will continue to come, heavily from only a few classifications.

Employees who have retired from DHT since January 1977 have mainly been in the highway maintenance job classifications. Table 21 shows that 62 percent of all retirements from DHT occurred in six residency maintenance classifications.

Table 21

RETIREMENTS FROM MAJOR RESIDENCY MAINTENANCE CLASSIFICATIONS
January 1977 - June 1982

Classification	Retirements	
Area Superintendent	8	
Foremen	106	
Timekeepers	18	
Equipment Operators	418	
Maintenance Helpers	89	
Subtotal	639	= 62%
Total Retirements	1,033	

Source: DHT Personnel Records.

Employees retiring from DHT over the next five years will also come primarily from maintenance classifications. Of a total of 751 imminent retirees 58 percent, or 439, are located in residencies, and 36 percent, or 274, are equipment operators. Of all field positions 6.9 percent, or 584, will become vacant by 1987 due to retirements. The central office will lose 5.6 percent, or 82, of its total positions to retirement. The distribution of employees on the April 1982 DHT payroll who will turn 65 years of age by 1987 is shown in Table 22.

The 751 imminent retirees identified in Table 22 represent the minimum number of retirements over the next five years. It is very likely that a significant number of additional employees will take early retirement.

Table 22

EMPLOYEES TURNING 65 AND CURRENT STAFFING

	Employees Turning 65 by 4/1/87*	Filled Positions 3/31/82
Central Office Divisions		
Urban	0	8
Secondary Roads	0	6
Commissioner's Office	2	53
Right of Way	4	69
Location & Design	13	248
Purchasing	7	107
Fiscal	7	64
Personnel	3	33
Bridge	5	89
Construction	2	41
Maintenance	1	32
Public Relations	1	31
Materials	4	73
Environmental Quality	1	61
Programming & Scheduling	1	22
Central Garage	2	19
Equipment	12	100
Budget	0	7
Traffic & Safety	9	189
Transportation Planning	0	54
Research Council	5	62
Rail Transportation	0	9
Data Processing	3	81
Management Services	0	15
Sub-Total	82	1,473
Toll Facilities		
Norfolk-Va. Beach	6	41
Tidewater Toll Facilities	15	122
Elizabeth River	13	171
Richmond-Petersburg Turnpike	51	271
Sub-Total	85	605
Districts (including residencies)		
Bristol	71	1,181
Salem	47	1,086
Lynchburg	61	811
Richmond	111	1,160
Suffolk	112	1,081
Fredericksburg	78	732
Culpeper	57	1,464
Staunton	47	927
Sub-Total	584	8,442
Total Permanent Employees	751	10,520

*Number of employees on the DHT payroll March 31, 1982.

Source: DHT Personnel Records

Although the mandatory retirement age is 70, employees may retire as early as age 60 and still receive full retirement benefits under VSRS if they have 30 years of service with the Commonwealth. Employees may retire even earlier, at age 55, and take reduced VSRS benefits if they have at least five years of service.

Although attrition may suffice as a means of achieving significant overall staffing reductions, attention should be devoted to developing alternatives to unplanned attrition, with its differential impact on job classifications and functions, and permanent layoffs. A planned or managed hiring freeze, which is applied only to classifications in which reductions are needed, should be developed to help control overall department attrition.

The department officially implemented a planned freeze on December 9, 1982, with the release of an intra-departmental memorandum on employment ceilings. The memorandum established ceilings on each district's total employment and set maintenance ceilings for each residency. The residency maintenance ceiling is set at "93% of the management system levels as developed by the Maintenance Division and is specified on the [attached strength tables]". Districts are authorized to fill residency vacancies for equipment operators, maintenance helpers, and foremen as long as the 93% level is not exceeded. All other positions remain frozen and can only be filled with central office authorization. The purpose of this policy is to manage DHT compliance with the 10,177 ceiling set by the 1982 Appropriations Act.

Central Garage

The central garage and car pool operation is currently administered under DHT. It was established as a division in 1948 to promote economy and efficiency in the use of State-owned automobiles.

Today, DHT administers the central garage pursuant to policies developed by an autonomous statewide committee. The central garage has 2,410 cars permanently assigned to individuals or to State agencies, leaving 258 available for use by State employees. Customer agencies are billed for vehicle use on a per-mile basis. With the exception of appropriations in the past to purchase additional cars, all costs associated with the central garage are paid from user fees. Revenue from agency charges and the sale of cars in FY 1981 was $8.4 million.

JLARC recommended in 1976, in 1979, and again in 1982 that the central garage be designated as a working capital fund. This recommendation was made because the operation meets established national and State criteria for working capital funds.

The National Council of Governmental Accounting, which has established standards for governmental accounting, defined working capital funds as funds that:

> . . .account for the financing of goods or services provided by one department or agency primarily or solely to other departments or agencies of the governmental unit, or to other governmental units, on a cost-reimbursed basis.

Each of Virginia's funds has been evaluated by JLARC on the basis of this definition in three previous studies. The central garage should be financed as a working capital fund in order to be consistent with Commonwealth accounting practices for similar activities.

CONCLUSION AND RECOMMENDATIONS

A variety of opportunities are available to achieve economies in central office staffing below the mandated July 1982 level of 1,312 positions. DHT should examine these opportunities as part of its mandated assessment of the feasibility of reducing central office staff to 900.

Recommendation (8). The department should consider proposing an alternative definition of "central office" to the 1983 General Assembly. The alternative definition should be based on administrative functions as well as location. If an amended definition is used, information about central office staffing should be presented for both definitions -- that used by DHT and that used during the 1982 General Assembly.

Recommendation (9). DHT should assess the feasibility of reducing central office staffing to 900 by July 1984. The assessment should identify efficiencies which can lead to staffing economies. All central office units should be included in the review.

Recommendation (10). DHT should assess the costs involved in implementing computer assisted design, and identify offsetting savings available through staffing economies and productivity improvements. The department should prepare a written report on the feasibility of implementing CAD in the bridge division and the location and design division.

Recommendation (11). DHT needs to specify all the projects which will require preliminary engineering and assess the need for staff in such activities over the six-year program.

Recommendation (12). The department should set productivity standards such as those used by the right of way division at levels above a long-term average. Targets should be linked to high levels of productivity that have actually been achieved by the sections. Steps for moving toward these levels should be identified and taken. In addition, guidelines for individual employee performance should be tied to the targets.

Recommendation (13). DHT should develop a method for recording hours worked by all employees. This method should provide for recording effort spent on major functions and any overtime worked, even if it is not compensated. The method should be a feature of the human resource planning system being developed by DHT.

Recommendation (14). DHT should audit positions classified as technician supervisor to determine whether the job content matches the job description. If there is need for separate promotional opportunities in technical and technical management tracks, separate job titles and descriptions should be established.

Recommendation (15). DHT should review spans of control assigned to all central office supervisory personnel. Positions which vary significantly from generally accepted standards should be considered for merger into other supervisory positions. Positions titled as supervisory but which actually spend a majority of the time performing work similar to that assigned to subordinates should be reclassified as subordinate positions and the supervisory responsibilities merged. Excess supervisory positions should be eliminated.

Recommendation (16). The merger of the programming and scheduling, secondary roads, and urban divisions as separate sections in one division should be under continuous study by DHT. Reductions from the current level of staffing should be considered. Cross-training of staff who currently develop and coordinate the programming and scheduling of projects on the primary, secondary, and urban systems may prove to facilitate staff reductions. Additional consolidation opportunities within the central office should be identified by the department.

Recommendation (17). JLARC may wish to direct the Comptroller to designate the central garage as a working capital fund.

IV. DHT'S MANPOWER PLANNING PROCESS

The JLARC assessment of the DHT staffing environment has demonstrated that minimum staffing levels can and should be linked to productive and efficient operations. The analysis indicated that there are a number of areas in which DHT could improve productivity. While DHT management appears to be aware that more efficient planning and work methods are possible, neither the department's Short-Range Approach to Manpower nor the Human Resource Planning System specifies how or whether these efficiencies will be achieved.

The Short-Range Approach to Manpower stated that it was intended to "document the steps and methodologies utilized by DHT to comply with the letter and intent of the Appropriations Act." In fact, the document was principally a compilation of requests from divisions and districts for 786 additional staff in the current biennium. This outcome apparently resulted from an earlier management strategy aimed at amending the department's maximum employment level upwards. Consequently, the document is of little use in determining the minimum staffing level for the department. DHT has acknowledged that the Short-Range Approach to Manpower is incomplete, and has deferred some of the document's objectives to its long-term effort.

The Department's effort to establish a long-term manpower plan is described in the Human Resource Planning System. This major manpower project is an ambitious effort to develop a total human resource planning system. The system is intended to be a comprehensive method for linking staffing with workload and for responding to alternate funding levels.

Manpower planning provides a method for matching the number and type of staff needed with the anticipated workload. Manpower plans typically include provisions for measuring workloads, for setting work standards which are tied to high levels of productivity, for adjusting work force size to accommodate workload changes, and for incorporating alternative revenue forecasts.

In its direction to DHT to prepare a manpower plan, the 1982 General Assembly specified that the plan should include three provisions:

- An identification of the minimum number of employees necessary to staff programs and activities funded by the Appropriations Act;
- Methods to expedite staff reductions to the minimum staffing levels; and

- A consideration of the feasibility of reducing central office employment to no more than 900 full-time equivalent positions by June 30, 1984.

Although the Human Resource Planning System addresses many aspects of the mandated provisions, the central office assessment is not included, and the planning document itself does not have the precision and consistency needed to fully assess compliance with the Appropriations Act. Other weaknesses evident in the document may hamper implementation of the planning system.

DHT's SHORT-RANGE APPROACH TO MANPOWER

The stated purpose of the Short-Range Approach to Manpower, a report compiling the department's short-term planning effort, was to

> ...recount and document the steps and methodologies utilized by DHT to comply with the letter and intent of the Appropriations Act and to establish the basis for the agency's Human Resource Planning and Management System that will be used in future years to plan and monitor an efficient and effective staffing program.

There were two components to the methodology employed by DHT in this effort. For preconstruction and construction activities, which are directly affected by changes in revenue, divisions and districts were to determine "the necessary manpower to accomplish the work" on the basis of anticipated revenues. Divisions not directly affected by revenue increases--primarily administrative support divisions--were to identify the probable impacts of decentralizing or eliminating some of their functions, and to offer judgements on needed staffing levels and achievable efficiency gains.

The Short-Range Approach to Manpower represents an extensive effort by the department to assemble functional descriptions of all divisions. According to DHT some efficiencies and staffing reductions were identified in the process of assembling the information, although none of these potential reductions or efficiencies are specifically explained in the report. The department states in the report that it "is committed to a philosophy of staffing activities in the most economical manner feasible," and identifies four areas for increased emphasis in the coming year:

- Development of "standard" or "normal time" for the completion of preconstruction activities, such as design and right-of-way acquisition, and an automated system to compare accomplishments to planned activities.

- Establishment of productivity improvement goals for those functions that have measureable units of output.

Statistical analysis of standards used by the preconstruction and maintenance divisions to insure accuracy.

Evaluation of the feasibility of further decentralization.

If properly implemented, all of these areas should be useful to the department in its effort to control its staffing levels. It is not certain, however, that increased emphasis on these activities "will achieve a minimum employment level through FY 1984" as stated in the Short-Range Approach to Manpower.

The Short-Range Approach to Manpower contains ten pages of background and analysis, and 91 pages of appendices. While all divisions are discussed in the appendices, there is no separate discussion of the eight districts and the Northern Virginia division. As a result of this omission, fewer than half of the 786 additional positions requested in the report are identified by location, and a significant number of these additional positions are not discussed at all.

A key weakness of the Short-Range Approach to Manpower is bias that was apparently built into the analysis at the outset. In addition, three of the specific requirements set out in the Appropriations Act are not completely addressed in the document: (1) identification of minimum staffing levels, (2) the feasibility of reducing central office staff to 900 positions by 1984, and (3) methods of reducing staff. Finally, there is very little documentation provided to determine how the proposed staffing levels were determined. Overall, the Short-Range Approach to Manpower is more a compilation of staffing requests than an assessment of staffing needs.

Initial Bias of the Planning Effort

The short-term effort was conducted in a manner that may have biased the results, because the outcome of the staffing analysis had apparently been predetermined by DHT management. The intended outcome of the effort was described in correspondence from DHT's director of administration to divisions and districts prior to the start of the short-term analysis. In a letter to division administrators the director stated:

> Laying the groundwork for change [in the Appropriations Act] should begin as soon as possible . . . . We need to demonstrate that we cannot reduce our numbers to 10,177 and expect to respond in a responsible manner to our basic mission of building and maintaining highways.

In a letter to district engineers, the director again stated:

> As a consequence of additional sources of revenue and the expanded construction program, the current [staffing] limitations may not be appropriate. In

> order to avoid this legal requirement, the Appropriations Act would have to be changed by the legislature when they meet in January 1983. To do this, groundwork should begin as soon as possible.

In a letter report to the department, JLARC questioned whether the department would conduct the needed "critical" organizational review if field personnel thought the outcome was already decided by management. It appeared that district and division engineers would have little incentive to thoroughly assess the efficiency of their units when top management's stated goal was to amend the staffing limitation upwards. The JLARC letter report is appended.

After the organizational review was completed, it was clear that the outcome was not focused on the mandated criterion of identifying a minimum staffing level. For example, the short-term effort generated a department-wide need for 10,927 positions in FY 1983, two percent above the 10,671 maximum employment level specified in the Appropriations Act. For FY 1984, DHT identified a need for 10,963 positions, eight percent above the 10,177 level set in the Act. However, the department did not incorporate any staff efficiencies or reductions. As a result, DHT's short-range effort did not focus on minimum staffing and could not provide a basis for the department's compliance with the mandated staffing levels.

Minimum Staffing

The inadequacy of using the Short-Range Approach to Manpower as a basis for establishing minimum staffing levels has been acknowledged by the department. The Human Resource Planning System document that DHT provided to JLARC noted that the short-term effort:

> ...concentrated on determining minimum staffing for the department between 1982 and 1984. This effort, based on traditional methods, determined that the department needed approximately 10,950 employees to staff the programs and activities funded by the Act. The number was considered by management to be above the minimum number of employees because it did not take into account efficiencies in planning, scheduling, or work methods.

Although staffing could apparently be reduced to reflect these efficiencies, the actual minimum level remained unclear. Consequently, the 10,963 position level is meaningless as a staffing target.

Inconsistent Definitions of Minimum Staffing. Different definitions of minimum staffing were apparently used by the divisions in identifying staffing needs. Such variation suggests that a consistent understanding of minimum staffing may not have been implemented during staffing assessments. A definition was stated, however, at the outset of the Short-Range Approach to Manpower:

> ...the least number of permanent positions required to accomplish the program funded by the Appropriations Act without reducing services to the public to such an extent that safety or investment in the transportation system would be seriously jeopardized.

This definition suggests a need for a thorough review of service levels and an assessment of possible staffing reductions. However, no such review is discussed in the report, and it is not clear which staffing projections were based on continuing or increasing current service levels and which projections were based on reduced or minimum service levels. The functional analysis described in the report could have led to lower service levels, but the net result of the effort was that the department did not eliminate any functions. Furthermore, there are no references in any of the analyses in the Short-Range Approach to Manpower that link the number of staff positions to a level of service below which "safety or investment in the transportation system would be seriously jeopardized", as the department's definition specifies.

In fact, several different definitions appear to have been used to justify identified staffing needs. In setting maintenance requirements, for example, the document states that a minimum number of staff would perform an "optimal amount of work [to] a standard that will provide reasonable comfort and safety to the traveling public." In the urban division, the document refers to the number of staff needed for the division to "effectively function." For the equipment division, the document states that understaffing would result in the department "being unable to accomplish its total mission." In the fiscal division, the current staffing level is justified to "satisfy meeting the needs of the organization." These different definitions reflect inconsistent implementation of the minimum staffing concept, and may reflect inadequate attention to this concept.

Need to Assess Efficiencies. Minimum staffing cannot be achieved until operations are efficient and employees are working at high productivity levels. In prior reports JLARC made several recommendations that could lead to higher productivity. Examples included eliminating area headquarters and establishing a maintenance methods improvement program. DHT did not, however, examine any staffing efficiencies in its short-term document. The department states that staffing estimates were "necessarily based on existing methods of workload assessment and did not take into account the impact of recommendations or suggestions made by JLARC relative to specific areas of potential staffing reductions." Consequently, opportunities for staffing economies were not assessed even though the divisions and districts expressed an overall desire for more staff.

In some cases, the division and district efforts did not yield minimum staffing numbers because average instead of above average productivity levels were applied to determine future staffing needs. Minimum staffing cannot be determined until staffing needs are tied to high productivity. Two examples of DHT's use of average productivity

levels were in determining the need for construction inspectors and maintenance workers.

Construction Inspectors. As part of DHT's projection for construction inspector needs, the average dollar value of work under way per inspector over the last three years was applied to the anticipated value of the construction program. As shown in the field staffing analysis contained in this report, however, the real value of construction work per inspector has declined more than 50 percent since 1975. Failure to consider returning productivity to higher levels actually achieved in past years suggests that more than the minimum number of inspectors was recommended in the Short-Range Approach to Manpower in the following statement:

> The Districts have based their inspector needs on the Six-Year Improvement Program. Staffing projections based on the proposed construction program, including anticipated maintenance projects requiring inspection and permit and subdivision inspections, reflect a need of approximately 800 inspectors for each of the next two fiscal years.
>
> It is anticipated that the current staffing levels in this area will have to be increased; however, not to the extent that would approach the 800-inspector level. The current level of inspector staffing is 697. This includes 30 project engineers and 70 permit inspectors.

The precise number of inspectors needed is never actually identified, although it will presumably range from 697 to 800 for FY 1983 and 1984.

JLARC estimated the number of project inspectors needed from June 1982 through June 1987 on the basis of project balance underway per inspector as supplied by DHT. The productivity level used in the estimate was the level achieved in June 1976, June 1977 and June 1978 by construction inspectors. The JLARC analysis showed a need for a total of 448 inspectors in June 1983 and 621 in June 1984, or between 76 and 249 fewer than the DHT request.

The department's requested inspector staffing level consequently appears to exceed the level achievable if higher productivity were attained. Minimum inspector staffing should be tied to these higher productivity levels, and steps should be identified for attaining these levels.

Maintenance Staffing. The Short-Range Approach to Manpower states that current staffing ceilings for maintenance are appropriate. Based on these ceilings the Department claimed to need as many as 219 additional maintenance employees for FY 1983 and 1984. These ceilings are determined in part by productivity standards, as the workload required for ordinary maintenance activities is divided by productivity standards to determine staff needs. As mentioned in the maintenance

productivity section of this report, however, DHT standards for some of these activities are set below the average performance actually achieved over the past several years. This practice is inconsistent with sound manpower management practices.

Based on JLARC's review of three routine maintenance activities, between 158 and 248 fewer maintenance positions would be needed if previous or above average productivity levels could be achieved. If this improvement were made, the FY 1983 and 1984 staffing request for additional maintenance positions could be reduced from 219 to no more than 61 additional positions. Indeed, if the upper range of productivity were achieved, some existing maintenance positions could be eliminated. Additional economies could be achieved if productivity were improved for other maintenance activities.

These examples and the differing notions of minimum staffing used throughout the Short-Range Approach to Manpower represent key defects in the initial planning effort.

Central Office Staffing

The Short-Range Approach to Manpower identifies a need for a central office staffing level close to or below the 1,312 level set in the Appropriations Act. The document states the "best estimate available" of total central office needs is 1,319 for FY 1983 and 1,298 for FY 1984. These estimates were based on analyses of projected workloads. According to descriptions in the report, however, needs were apparently developed without reference to minimum staffing, and in other cases inconsistent definitions of minimum staffing were used.

It does not appear that serious consideration was given in the document to assessing the feasibility of reducing central office staffing to 900 positions in the by 1984. While the document indicates that central office needs are substantially above the 900 level, no reference is made to the feasibility study required under the Appropriations Act. However, reference is made to decentralizing activities and positions and to other potential ways of reducing central office staff. Further assessment is needed to comply with the Act.

Workforce Reduction Methods

The 1982 Appropriations Act also required DHT to prepare a manpower plan which "identifies methods to expedite reductions in staff to meet minimum staffing levels." The one page in Short-Range Approach to Manpower which discusses the management of workforce size does not discuss how the methods would be used to achieve reductions.

For example, eight methods are listed and are divided into two categories: "methods to effectively manage surplus employment" and "methods to reduce new employment need." The report states that the "utilization of these methods will provide for orderly reductions to

achieve minimum staffing and provide adequate flexibility to respond to changes in revenue," and that "the choice of option will also be dependent upon whether the surplus or need is expected to be temporary or permanent." The document does not address the effects of different reduction methods on the department or the circumstances under which these methods might be implemented.

A key reason for more consideration of alternative workforce reduction methods is that to date DHT has used only an across-the-board hiring freeze (which depends on attrition) and permanent layoffs as methods to reduce staffing. In a recent letter to the Chairman of JLARC, the Commissioner of DHT stated that the department would reduce staff to the 10,177 level and reiterated a commitment to attrition as the means to reduce staffing. He also stated that if attrition were not sufficient to achieve the 10,177 level by July 1983, layoffs would be implemented. As suggested below and previously discussed in Chapter III, a planned or selective hiring freeze, cross-training, and shifts between classifications are preferable.

Planned Hiring Freeze. A planned hiring freeze, in which only vacancies in certain designated classifications would remain unfilled, could be used to facilitate staffing reductions. Under this approach, only those classifications that are above a targeted level would be reduced through attrition. Vacancies occurring in classifications that are already below a specified level would be filled.

This method of adjusting the workforce hinges on establishing target levels that should be maintained within classifications. The decision to hire or not to hire would be based upon whether the actual staffing complement was at or below the target level. A step in this direction was taken by the department in its December 9, 1982, policy memorandum which established a ceiling of 93% of authorized strength on certain maintenance classifications in residencies.

Although such an approach requires careful workforce planning, it has the advantage of facilitating staffing reductions while ensuring that critical positions remain filled. In addition, the mix of classifications within the department could be adjusted to meet, say, a decreasing need for preconstruction positions.

Other Workforce Adjustment Methods. DHT's mission statement identifies two additional methods for adjusting the size of the workforce: cross-training, and shifting personnel between job classifications and between locations. Cross-training construction inspectors to work as draftsmen and then shifting them to draftsman vacancies, for example, could create staff reductions in one area and fill vacancies in another.

Shifting employees between job classifications is a potentially effective method of adjusting the current workforce to meet changing needs, provided that re-training opportunities are extended to existing staff. In a December 3, 1982, intra-departmental memorandum, DHT "restated" its policy on employee transfers. The policy does not

limit classifications between which employees can be shifted. The policy is emphatic in stating that:

> There is no recourse to layoff for employees refusing to accept lateral transfer within their position classifications where the duties of the employee's current position is of lower priority than those of a vacant position, there are not other positions with lower priority duties in that classification in the same organizational unit, and the Department is willing to reimburse the employee for moving expenses in transfers requiring residence relocation.

Shifting employees between locations is already done in some job classifications. Construction inspectors, for example, are often temporarily transferred to job sites away from their permanent location. In other cases, however, location shifts have not occurred when needed:

> *A foreman at an area headquarters resigned to take another job. Because of the hiring freeze the position went unfilled. An adjacent area headquarters, meanwhile, had two foremen on the job. The maintenance supervisor for the residency stated that one foreman was needed in the first area, while two foremen were not necessary in the second area. No change in assignments was made, however.*

In this case one foreman could have been assigned temporarily to the area that needed a foreman.

The department's December 3 memorandum provides for temporary assignments between classifications. The department should also consider including temporary and, where warranted, permanent transfers between classifications as an alternative to layoffs. Classifications between which employees can transfer should be identified, and suitable training programs considered.

Inadequate Documentation

The Short-Range Approach to Manpower includes judgements about where current staffing levels are believed to be appropriate, and where staff additions or reductions are believed to be justified. Documentation for many of these judgements, however, is not included. Many of the projected staff needs are assertions rather than assessments. Consequently staffing projections cannot be evaluated on the basis of information supplied in the document. Neither can the extent to which the projections reflect minimum staffing levels be evaluated from the information provided. Examples of inadequate documentation follow:

- In a page-long discussion of the materials division, four paragraphs are devoted to the background and responsibilities of the division and one paragraph is devoted to recent reductions in the division. Projected personnel needs for the next two years, on the other hand, are provided in a table and are not explained.

- Two paragraphs about the data processing division discuss the responsibilities of the division and current staffing levels. A projected need for six more staff members, however, is mentioned and placed in a table but not explained.

- For the research council, the document concludes "the programmed manpower distribution for FY '83 is as follows," and follows with a table that is not explained.

- For the traffic and safety division, there is no justification offered for the statement that "manpower projections for the District units remain relatively constant throughout the 1982-84 biennium," but a lengthy discussion of the division's responsibilities is included.

- Two paragraphs of discussion on the responsibilities of the purchasing division are followed with two unsupported assertions that 101 staff members are currently needed to perform activities, and that next fiscal year the addition of one person is planned.

Fuller discussion of the justification for current staff levels and of requests for additional positions is necessary. Documentation provided by the Short-Range Approach to Manpower is generally insufficient to determine the basis for the requested positions.

Conclusion

The Short-Range Approach to Manpower represented an incomplete effort to assess DHT staffing needs in FY 1983 and 1984. It did not address legislative concerns about minimum staffing, central office reductions, or methods of reducing staffing. In addition, the report documented neither current staffing nor the projected need for 600 additional positions. Due to these shortcomings, the Short-Range Approach to Manpower may comply with, but does not satisfy, the Appropriations Act mandates.

The department acknowledged many of the deficiencies in the Short-Range Approach to Manpower and redirected to the long-term manpower plan its efforts to comply with Appropriations Act requirements. A letter from the Commissioner of DHT to the Chairman of JLARC noted that "the long-term manpower planning system . . . will address the specific question of central office staffing outlined in the 1982-84 Act, as well as provide data on DHT staffing needs for the 1984-86 biennium." Consequently, a determination of how DHT intends to comply with the Act should focus on the department's long-term manpower plan.

DHT'S HUMAN RESOURCE PLANNING SYSTEM

The DHT Commissioner assembled a task force in April, 1982, and charged it to develop a long-term manpower plan. The task force, designated the Manpower Advisory Group (MAG), began to develop methods and identify resources within the agency. The overall approach of the group was to develop a manpower forecasting tool incorporating work measures for most DHT employees.

An interactive review process was used to assess the MAG effort. JLARC staff met with the Manpower Advisory Group on five occasions to receive progress reports on the group's work. Meetings took place on:

May 13, 1982;
June 8, 1982;
June 23, 1982;
September 10, 1982; and
October 8, 1982.

MAG also provided JLARC staff with six written status reports over the course of the summer. In response, JLARC identified 11 concerns about the MAG effort in a letter report submitted to the department on August 23, 1982. (A copy of this letter may be found in the appendix.)

DHT submitted to JLARC the Human Resource Planning System (HRPS), a document prepared by MAG about the department's long-term plan, on November 5, 1982. HRPS consists of 38 pages describing the long-term planning process and 95 pages of appendices, which include a case example of how one division, traffic and safety, will implement the system. The focus of the document is on establishing a computerized system which will improve DHT's ability to forecast future staffing needs. The document outlines how the system will operate, and illustrates the substantial progress made by the department toward implementation of an agency-wide manpower plan.

The manpower planning system described in the document is meant to link staffing projections with productivity levels, and to provide for improved efficiency and productivity through refinement of work standards. All DHT staff will eventually be included in the system. The document also acknowledges that since 1978 attrition has resulted in "unmet staffing needs in some areas and surplus personnel in areas such as the preconstruction progams that are more directly revenue related." The manpower planning system is being designed to anticipate and correct similar imbalances in the future.

While the department intends HRPS to comply with the Act, the report lacks the documentation and precision needed for compliance. First, the document fails to fully address the requirements set by the Appropriations Act: (1) identification of minimum staffing levels, (2) feasibility of reducing central office staff to 900 positions by 1984, and (3) methods of reducing staffing. These requirements were called

to the department's attention in the August 1982 JLARC letter (appended), but the concerns raised have not been adequately addressed in HRPS. In addition, the methods for assessing staffing efficiencies are not spelled out in the department's effort to establish a minimum staffing level. Finally, the means of determining service levels from predicted revenue, a vital step in forecasting staffing needs under the system, is unclear.

While the department may fully intend to address such concerns as part of its manpower planning efforts, these intentions are not explicitly discussed in HRPS. For the department's manpower process to comply fully with Appropriations Act intent and be effectively implemented, the plan should explicitly address the Act's requirements.

Minimum Staffing Levels

As noted previously, HRPS acknowledges that the Short-Range Approach to Manpower did not generate minimum staffing levels for the 1982-84 biennium. However, the first document did define minimum staffing as:

> ...the least number of permanent positions required to accomplish the program funded by the Appropriations Act without reducing services to the public to such an extent that safety or investment in the transportation system would be seriously jeopardized.

In HRPS the department affirms a concern that "the number of employees never should be more than that required to provide essential public services."

HRPS does not, however, adequately document how the long-term effort will aid in the identification of "essential public services" or the staff "required" to provide those services. For example, the document does not specify a minimum or essential level of service. Although the first component of the human resource planning system requires "the district or division manager to identify the mission, goals, and objectives of the work force," HRPS does not state how the manager will identify these goals and objectives, or how "essential" services will be related to these goals and objectives. Moreover, decentralizing the determination of goals and service levels to numerous managers will not necessarily help the department achieve minimum staffing levels. In addition, the document may imply that service levels are tied more to available staffing than to need or funding:

> The mission, goals, objectives and scheduling combine to determine the projected number of work units to be performed . . . If the work need does not match the available resources, the manager and his supervisors establish priorities among the goals and make decisions regarding the levels of services to be provided in order to utilize the available human resources in the most effective manner.

In order to focus on minimum staffing, managers should establish work priorities and identify essential or minimum service level options, and should do so prior to comparing projected workloads with available resources. Otherwise, service levels may reflect a bias in favor of current staffing rather than essential or minimum service levels. Since the results of the long-term effort will not be available until mid-1983 or later, the following unsupported statement in the Commissioner's letter at the beginning of HRPS indicates that such a bias may be of concern:

> . . . it is approaching the point at which further major reductions [in DHT statewide employment] could jeopardize its ability to fully meet responsibilities to improve, maintain, and operate the 52,600-mile State highway system.

To ensure that HRPS focuses on minimum staffing, any bias in favor of current staffing levels should be avoided. A clear means of setting service levels should be articulated and service levels should be set prior to determining staff levels. A means of linking staffing forecasts with revenue forecasts should also be specified. For example, the work currently under way to establish two levels of maintenance funding should be related to staffing levels in HRPS.

Work standards. A system designed to achieve minimum staffing levels should also identify the staff level needed to perform essential services once operations are efficient and employees are working at high productivity levels. In HRPS, MAG states that "the department will be able to assure improved productivity through the work standard." While the work standard is a crucial element of the long-term plan, MAG is tentative in its discussion of how standards will be set and who will set them. For example, MAG states that each division and district will annually review "its work standards, or the normal manhour requirements for accomplishing work units." On the other hand, MAG states that "it is currently envisioned that all work standards should be established above the statistical mean." HRPS does not specify how the department will ensure that this objective is met.

The document gives an overall impression that initially work standards will be set at average levels, and subsequently refined to reflect high productivity levels:

> Initial work standards were determined by evaluating the amount of time each work unit has historically taken to be performed. Since some work units have not been recorded before, some divisions and districts entered a composite of the best estimates of the time required to do a representative work unit. These estimates will be modified using the most appropriate statistical measure as actual data becomes available.

Despite this discussion, however, HRPS does not explain how the standards will be validated or refined. For example, the traffic and safety division currently has a pilot program under way to validate

work standards which have been developed from historical data. It appears that validation will be made by comparing the standards developed from historical sources with data collected from traffic and safety employees in October-December 1982. MAG does not elaborate on what appropriate statistical measures or comparisons might be used to validate the standards.

If minimum staffing is an objective, an emphasis on establishing work standards above average performance seems appropriate. Consideration of a specific performance target for each standard should be included, such as performance at the 75th percentile of the highest productivity level actually achieved by one district or unit. Steps for achieving this higher level should also be identified.

Productivity. As discussed in this report, productivity improvements may lead to staffing reductions. HRPS does not, however, reflect a careful consideration of the term "productivity".

Productivity improves when more units of output, or work, are produced per unit of input, or resource. Therefore, when referring to productivity, HRPS should compare DHT work output to man-hours used to accomplish that work. Instead, the document refers to productivity in an imprecise manner. For example, the document states that:

> Within the next year, increased emphasis will be placed on the establishment of productivity improvement goals for those functions that have measurable units of output. For example, increase by 5% the number of miles of ditching accomplished.

An increase of five percent in the number of miles ditched, however, is a production rather than a productivity goal. The goal could be achieved, for example, by increasing the number of man-hours devoted to machine ditching by five percent or more. The relationship between productivity improvements and staffing should be identified. The document also states:

> . . . a comparison of FY 1978-79 to FY 1982-83 shows a revenue increase of $18.7 million. It should be noted these increases were directed to the system acquisition and construction, and system maintenance categories; the administration and support services category decreased by $2.8 million constant dollars. A comparison of personnel shows 11,817 for FY 1978-79 and approximately 10,269 for July, 1982 . . . the above data is indicative of reasonable progress in productivity and efficiency.

The referenced data does not indicate anything about productivity and efficiency, because it relates neither funding nor staff levels to workload. The department should give more careful consider-

ation to the difference between productivity improvements and production increases. This would help ensure that minimum staffing levels can be reached.

It should also be noted that when measured in constant dollars, DHT appropriations have not increased as HRPS claims. For example, in FY 1979, $439.1 million was appropriated for highway system acquisition and construction, and for FY 1983 $458.8 million was appropriated for that purpose. However, due to inflation it would require an FY 1983 appropriation of $508.1 million in current dollars just to equal the FY 1979 appropriation.

A key concern is that adjusting or validating work standards based on current productivity may lock in productivity levels that are historically low. As shown in the construction inspector analysis in Chapter III of this report, current productivity is less than that achieved in past years. The manpower planning system needs to ensure that overall department productivity will increase significantly, so that staffing forecasts will not be tied to an historically low productivity period.

As demonstrated in this report, a variety of productivity improvements are available to DHT. If achieved these improvements could result in reduced staffing. While HRPS reiterates DHT's commitment to "the establishment of productivity improvement goals for those functions that have measurable units of output," it is not clear that such productivity goals will differ from production goals. In addition, HRPS does not identify any examples where productivity improvements may be achieved in the organization, or how such improvements will impact overall staffing. HRPS states:

> The above described productivity improvement effort and continued concern will achieve a minimum employment level through FY 1983-84.

Inasmuch as HRPS was submitted in November 1982 and contained no details of the productivity improvements to be achieved, it remains unclear how the "productivity improvement effort and continued concern" will reduce staffing as early as July 1983. For HRPS to effectively focus DHT attention on productivity improvement, it is essential that the plan itself explicitly require the attainment of higher standards of productivity. High standards should be set, and provisions should be made to monitor the progress of organizational units in achieving those standards.

Central Office Staffing

The Appropriations Act limits DHT central office employment to 1,312 positions, and directs the department to address the feasibility of reducing that employment to 900 positions or less by June 30, 1984. As shown in the central office staffing analysis contained in this report, DHT achieved the required level of 1,312 positions in September 1982. This level was attained after a layoff was imposed in June.

The required assessment of further central office reductions is not contained in HRPS. The document does suggest that the assessment will be undertaken at some point in 1983, although the precise time frame is unclear. For example, the summary states:

> Priority in implementing the system is being directed at maintenance employees and at key divisions representing approximately 80 percent of the department personnel. For these groups, the system will be in full operation in July, 1983. Attention will then be given to support functions located primarily in the central office . . .

On page five, the document states that the department will address the central office question by July 1983:

> As the overall Human Resource Planning System develops, more accurate methods of predicting required staffing will become available. Utilization of this data . . . will permit VDHT to address [the central office] aspect of the Act by July, 1983.

A timetable should be developed for assessing, before the 1984 General Assembly session, the feasibility of reducing central office staff to 900 positions by June 30, 1984. The department also should discuss how the human resource planning system will be used to determine the feasibility of the 900 level.

Reduction Methods

HRPS includes a chart, first presented in the department's Short-Range Approach to Manpower that lists eight possible reduction methods. Neither document contains a full discussion of these methods, their effects on the department, or the circumstances under which they might be implemented. HRPS cites §4-7.01f of the Appropriations Act as specifying attrition as the method of reduction. The section states:

> The Governor shall administer a plan whereby the number of employees in the Executive Department may be further restricted to the number required for efficient operation of those programs approved by the General Assembly. The plan shall include the systematic review and analysis of the staffing requirements of all Executive Department agencies with the objective of eliminating through attrition, and over a period of time, positions not necessary for the efficient operation of programs.

This section clearly states that attrition is the preferred method of eliminating positions not necessary to efficient operations. The section does not necessarily exclude, however, attempts to manage

attrition. DHT's current hiring freeze, articulated in the December 9 memorandum, uses attrition as the means of reducing staffing but provides for selective hiring to ensure that critical jobs remained filled in the maintenance area. DHT should develop a plan for implementing selective hiring freezes as part of its human resource planning system. The plan should provide for hiring to fill a wide range of specified positions, for achieving overall reductions, and for responding to alternative revenue forecasts.

The specified section also focuses on "positions not necessary for the efficient operation of programs." One problem with HRPS is that it contains no provision for identifying inefficient employees. If productivity targets were set for individual positions, then under-achieving employees could be identified and steps could be taken to improve performance. With a change in State policy, continued low productivity could be considered grounds for dismissal or for identification of personnel eligible for layoff. Such a policy change would be necessary because, as noted in HRPS, "the State layoff policy is based on seniority which may limit the organization's ability to layoff the least productive worker." DHT and the Department of Personnel and Training should review the State layoff policy, specifically considering whether employee productivity may be a factor in the determination of eligibility for layoff.

CONCLUSION AND RECOMMENDATIONS

The Human Resource Planning System reflects the considerable effort which DHT has devoted to developing a method for linking workload with current staffing levels. The department is confident that when implemented, the system described in the document will address both the Appropriations Act mandates and the concerns identified during this review period. The document submitted for JLARC review, however, does not focus on several of the key issues specified in the Appropriations Act.

Based on this assessment of the DHT manpower planning process, the following recommendations are submitted.

Recommendation (18). The Human Resources Planning System should specifically include:

a) A clear and consistent definition of minimum staffing, which incorporates an above average level of productivity. This definition should be consistently used in developing the system.

b) A clearly articulated method for linking available and forecasted revenues with service levels and staffing levels. The method should address the two levels of maintenance under development by the department, and provisions for contracting to the private sector for ordinary maintenance.

c) Specific performance targets for all work standards. For example, productivity at the 75th percentile of the past highest performance could be required. Steps for achieving this higher level should be identified.

d) An assessment of the feasibility of reducing central office staffing to 900. The assessment should specify analytical methods used to determine feasibility, and be completed prior to the 1984 session of the General Assembly.

e) An identification of the relationship of productivity improvements to staffing levels. Productivity improvements should be clearly distinguished from production increases.

Recommendation (19). DHT should develop alternative methods of adjusting workforce size. Methods should include:

a) A department-wide plan for selectively implementing a hiring freeze as part of HRPS. The plan should specify the conditions under which the freeze would be invoked, and the job classifications which would be affected. The freeze should be tailored to meet maximum employment levels specified in legislation. Targeted position levels should be specified for the affected classifications. Plans should be developed for maintaining the specified levels.

b) An expansion of department policy on temporary transfers to include transfers between classifications. Classifications suitable for such transfers should be identified. Suitable training should be provided. Guidelines should be developed for district and resident engineers to follow in effecting such transfers.

Recommendation (20). DHT, with the cooperation of the Department of Personnel and Training, should review the State layoff policy as it applies to DHT, specifically considering whether individual employee productivity may be a factor in the determination of eligibility for layoff. Positions covered by work standards which incorporate productivity goals should be the focus of the review.

Recommendation (21). The implementation of DHT's long-term manpower planning system should be reviewed. A report on implementation should be made by JLARC to the appropriate legislative committees as part of the routine follow-up report to be submitted to the General Assembly prior to the 1984 session.

APPENDIXES

APPENDIX A:
AGENCY RESPONSE

As part of an extensive data validation process, each State agency involved in JLARC's review and evaluation effort is given the opportunity to comment on an exposure draft of the report.

Appropriate technical corrections resulting from the written comments have been made in the final report. Page references in the agency response relate to the exposure draft and may not correspond to page numbers in the final report.

STAFF NOTE

The following letter represents DHT's final response to the report on staffing and manpower planning. The response deals primarily with the recommendations contained in the report. Comments by JLARC staff are included where appropriate.

The department's final response is significantly different from its preliminary response, transmitted to JLARC staff on December 8, 1982, which questioned various aspects of the methodology used in the research. The DHT Commissioner made a presentation at the December 13 JLARC meeting which also raised several methodological concerns. At that meeting, Senator Edward E. Willey was appointed to chair a subcommittee on the report, and the staffs of JLARC and DHT were directed to meet and resolve, to the extent possible, methodological issues. The staffs met on four occasions.

As a result of those discussions, the report was modified to provide a fuller description of the research where it had been misunderstood. Therefore, the present technical appendix (Appendix D) provides additional details on only the maintenance productivity area. In addition, the range of potential staffing economies was reduced to reflect goals that the department felt would be more reasonable to achieve. For example, a projection of the number of construction inspectors that would be surplus if previous levels of productivity were achieved was reduced from 350 to 228 positions because JLARC agreed to use an alternative approach to workload measurement. Another change was made regarding right-of-way productivity targets.

At a meeting of the subcommittee on January 5, 1983, the DHT Commissioner reported that all methodological questions had been resolved and the department concurred in all but two of the recommendations. The Commissioner said the department did not wish to suggest a central office definition--Recommendation (8), numbered 3-1 in the department's response--as he regarded the matter to be a legislative prerogative. The Commissioner further believed that the Secretary of Transportation, not the department, should address Recommendation (17)--numbered 3-10 in the department's response--concerning the designation of the central garage as a working capital fund.

COMMONWEALTH of VIRGINIA
DEPARTMENT OF HIGHWAYS & TRANSPORTATION
1221 EAST BROAD STREET
RICHMOND, 23219

January 5, 1983

JAN 5 1983

Mr. Ray D. Pethtel, Director
Joint Legislative Audit and
Review Commission
General Assembly Building, Suite 1100
910 Capitol Street
Richmond, Virginia 23219

Dear Mr. Pethtel:

This letter is intended to provide the Department's response to the findings and recommendations contained in the December 30 staff exposure draft Staffing and Manpower Planning in the Department of Highways and Transportation. I hope the following comments prove useful to the deliberations of the JLARC subcommittee which I understand will now review the staff report.

GENERAL COMMENT ON STAFFING ESTIMATES

The Department considers all but one of the substantive recommendations included in the staff draft to be sound, and, where appropriate, full consideration will be given to their adoption. Responses to individual recommendations are included in the following sections.

While the Department fully recognizes that the JLARC staff has not formally included any of the "potential staffing reductions" as listed in Table 1 of the Executive Summary in their recommendations, the Department also believes that many of the positions which underlie the suggested maximum staffing range of between 9,767 and 9,925 FTE are not appropriate candidates for elimination. The following points are offered to provide our perspective on ths important issue.

Three components of Table 1 in the Executive Summary to the exposure draft are, we believe, subject to important qualifications. These three include (1) the inspector productivity estimates, (2) elimination of plant technicians, and (3) centralization of timekeepers.

In addition, while the Department is engaged in an interim reduction in force in maintenance staffing pending completion of the Human Resources Planning System, the 158-248 FTE estimate derived by the JLARC staff reflects analysis of only three work activities and does not include an evaluation of the costs of the suggested means of achieving

increased efficiencies. Therefore, VDH&T staff believes substantial additional analysis and verification is necessary to ensure that the means of achieving the proposed efficiencies will, in fact, be cost-effective.

Inspector Staffing Levels

The staff report identifies 228 FTE "surplus" project inspectors within VDH&T. The JLARC staff report states:

> "If inspectors in June 1982 could have achieved the productivity level average achieved in June of 1976, 1977 and 1978, only 370 inspectors would have been needed instead of the actual 598. Based on the balance underway data, DHT in June of 1982 had as many as 228 surplus inspectors. Elimination of 228 positions could achieve a savings of $3.4 - $4.6 million in salaries and fringe benefits annually."

The 228 position figure is included in Table 1 on page 3 of the Exposure Draft as a component of the "potential DHT staffing reductions" which, in turn, are used to produce the maximum staffing levels included in the report.

However, the same data in the JLARC staff report suggest that the circumstances are substantially more complex. The following data are developed from Table 9, page 61 of the JLARC report.

Time Period	Inspector Staffing June 1982	Inspectors Needed Per JLARC Analysis	"Difference"
June 1982	598	370	228 "surplus"
December 1982		421	177 "surplus"
June 1983		448	150 "surplus"
June 1984		621	23 deficit
June 1985		694	96 deficit

The data show that at the present time the "surplus" is 177 rather than 228 positions. By June 1983 the need for inspectors would increase to 78 above the 228 figure suggested by JLARC staff's estimate of potential staffing reductions. Finally, by the end of the current biennium VDH&T will be short of qualified inspection personnel, a shortage which will extend into mid-decade.

Using the above data a different conclusion can be drawn from that included in the staff report. Clearly, 228 positions are not now available for elimination. Instead, if the exposure draft logic is followed, VDH&T would be required to lay off up to 150-177 experienced personnel, with the intent of rehiring all laid-off employees within 12-18 months. No long-term staffing reductions are indicated by the analysis.

The construction inspector analysis must also be considered preliminary because of the yet to be determined impact of the recent federal

gasoline tax increase. Virginia anticipates approximately $44 million in additional federal assistance between April and October 1983. Initial federal policy discussions have emphasized the need for states to obligate additional funds soon after their receipt. Therefore, while the Highway and Transportation Commission has not been able to react to the recent federal actions, it can be assumed that Virginia will increase its 1983 advertisement schedule for the spring and summer construction season by as much as twenty percent over previously anticipated levels. This action will further reduce whatever temporary staffing reductions might be gained by application of the JLARC staff analysis.

In summary, the Department believes whatever "surplus" positions may have existed in June 1982 were the result of the major cutbacks in construction work during 1980 and 1981 associated, in turn, with revenue shortfalls experienced by all states following the 1979 oil embargo. The data in the JLARC staff report confirm that these "surpluses" will be fully eliminated within 18 months. Finally, the availability of additional federal construction aid will accelerate the elimination of temporary "surpluses" and reduce the time span necessary to eliminate any existing overstaffing.

JLARC Staff Note

The department had projected a need for between 700 to 800 construction inspectors in its Short Range Approach to Manpower. The JLARC calculations compared actual staffing with actual need during 1982 and projected staffing with projected need for subsequent years. Furthermore, JLARC did not recommend "laying off" construction inspectors. JLARC's report logic would, however, suggest reducing the number of positions dedicated to construction inspecting tasks and transferring people from unproductive jobs to vacancies that occur in maintenance jobs which need to be filled.

Plant Technicians

Table 1 of the exposure draft also cites 65 FTE positions for elimination through expansion of the quality assurance program. Under this program manufacturers of certain road materials may chose to certify that materials supplied to VDH&T meet Department specifications. If the certification is provided, no on-site inspection at the manufacturing plant is required.

As you note in your report, the program is voluntary and, to date, 46 of 150 bituminous concrete and aggregate plants have agreed to the certification requirement. You do not recommend that VDH&T make the certification program mandatory, therefore the elimination of the full 65 FTE is not now achievable. The Department will explore means of increasing the voluntary participation in the program but does not believe mandating participation is appropriate at the present time.

JLARC Staff Note

It is correct that elimination of all 65 FTEs is not achievable until all plants are certified. However, since 31% of the plants have agreed to the certification requirement, approximately 20 FTE employees are no longer necessary. We concur that the department should consider ways to expand voluntary compliance or consider making the quality assurance program mandatory.

Centralization of Timekeepers

The JLARC staff report recommends the elimination of between 87 and 114 positions by eliminating the assignment of timekeepers to area headquarters. It must be recognized that this action has several consequences which argue against such a move. As the staff report states,

> "...JLARC staff learned that timekeepers actually perform a wide variety of tasks across the State. These tasks include mowing the headquarters lawn, repairing equipment, loading trucks and assisting crew with road work."

These functions are in addition to the maintenance of records on labor, equipment and materials utilization, dispensing of motor fuel to state vehicles during business hours, and receiving public requests for road information and maintenance work.

The exposure draft does not state that the functions listed above are unnecessary. Therefore, elimination of the timekeeper positions will, by definition, require shifting work responsibilities to maintenance field staff.

As you are aware, the Department has set an interim goal of reducing budgeted maintenance field staff levels through a selective hiring freeze. This initiative is intended to significantly reduce costs while providing for necessary maintenance work. At the same time it is unlikely that VDH&T can eliminate as many as 114 timekeepers in addition to maintenance field reductions already underway, without suffering an unacceptable service loss.

VDH&T intends to carefully review the timekeeper job description to better reflect the important nature of the position. Where physical co-location is feasible, as is the practice in Giles, Pulaski, and Montgomery Counties, the Department will continue to review staffing reduction potential.

In summary, the Department believes as many as 407 of the FTE identified in Table 1 of the Executive Summary may not be available for

elimination. This is not to suggest that productivity improvements are not possible, but to present some different and, we believe, important perspectives on the specific numbers contained in the JLARC staff draft.

JLARC Staff Note

The point made in the report is that the timekeeper position is not required on a full-time basis at each area headquarters. The maintenance work actually done by timekeepers at the area level can be handled by other staff assigned to routine maintenance tasks -- a staff component which also has a great amount of reserve capacity. The timekeeper job can be handled at the residency level and it can be done by up to 114 fewer people.

RESPONSE TO SPECIFIC RECOMMENDATIONS

Recommendation 2-1

The Department agrees that the number of area headquarters should be reduced wherever conditions warrant. However, other factors besides a mileage standard must be considered. An evaluation of each of the "potential headquarters reductions" identified by JLARC staff has been conducted, and I have been advised that in eight counties consolidations are feasible. In five other counties past experience suggests consolidation would not be useful, however, additional review may be considered.

In five of the counties listed in the JLARC draft, the consolidation you propose would eliminate the single existing area headquarters. The Department believes that retaining a minimum of one area headquarters per county is a necessary means of maintaining proper coordination with the local governing body and individual citizens.

You also proposed the elimination of three areas in Norfolk, Chesapeake and Virginia Beach which have been assigned relatively low mileages. What is not reflected in the table is that these are extremely high-volume interstate and urban freeway segments including I-64, I-264, I-564, and the Virginia Beach-Norfolk Expressway. The Department believes that the particular maintenance needs of these segments precludes elimination of the aforementioned facilities.

Topography and geography are a third factor which must be considered. In three counties you propose for consolidation -- Giles, Bath and Highland -- the one remaining maintenance superintendent would be required to travel 140 miles just to inspect all primary mileage. In Patrick County the Vesta headquarters is located of necessity on a mountain top to serve its assigned area, while the topography of Grayson County is among the most rugged in the Commonwealth. In each of these five cases the current distribution of area headquarters is believed most appropriate for coverage of the assigned geographic area.

The Department believes that the distribution of headquarters in Russell, Tazewell, Wise, Scott and Buchanan Counties is appropriate due to the coal-haul roads which create special maintenance inspection and service requirements.

Finally, the future growth potential of urban and suburban counties must be considered. The data in the staff report suggest elimination of area headquarters in Fairfax, Chesterfield, Henrico, Loudoun, Roanoke, Prince William, Campbell, Frederick and Stafford Counties. Travel statistics and the six-year advertisement schedule for new construction confirm the growing maintenance needs of these areas. Reduction of facilities in growing areas is not likely to have long-term benefit for the Department.

The maintenance division has completed an indepth review of each jurisdiction identified for consolidation by the JLARC staff. Division representatives will be available to discuss each jurisdiction in detail should this be considered necessary.

JLARC Staff Note

JLARC did not identify specific area headquarters that should be eliminated or downgraded to sub-area status. We did identify a potential range of between 23 and 64 areas that might be appropriate to eliminate, downgrade, or consolidate depending on which criteria are used.

The department has agreed to assess all areas using standard workload guidelines. We await the results of that analysis.

Recommendation 2-2

This recommendation which deals with the assignment of timekeepers was addressed under the general comments section.

Recommendation 2-3

The Department will examine in detail the problems with equipment and spare parts availability cited in your report. With regard to spare parts availability the Department has a detailed policy governing the stocking of parts and supplies at each level of the field organization. The policy is intended to balance lost crew time against the cost of purchasing and maintaining individual stock items.

Recommendation 2-4 Concur

Recommendation 2-5 Concur

Recommendation 2-6 Concur

Recommendation 2-7 Concur

Recommendation 3-1

The Department believes that the decision to use a special definition of "central office" as contained in the 1982-84 Appropriation Act is a legislative prerogative. The key to such a statutory control remains consistency of definition.

Recommendation 3-2

The Department fully intends to comply with this provision as stated in my letter of October 13 to the JLARC Chairman.

Recommendation 3-3

The Department has placed first priority on a full study of the existing ADP environment and how best to take advantage of the expanded capacity offered by the West Broad Street Center. A follow-up review of CAD will be considered.

Recommendation 3-4

The Department concurs in the need to continue to fully incorporate preliminary engineering as a component of the six-year planning cycle for construction.

Recommendation 3-5	Concur
Recommendation 3-6	Concur
Recommendation 3-7	Concur
Recommendation 3-8	Concur
Recommendation 3-9	The Department does not agree that a merger of the programming and scheduling, secondary, and urban divisions is advisable.
Recommendation 3-10	The Department believes that the JLARC staff should address this recommendation to the Secretary of Transportation.

Recommendation 4-1

Concur. However, it is the Department's view that the items you suggest are already included in the research program for MAG as has been shared with your staff on several occasions.

Recommendation 4-2

Concur, a selective hiring freeze has been in force for several months. In should be noted that the affected job classifications and levels of employment will change over time.

Recommendation 4-3 — The Department of Personnel and Training has been requested to assist VDH&T as suggested.

Recommendation 4-4 — The Department understands that this recommendation is directed to the JLARC staff. We will be happy to provide whatever additional reports may be called for by the several legislative committees.

Department staff stand ready to meet with you and the JLARC subcommittee to discuss your recommendations in more detail.

Sincerely,

Harold C. King
Commissioner

APPENDIX B:
JLARC LETTER REPORT TO DHT CONCERNING
THE MANPOWER PLANNING PROCESS

COMMONWEALTH of VIRGINIA

Joint Legislative Audit and Review Commission
Suite 1100, 910 Capitol Street
Richmond, Virginia 23219
(804) 786-1258

August 23, 1982

The Honorable Harold King
Department of Highway & Transportation
1221 East Broad Street
Richmond, Virginia 23219

Dear Commissioner King:

Section 649.2 of the 1982 Appropriations Act requires JLARC to examine the department's manpower planning process. As we agreed, I will transmit periodic feedback to you in order to help accomplish both of our objectives and mandates. The staff paper, which I have attached, contains our initial comments on the department's manpower planning effort. The comments are based on a series of status reports and correspondence from DHT staff (appended), three meetings with the Manpower Advisory Group, and our independent observations and research. We believe these interactions have provided us with a sufficient overview of the department's manpower effort to prepare this initial communication.

Several additional evaluations of your on-going planning effort will be made during the fall months. Accordingly, this paper attempts to identify key issues or concerns with the manpower planning effort as it has evolved to date.

We hope the staff paper provides constructive feedback to the department; it is certainly offered in that spirit.

Sincerely,

Ray D. Pethtel
Director

RDP:daa

cc: JLARC Members
Mr. Gosher
Mr. Warren
Mr. Alexander
Mr. Landsidle

THE DHT MANPOWER PLANNING PROCESS

The Department of Highways and Transportation (DHT) has undertaken manpower planning in response to a legislative mandate. The planning process encompasses a short-term effort, to be completed prior to the 1983 session, and a longer-term planning effort.

Legislative Mandate

The 1982 General Assembly mandated the Department of Highways and Transportation to prepare a manpower plan. Under Items 649.2 and 649.3 of the Appropriations Act, the DHT manpower plan is to identify the minimum number of employees necessary to staff programs funded by the Act, and is to include methods of expediting staff reductions to meet the minimum levels. The Act limits the Department to a maximum of 1,312 full-time positions in the central office. It further requires the DHT plan to consider and report on the feasibility of reducing central office employment to 900 or fewer full-time equivalent employees (FTEs) by June 30, 1984. In addition, the Act caps DHT full-time equivalent salaried employment at 10,671 in FY 1982-83, and at 10,177 in FY 1983-84.

JLARC is required by the Act to review the DHT manpower plan, the planning process, and the resulting staffing actions. The Act also directs JLARC to report its findings by December 1, 1982.

At a meeting of DHT and JLARC staff on June 23, it was agreed that the department would submit to JLARC staff a written description of its manpower planning effort. Initial documents covering two phases of the effort (Appendices I and II) were received on June 29 and July 19, 1982. Status reports (Appendix III) on the manpower group's activities had been received previously, and an additional status report was received August 5, 1982. The status reports are attached as Appendix III. In addition, JLARC staff met with the advisory group to discuss the manpower effort on May 13 and June 8, 1982. A third meeting was held, with Commissioner King and Manpower Advisory Group staff, on June 23, 1982.

Current DHT Activities

The department has organized a manpower planning effort based on two separate processes under the supervision of the director of administration. A short-term effort is intended to address the Appropriations Act requirements and develop a staffing recommendation for the 1983 General Assembly. A long-term effort is intended to develop a manpower forecasting tool incorporating work measures for most DHT employees.

The short-term manpower effort is focused on determining department staffing levels for use by the 1983 General Assembly. It is being conducted by two staff members on a part-time basis. According to a June 28 letter from Mr. G. W. Alexander (Appendix I),

> the short-range methodology insures that the Department will be staffing on effective minimum levels, it addresses centralization, decentralization, and the feasibility of reducing Central Office staffing to 900 or less.

Thus the short-term effort is focused on the Appropriations Act requirements.

The long-term effort was established when the Manpower Advisory Group (MAG) was formed in April 1982 with the general direction to prepare a manpower plan. The group initially consisted of four staff members devoting most of their time to the project, with additional assistance from the divisions and districts. The basic purpose of the MAG unit is, according to the July 16 letter from Mr. Gosher, (Appendix II):

> to develop a manpower planning tool for VDHT which, when fully implemented, will indicate with a reasonable degree of accuracy the numbers of personnel required to perform a specified workload.

Initial implementation is scheduled to occur by June 30, 1983, with usable results to follow some time in 1984-85.

ASSESSMENT OF THE SHORT-TERM STAFFING ANALYSIS

The short-term staffing analysis is intended to meet the Appropriations Act requirements and to generate recommended staffing levels for the 1983 General Assembly. However, several problems are apparent with the short-term analysis as it is described in the June 28 letter from Mr. Alexander (Appendix I). Problems include some potential biasing of the overall goals, the level of documentation for the effort, the department's concept of minimum staffing, the department's attention to previously recommended ways of reducing staff and methods of achieving reductions, and the method of conducting the functional analysis.

Potential Biasing of Goals

The June 28 letter and attachments suggest in several places that the department has already concluded that specific levels set by the Appropriations Act are "unrealistic" and "arbitrary." Transmittal of this message to the divisions and districts may undermine a thorough effort to reduce current staffing levels to a minimum level.

Evidence of this premature conclusion is clearest in Director of Administration Warren's June 23 letter to division administrators (attached to Appendix I), in which he stated,

> Laying the groundwork for change [in the Appropriations Act] should begin as soon as possible . . . . We need to demonstrate that we cannot reduce our numbers to 10,177 and expect to respond in a responsible manner to our basic mission of building and maintaining highways.

In a June 24 letter to district engineers Mr. Warren again stated,

> As a consequence of additional sources of revenue and the expanded construction program, the current [staffing] limitations may not be appropriate. In order to avoid this legal requirement, the Appropriations Act would have to be changed by the legislature when they meet in January 1983. To do this, groundwork should begin as soon as possible.

Mr. Alexander's June 28 letter also appears to conclude that, for maintenance at least, "little or no change is expected in assessed manpower needs."

We question whether the department will have sufficient interest in conducting the "critical" organizational review called for in the June 23 Warren letter if the outcome has already been decided by management. District and division engineers will have little incentive to thoroughly assess the efficiency of their organizations when top management's stated goal is to amend the staffing limitation upwards. In addition, it is not apparent to JLARC staff how DHT management arrived at its conclusion when the results of its long-term effort will not be available for several years.

> *Concern (1). If the goals of the short-term staffing analysis are to objectively assess minimum staffing levels and determine ways of complying with the limitation of 10,177 FTEs specified in the Appropriations Act, instructions to the field from management should be supportive of these goals. Productive input to the staffing analysis cannot be expected if top management appears to have prejudged the outcome.*

Documentation of General Method

Mr. Alexander's June 28 letter (Appendix I) states that the short-term analysis will address the Appropriations Act mandates. The letter, however, does not specify how the mandates will be addressed. Instead the letter contains a general discussion of workload and staffing in preconstruction, construction, and maintenance. The letter also identifies a "ball park staff tool to predict trends" in staffing for acquisition and new highway construction.

Although the June 28 letter was not necessarily intended as the final description of the short-term analysis, a better description of the methods intended for use is necessary. For example, the letter states:

> The Department intends to staff for mean workload, balancing peaks and valleys between Residencies and Districts on a statewide basis. Remaining imbalance will be addressed by overtime, part-time, temporary employees, and temporary transfer of employees from one discipline to another, such as Maintenance to Construction. Periods of depressed workload will be addressed by contingency tasks and cross-training offered. The need for this process will be minimized by careful planning to stabilize the workload as much as possible.

This excerpt contains several statements that will require extensive workload and staffing analysis, yet the letter is silent about how this analysis will be conducted. "Mean workload," "balancing peaks and valleys," "remaining imbalances," "depressed workload," "contingency tasks," and "cross-training" all seem to imply that the department is currently capable of detailed staffing and workload analyses. Yet these are precisely the types of terms the Manpower Advisory Group is only now defining and such data apparently will not be available for some time to come.

A more detailed description of the methods proposed for the short-term analysis appears necessary. This description would facilitate linkage with the long-term effort, as well as provide a source document for evaluating the short-term effort.

> *Concern (2). A more detailed description of the short-term effort's methods will be needed. The description should provide more detail on workload measures and specify how workload balances will be achieved.*

Minimum Staffing

The Act requires DHT to identify minimum staffing levels necessary to implement programs and activities funded by the Act. The Act also implies that reductions will be necessary to achieve minimum staffing. Current documentation provided to JLARC, however, does not adequately define "minimum staffing." For example, Alexander's June 28 letter distinguishes "absolute" from "effective" minimum staffing:

> Absolute minimum staffing would require maximum use of consultants, contract maintenance, and bare-bones level of service. Effective minimum staffing assumes moderate (subjective) levels of service and administration of the Six-Year Plan in the most economical manner. The Department's intent is staffing for the effective minimum.

Neither term appears adequate to meet the Appropriations Act mandate. Increasing the use of consultants and contractors may not be a cost-effective method of reducing DHT staff positions. "Moderate" service levels and "economical" plan administration need further clarification. Such terms do not appear congruent with the legislatively required emphasis on minimum staffing, or with the apparent intent that minimum staffing be established below current levels.

Although minimum staffing levels may be tied to minimum service levels, the short-term analysis contains no discussion about how service levels will be assessed. This assessment appears to be a necessary step in a definition of minimum staffing.

> *Concern (3). A clear definition of minimum staffing is needed. A method for identifying a minimum staffing level lower than the current employment level as well as minimum service levels, should be included in the short-term manpower planning effort.*

Previously Recommended Reductions

Several potential staffing reductions have already been identified by JLARC and by DHT. Examples include area timekeepers, convict crew staffing, and cross-training between divisions. The work of up to 65 construction inspectors has recently been eliminated by the department, although the positions remain on the payroll.

These opportunities for reducing staff need to be addressed by the short-term manpower planning effort. Such reductions, if achieved, may not accomplish a minimum staffing level but will reflect a significantly lower staffing level.

> *Concern (4). DHT's short-term staffing analysis should consider reduced staffing in areas already identified by JLARC and the department.*

Reduction Methods

The Appropriations Act calls for the department to specify the methods it intends to use to reach minimum staffing levels. It also mandated reduction of central office staffing to 1,312 by the effective date of the Act.

Attrition has been the department's primary strategy for reducing staff. The department operated under a hiring freeze from January 1980 to June 30, 1982. Under the freeze, positions that became vacant went unfilled, and total DHT staffing dropped from 11,620 in July 1980 to 10,605 in June 1982 -- an 8.7 percent reduction.

In 1982, attrition under the freeze was insufficient to reduce central office staffing to the 1,312 level specified by the Appropriations Act. A layoff was consequently imposed to achieve the specified level. The rushed manner in which the layoff was implemented, however, emphasizes the need to prepare for further workforce adjustments.

> The Appropriations Act was passed by the General Assembly in March and approved by the Governor on April 21. Commissioner King met with central office division administrators on June 2 and directed them to identify surplus positions within their units. The administrators were asked to report their findings by June 3.

Twelve divisions identified 35 positions from which personnel could be laid off. These included three positions which had been filled on April 16, May 16, and June 1, 1982. These positions had been justified as exceptions to Governor Robb's hiring moratorium, yet were declared surplus within weeks of being filled. Better planning is needed to avoid rushed layoff decisions and incongruous outcomes in individual cases.

The Alexander letter argues against further layoffs but does not discuss other methods of reducing staff. DHT's current mission statement identifies four workforce adjustment methods (attrition, layoffs, cross-training, and shifts between classifications and locations). While these appear to be viable methods, further specification of the conditions under which they will be implemented is needed.

> *Concern (5). The methods for reducing staff mentioned in the mission statement need to be described in more detail. The conditions under which the different methods will be used to move the department toward minimum staffing need to be described. Specific guidelines for identifying surplus positions are necessary. The short-term analysis might provide the appropriate opportunity for this description.*

Functional Analysis

The Alexander letter mentions functional analysis as an appropriate method for assessing support service staffing. Functions performed by the entire department should not only be identified, they should also be assessed for relevance to the agency's mission. The short-term analysis apparently intends to identify functions, but it is not clear that an assessment for relevance to the mission will be conducted.

Determining relevance to the agency mission is a crucial step in the functional analysis. No mention is made in any of the corres-

pondence about whether or how this determination will be made. Division heads are, however, asked to identify the impact of eliminating and relocating the functions their units perform. They are also asked to list objectives "related to what is produced for the taxpayer" by their units. Additional guidance is needed to link these impacts and objectives to functions, and in turn to link functions with the agency mission.

An additional problem is that "function" is not defined in any of the letters although it is a key term in the analysis. Consequently, a disparate range of activities and staffing could be included: "Statewide highway maintenance" could be a function requiring 5,000 full-time positions, as well as "brush cutting in the Bon Air area," requiring five part-time positions. The short-term analysis should specify the level of aggregation intended for use in the functional analysis.

Finally, the method selected for implementing the functional analysis may not be adequate. The analysis hinges on the participation of 22 divisions and 8 districts (no mention is made in the letters of the Northern Virginia division). But a similar approach used in an assessment conducted earlier this year resulted in incomplete responses from some organizational units and no participation from 5 units.

> *Concern (6). If a functional analysis is included in the short-term effort, then further clarification is necessary. For example, a definition of "function" should be established which specifies mutually exclusive categories and an appropriate level of aggregation. The definition should be used consistently throughout DHT's manpower planning effort. The plan should detail how each organizational unit will participate in the analysis. Methods for linking functions to the agency mission should be specified. The plan also should specify how the judgment of relevance to the agency's mission will be made.*

ASSESSMENT OF THE LONG-TERM PLANNING PROCESS

The long-term effort now underway within the department appears to reflect the legislative concern with manpower forecasting. The Manpower Advisory Group (MAG) has undertaken an ambitious task which will involve every organizational unit within the department. Primary effort is currently devoted to identifying measurable work units in nine divisions, comprising close to 80 percent of the total DHT workforce.

The overall thrust of the MAG effort appears reasonable and appropriate. JLARC staff have several concerns about the approach, however.

First, there are no apparent plans to incorporate the legislatively required focus on minimum staffing and central office staffing. Second, the scope of the effort appears to exclude some key concerns, and the timeframe for implementing the plan has not been specified. Third, requirements for reporting and review of workload data, and for accountability, need attention. Finally, better documentation is needed.

Appropriations Act Compliance

The major thrust of the MAG effort is to link staffing with workload. It is not clear, however, whether MAG will identify minimum staffing levels and how staffing standards will be set. Also unclear is whether the plan will specifically address central office staffing, as required by the Appropriations Act.

Minimum Staffing Levels. The "bottom-up" approach adopted by MAG, where each of the divisions has been asked to determine the units which best measure their work, is a reasonable start toward identifying work accomplishment measures. The approach does not address productivity or ensure that divisions are efficiently accomplishing their work, however. Only some form of task analysis, where tasks performed by DHT staff are analyzed for efficiency, would provide this assurance. Given the multi-year time frame of the MAG study, and the ongoing nature of the manpower system, provision for task analyses should be included. This approach would help identify minimum levels of staffing needed to conduct the department's work.

> *Concern (7). Provision in the manpower plan for task analyses may be appropriate to determine whether work currently performed by department employees is being performed as efficiently and productively as possible. Such analyses may involve observation and analysis of each major task performed to ensure that the most productive methods of work are actually used.*

Staffing Standards. MAG has chosen to use actual performance data to determine the standards. Mr. Gosher's July 16 letter (Appendix II) makes this clear:

> In order for work standards to be developed, historical data will be utilized as most tasks do not lend themselves to an industrial engineering form of measurement. However, the historical data will be statistically analyzed . . .

How this analysis will be accomplished has not been clarified by MAG. The group has stated at various times that the "average" performance, the "best achievable" performance, or evaluations of "statistical ranges" would be used in establishing standards.

The resolution of this question is important. The goal of independent task or activity observation would be to set the standards at levels judged to be efficient and obtainable with the adoption of best available practices. If, on the other hand, standards are set to reflect merely average performance, the standards will only reflect what is being accomplished rather than what should be accomplished. If standards are keyed to a low productivity period, they could serve to perpetuate inefficiences. Further, averages are sensitive to extreme values, so a standard based on average performance might be so low as to be meaningless, or so high as to be generally unattainable. A range of performance levels within standards may be useful in developing standards that are sensitive to productivity. For example, a task with a standard of 8 units per day might be established where 5 or 6 units completed would be termed marginal performance; 7, 8, or 9 units would be termed satisfactory performance; and 10 or more units would be termed outstanding performance.

A problem with setting work standards to reflect the "best achievable" performance is the difficulty of determining that level of performance without undertaking some type of task or activity analysis. MAG's solution to this problem does not appear acceptable. MAG has written that it will be forwarding work units to "each affected group for development of manhour standards," which may indicate that the divisions will have significant input into determining their own "best achievable" performance. These division-generated work units, and division-suggested performance levels, must be carefully reviewed for appropriateness. However, MAG may lack any independent data to review or adjust these division-established performance levels.

> *Concern (8). The manpower plan should specify how staffing standards will be set for each organizational unit or job classification. This specification should identify the method for judging the appropriateness of the standards, and should explicity show how the standard will be calculated. Consideration might be given to establishing ranges within the standards, as a means of gauging and encouraging productivity.*

Central Office. None of the MAG documents specifically addresses the matter of central office employment. The group plans eventually to define work measures for most DHT divisions, including those whose staffs are housed in Richmond. The Appropriations Act, however, focuses specifically on central office employment, and requires the Department's manpower plan to do the same. While the short-term effort will address the immediate concern, it would be appropriate for the long-term effort to include specific plans for central office staffing.

> *Concern (9). It would be appropriate for MAG to specify the method for addressing central office staffing, and for assessing the feasibility of reducing central office staffing to 900 prior to July 1, 1984.*

Scope and Time Frame of the Plan

The manpower forecasting effort is ambitious. However, documentation and discussions to date leave unclear whether several key considerations will be included. These considerations are: (1) the method for tying staffing projections to revenue forecasts and to alternative service levels, (2) plans for addressing certain staff reduction opportunities; (3) plans for describing staff reduction methods; and (4) the project's schedule, usually described as "two to three years."

Developing Alternative Forecasts. Efforts are underway within the department to identify alternative highway maintenance levels and to develop long-term revenue forecasts. These are important efforts which need to be accommodated by the manpower plan. Mr. Gosher stated at the June 23 meeting that the plan would be revenue-responsive and would forecast alternative staffing levels for alternative revenue estimates. None of the plan's documentation discusses how this capability will be built into the plan. The documents are also silent as to whether alternative levels of maintenance and construction will lead to alternative staffing levels.

> *Concern (10). The manpower plan needs to address how manpower forecasts will respond to alternative revenue projections and to alternative levels of maintenance currently under development with DHT. It is important that some consideration be given to alternate levels of maintenance staffing.*

Staff Reduction Targets. MAG does not state whether opportunities for staff reductions previously identified by JLARC and the Department will be incorporated into the plan. The final JLARC report on the Organization and Administration of Department of Highways and Transportation discusses several possible reductions, including staffing of area headquarters, staffing of inmate crews, and cross-training of staff between divisions. Additional opportunities have been identified by DHT staff. For example, the work of as many as 65 construction inspectors who inspected materials at the point of manufacture has recently been eliminated. Although these employees may be reassigned to other duties, their freed-up staff time could be converted into surplus positions and eliminated.

> *Concern (11). The manpower plan needs to address specific staffing reductions from prior JLARC studies as well as potential reductions identified within the department.*

Reduction Methods. Provisions for workforce reduction are key elements of manpower effort. None of the MAG documents mentions possible methods of adjusting workforce size, although this concern is clearly reflected in Appropriations Act language about methods for reducing staffing.

Concern (12). The manpower plan needs to specify methods that may be used to reduce staffing, and conditions for using those methods.

Timeframe. The multi-year nature of the project appears appropriate, since sufficient history must be collected for each work unit to identify a standard or norm. However, two years' worth of data may not be necessary for every work unit. This is especially true for divisions such as Location and Design which have already accumulated several years of work accomplishment data. Further, MAG was established with only a six to eight month charter. Who will actually implement the plan has yet to be determined.

Concern (13). A schedule for implementing the manpower system needs to be established. It should specify when data collection will begin and end for each organizational unit, and who within each unit will coordinate the plan.

Review and Accountability

The accuracy of reporting work accomplishments is crucial to effective review of such accomplishments. Accuracy may not be assured under current MAG documents. The means of providing accountability also need further definition.

Reporting. An initial concern about the massive data collection involved in the plan is whether work accomplishments will be accurately reported. The proposed method is to collect data from timesheets which cover many, but not all, employees. There is an obvious question of how data will be collected from employees who do not currently report their time on time sheets. An additional question involves ensuring the accuracy of work accomplishment data that are submitted on timesheets.

The information sought by MAG will differ from the payroll information historically collected on timesheets. MAG is attempting to modify existing timesheets for data collection instead of introducing a new form. The July 16 letter also notes that this will "avoid the necessity of training several thousand individuals to fill out a new input document."

The need for special training should not be dismissed at this point, as it may prove essential to gathering accurate data. It would appear that, at minimum, a new coding structure will be required on timesheets in order to collect the needed accomplishment data. Without training and detailed documentation provided to each person who completes a timesheet, it is unclear how the necessary data will be collected.

Concern (14). A means for collecting data on each position in the department is essential. Special training for supervisors who review timesheets and employees who fill out timesheets may well be necessary. Data on positions not currently covered by timesheets will also be necessary.

Review. DHT must develop a systematic method for reviewing performance in the field if the work standards set by MAG are to impact staffing. An initial concern is who will be responsible for reviewing the data, and how the review will be conducted. The MAG documentation does not address these points.

A further concern is that performance printouts may not be adequately reviewed to identify high and low performance. This has been a common response to the printouts generated by other data systems (notably the maintenance management and equipment information systems), and should be considered in the design of automated reports. Responsibility for review needs to be established as well as what will be reported.

Concern (15). Automated reports should be carefully tailored for greatest usefulness. Usefulness may be promoted by including managers with staffing review responsibilities in the report development. Exception reports which highlight unusual occurrences could be developed for management use.

Accountability. A final concern is how divisions and districts will be held accountable for achieving their manpower goals. Who will be held accountable and how accountability will be achieved are not specified in any of the MAG documents. Without adequate attention to the implementation of accountability, the entire MAG effort may be seriously undermined.

Concern (16). The department's manpower plan should specify who will be held accountable for achieving the standards and how units will be held accountable.

Documentation

Documentation is a key element of any effort as massive and long-range as DHT's manpower planning process. MAG's goal is to produce a draft manpower plan by September 1982. According to the July 16 letter from Mr. Gosher,

> the plan will include the details relative to each Division, an explanation of why it was developed in the manner presented, the input and output documents the Division will utilize for analysis and refinement, and the methods proposed to perform such analysis.

Consequently, the plan will reflect considerable attention to detail, and may be an extensive document. The draft manpower plan should describe the process and specific methods in sufficient detail so that field personnel, unfamiliar with the plan's development, could implement its provisions. This guideline would also facilitate external review of the plan.

> *Concern (17). A key component of the success of the draft manpower plan will be documentation that describes processess and methods in sufficient detail.*

Note: Documents referenced herein may be viewed upon request at the JLARC staff offices, 910 Capitol Street, Suite 1100, Richmond, Virginia.

APPENDIX C:
JLARC LETTER TO DHT CONCERNING
THE SHORT-TERM STAFFING ANALYSIS

COMMONWEALTH of VIRGINIA

Joint Legislative Audit and Review Commission

Suite 1100, 910 Capitol Street
Richmond, Virginia 23219
(804) 786-1258

September 28, 1982

The Honorable Harold King
Commissioner
Department of Highways and
Transportation
1221 East Broad Street
Richmond, Virginia 23219

Dear Commissioner King:

Subsequent to our first interim report concerning the department's manpower planning process, members of the JLARC staff met with Mr. William Landsidle, Mr. Joseph Warren, Mr. G. W. Alexander, and Mr. Philip Gosher to obtain the department's reaction to our concerns. According to Kirk Jonas and Walt Smiley, the department substantially agreed with our observations on the long-term staffing analysis and indicated changes would be made in the plan. There is, however, some confusion concerning the nature and direction of the department's short-term staffing analysis.

It was our understanding, based on correspondence and prior meetings we held with DHT staff, that an assessment of short-term staffing needs was being prepared for the 1983 General Assembly. The department indicated the short-term study would likely be used to request relief from statutory limitations. The specific methodology to be employed was first described by Mr. Busser at our meeting on June 23. The "short-range methodology" was also clearly laid out to us in a June 28 letter from G. W. Alexander.

At about the same time, letters were sent to division heads and district engineers by Mr. Warren which described the methods to be used as part of a short-term analysis of functions and staffing levels. Mr. Warren's letters (June 23, 1982 and June 24, 1982) called for such an analysis to be completed by July 9, 1982 and to "address functions and staffing levels... which can be eliminated or decentralized as well as monitoring (those) which can be eliminated or reduced." That analysis was intended to "be used to... remove the legislative restrictions on staffing" and to "honestly address the issues before us."

At our September 10 meeting, however, Mr. Landsidle indicated that a revised staffing target for FY 1984 has already been recommended to the Governor. The recommended target is said to be slightly above 10,387, which was the actual June 30, 1982 staff complement according to Mr. Landsidle.

It is our understanding at this time that the staffing recommendation was not based on the outcome of the study methodology that we assessed in the letter report, but was based on the "judgement of the Secretary and other highway officials." It is our understanding, further, that the rationale used to make that judgement was that the legislative intent behind the 10,177 staffing level specified in the Appropriations Act was contradicted by the late-hour vote to increase revenues to DHT. The necessary consequence of the extra revenue, it has been asserted, is that the department needs extra staff.

We do not believe the available evidence fully supports that position.

First, suggesting that the department might reduce staff while providing additional construction funds is not necessarily contradictory. The General Assembly requested the department to assess its staffing levels both when it passed the tax measure (HB 532), and when it appropriated construction funds (HB 30). In fact, the finance committee specifically requested that HB 532 carry a language provision similar to that proposed for the Appropriations Act to ensure the department did examine ways and means to reduce staff. Completion of some rigorous short-term staffing analysis would seem to be a necessary precursor to any modification of existing maximum employment levels.

Second, there is evidence that some staffing efficiencies and economies are possible even with the provision of new funds. For example, our earlier reports identified possible reductions in maintenance and field operations staff. Our current assessment of the DHT staffing environment is identifying other areas where economies may be possible in construction and other highway department activities.

It is important that we have a clear statement from the department whether there will or will not be a short-term analysis of staffing needs. Our preliminary assessment of the departments manpower planning process is scheduled to be reported to the Commission on October 11. The need for a short-term staffing analysis will constitute

a substantial part of our presentation. In order to clearly communicate our position and to receive your statement about the short-term analysis, I have asked Walt Smiley to meet with you and your manpower planning team before October 5th so that you may hear our briefing information and clarify your position on this matter.

Sincerely,

Ray D. Pethtel
Director

RDP:bjk

cc: Members, Joint Legislative Audit and Review Commission
The Honorable Andrew B. Fogarty

Note: Documents referenced herein may be viewed upon request at the JLARC staff offices, 910 Capitol Street, Suite 1100, Richmond, Virginia.

APPENDIX D:
TECHNICAL APPENDIX

Maintenance Productivity Review

For its November 1981 report, Highway Construction, Maintenance, and Transit Needs in Virginia, JLARC staff performed regression analysis to measure the relationship between the amount of work accomplished by each residency and the resources expended to accomplish that work. Sixteen maintenance activities were assessed. The six activities examined in the productivity section of this report, and the coefficients of determination for these activities on each of the three productivity measures, are shown in Table 1.

A standard error of the regression measures the average variation of any individual measurement from the estimated mean. The standard error of the regression can be used to estimate the precision of the estimate resulting from the sampling process. For the productivity analysis, medium productivity residencies for an activity were

Table 1

RELATIONSHIP BETWEEN ACCOMPLISHMENTS AND RESOURCES

Maintenance Activity	Accomplishment Measure (Dependent Variable)	Coefficient of Determination (R^2) Explaining Variation Using Three Productivity Measures: Number of Residencies	Expenditures	Man-Hours	Equipment Hours
Spot Seal and Skin Patching	Tons of Material	45	.91	.64	.84
Premix Patching	Tons of Material	44	.94	.64	.72
Tractor Mowing on:					
Secondary System	Acres Mowed	44	.51	.58	.63
Primary System	Acres Mowed	45	.52	.57	.63
Interstate System	Acres Mowed	27	.90	.90	.90
Brush Cutting	Acres Cut	45	.54	.52	.60
Machine Ditching and Hauling Spoil	Miles of Ditch	45	.69	.70	.74
Hand Cleaning Ditches	Feet of Ditch	45	.80	.76	.70

residencies whose quantity accomplishment was within two standard errors of the statewide norm for any one of the three productivity measures. Low productivity residencies on an activity accomplished quantities of work which were more than two standard errors below the norm; high productivity residencies accomplished quantities of work which were more than two standard errors above the mean.

To illustrate this method, two residencies and their performances for the skin patching activity are discussed in Exhibit A.

Exhibit A

PATCHING IN TWO RESIDENCIES

The Bedford residency expended $397,308 and 42,155.2 man hours and 13,493.5 equipment hours for skin patching over the 1978-80 biennium. Residency performances statewide indicate that with the dollars which Bedford expended on patching, the residency could have been expected to put down 12,070.0 work units, in this case, tons of material. Given just the number of man-hours Bedford used, statewide residency performances indicate that Bedford should have put down 18,484.4 tons of material, and given the number of equipment-hours Bedford used, 12,781.3 tons of material should have been put down. However, Bedford was only able to produce 10,322.9 work units. In all three cases (dollars, man-hours, and equipment-hours), the quantity Bedford achieved was more than two standard errors below the quantity predicted by the statewide norm. Thus, Bedford was rated low in productivity for skin patching.

In Culpeper, $127,751 was spent on skin patching over the 1978-80 biennium. The residency also used 4,760 man-hours and 2,658.0 equipment-hours for skin patching. Residency performances statewide indicated that with the three resources Culpeper used in patching, the residency could be expected to produce between 2,633.5 and 3,328.8 work units. However, Culpeper actually produced 5,956.4 work units, a quantity which was more than two standard errors above the statewide norm for all three productivity measures. Thus, Culpeper was rated high in skin patching productivity.

In stratifying residencies into three productivity groups for all six activities reviewed, several steps were followed. Specifically, a score of +1 was assigned for each of the six activities in which a residency was high on all three productivity measures. A score of -1

was assigned for any activity in which a residency was low on all three productivity measures. A score of 0 was assigned for any activity in which a residency was neither high nor low on all three productivity measures. An overall score for a residency was determined by adding up its scores for the six activities. High productivity residencies had scores of +3 or better, while medium productivity residencies scored +2, +1, 0, -1, or -2, and low productivity residencies had scores of -3 or worse. Statewide there were four high productivity residencies, seven low productivity residencies, and thirty-four medium productivity residencies.

The overall approach to the JLARC assessment of maintenance productivity involved three distinct steps. First, the existence of variation in productivity between residencies was established using maintenance management system data, and bivariate regression analysis was used to test for relationships between inputs and outputs.

Following the logic of an analysis of residuals, in a second step JLARC staff sought explanations for residency differences from the regression predictions. Explanations for productivity differences were generated by DHT maintenance personnel, Highway and Transportation Research Council staff, management principles, and from other sources. An unbiased sample of four residencies in each of the three overall productivity classifications was chosen. To ensure consistency within residencies, JLARC staff independently interviewed randomly selected maintenance superintendents in each residency and used a group interviewing technique for all superintendents within the 12 residencies visited. In addition, the maintenance supervisor in each residency was interviewed.

Patterns of variation with respect to occurrence of each of the explanatory variables were recorded. In general, high productivity residencies were distinguished from low productivity residencies on the basis of equipment use, or specific management or operational procedures. No potential staffing economies were identified unless a specific method for improving the specific activity could be identified.

Tidewater Adjustment. For the activity machine ditching and hauling spoil, a significant variation in productivity was observed between regions. To make the reductions of between 19 and 42 positions for machine ditching and hauling spoil achievable, the following criteria were used: 1) medium and low productivity mountain and piedmont residencies achieved the level of performance of residencies representative of the lower and upper bounds of mountain and piedmont high productivity in the 1978-80 biennium, and 2) tidewater residencies achieved the level of performance of residencies representative of high tidewater productivity. Reductions were calculated differently because data reviewed indicates that tidewater residencies expend more manhours per quantity unit than other residencies with machine ditching. Maintenance division definitions of mountain, piedmont, and tidewater residencies were used in calculating the reductions.

JOINT LEGISLATIVE AUDIT AND REVIEW COMMISSION

Research Staff

John M. Bennett
L. Douglas Bush, Jr.
Suzette Denslow
Lynn L. Grebenstein
Stephen W. Harms
Gary T. Henry
Clarence L. Jackson
Kirk Jonas
R. Jay Landis
Sarah J. Larson
Philip A. Leone
John W. Long
Joseph H. Maroon
Barbara A. Newlin
Ray D. Pethtel
Cynthia Robinson
Robert B. Rotz
Mary H. Schneider
Walter L. Smiley
E. Kim Snead
Ronald L. Tillett
Glen S. Tittermary
Susan L. Urofsky
Mark D. Willis
William E. Wilson
R. Shepherd Zeldin

Administrative Staff

Deborah A. Armstrong
Vivian L. Dorrough
Sharon L. Harrison
Joan M. Irby
Betsy M. Jackson
Patricia L. Jordan
David W. Porter

Interns

Florence R. Haines
Carolyn C. Tedholm
Geraldine A. Turner

RECENT REPORTS ISSUED BY THE JOINT LEGISLATIVE AUDIT AND REVIEW COMMISSION

The Virginia Community College System, March 1975
Virginia Drug Abuse Control Program, October 1975
Working Capital Funds in Virginia, February 1976
Certain Financial and General Management Concerns, Virginia Institute of Marine Science, July 1976
Water Resource Management in Virginia, September 1976
Vocational Rehabilitation in Virginia, November 1976
Management of State-Owned Land in Virginia, April 1977
Marine Resource Management Programs in Virginia, June 1977
Sunset, Zero-Base Budgeting, Evaluation, September 1977
Use of State-Owned Aircraft, October 1977
The Sunset Phenomenon, December 1977
Zero-Base Budgeting? December 1977
Long Term Care in Virginia, March 1978
Medical Assistance Programs in Virginia: An Overview, June 1978
Virginia Supplemental Retirement System, October 1978
The Capital Outlay Process in Virginia, October 1978
Camp Pendleton, November 1978
Inpatient Care in Virginia, January 1979
Outpatient Care in Virginia, March 1979
Management and Use of State-Owned Vehicles, July 1979
Certificate-of-Need in Virginia, August 1979
Report to the General Assembly, August 1979
Virginia Polytechnic Institute and State University Extension Division, September 1979
Deinstitutionalization and Community Services, September 1979
Special Study: Federal Funds, December 1979
Homes for Adults in Virginia, December 1979
Management and Use of Consultants by State Agencies, May 1980
The General Relief Program in Virginia, September 1980
Federal Funds in Virginia, October 1980
Federal Funds: A Summary, January 1981
Methodology for a Vehicle Cost Responsibility Study: An Interim Report, January 1981
Organization and Administration of the Department of Highways and Transportation: An Interim Report, January 1981
Title XX in Virginia, January 1981
Organization and Administration of Social Services in Virginia, April 1981
1981 Report to the General Assembly
Highway and Transportation Programs in Virginia: A Summary Report, November 1981
Organization and Administration of the Department of Highways and Transportation, November 1981
Highway Construction, Maintenance, and Transit Needs in Virginia, November 1981
Vehicle Cost Responsibility in Virginia, November 1981
Highway Financing in Virginia, November 1981
Publications and Public Relations of State Agencies in Virginia, January 1982
Occupational and Professional Regulatory Boards in Virginia, January 1982
The CETA Program Administered by Virginia's Balance-of-State Prime Sponsor, May 1982
Working Capital Funds in Virginia, June 1982
The Occupational and Professional Regulatory System in Virginia, December 1982
Interim Report: Equity of Current Provisions for Allocating Highway Construction Funds in Virginia, December 1982
Consolidation of Office Space in the Roanoke Area, December 1982
Staffing and Manpower Planning in the Department of Highways and Transportation, January 1983
Consolidation of Office Space in Northern Virginia, January 1983
Interim Report: Local Mandates and Financial Resources, January 1983
Interim Report: Organization of the Executive Branch, January 1983
The Economic Potential and Management of Virginia's Seafood Industry, January 1983
Follow-Up Report on the Virginia Department of Highways and Transportation, January 1983